**BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI**



**WORK INTEGRATED LEARNING PROGRAMMES**

**COURSE HANDOUT**

**Part A: Content Design**

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| --- | --- |
| **Course Title** | Middleware Technologies |
| **Course No(s)** | CSI ZG524/SE ZG589/SS ZG589 |
| **Credit Units** | 4 |
| **Course Author** | Mr Ravi Kiran Mallidi, Prof. Shan Balasubramaniam |
| **Version No** | 1.0 |
| **Date** |  |

**Course Description**

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| --- |
| Evolution of Middleware Technologies: Transaction Processing, Remote Procedure Calls, Message-Oriented-Middleware, Object Request Brokers, Web services and REST; Forms of Middleware: Enterprise Middleware, Web Middleware, and Cloud / Services Middleware; Middleware Elements: communication protocols, middleware protocols, data representation, server process control, naming and directory services, security, system management; Select case studies such as MS .NET, J2EE. Service Oriented Architecture: Loosely Coupled Systems, Business processes, Tiers, Architectural Choices; Resiliency in Middleware: resiliency techniques, hardware failures, communication failures, software failures; Performance and scalability in Middleware; Security in Middleware; Implementation Aspects: business process implementation, enterprise integration, web and database middleware (e.g. NoSQL middleware) change management. Case studies of Enterprise application architecture (EAI) - Eg. Tibco, Websphere |

**Course Objectives**

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| --- | --- |
| **No** | **Objectives** |
| **CO1** | Describe the architecture and applications of CORBA and its elements such as IDLs, naming service, and demonstrate how to deploy an application on Application server such as JBoss |
| **CO2** | Demonstrate understanding of EAI concepts and deploy applications in Application Server such as Apache Camel / Fuse ESB |
| **CO3** | Demonstrate ability to apply 64 design patterns, Message Oriented Middleware and clustering of the application server (Apache Camel / Fuse ESB) |
| **CO4** | Compare different architectures in web based applications such as SOAP and REST, protocols in Middleware, and demonstrate ability to deploy applications on a Cloud platform (such as AWS) |
| **CO5** | Describe the fundamentals of NoSQL Database, its usage along with middleware and performance tuning of the application and server |

**Text Book(s)**

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| --- | --- |
| No | Author(s), Title, Edition, Publishing House |
| T1 | INTRODUCTIONTOMIDDLEWARE (Web Services, Object Components,and Cloud Computing) by Letha Hughes Etzkorn |
| T2 | Java RMI (Designing & Building Distributed Applications) by William Grosso |

**Reference Book(s) & other resources**

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| --- | --- |
| No | Author(s), Title, Edition, Publishing House |
| R1 | Enterprise Integration Patterns by Bobby Woolf |
| R2 | MongoDB in Action |

**Content Structure**

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| --- | --- | --- |
| **No** | **Title of the Module** | **References** |
| M1 | Introduction and Evolution   * Transaction Processing * Remote Procedure Calls (Marshalling, Stubs) * Messaging Middleware (Request Brokers) * CORBA as a standard * Remote Methods (Java RMI) | T1, T2  (4Hrs.) |
| M2 | Enterprise Middleware   * EAI,Enterprise Bus (e.g. TIBCO)and Publish-Subscribe Models * Real-time requirements * Security aspects * Business Processes and Middleware Implementations | T1, R1  (2Hrs.). |
| M3 | Middleware Design and Patterns   * Objects and Services vs. Messages and Requests * Lookup and Discovery – Registry and Broker Patterns * Message Formats and Protocols * Service Mediation * Failure and Resiliency – Availability, Recovery * Performance and Security | T1, R1  (10Hrs.) |
| M4 | Middleware for Web-based Application and Cloud-based Applications   * Tiered Architectures and * Loosely Coupled Systems - Services (WS, REST, SOA), Services Middleware * Deployment of applications on the cloud – middleware configurations * Cloud Middleware and usage (Load Balancers, Provisioning middleware, Hybrid Cloud Infrastructure, Multi-cloud Infrastructure). | T1  (10Hrs.) |
| M5 | Specialized Middleware   * Peer-to-Peer systems and Middleware (Overlays, SuperPeers) * Performance Middleware (Caching, Content Distribution) * Middleware for NoSQL databases | T1  (4Hrs.) |

