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| C:\Users\TEMP.WDC.013\Downloads\VIT logo.png  **Version 07/19-11** | **Consolidated Academic Administration Plan for the Course*\_core (mention elective / core as per NBA) Sem.VIII – Program :UG 2024-25 –Even Semester Faculty - Prof. \_Amit Nerurkar (Cluster Mentor) &***  ***Prof. Prakash Parmar and Dr. Umesh Kulkarni*** |

**The academic resources available in VIT –**

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| --- | --- | --- | --- |
| **VMIS (ERP)** | **V-Refer and V-Live** | **VIT Library** | **VAC & MOOC Courses** |
| Institute & Department Vision and Mission | Former IA question papers and solutions (prepared by faculty) | Former IA question papers solutions - hardcopy | Value Added Courses (VAC) are conducted throughout the semester & in the semester break - Enrol for the VACs |
| Program Educational Objectives (PEO) | MU end semester examination question papers and solutions (prepared by faculty) | MU end semester exam question paper & solutions - by faculty, hardcopy |
| Program Specific Outcome (PSO) | Class notes and Digital Content for the subject (scanned / typed by faculty) | All text books, reference books, e -books mentioned in the syllabus & AAP | Online courses from NPTEL, Coursera etc. are pursued throughout the semester - Register for the course & get certified |
| Program Outcome (PO) | Comprehensive question bank, EQ, GQ, PPT, Class Test papers | Technical journals and magazines for reference |
| Departmental Knowledge Map | Academic Administration Plan & Beyond Syllabus Activity report | VIT library has many resources e:g :- IEEE, Nimbus, xplore, EBSCO etc. | Watch former lectures captured in LMS at VIT |

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| **1.a** | **Course Objectives (Write in detail – as per NBA guidelines)** |

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| Cognitive | What do you want students to know? | Student should gain fundamental knowledge in Distributed systems and its applications |  |
| Affective | What do you want students to think / care about? | Student should analyse the importance of the performance of parallel and distributed systems. |  |
| Behavioural | What do you want students to be able to do? | Student should apply appropriate algorithms for synchronization in DS. |  |

**Advice to Students:**

Attend every class!!! Missing even one class can have a substantial effect on your ability to understand the course. Be prepared to think and concentrate, in the class and outside. I will try to make the class very interactive. Participate in the class discussions. Ask questions when you don’t understand something. Keep up with the class readings. Start assignments and homework early. Meet me in office hour to discuss ideas, solutions or to check if, what you understand is correct.

The v-Refer Link

<http://vidyalankarlive.com/vrefer/index.php/apps/files/?dir=/vRefer/CMPN/SEM%20VIII/2024-25/DC&fileid=937681>

Creation of microsite or teams link

Example:- <https://teams.microsoft.com/v2/>

<https://teams.microsoft.com/v2/>

**Collaboration Policy:**

We encourage discussion between students regarding the course material. However, no discussion of any sort is allowed with anyone on the assignment and homework for the class. If you find solution to some problems in a book or on the internet, you may use their idea for the solution; provided you acknowledge the source (name and page in the book or the website, if the idea is found on the internet). Even though you are allowed to use ideas from another source, you must write the solution in your own words. If you are unsure whether or not certain kinds of collaboration is possible, please ask the teacher.

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| **1.b** | **Course Outcome (CO) Statements and Module-Wise Mapping (follow NBA guideline)** |

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| CO No. | Statements | Related Module/s |
| CO1 | Demonstrate knowledge of the basic elements and concepts related to distributed system technologies. | 1 to 8 |
| CO2 | Illustrate the middleware technologies that support distributed applications such as RPC, RMI and Object based middleware. | 2 |
| CO3 | Analyze the various techniques used for clock synchronization and mutual exclusion | 3 |
| CO4 | Demonstrate the concepts of Resource and Process management | 4 |
| CO5 | Demonstrate the concepts of Consistency and Replication Management | 5 |
| CO6 | Apply the knowledge of Distributed File Systems in building large-scale distributed applications. | 6 |

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| **1.c** | **Mapping of COs with POs (mark S: Strong, M: Moderate, W: Weak, Dash ‘–’: not mapped)**  **(List of POs is available in V-refer)** |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|  |  | Analysis | Design | Investigation | Modern Tools | Society | Environment &sustainability | Ethics T | Teamwork C | Communication | Project Mgt | Life long learning |
| CO 1 | **W** | **M** | **S** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| CO 2 | **W** | **W** | **M** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **S** |
| CO 3 | **M** | **W** | **S** | **M** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **S** |
| CO 4 | **M** | **W** | **S** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **S** |
| CO 5 | **M** | **-** | **S** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **-** | **S** |
| CO6 | **M** | **-** | **S** | **-** | **M** | **-** | **-** | **-** | **-** | **-** | **-** | **S** |

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| **1.d** | **Mapping of COs with PSOs (mark S: Strong, M: Moderate, W: Weak, Dash ‘–’: not mapped)** |

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| --- | --- | --- | --- | --- |
|  | PSO 1 | PSO 2 | PSO 3 | PSO 4 |
| CO 1 | **S** | **-** | **M** |  |
| CO 2 | **M** | **-** | **M** |  |
| CO 3 | **S** | **-** | **-** |  |
| CO 4 | **S** | **-** | **-** |  |
| CO 5 | **M** | **-** | **-** |  |
| CO6 | **S** | **M** | **M** |  |

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| **1.e** | **Teaching and Examination Scheme (As specified by the autonomous syllabus) for the Course** |

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| Verticals | BSC/ESC | Program Courses | Multidisciplinary Courses | Skill Courses | HSSM | Experiential Learning | Liberal Learning |
| Tick suitable category |  |  | **Core** |  |  |  |  |

