Question 1:
- **(a)** Out of course
- **(b)** Out of course
- **(c)** **Explain** the difference between layers and tiers using a system example of your own choice.
- **(d)** **Explain** two differences between application servers and web servers.
- **(e)** **Explain** three differences between monolithic and microservice-based applications.

Question 2:
- **(a)** [4 marks] Categorize each of the following requirements according to the sub-categories of non-functional requirements explained within the course. You must provide a written explanation for your answer. **If no explanation is provided, no mark will be given for the corresponding part.**

    i. Within Acadox learning management system, the teaching assistant of the course "CS 101" should not be able to ban a student from accessing the course's content. Such banning should only be done by the course instructor.

    ii. SatWatch (a satellite-moderated watch) should display the correct time zone within 5 minutes of the end of a GPS blackout period.

    iii. The ARENA system must support the kick-off of many parallel Tournaments (e.g., 20), each involving up to 64 Players and several hundreds of simultaneous Spectators.

    iv. Money transfer between different banks must be guaranteed to succeed with no money loss

- **(b)** Consider an application that can process at most 1000 customer transactions per second. Explain how you would scale that application to support 10000 customer transactions per second. You need to **explain two options for scalability**: scaling out and scaling up.
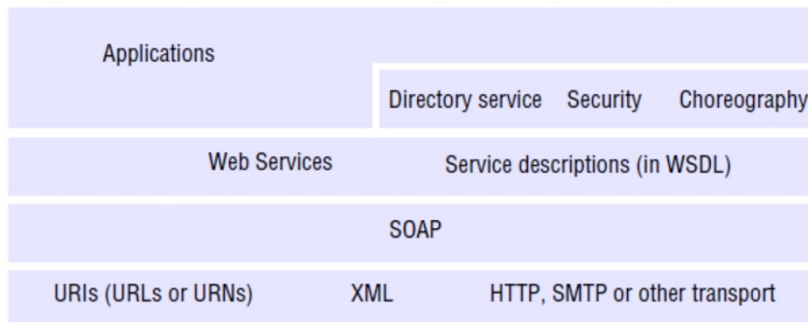
Question 3: Out of course

Question 4 [11 marks]:
- **(a)** Identify the most appropriate architectural style for each of the following different systems' descriptions. You must provide a written explanation for your answer. *If no explanation is provided, no mark will be given for the corresponding part.*

    i. Need software for managing and providing different kinds of information (weather, location, points-of-interest etc.) to app- and web-developers. The information will be gathered from various sources and processed by through the software. The software should provide open data access to anyone who wants to use the information through standard APIs.

    ii. Need software for a smartphone game where players can compete against each other through Bluetooth (no need to access the Internet)

    iii. Need a web-based system where the centralized computing resources are divided into three parts: A presentation part which displays information related to various services, an application part – which controls the system's functionality and carries out the processing, and a data part where data is accessed, stored, changed and maintained.

(b) Out of course

(c) Consider the following figure that explains the web service infrastructure and components. Explain what is meant by **directory service**, and **Service descriptions**.

Applications			
	Directory service	Security	Choreography
Web Services	Service descriptions (in WSDL)		
SOAP			
URIs (URLs or URNs)	XML	HTTP, SMTP or other transport	

Question 5: Out of course

Question 6 [11 marks]:
Consider a web-based application that allows users to find nearby restaurants, place a reservation, cancel a reservation, and make a review on a specific restaurant.

(a) **Sketch** a diagram to show a layered architecture for such a system. Explain your diagram

(b) Consider that such a system would be changed to allow using different devices besides the web-based application (e.g., using an Android mobile application or an iOS mobile application). **Sketch** a diagram for how your proposed design in part (a) would be modified to achieve such change. You need to **justify** and **explain** your modification.

(c) Consider that such system would be updated once more to allow placing a different number of workloads (i.e., user requests) on different functionalities simultaneously. **Sketch** a diagram for the design of such a system to achieve that change. You need to **justify** and **explain** your design.

(d) Consider that such system would allow a variety of different devices with different information needs from the provided system's functionality. For example, a mobile app version of the application would only show a subset of the restaurants based on two main filters: the location of those restaurants within the same location of the cell phone of the user, and the restaurants where the user has given his contact information when he physically visited them before. On the contrary, a web-based version of the application would not apply any of those filters. **Sketch** a diagram for how your proposed design in part (c) would be modified to achieve such change. You need to **justify** and **explain** your modification.