**Learning Outcomes:**

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| --- | --- |
| No | Learning Outcomes |
| LO1 | Demonstrate understanding on CORBA and EJB’s, and ability to deploy applications in Java servers |
| L02 | Describe relevant integration concepts for middleware, integration patterns and usage, and demonstrate ability to deploy applications in middleware servers |
| LO4 | Describe the various architecture styles and usages, deploy applications and enable integration between different systems by the application of the right protocol / communication between them |
| LO5 | Describe the usage of NoSQL database in middleware, performance tuning and sizing of the application server based on Load (Java) |

**Part B: Contact Session Plan**

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| **Academic Term** | First Semester 2023-2024 |
| **Course Title** | Middleware Technologies |
| **Course No** | CSI ZG524/SE ZG589/SS ZG589 |
| **Lead Instructor** | Pawan Gupta |

**Course Contents**

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| --- | --- | --- | --- | --- |
| **Contact Session 1**  **M1: Introduction and Evolution** | | | | |
| Time | Type | | Description | Text/Ref Book/external resource |
| Pre CS | RL1.1 | Introduction to Transactions |  | T1 – Chapter 1,8 |
| RL1.1 | Sockets overview |  |
| RL1.1 | Early middleware technologies |  |
| During CS | CS 1 | Cover the topics in detail |  |
|  |
| **Contact Session 2**  **M1: Introduction and Evolution** | | | |  |
| Time | Type | | Description | Text/Ref Book/external resource |
| Pre CS | RL1.2 | Cobra basics |  | T1 – Chapter 1,8 |
| RL1.2 | IDL |  |
| RL1.2 | IDL Addressing Naming |  |
| During CS | CS 2 | All the remaining topics of module 1 |  |
| **Contact Session 3**  **M2: Enterprise Middleware** | | | |  |
| Time | Type | | Description | Text/Ref Book/external resource |
| Pre CS | RL 2.1 | Introduction to EAI-Message Channels |  | R1- Chapter 4  T1- Chapter 5 |
| RL 2.1 | Middleware Security |  |
| During CS | 3 | All remaining topics of module 2 |  |
| **Contact Session 4,5**  **M3: Middleware Design and Patterns** | | | |  |
| Time | Type | | Description | Text/Ref Book/external resource |
| Pre CS | RL 3.1 | Integration styles |  | R1 – All Chapters, Apache Camel (<http://camel.apache.org>), T1- Chapter 9, Apache JMeter (https://jmeter.apache.org) |
| RL 3.1 | Messaging Systems |  |
| RL 3.1 | Message Construction |  |
| RL 3.1 | Message routing |  |
| During CS | CS 4,5 | All the remaining topics of module 3 |  |  |
| **Contact Session 6: Review**  **Contact Session 7,8**  **M4: Middleware for Web-based Application and Cloud-based Applications** | | | |  |
| Time | Type | | Description | Text/Ref Book/external resource |
| Pre CH | RL 4.1 | Intro-Middleware-Web |  | T1 – Chapter 9, 10, 11  T1- Chapter 13, 14  <https://aws.amazon.com/>  <https://github.com/aws-samples> |
| RL 4.1 | Non-REST-WebServices |  |
| RL 4.1 | REST-WebServices |  |
| RL 4.1 | CloudMiddleware-AWS |  |
| RL 4.1 | Hybrid-Multi-Cloud |  |
| During CH | 7, 8 | All the remaining topics from module 4 |  |
| **Contact Session 9**  **M5: Specialized Middleware** | | | |  |
| Time | Type | | Description | Text/Ref Book/external resource |
| Pre CH | RL 5.1 | No SQL |  |  |
| RL 5.1 | Caching |  |
| During CH | CS 9 | All the remaining topics from module 5 |  |
| **Contact Session 10: Review** | | | |  |