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| Subject Code | Subject Name | **Teaching Scheme** | | | Credits Assigned | | | |
| Theory | Practical | Tutorial | Theory | TW/Practical | Tutorial | Total |
| **CPC801** | **Distributed Computing** | **3** | **2** | **-** | **3** | **1** | **-** | **5** |

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| Subject Code | Subject Name |  | |  | | **Examination Scheme** | | | | | |
| **Theory** | | | | | **Total**  **(Theory)** | **Practical** | | | **Total**  **(Practical)** |
| ISA | MSE | | ESE | | ISA | ESE | ORAL |
| CSC 801 | Distributed Computing | 20 | 30 | | 50 | | 100 | 25 | -- | 125 | 150 |
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| Subject Code | Subject Name | **MSE\*** | | |
| Q, No | **Distribution** | Relevant to Bloom Taxonomy |
| CSC 801 | Distributed Computing | **Q1** | **10 marks** | L1,L2,L3 |
|  |  | **Q2** | **10 marks** | L2 |
|  |  | **Q3** | **10 marks** | L2 |
| CSC 801 | Distributed Computing | **Q1** | **10 marks** | L1,L2 |
|  |  | **Q2** | **10 marks** | L2 |
|  |  | **Q3** | **10 marks** | L2 |

L2L2

Q3Q3Q3

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Subject Code | Subject Name | **ESE#** | | |
| Q, No | Distribution | Relevant to Bloom Taxonomy |
| CSC 801 | Distributed Computing | **Q1** | **10 marks** | L1,L2 |
|  |  | **Q2** | **10 marks** | L2 |
|  |  | **Q3** | **10 marks** | L3 |
|  |  | Q4 | **10 marks** | L3 |
|  |  | Q5 | **10 marks** | L3,L4 |

**\* Recommended distribution: -** 30 Marks from Assignments, 40 marks based on assignments with slightly enhance difficulty /complex, 30 marks from thought provoking

**# Recommended distribution: -** 30 Marks from Assignments, 40 marks based on assignments/MSE with slightly enhance difficulty /complex, 30 marks from thought provoking

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| **1.f** | **Faculty-Wise Distribution of all Lecture-Practical-Tutorial Hours for the Course** |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Divisions | Lecture (Hrs.) | Practical (Hrs.) | | | | Tutorial (Hrs.) | | | |
| Batch 1 | Batch 2 | Batch 3 | Batch 4 | Batch 1 | Batch 2 | Batch 3 | Batch 4 |
| **A** | **UMK 3hr** | **UMK** | **UMK** | **UMK** | **UMK** | NA | NA | NA | NA |
| **B** | **UMK 3 hrs** | PJP | PJP | PJP | PJP | NA | NA | NA | NA |

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| **1.g** | **Office Hours (Faculty will be available in office in this duration for solving students’ query)** |

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| --- | --- | --- | --- |
| Division | Day | Time (at least 1 Hr. / Division) | Venue (Office Room No.) |
| A | **Monday** | **3.45 to 4.45 pm** | **M- 209** |
| B | **Monday** | **3.45 to 4.45 pm** | **M -209** |
| C |  |  |  |

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| **2.a** | **Syllabus: Module Wise Teaching Hours and % Weightage in autonomous syllabus Question Paper** |

