**Questions and Answers:**

**Birla Institute of Technology & Science, Pilani**

**Work-Integrated Learning Programmes Division**

**Second Semester 2021-2022**

**Comprehensive Examination**

**(EC-3 Regular)**

Course No. : SE ZG651

Course Title : SOFTWARE ARCHITECTURES

Nature of Exam : Open Book

No. of Pages = 8

# No. of Questions = 4

Weightage : 45%

Duration : 2 Hours

Date of Exam : Saturday, 21/05/2022 (FN)

Note:

1. Please follow all the *Instructions to Candidates* given on the cover page of the answer book.
2. All parts of a question should be answered consecutively. Each answer should start from a fresh page.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.
4. 12 Marks
5. Consider the back-end warehouse operations module of a software as a service system for which you need to assess its availability. The application has been in production for a sufficiently long time, and it is possible to compute the availability information of each module. The module-view showing a few of its critical modules is presented below with the availability values. The operating strategy selector module never fails (100% availability). The warehouse system can function without failure if the operation strategy module is available and either the Normal operations module or the Emergency operations module is available. The Normal operations module functions only if both “Module1” and “Module2” are available. Similarly, the Emergency operations module is functional only if both “Module3” and “Module4” are available. Availability of Module1, Module2, Module3 and Module4 are shown in the diagram. Calculate the probability of normal functioning (i.e. availability) of the normal operations module, and the emergency operations module, and then compute the probability of normal functioning of the warehouse operations module. The answer must be at least up to 3 places after the decimal point. Answer like 1, 0.9. 0.99 is not correct. [7]

