1. Introduction

a) define a DS

b) name, describe and justify DS characteristics

c) name and define important DS classifying aspects

d) evaluate a given well-known DS against a set of classifying aspects

e) list several levels of network abstraction behind a typical DS; for each level identify the key concepts that are relevant to a DS developer

f) define and correctly use terms: TCP port, TCP channel, URL, secure channel, multicast

g) explain difference between synchronous and asynchronous send

h) give the main idea of an efficient multicast implementation

i) start remote programs, copy files using SSH

2. Message-oriented and peer to peer systems

a) to program messaging among Java applications using the JMS standard

b) to implement synchronous message sending using asynchronous sending

c) describe the characteristics and benefits of a P2P DS

d) explain why peers need to implement a routing facility, giving at least two reasons

e) explain how prefix routing works giving a simplified example

f) explain and modify a simple P2P system programmed using JMS

3. Client-server architectures

a) describe the functionality of each tier in a standard 3-tiered system and how they interact

b) describe the advantages/disadvantages of having more or less tiers in a client-server DS

c) given an example tiered system, identify ways to improve its scalability, in particular which services can be cached, replicated and/or transferred as mobile code

4A. Java Remote Method Invocation: Basics

a) read and modify existing Java RMI applications

b) write simple Java RMI applications correctly, in particular:

- program initial contact to a remote object
- exchange remote references to objects
- exchange serialisable parameters
- synchronise remote access to the state of remote objects

c) discuss the differences between JMS and Java RMI

4B. Java Remote Method Invocation: Further Look

a) describe the purpose of notification in a distributed object model and give examples of its use

b) program Java RMI notification listeners and notification subscription services

c) describe the purpose of a factory using an example

d) program a simple factory featuring automatic removal of unreferenced instances

e) describe the Java RMI garbage collection process

f) briefly describe and correctly use the Java RMI exception propagation mechanism

g) list several common errors that are represented by Java RMI various remote exceptions (no need to memorise the exception names but should recognise them when shown)

5. RESTful Web Services

a) state the defining principles of RESTful systems

b) design a RESTful remote interface for a simple client-server system

c) argue for and against using RESTful Web Services for DS development comparing it to Java RMI

d) extend an existing simple RESTful application in Java using JAX-RS and the Jersey library

e) make good use of XML and XML schemata in RESTful applications

6. Service Oriented Architecture

a) Using examples, describe the importance of various WS standards for security, resources, orchestration, addressing and notification in developing open, widely applicable services.

b) Describe the UDDI mechanism for automated publishing and discovering of Web Services and argue its strengths and weaknesses.

7. Remote Procedure Calls using Web Services

a) describe the conceptual differences between WS RPC and RESTful WS and RMI as DS development methodologies

b) describe the roles of SOAP and WSDL in WS

c) correctly interpret simple given WSDL document and represent the document by an appropriate diagram

d) list the usual components of both a server and a client of a Web Service generated from a WSDL document and explain the function of each component

e) generate a Java client proxy for a service described by a given WSDL document

f) develop a Java program providing a service described by a given WSDL document

8. Web Services with Resources

a) Describe the concept of WS-Resource using suitable examples and diagrams.

b) Explain how WS-Addressing, WS-ResourceProperties and WS-Notification standards relate to WSRF, illustrating the ideas with examples.

c) Name three standard port types used in basic notification according to WS-Notification and draw a collaboration diagram illustrating their use.

9. High Performance Distributed Systems

a) describe the characteristics of clusters and grids

b) name several applications that would make good use of clusters/grids and explain why it is the case

c) name three important components of Globus and briefly explain their purpose

d) describe the purpose of MPI and explain its advantages and disadvantages against RMI and against Web services