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| --- | --- | --- | --- | --- | --- | --- |
| Module No. | Module Title and Brief Details | Teaching Hrs. for each module | % Weightage in autonomous syllabus Question Papers | | | Performance Indicator Mapping |
| ISA | MSE | ESE |
| 1 | Introduction to Distributed Systems Characterization of Distributed Systems: Issues, Goals, and Types of distributed systems, Distributed System Models, Hardware concepts,  Software Concept. Middleware: Models of Middleware, Services offered by middleware, | 05 | **20** | **10** | **10** |  |
| Learning Outcome | * **Conceptual Understanding:** Develop a comprehensive understanding of the design principles, goals, and challenges of distributed systems. * **Middleware Proficiency:** Gain knowledge of middleware models and their role in simplifying distributed systems' complexities. * **Problem-Solving Skills:** Learn to address common distributed system issues such as synchronization, consistency, scalability, and fault tolerance. * **Architectural Insight:** Develop the ability to analyze and design distributed system architectures with appropriate hardware, software, and middleware components. | | | | | |
| 2 | Communication Interprocess communication (IPC):, Remote Procedure Call (RPC), Remote Object Invocation, Remote Method Invocation (RMI)  Message Oriented Communication, Stream Oriented Communication,  Group Communication | 06 | 20 | 10 | 10 |  |
| Learning Outcome | * Develop a foundational understanding of various communication models in distributed systems. * Gain the ability to choose the appropriate communication mechanism based on system requirements. * Acquire skills to implement and optimize communication techniques to ensure scalability, fault tolerance, and real-time responsiveness. * Address challenges in distributed communication, such as latency, consistency, and synchronization, while designing efficient and robust systems. | | | | | |
| 3 | Synchronization Distributed Mutual Exclusion , Requirements of Mutual Exclusion Algorithm performance measures  Non Token based Algorithms: Lamport Algorithm, Ricart–Agrawala‘s  Algorithm, Maekawa‘s Algorithm Token Based Algorithms: Suzuki-Kasami‘s Broadcast Algorithms, and Raymond‘s Tree based Algorithm, Comparative Performance Analysis | 08 | 30 | 20 | 30 |  |
| Learning Outcome |  **Conceptual Understanding:** Gain a deep understanding of distributed synchronization and its significance in ensuring consistent and coordinated system operations.   **Algorithm Proficiency:** Develop expertise in various mutual exclusion algorithms, including both token-based and non-token-based approaches.   **Performance Evaluation:** Learn to evaluate and compare mutual exclusion algorithms based on their efficiency, fault tolerance, and scalability.   **Problem-Solving Skills:** Acquire the ability to design and implement appropriate synchronization techniques for specific distributed system scenarios, addressing challenges like communication delays and process failures. | | | | | |
| 4 | Resource and Process Management Desirable Features of global Scheduling algorithm, Task assignment approach, Load balancing approach, load sharing approach Introduction to process management, process migration, Code Migration, | 06 | 20 | 10 | 20 |  |
| Learning Outcome | **Conceptual Understanding:**Understand the principles of resource and process management, including scheduling, task assignment, load balancing, and load sharing.  **Algorithm Design:**Learn to design global scheduling algorithms that are fair, efficient, and scalable for distributed systems.  **Practical Skills:**Develop the ability to implement process migration and code migration to improve resource utilization and fault tolerance.  **Problem-Solving Skills:**Address challenges like dynamic workloads, resource contention, and fault recovery in distributed environments. | | | | | |
| 5 | Replication, Consistency and Fault Tolerance Distributed Shared Memory: Architecture, design issues.  Introduction to replication and consistency, Data-Centric and Client- Centric Consistency Models, Replica Management Fault Tolerance: Introduction, Process resilience, Recovery | 06 | 10 | 20 | 20 |  |
| Learning Outcome |  **Understanding Key Concepts:**   * Gain a strong understanding of replication, consistency models, fault tolerance, and distributed shared memory.    **Trade-Off Analysis:**   * Learn to analyze trade-offs between performance, consistency, fault tolerance, and scalability in distributed systems.    **Practical Skills:**   * Acquire skills to design and implement replication strategies, consistency models, and fault-tolerant mechanisms.    **Problem-Solving:**   * Develop the ability to handle replication conflicts, maintain consistency across replicas, and design resilient distributed systems.    **Architectural Design:**   * Understand the architecture of distributed shared memory and how to address its challenges in real-world applications. | | | | | |
| 6 | Distributed File Systems and Name Services  Introduction and features of DFS, File models, File Accessing models,  File-Caching Schemes, File Replication, Case Study: Distributed File Systems (DSF), Network File System (NFS),  Designing Distributed Systems: Google Case Study | 08 | 10 | 10 | 10 |  |
| Learning Outcome | 1. **Understanding DFS Features and Design:**    * Gain an in-depth understanding of the core features of DFS, including file models, access models, caching schemes, and replication. 2. **Analyzing Performance and Trade-Offs:**    * Learn to evaluate the trade-offs between performance, consistency, scalability, and fault tolerance in DFS. 3. **Practical Applications:**    * Study real-world systems like NFS and GFS to understand the practical implementation of DFS principles. 4. **Designing DFS:**    * Develop the ability to design a distributed file system that balances performance, fault tolerance, and user requirements. 5. **Problem-Solving Skills:**    * Address challenges like concurrent file access, consistency in replication, and latency in accessing distributed files. | | | | | |
| **\* Insert rows for more modules in the Course Total** | | **39** |  |  |  |  |

\*\*Learning Outcome should be in bulleted form.

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| **2.b** | **Prerequisite Courses** |

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| No. | Semester | Name of the Course | Topic/s |
| 1 | 5 | Computer Networks | Tcp/ip networking |
| 2 | 4 | Operating Systems | Kernel, Threads, Process, Mutual Exclusion, Message passing |
| 3 |  |  |  |

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| **2.c** | **Relevance to Future Courses** |

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| No. | Semester | Name of the Course |
| 1 | M.S | Distributed Systems |
| 2 |  |  |
| 3 |  |  |

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| **2.d** | **See :- Identify real life scenarios/examples which uses the knowledge of the subject ,(Discussion on how to prepare examples and case studies e.g.** [**“Boeing Plane”: C Programming Language – Intro to Computer Science – Harvard’s CS50 (2018) – Bing video**](https://www.youtube.com/watch?v=ix5jPkxsr7M)**)** |

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| Real Life Scenario | Concept Used |
| Real-time process control: aircraft control systems | Process control, Scheduling |
| Real-time tracking systems | Concept of operating system |
| Web Browsers | Replacment Algorithms |
| Mobile and Pervasive Computing systems | Multi tasking and ,ultiprocessing |

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| **3** | **Past Results – Division-Wise** |

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| --- | --- | --- | --- | --- |
| Details | Target – MAY 2025 | DEC 2024 | MAY 2024 | DEC 2023 |
| Course Passing % – Average of 2 Divisions | **100%** | **NA** | **100** | **NA** |
| Marks Obtained by Course Topper (mark/100) | 80 | NA | 55 | NA |

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| --- | --- | --- | --- | --- |
|  | Division A | | Division B | |
| Year | Initials of Teacher | % Result | Initials of Teacher | % Result |
| May 2024 | Umk | 100 | Umk | 100 |
| May 2023 | Umk | 100 | Umk | 100 |
| May 2022 | umk | 100 | umk | 100 |

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| **4** | **All the Learning Resources – Books and E-Resources** |

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| **4.a** | **List of Textbooks (T – Symbol for Textbooks) to be Referred by Students** |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Sr. No | Textbook Titles | Author/s | Publisher | Edition | Module Nos. | Available in our Library |
| 1 | Distributed Systems: Principles and  Paradigms | Andrew S. Tanenbaum and Maarten Van Steen | Pearson | 2nd | 1 to 6 | Yes |
| 2 | Distributed Systems: Concepts and Design | George Coulouris, Jean Dollimore, Tim Kindberg | Pearson | 4th | 1 to 6 | Yes |

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| **4.b** | **List of Reference Books (R – Symbol for Reference Books) to be Referred by Students** |