**Module4** (99.99%)

**Module3** (99.95%)

**Module1** (99.5%)

**Module2** (99.8%)

**Emergency Operations Module**

**Normal operations Module**

**Operation strategy selector** (100%)

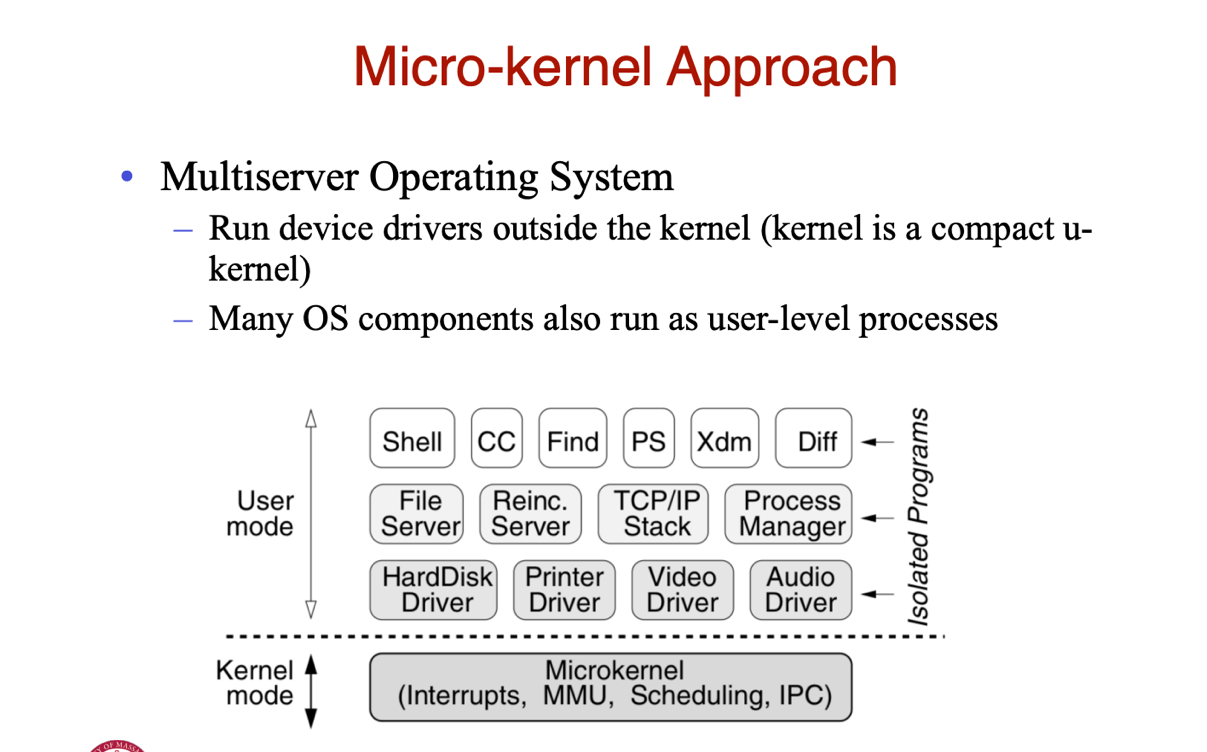
**Warehouse Operations**

1. Security is one of the most important quality attributes. Take an example of a remote proxy that performs the function of protection and firewall, to explain the implementation of security tactics. For the proxy take an example of a client accessing the external data (over the network) (Hint: Use of proxy pattern). Please explain the working of this architectural solution in the context of the scenario: “Connect with original to get the latest data when the data in proxy is stale.” [3]
2. Assume that, during the setup of an IPhone, we must incorporate a *setup option: “Select your language and country*.” So that the application can be used in various countries in various languages. Which of the quality attributes and the associated tactics is being achieved by this option? Explain your answer. [2]
3. 12 Marks
4. A single lift control system (LCS) controls more than one lift. LCS software module controls the electrical input to control and manage the movement of each lift car. LCS module uses a communication bus to send in commands and receive data from each LC software, running in each lift car. LCS server runs on a Windows server. The LCS GUI interface, which interacts with a server, is used to monitor, configure, and control the LCS. An LC software is in a programmable firmware, installed in each lift car.

Each lift car has sensors- namely, the laden weight sensor, current-floor sensor, speed sensor, position sensor and power-failure sensor. LCS receives these sensor values in real-time from each LC. LCS can also configure these sensors and control these sensors. An emergency light is installed which switches on when the power fails. This light is controlled by the LCS. Each lift car has an auto-rescue-device (ARD) which receives current floor, and current location from the LC. ARD is controlled by LCS. LCS is to be designed for handling each LC in a separate thread, where the sensor data collection, data processing and controlling for each LC will be handled in a separate thread. The operations team is expected to use the GUI from a different system to connect to the LCS server.

ARD can sense the power failure and the loss of communication with LCS. In that case ARD can take the car to the nearest lower floor. Each LC also has a user-interface which displays the present floor, present weight of the lift, speed of the lift and it shows time-of-day. An input interface is present which allows certain inputs from the users for floor request, alarm and internal light switch on/off.

1. Draw a deployment diagram using UML notations for the LCS that is managing 3 lift cars. [4]
2. Draw a module view of the LC and LCS, describing various submodules and their responsibilities. [4]
3. There are two applications with the following operational failure characteristics on a given day. Application 1 crashed 10 times and it took 5min to restart every time after the crash. Application 2 crashed 20 times and it took 2min to restart. Show with elaborate calculation which one has a better availability? [4]
4. . 12 Marks
5. Consider a computer system that has a scanner installed. Assume that the OS (follows a Microkernel architecture), has already detected a scanner and is ready to be used. The OS is a particular flavor of UNIX. Now consider a scenario that a user uses GUI application to scan a document.
6. Identify the essential modules for this problem. [4]
7. Map each module with the components of the Microkernel pattern. [4]



1. Question paper Correction and Reporting Application Assume that you are asked to design a system having the following display input and output requirements:

Input of the system is a set of answers for multiple choice questions (MCQ). This input is provided in a comma separated format with each line providing the question number and the solution as marked by the person taking the test.

1. This input is processed against the answer template and the following data is made available
   * Student ID (which is also the Key), total number of correct and wrong answers for each answer sheet, total number of unmarked answers for each answer sheet, total number of answer sheets validated
2. The following data is shown on the display in real time
   * A bar graph of the number of students who have passed and failed the test with two bars. Color is configurable from the same display window
   * Analysis of total number of unanswered questions from each paper in the form of Student ID and total un-answered in a tabular format

Based on the details provided above, identify the modules for this problem that play the roles of M, V and C. [4]

1. 12 Marks

A software development for Self-Driving-Missile-System (SDMS) in embedded scenario is carried out. The said software architecture of SDMS is developed by considering the following issues of reusability:

1. The application could be ported to new hardware by changing only the Hardware-Interface layer and parts of the SDMS interface architecture.
2. The architecture would remain useful in defining other domain-specific software architectures, especially for embedded control applications.
3. What type of facility is justifiable out of closed-layer and open-layer in this layered architecture? Explain briefly. [4]
4. Can you highlight any possibility of tending monolithic applications in this layered architecture in the context of reusability? [4]
5. Give one example of mock testing for each layer after being ready for reusability for any other control system. [4]
6. 12 Marks

A software development for Self-Driving-Missile-System (SDMS) in embedded scenario is carried out. The said software architecture of SDMS is developed by considering the following issues of reusability:

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2. The architecture would remain useful in defining other domain-specific software architectures, especially for embedded control applications.
3. Can any advantage be found if business layer and persistence layer are combined? Justify your answer. [4]
4. Is there any sort of possibility to make the layers autonomous? Justify your answer. [4]
5. Is it possible to deploy SDMS for self-driving cars? If it is, then highlight what type of evaluation of alternatives is required to be made? [4]
6. 12 Marks

A software development for Self-Driving-Missile-System (SDMS) in embedded scenario is carried out. The said software architecture of SDMS is developed by considering the following issues of reusability:

1. The application could be ported to new hardware by changing only the Hardware-Interface layer and parts of the SDMS interface architecture.
2. The architecture would remain useful in defining other domain-specific software architectures, especially for embedded control applications.
3. The developer of SDMS split the application logic into smaller components and spread across several networks. Can this situation lead to the design of multiple tiers in the application layer? Justify your answer. [4]
4. If the system requires faster network communications, high reliability and great performance, then is it possible for this layered architecture to support these? Justify your answer. [4]
5. The scalability and extra dimensions of functionality can be achieved with the multi-layered architecture. How can this statement be justified for this embedded system? [4]
6. 12 Marks

MRF pace foundation was a fast bowlers training Academy. Since This idea was very successful the idea was further expanded to bring up potential fast bowlers from the sub-continent region that included players from India, Pakistan, SriLanka and Bangladesh from which Pakistan later opted out.

This training academy was named as Subcontinent Pace Academy (SPA).

Initially players from small district HQs are to be trained and based on their performance the best players reach the HQ of the academy.

Case Study on Device Integrated SMAC as Solution for Subcontinent Pace Academy (SPA). This application is named as GroomigFastBowlers This application allows the coach

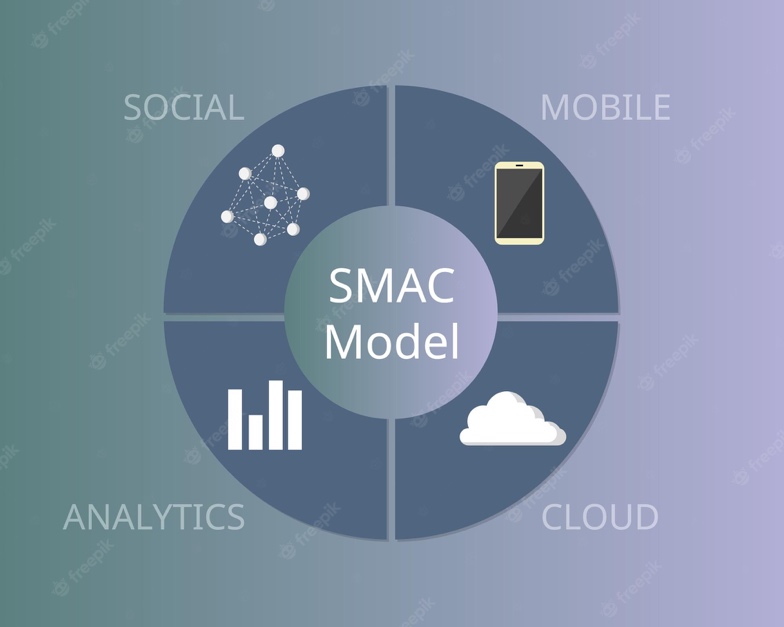
and trainer to track their daily progress. The Coach shall access the global data and assign an assistant coach for set of fast bowlers who shall monitor each of bowler’s fitness development and the progress of their bowling abilities via their mobile device. The bowlers shall have the wearable device (MyMonitor) with them and execute the bowling training programme.

MyMonitor shall be integrated with the GroomigFastBowlers application that enables assistant coach or coach to get real-time updates on the training statistics in their mobile app.

Based on the mobile app and wearable input, the web application shall generate the result and statistics for each bowler.

