✅ Java Threads and Concurrency

1. What is the difference between Process and Thread?

- **Process** is an independent executing program with its own memory space.
- **Thread** is a lightweight subprocess that shares the same memory of the process.

2. What are the benefits of multi-threaded programming?

- Better CPU utilization
- Simultaneous task execution
- Improved application performance
- Efficient resource sharing

3. What is the difference between user Thread and daemon Thread?

- **User thread** performs actual tasks and keeps JVM running.
- **Daemon thread** is a low-priority thread used for background tasks; JVM exits when only daemon threads remain.

4. How can we create a Thread in Java?

- By extending Thread class and overriding run() method.
- By implementing Runnable interface and passing it to a Thread object.

5. What are different states in the lifecycle of a Thread?

- New → Runnable → Running → Blocked/Waiting → Terminated

✅ Remote Method Invocation (RMI)

6. What is the role of java.rmi.Naming class?

- It provides methods like bind(), rebind(), lookup() to register and access remote objects.

7. What is RMI?

- RMI (Remote Method Invocation) allows an object to invoke methods on an object running in another JVM.

8. What is RMI Registry?

- A server-side application that stores references to remote objects, enabling lookup by clients.

9. What is the basic principle of RMI architecture?

- RMI allows method invocation between JVMs using stubs and skeletons over the network.

10. What are the layers of RMI Architecture?

- **Application Layer**, **Stub/Skeleton Layer**, **Remote Reference Layer**, **Transport Layer**

11. What is meant by binding in RMI?

- Associating a name with a remote object in the RMI registry.

12. What is the difference between bind() and rebind() methods of Naming class?

- bind() adds a new object reference (throws error if name exists).
- rebind() replaces existing binding with a new object.

13. What is the use of UnicastRemoteObject in RMI?

- It exports the remote object to receive incoming calls.

✅ CORBA (Common Object Request Broker Architecture)

14. What is CORBA?

- A standard defined by OMG for communication between objects across languages and networks.

15. Which protocol is used for invoking methods on CORBA objects over the internet?

- **IIOP** (Internet Inter-ORB Protocol)

16. Explain Naming Service in CORBA.

- It allows clients to locate remote CORBA objects by name.

17. What is IDL?

- **Interface Definition Language** is used to define interfaces between CORBA objects.

18. How does CORBA support interoperability?

- Through standard IIOP and IDL, it allows cross-platform communication.

✅ Message Passing Interface (MPI)

19. What are the message passing primitives of MPI?

- MPI_Send, MPI_Recv, MPI_Bcast, MPI_Scatter, MPI_Gather

20. What are Message Passing Interface methods?

- Methods like MPI_Init, MPI_Comm_rank, MPI_Comm_size, MPI_Finalize

21. How to compile and execute MPI programs?

- **Compile:** mpicc program.c -o output
- **Run:** mpirun -np 4 ./output

22. What is the purpose of Communicator in MPI?

- It defines a group of processes that can communicate with each other.

23. Which MPI method is used to identify the processor ID?

- MPI_Comm_rank()

24. Which MPI routine returns the number of processes with a communicator?

- MPI_Comm_size()

25. What are the basic datatypes in MPI (C/Java)?

- **C:** MPI_INT, MPI_FLOAT, MPI_CHAR
- **Java:** MPI.INT, MPI.DOUBLE, MPI.OBJECT

✅ Clock Synchronization

26. How does the Berkeley algorithm synchronize physical clocks?

- A master polls slaves, collects their times, calculates average, and instructs adjustments.

27. What are the issues resolved by Berkeley's algorithm?

- Clock drift, time inconsistencies in distributed systems.

28. What are the techniques used to synchronize clocks?

- **Cristian's Algorithm**, **Berkeley Algorithm**, **NTP (Network Time Protocol)**

29. How do you calculate average time in Berkeley algorithm?

- Ignore extreme values, take average of others, and adjust local clocks accordingly.

✅ Mutual Exclusion Algorithms

30. What is token ring algorithm for mutual exclusion?

- A logical ring passes a token; only token holder can enter the critical section.

31. What is a token-based mutual exclusion algorithm?

- It ensures mutual exclusion using a special token that circulates among nodes.

32. What are the advantages of token-based algorithm?

- Avoids starvation, no deadlocks, ensures fairness.

33. What is a common issue with token-based mutual exclusion algorithms?

- **Token loss** — if token is lost, it must be regenerated, which is complex.

✅ Leader Election Algorithms

34. Which leader election algorithm uses priority values to select a leader?

- Bully Algorithm

35. What is the advantage of ring-based leader election over bully algorithm?

- Ring algorithm uses less message passing and works with minimal information.

36. What is the best-case time complexity of Bully and Ring Leader-Election Algorithm?

- **Bully:** O(1)
- **Ring:** O(n)

✅ Web Services

37. What are the important components of SOAP-based web services?

- **SOAP message**, **WSDL**, **UDDI**, **Service Endpoint**

38. What are the disadvantages of SOAP-based web services?

- Complex and slow, requires more bandwidth, tight coupling.

39. What are RESTful web services?

- Services that use HTTP methods (GET, POST, PUT, DELETE) and are stateless.

40. What are the advantages of RESTful web services?

- Lightweight, easy to integrate, better performance, scalable.

41. Differentiate between SOAP and RESTful web services:

Feature	SOAP	REST
Protocol	Uses only XML	Uses multiple formats (JSON, XML)
Transport	Can use HTTP, SMTP, etc.	Uses only HTTP
Complexity	Complex	Simpler
Performance	Slower	Faster