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| --- | --- | --- | --- | --- | --- | --- |
| Sr. No | Reference Book Titles | Author/s | Publisher | Edition | Module Nos. | Available in our Library |
| 1 | Distributed Systems: Concepts and  Design | Andrew S. Tanenbaum and Maarten Van Steen | Pearson | 2nd | 1 to 6 | Yes |
| 2 | Distributed Operating Systems : Concepts and design | P.K. Sinha | IEEE  computer society press | 2nd | 1 to 6 | Yes |

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| **4.c** | **List of E - Books (E – Symbol for E-Books) to be Referred by Students** |

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| --- | --- | --- | --- | --- | --- | --- |
| Sr. No | E- Book Titles | Author/s | Publisher | Edition | Module Nos. | Available in our Library |
| 1 | Distributed Systems | Maarten Steen | Distributed Systems.NET | 3rd | 4-8 | Yes |

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| **4.d** | **Reading latest / top rated research papers (at least 5 papers)** |

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| --- | --- | --- | --- | --- | --- |
| Name of Paper | Name of Authors (Background) | Published in | | Problem Statement | Available in our Library |
| Date | Journal |
| A Specialized Long-Term Distribution System Expansion Planning Method With the Integration of Distributed Energy Resources | TAYENNE D. DE LIMA 1, (Student Member, IEEE),  JOHN F. FRANCO 1,2, (Senior Member, IEEE), FERNANDO LEZAMA 3, (Member, IEEE),  AND JOÃO SOARES 3, (Member, IEEE) | date of current version February 23, 2022. | IEEE | Distribution system expansion planning, integrated planning of electrical distribution  system and EV charging stations, long-term stochastic planning model, renewable distributed generation |  |
| Blockchain-Based Peer-to-Peer Transactive Energy Management  Scheme for Smart Grid System | Aparna Kumari 1 , Urvi Chintukumar Sukharamwala 2, Sudeep Tanwar 1,\* , Maria Simona Raboaca 3 , Fayez Alqahtani 4 , Amr Tolba 5 , Ravi Sharma 6, Ioan Aschilean 7,\* and Traian Candin Mihaltan 8 | Peer-to-Peer Transactive Energy  Management Scheme for Smart Grid  System. Sensors 2022, 22, 4826.  <https://doi.org/10.3390/s22134826> | https://www.mdpi.com/journal/sensors | blockchain; smart grid; transactive energy management; peer-to-peer energy trading;  ethereum |  |
| Peer-to-peer energy sharing with battery storage: Energy pawn in the smart grid. | L He et al. | 2021 | Appl. Energy 2021, 297, 117129. [CrossRef] | In a community market with a  shareholder energy storage  system, prosumers, and consumers; it suggested an energy-sharing framework which is based on energy?  pawn (EP) For efficient outcomes, netload forecasting must be improved |  |
| Blockchain-enabled Peer-to-Peer energy trading. | Wongthongtham  et al. [33] | 2021 | Computer. Electr. Eng. 2021, 94, 107299. [CrossRef] | Examines the most effective use of blockchain technology for P2P energy trading Data storage cost issue on  blockchain and scalability issue |  |
| Decentralized blockchain-based peer-to-peer energy-backed token  trading for active prosumers. | Mehdinejad et al. [35] | 2022 | Energy 2022, 244, 122713–122731. [CrossRef] | Leverage blockchain platform  to achieve P2P energy  token trading  The proposed approach  ensures a worldwide and  realistic solution while  demanding no personal  information from the  participants |  |

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| **4.e** | **Based on research paper an identify the current Problem statement** |

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| Problem Statement |  | | Used in | | | | |
| Quiz | Assignment | Lab | Mini Project | Poster Presentation | Test | Any Other |
| Distribution system expansion planning, integrated planning |  |  | Design of environment |  | Yes | Yes |  |
| Data storage cost issue on blockchain and  scalability issue |  |  | Design of distributed system |  | Yes | Yes |  |

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| **4.f** | **Identify Companies / Industries which use the knowledge of the subject and thus may provide Internships and final Placements** |

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| Name of the Company | To be / Contacted for | | |
| Student Internship | Student Final Placement | Faculty Internship |
| TCS |  |  | placments |

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| **4.g** | **Identify suitable relevant TOP Guest Speakers from Industry,**  **Example: - (CS50 Lecture by Mark Zuckerberg - 7 December 2005 - YouTube)** |

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| --- | --- | --- |
| Name of the Identified Guest Speaker | Designation | Name of the Company |
| Dr. G. A.PATIL | Director of Information Technology | JSPM University |
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| **4.h** | **Identify relevant technical competitions to participate [Competitions -Paper Presentations, Projects, Hackathons, IVs etc..]** |

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| Name of the Relevant Technical Competition Identified to participate | Organized by | Date of the Event |
| Link of hackathons | many organisers | Over a period |
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| **4.i** | **Identify faculty in TOP schools / Universities who are teaching same / similar subject and develop rapport e.g. Exchange Lecture Material (Assignments / Tests / Project etc..), Joint Paper Publication** |