## Lab Details

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| **Title** | **Access URL** |
| Lab Setup Instructions |  |
| Lab Capsules |  |
| Additional References |  |

**Select Topics and Case Studies from business for experiential learning**

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| --- | --- | --- |
| **Topic No.** | **Select Topics in Syllabus for experiential learning** | **Access URL** |
| M1 | Echo Example using Java  CORBA Exercises | T1 – Chapter 8, Section 8.2.9 and 8.9.10  T1 – Chapter 8 – CORBA Exercises |
| M3 | Examples on Middleware (Apache Camel) | https://github.com/apache/camel/tree/master/examples |
| M3 | Examples on Message Routing (Apache Camel)   * POJO Routing * Spring Boot POJO | https://github.com/apache/camel/tree/master/examples |
| M3 | Load Balancing Example using TCP / IP (Tomcat / Mina server) | https://github.com/apache/camel/tree/master/examples |
| M3 | * Spring Security Example * Web Services Security Examples | <https://github.com/apache/camel/tree/master/examples> |
| M4 | * SOAP Services Samples Execution | <https://github.com/apache/camel/tree/master/examples> |
| M4 | * Rest Services Samples Execution | <https://github.com/apache/camel/tree/master/examples> |
| M4 | * Application Samples on AWS environment * LAMBDA Samples * Example showing AWS-S3 | <https://github.com/apache/camel/tree/master/examples>  <https://github.com/aws-samples> |
| M5 | * Example showing Camel using DataBase (NoSQL * Example showing Camel using JDBC | <https://github.com/apache/camel/tree/master/examples> |

**Evaluation Scheme**

Legend: EC = Evaluation Component

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| --- | --- | --- | --- | --- | --- |
| No | Name | Type | Duration | Weight | Day, Date, Session, Time |
| EC1 | Quiz-1 | 20 questions, MCQ |  | 5% | September 1-10, 2023 |
| Quiz-2 | 20 questions, MCQ |  | 5% | October 1-10, 2023 |
| Quiz-3 | 20 questions, MCQ |  | 10% | November 1-10, 2023 |
| EC2 | Mid Semester Test | CLOSED BOOK | 2 Hours | 35% | Saturday, 23/09/2023 (AN) |
| EC3 | Comprehensive Examination | Open Book | 2½ Hours | 45% | Saturday, 25/11/2023 (AN) |

***Note*** *- Evaluation components can be tailored depending on the proposed model.*

**Important Information**

Syllabus for Mid-Semester Test (Open Book): Topics in Weeks 1-8

Syllabus for Comprehensive Exam (Open Book): All topics given in plan of study

Evaluation Guidelines:

1. EC-1 consists of either two Assignments or three Quizzes. Announcements regarding the same will be made in a timely manner.
2. For Closed Book tests: No books or reference material of any kind will be permitted. Laptops/Mobiles of any kind are not allowed. Exchange of any material is not allowed.
3. For Open Book exams: Use of prescribed and reference text books, in original (not photocopies) is permitted. Class notes/slides as reference material in filed or bound form is permitted. However, loose sheets of paper will not be allowed. Use of calculators is permitted in all exams. Laptops/Mobiles of any kind are not allowed. Exchange of any material is not allowed.
4. If a student is unable to appear for the Regular Test/Exam due to genuine exigencies, the student should follow the procedure to apply for the Make-Up Test/Exam. The genuineness of the reason for absence in the Regular Exam shall be assessed prior to giving permission to appear for the Make-up Exam. Make-Up Test/Exam will be conducted only at selected exam centres on the dates to be announced later.

It shall be the responsibility of the individual student to be regular in maintaining the self-study schedule as given in the course handout, attend the lectures, and take all the prescribed evaluation components such as Assignment/Quiz, Mid-Semester Test and Comprehensive Exam according to the evaluation scheme provided in the handout.