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| --- | --- | --- | --- | --- | --- |
| University | Name of the Course | Name of Faculty | Type of Collaboration | | |
| Exchange of Lecture Material | Joint Publication/ Research | Other |
| IIT Patna | Distributed System | Dr, Ravi Mishra | Yes video lectures |  |  |
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| **4.j** | **Module Best Available in – Title of the best resource [from *4.a* to *4.d* in this AAP] and other details as necessary** |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Module No. | Title of the Module | Textbook | Mention the Tile | | | | | |
| Reference Book | E-books | Journal | E-Journal | Available in our Library | V-refer |
| 1 | Introduction |  | <http://micronica.com.au/catalog/sharer/>  <https://www.youtube.com/watch?v=mm3r8EG4wLQ&index=6&list=PLmPpJG5-RKf0RUQ7VYjHn6pnoWT2__4CM>  tps://nptel.ac.in/courses/106106168 |  |  |  |  |  |
| 2 | Basic of message passing |  | [http://www.sanfoundry.com/computer-networks-questions-answers-rpc](http://www.sanfoundry.com/computer-networks-questions-answers-rpc%20)  <https://www.youtube.com/watch?v=-6Uoku-M6oY&t=556s>  <https://www.youtube.com/watch?v=I_3zU9HeDOs>  https://nptel.ac.in/courses/106106168 |  |  |  |  |  |
| 3 | Synchronization |  | <https://youtu.be/nj6RJuK3LPA?si=F1kuzYD3Ql6rPG_3>  <https://youtu.be/lP_dzsdnfLo?si=46WDRqSBT1VeLaGu>  <https://youtu.be/MUmCrwyzMCE?si=bb0k43xmUPGpEJ23>  <https://youtu.be/thfRfBf_Bx8?si=WkMFVMMXTXbsgT5j>  <https://youtu.be/34WuUc6r0mw?si=yTPVmqpq-5gePdn6>  <https://youtu.be/EcoTlY0GXrA?si=hRLIy2hSQYraRQYt>  <https://youtu.be/D_XLu653GOo?si=OZzqL_3H94cnLAzm>  <https://youtu.be/r_ADh8RvG8I?si=lSD4VjjTkDvuYQnK>  <https://youtu.be/t3uuvtiHD3s?si=9mzM1D1ejRYjzMdn>  <https://youtu.be/-mnSxGp7rXk?si=uf-8mJdu2RUIc07u> |  |  |  |  |  |
| 4 | Replication |  | <https://www.youtube.com/watch?v=GAZAT068Hbg>  <https://www.youtube.com/watch?v=bnrD2n55dfk>  <https://www.youtube.com/watch?v=7_9CR9aRKBk>  https://nptel.ac.in/courses/106106168 |  |  |  |  |  |
| 5 |  |  | <https://www.youtube.com/watch?v=Lz5DNqfpN1w>  <https://www.youtube.com/watch?v=L_sUyOAjC6M> |  |  |  |  |  |
| 6 | NFS , HDFS, goog;e file system |  | <https://youtu.be/NZDOEliqBd4?si=lx_cRm-KH2G-r4Kj>  https://nptel.ac.in/courses/106106168 |  |  |  |  |  |

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| **4.k** | **Referred to any top-rated university in that subject for content** |

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| University | Name of the Course | Name of Faculty | Date of Delivery of the Course | Remarks |
| IIT Patna | Cloud Computing and Distributed system | Dr. Ravi Mishra | Jan to March |  |
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| **4.l** | **Faculty received any certification related to this subject. List of Certifications Identified / Done** |

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| Course | Certifying Agency | No. of Hours | Level of the Course | | Certification | | Remarks |
| Introductory | Advance Skill Development | Done on | Proposed to be on |
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| **4.m** | **Completed subject wise/cluster wise training with cluster mentor.**  **List of relevant Refresher Course Identified / Done** |

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| Course | Certifying Agency  (As suggested by DAB/Cluster Mentor/Industry/University other than MU) | Certification | | Remarks |
| Done on | Proposed to be on |
| Pedagogy |  |  |  |  |
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| PBL |  |  |  |  |
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| Sub. Content Training |  |  |  |  |
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| **4.n** | **Best Practices Identified and adopted** |

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| --- | --- | --- | --- | --- |
| No. | Item | Best Practices Identified | | |
| Univ. sanfoundry.com | Univ. 2 IIT | Univ. 3 |
| 1 | Microsite | https://www.stanford.edu/search/?q=distrobuted+computing&search\_type=web&submit= | https://nptel.ac.in/courses/106106168 |  |
| 2 | Video Lectures | Yes | <https://nptel.ac.in/courses/106106168> |  |
| 3 | Assignments | <https://cs.stanford.edu/people/eroberts/courses/soco/projects/distributed-computing/html/body_efficiency.htmlhttps://www.stanford.edu/search/?q=distrobuted+computing&search_type=web&submit=> | <https://onlinecourses.nptel.ac.in/noc25_cs12/unit?unit=16&assessment=118> |  |
| 4 | Mini Project |  |  |  |
| 5 | Assessment Metric | Yes | Yes |  |
| 6 | Quizzes |  |  |  |
| 7 | Labs/ Practical (PBL) |  |  |  |
| 8 | Tests |  |  |  |
| 9 | Peer Assessment | Yes | Yes |  |
| 10 | Any Other |  |  |  |

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| **4.o** | **Web Links for Online Notes/YouTube/VIT Digital Content/VIT Lecture Capture/NPTEL Videos** |

Students can view lectures by VIT professors, captured through LMS ‘Lecture Capture’ in VIT campus for previous years.

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| No. | Websites / Links | Module Nos. |
| 1 | International Journal of Distributed computing and cloud computing. | Methods in Practice- Distributed Computing Magazine |
| 2 | International Journal of Distributed computing and parallel computing by Elsevier | Computing Grid by Katie Yurkewicz |
| 3 | International journal of networked distributed computing ISSN:2211-7938 |  |
|  | Distributed Computing ISSN : 0178-2770 |  |

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| **4.p** | **Recommended MOOC Courses like Coursera / NPTEL / MIT-OCW / edX/VAC etc.** |

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| Sr. No. | MOOC Course Link | Course conducted by – Person / University / Institute / Industry | Course Duration | Certificate (Y / N) |
| 1 | Distributed Systems & Cloud Computing with Java | Michael Pogrebinsky  Professional Software Engineer| SW Architect | Instructor | 7 Weeks | Y |

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| **5** | **Consolidated Course Lesson Plan** |

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|  | | | | From (date/month/year) | | From (date/month/year) | | | Total Number of Weeks | | |
| Semester Duration | | | | 06/01/2025 | | 19/04/2025 | | | 15 | | |
| Week | Lecture no. | Module No. | Lecture Topics / MSE / BSA planned to be covered | | Actual date of Completion  (Handwritten) | | COs  Mapped | Mapping Bloom Taxonomy level | | Recommended  Prior Viewing / Reading | |
| Lecture No. (on LMS) | Chapter No./ Books/ Web Site |
| 1 | 1-2 | 1 | AA Plan Discussion  Asssignment 0 discussion Characterization of Distributed Systems: Issues, Goals, and Types of distributed systems, | |  | | CO1 | L1 | |  | T1-CH-1,1-56  T2-CH-1,1-33  T2-CH-2, 37-76  R1-CH-1,1-24  R2-CH-1, 1-44 |
| 3 | 1 | Distributed System Models, Hardware concepts, Software Concept. | |  | | CO1 | L1 | |  | T1-CH-2,56-127  T2-CH-4, 145-169  T2-CH-5, 185-225  R1-CH-4, 115-163  R2-CH-3, 114-153  R2-CH4-4, 167-230 |
| 2 | 4-5 | 1-2 | Middleware: Models of Middleware, Services offered by middleware, Client Server model | |  | | CO2 | L1 | |  | T1-CH-5, 241-280  T2-CH-14, 595-626  T2-CH-15, 629-671  R1-CH-6, 231-269  R2-CH-6, 282-332 |
| 6 | 2 | Interprocess communication (IPC):, Remote Procedure Call (RPC), Remote Object | |  | | CO2 | L1 | |  | T1-CH-5, 241-280  T2-CH-14, 595-626  T2-CH-15, 629-671  R1-CH-6, 231-269  R2-CH-6, 282-332 |
| 3  4 | 7-8 | 2 | Message Oriented Communication, Stream Oriented Communication synchronization  Invocation, Remote Method Invocation (RMI) | |  | | CO2 | L2 | |  | T1-CH-5, 241-280  T2-CH-14, 595-626  T2-CH-15, 629-671  R1-CH-6, 231-269  R2-CH-6, 282-332 |
| 9 | 2 | Layered Protocols, Remote Procedure Call, Remote Object Invocation, | |  | | CO2 | L` | |  | T1-CH-5, 241-280  T2-CH-14, 595-626  T2-CH-15, 629-671  R1-CH-6, 231-269  R2-CH-6, 282-332 |
| 10-11 | 3 | Clock Synchronization, Physical clock, Logical Clocks, Election Algorithms, Logical Clocks, Election Algorithms, | |  | | CO3 | L2 | |  |  |
| 5 | 12 | 3 | Distributed Mutual Exclusion, Requirements of Mutual Exclusion Algorithm performance measures | |  | | CO3 | L3 | |  | T1-CH-3,135-175  T2-CH18, 765-814  R1-CH-3, 69-110  R2-CH-7, 347-380  R2-CH-8, 381-420 |
| 13-14 | 3 | Non-Token based Algorithms: Lamport Algorithm Ricart–Agrawala’s Algorithm, Maekawa’s Algorithm  Token Based Algorithms: Suzuki-Kasami’s Board cast Algorithms, | | , | | CO3 | L3 | |  | T1-CH-3,135-175  T2-CH18, 765-814  R1-CH-3, 69-110  R2-CH-7, 347-380  R2-CH-8, 381-420 |
| 6 | 15 | 3 | Raymond ‘s Tree based Algorithm, Comparative Performance Analysis | |  | | ,CO3 | L3 | |  | T1-CH-6,291-345  T2-CH-18, 765-814  R1-CH-7, 273-315  R1-CH-8, 321-348  R2-CH-9, 421-495 |
| 16-17 | 3 | Deadlock Introduction, Deadlock Detection Centralized approach, Chandy Mishra \_Hass Algorithm | |  | | CO3 | L2 | |  | T1-CH-6,291-345  T2-CH-18, 765-814  R1-CH-7, 273-315  R1-CH-8, 321-348  R2-CH-9, 421-495 |
| 7 | 18 | 4 | Resource and Process Management | |  | | CO4 | L3 | |  | T1-CH-4, 189-232  T2-CH-12, 521-563  T2-CH-13, 565-592  T2-CH-21, 915-964  R1-CH-5, 179-222R2-CH-9, 421-495 |
| 19-20 | 4 | Desirable Features of global Scheduling algorithm, Task assignment approach, Load balancing approach, load sharing approach | |  | | CO4 | L1 | |  | T1-CH-4, 189-232  T2-CH-12, 521-563  T2-CH-13, 565-592  T2-CH-21, 915-964  R1-CH-5, 179-222  R2-CH-9, 421-495 |
| 8 | 21 | 4 | Introduction to process management, process migration, Code Migration, | |  | | CO4 | L2 | |  |  |
| 22-23 | 5 | Replication, Consistency and Fault Tolerance  Introduction to replication and consistency, Data-Centric and Client- Centric Consistency Models, Replica Management | |  | | CO% | L3 | |  | T1-CH-6,291-345  T2-CH-18, 765-814  R1-CH-7, 273-315  R1-CH-8, 321-348  R2-CH-9, 421-495 |
| 10 | 24 | 5 | Fault Tolerance: Introduction, Process resilience, Recovery | |  | | CO5 | L2 | |  | T1-CH-4, 189-232  T2-CH-12, 521-563  T2-CH-13, 565-592  T2-CH-21, 915-964  R1-CH-5, 179-222R2-CH-9, 421-495 |
| 25-26 | 6 | introduction and features of DFS, File models, File Accessing models,  File-Caching Schemes, | |  | | CO5 | L2 | |  | T1-CH-4, 189-232  T2-CH-12, 521-563  T2-CH-13, 565-592  T2-CH-21, 915-964  R1-CH-5, 179-222  R2-CH-9, 421-495 |
| 11 | 27 | 6 | File Replication, Case Study: Distributed File Systems (DSF), | |  | | CO6 | L2 | |  | T1-CH-6,291-345  T2-CH-18, 765-814  R1-CH-7, 273-315  R1-CH-8, 321-348  R2-CH-9, 421-495 |
| 12 | 28-29 | 6 | Introduction to Designing Distributed Systems: Google Case Study Network File System (NFS), | |  | | CO6 | L2 | | google |  |
| 30 |  | Revision (This is optional based on college festival) | |  | |  |  | |  |  |
| 13 | 31-32 |  | Testing Discussion and real time application | |  | |  |  | |  |  |

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| **6** | **Rubric for Grading and Marking of Term Work (inform students at the beginning of semester)** |

* Activity/ies should be designed as per reference of credit structure.
* If the subject is of 2 credit, activity/ assignment should be design for 2 hours with appropriate complexity and engaging time.

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| Theory (ISA=\_\_20\_\_ ) | | | | | | | |  |  |  |  | Total |
| Class Participation | Activity-1 | Activity-2 | Activity-3 | Activity-4 | Activity-5 | Activity-6 | Activity-7 | Activity-8 | Activity-9 | Activity-10 | Activity-11 |
|  | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 | 20 |

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| Practical (ISA=\_25\_\_\_ ) | | | | | | | |  |  |  |  | Total |
| Class Participation | Activity-1 | Activity-2 | Activity-3 | Activity-4 | Activity-5 | Activity-6 | Activity-7 | Activity-8 | Activity-9 | Activity-10 | Activity-11 |
|  | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 | 25 |

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| Class Participation | MSE-1 | MSE-2 | ESE | Total |
|  | 30 | 30 | 50 | 80 |

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| **7** | **Assignments / Tutorials Details** |

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| Assignment/ Tutorial No. | Title of the Assignments / Tutorials | CO Map | Mapping Bloom Taxonomy  Level | Assignment/ Tutorials given to Students on | Assignments to be submitted back on |
| 1 | **Introduction** | CO1 | 1 | Week 01 | 7/2/2025 |
| 2 | **Global Platform** | CO1 | 1 | Week 01 | 14/2/2025 |
| 3 | **collaborative real-time multiplayer** | CO2 | 2 | Week 01 | 21/02/2025 |
| 4 | **clock synchronization challenges** | CO3 | 3 | Week 01 | 28/02/2025 |
| 5 | **Token-based algorithms** | CO3 | 3 | Week 01 | 07/3/2025 |
| 6 | **scheduling algorithm** | CO3 | 3 | Week 01 | 15/3/2025 |
| 7 | **Load Balancing** | CO4 | 4 | Week 01 | 21/3/2025 |
| 8 | **Replication for performance** | CO5 | 5 | Week 01 | 28/3/2025 |
| 9 | **Balancing Consistency and Performance:** | CO5 | 5 | Week 01 | 4/4/2025 |
| 10 | **Case distributed file systems (NFS)** | CO6 | 6 | Week 01 | 11/4/2025 |
| 11 | **Case distributed file systems (DFS)** | CO6 | 6 | Week 01 | 17/4/2025 |

**Analysis of Assignment / Tutorial Questions and Related Resources**

| Assignment / Tutorial No. | Week No. | Type\* (√) | | | Module No. | Based on # | | | Question Type (√) | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| OT | CS | DTP | Textbook | Reference  Book | Other Learning Resource | Real Life Assignments | Thought Provoking |
| 1 | 01 |  | √ |  | 1 | √ | √ | - | √ |  |
| 2 | 02 |  | √ |  |  | √ | √ | - | √ |  |
| 3 | 03 |  | √ | √ |  | √ | √ |  | √ | √ |
| 4 | 04 |  | √ |  |  | √ | √ |  | √ |  |
| 5 | 05 |  | √ |  |  | √ | √ |  |  |  |
| 6 | 06 |  | √ |  |  | √ | √ |  | √ |  |
| 7 | 07 |  | √ |  |  | √ | √ |  | √ |  |
| 8 | 08 |  | √ |  |  | √ | √ |  | √ |  |
| 9 | 09 |  | √ |  |  | √ | √ |  | √ |  |
| 10 | 10 |  | √ |  |  | √ | √ |  | √ |  |
| 11 | 11 |  | √ |  |  | √ | √ |  | √ |  |

\* Tick (√) the Type of the Assignment: Online Tools (OT); Collaborative Assignments (CS); Design /Thought provoking (DTP)

# Write number for textbook, reference book, other learning resource from this AAP – *from* *Points 4.a to 4.d*

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| **8** | **In Semester Assessment (ISE) / Other Class Test / Open Book Test (OBT)/Take Home Test (THT) Details** |

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| --- | --- | --- | --- | --- | --- |
| Tests | Test Dates | Module No. | CO Map | MSE Question Paper Pattern | Policy |
| ISE | Every week form 03 onwards | 01-06 | CO1,CO2,CO3 | 05 marks ,10marks , 10 marks MCQ |  |
| Pop Quiz | Week 08 and 10 week | 03 and 05 | CO2,CO3,CO5 | 10 marks each |  |
| Open Book Test | Week 07 | Model 04 | CO4 | 10 marks |  |
| Take Home Test | Week 12 | 06 | CO6 | 10 marks |  |
| Class tests / prelims |  |  |  |  |  |
| Class tests / prelims |  |  |  |  |  |
| Any other test/exams |  |  |  |  |  |

**\* Failures of IA test (IA1+IA2) shall appear for IA test in the next semester. There is no provision for re-test in the same semester.**

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| **9.** | **Practical Activities** |

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| Practical No. | Module No. | Title of the **Experiments** | Type of Experiment | | Topics to be highlighted | CO Map |
| PBL | Newly Added |
|  |  | **Design distributed system for a collaborative real-time multiplayer gaming platform.** |  |  |  |  |
| 1 | 1 | Identify the concept on which operating system distributed computing works |  |  | Distributed OS | CO1 |
| 2 | 2 | Implement a Distributed application using socket. Application consists of a server which takes an integer value from the client, calculates factorial and returns the result to the Client program. Activity 02 |  |  | Communication | CO2 |
| 3 | 2 | Design a Distributed Application for remote computation |  |  | RPC/RMI | CO2 |
| 4 | 3 | Simulate a distributed system with multiple nodes (processes or computers), each with its own local clock. | Thought provking | new | Clock Synchronization | C03 |
| 5 | 3 | Using messages between nodes at random intervals, with timestamps assigned based on the node's local clock. |  |  | Multiple Nodes and Local Clocks | CO3 |
| 6 | 3 | Simulate a distributed system where multiple processes request and hold shared resources |  |  | Deadlock Management | CO3 |
| 7 | 3 | Apply concept of Mutual Exclusion algorithm for distributed system othim) activity 06 |  |  | Mutual Exclusion | CO3 |
| 8 | 3 | Compute concept for Token based Mutual Exclusion (Raymond Tree) Activity 07 |  | New | Mutual Exclusion | CO3 |
| 9 | 4 | Create multiple "server nodes" (processes or threads) to handle incoming tasks. | Yhought provking |  | Load management | CO4 |
| 10 | 4 | Design a distributed application which consist of a server and client using threads.  Activity 09 |  |  | Multithreading | CO4 |
| 11 | 6 | Understanding the mounting and unmounting process of files using NFS  Activity 10 |  |  | DFS | CO6 |
|  |  | **Scenario:** Imagine a distributed cloud computing platform that handles user requests for running computational tasks, such as data analysis, machine learning training, and video rendering. The system consists of multiple geographically distributed nodes with varying capacities and workloads. Users expect their tasks to be executed quickly and efficiently while the system must minimize costs, balance workloads, and ensure fairness across nodes.  However, challenges arise when:   1. Some nodes become overloaded while others are underutilized. 2. High-priority tasks get delayed because resources are occupied by lower-priority tasks. 3. Task dependencies across nodes lead to inefficient execution and delays.   **Problem Statement:** How can the distributed system implement an efficient scheduling algorithm that:   1. Balances workloads across nodes to optimize resource utilization. 2. Ensures fairness and prioritization for critical tasks. 3. Handles task dependencies and communication overhead effectively. 4. Adapts to dynamic changes in workload and resource availability | PBLE |  |  |  |
|  |  | **Scenario:** A team building a distributed ticket booking system for a global event. The system is hosted across multiple servers in different regions to handle high user traffic. Each server maintains a replica of the ticket inventory to reduce latency and improve availability. However, since thousands of users are attempting to book tickets simultaneously, the following synchronization issues arise:   1. **Overbooking:** Multiple users are allocated the same ticket due to race conditions between servers. 2. **Inconsistent State:** Some servers show available tickets while others show sold-out, leading to user dissatisfaction. 3. **Delayed Updates:** Due to network delays, updates about ticket availability take too long to propagate across servers, creating confusion. | PBLE |  |  |  |

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| **10** | **Uncovering syllabus with different Activities.** |

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| No. | Type of the Activity | | Activities | Number of beneficiaries | Other Details – guest profile, feedback, mark sheet, report | |
| 1 | **Experiential learning/Interaction with Outside World** | | 1- Guest Lectures by Industry Expert | Dr  Dr. G A Patil Director Information Technology JPM University |  | |
| 2- Workshops |  |  | |
| 3- Mini Project |  |  | |
| 4- Industrial Visit |  |  | |
| 5- Any other activity |  |  | |
| 2 | **Collaborative & Group Activity** | | 6- Poster Presentation | Yes |  | |
| 7- Minute Papers | Yes |  | |
| 8- Students Seminars |  |  | |
| 9- Students Debates |  |  | |
| 10- Panel Discussion / Mock GD |  |  | |
| 11- Mock Interview |  |  | |
| 12- Any other activity |  |  | |
| 3 | **Co-Curricular Activity** | | 13- Informative videos (NPTEL/YouTube /TEDx/ MIT OW/edX) | Yes |  | |
| 14- Lecture Capture Usage |  |  | |
| 15-Any other activity |  |  | |
| 4 | **Tests & Assessments** | | 16- Class Tests/ Weekly Tests |  |  | |
| 17- Pop Quiz | Chap 3 and chap 5 |  | |
| 18- Mobile App Based Quiz |  |  | |
| 19- Open Book Test |  |  | |
| 20- Take Home Test | Yes |  | |
| 21-Any other activity |  |  | |
| **11** | | **AAP** | | | |

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| No. | Programme | Course | Uploaded on V-refer | Date |
| 01 | UG | BE CSC 801 |  |  |
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| **12** | **Lecture Guide** |

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| No. | Programme | Course | Uploaded on V-refer | Date |
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**\* Do not delete any activity. Give details for planned events. Write ‘NA’ for activity Not Planned.**

Consolidated Academic Administration PlanPrepared by (mention all theory teaching faculty names with signature)

Please write below your name and sign with date of the external cluster mentor meeting

|  |  |  |
| --- | --- | --- |
| Faculty 1 | Faculty 2 | Faculty 3 |

|  |  |  |  |
| --- | --- | --- | --- |
| External Industry Mentor | External Academic Mentor | VIT Cluster Mentor | Program HOD |