1. Define the term SMAC. [2]
2. Explain how this application fits into a SMAC framework. [3]
3. Show the relation between the cloud, mobile, social and analytics components diagrammatically by giving a view of the application architecture. [4]
4. Explain CAP theorem in the context of this application. [3]

SMAC is a digital architecture based on the convergence of four diverse technologies; **Social media, Mobility, Analytics and Cloud computing**.



S-Social Media: The Coach shall access the global data and assign an assistant coach

M-Mobile: Mobile application

A-Analytics: Processing data and result provided to coach on web application.

C – Cloud: Web portal will rely on this

Social distinctly stood as a standalone component in the SMAC architecture. Social media may be a website but Web component in the SWIMAC architecture does not refer merely to websites though websites may be a part of it. It includes an array of technologies that optimize web searches and makes the web look semantically better. Web also includes technologies to cite and index web pages in order to make the Web a better place to be. Social Media

The CAP theorem is a belief from theoretical computer science about [distributed data stores](https://en.wikipedia.org/wiki/Distributed_data_store) that claims, in the event of a network failure on a distributed database, it is possible to provide either consistency or availability—but not both.

1. 12 Marks

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1. State the need for the SMAC framework [2]
2. How do the cloud, mobile, social and analytics components fit into this application? [4]
3. State the need for CAP theorem in the context of this application. [3]
4. Define the terms CA and P and the tradeoff between these terms in this application [3]

**CAP Theorem**

**C**onsistency:

– All nodes should see the same data at the same time

**A**vailability:  
– Node failures do not prevent survivors from continuing to operate

**P**artition-tolerance:  
– The system continues to operate despite network partitions

Described the *trade-offs involved in distributed system*

• It is impossible for a web service to provide following *three guarantees at the same time*:

• **Consistency**• **Availability**• **Partition-tolerance**

1. 12 Marks

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Based on the mobile app and wearable input, the web application shall generate the result and statistics for each bowler.

1. Does this application fit into a SMAC framework? Justify. [2]
2. State the need for CAP theorem in the context of this application. [3]
3. How do the cloud, mobile, social and analytics components fit and integrate into this application? [4]
4. CAP theorem is specifically suitable for designing distributed applications. Justify that this application is really distributed [3]
5. 9 Marks

On 19 February 2008, Yahoo! Inc. launched what they claimed was the world's largest Hadoop production application. The Yahoo! Search Web map is a Hadoop application that runs on a Linux cluster with more than 10,000 cores and produces data that is used in every Yahoo! web search query. There are multiple Hadoop clusters at Yahoo! and no HDFS file systems or MapReduce jobs are split across multiple data centers. Every Hadoop cluster node bootstraps the Linux image, including the Hadoop distribution. The work that the clusters perform is known to include the index calculations for the Yahoo! search engine. In June 2009, Yahoo! made the source code of its Hadoop version available to the open-source community.

In 2010, Facebook claimed that they had the largest Hadoop cluster in the world with 21 PB of storage. In June 2012, they announced the data had grown to 100 PB and later that year they announced that the data was growing by roughly half a PB per day.

As of 2013, Hadoop adoption had become widespread: more than half of the Fortune 50 companies used Hadoop.

1. What architectural pattern studied in this course is used in Hadoop? Why is this pattern relevant? [2]
2. Draw a diagram to explain this architectural pattern in the above context. [3]
3. Explain in terms of the two major components of the Hadoop system how it is relevant in this case and how the way it is used boosts the NFRs. [4]

**Answer:**

**MapReduce**

* Executes in parallel
* Leads to low latency & high availability
* Map performs extract & transform and produces <Key, Value> instances
* Reduce summarizes transformed data

Hadoop uses **master-slave architecture** to manage the resource of cluster, a master node named JobTracker is responsible for the entire cluster of job scheduling, and the rest of the nodes named TaskTrackers apply for tasks from the JobTracker when they are idle.

First off, Map Reduce is an algorithm, Hadoop is an Ecosystem. Both are independent of underlying hardware or programming language or technology stack.

Knowing the difference is important.

Map reduce algorithm has existed for a long time, even before Big Data was such a hype and can be implemented independent of the Hadoop ecosystem.

Now, Hadoop leverages this algorithm to split up tasks across multiple processing nodes and then recombining them. So, you can say the Apache Hadoop ecosystem leverages the Map reduce algorithm over a Java platform to do parallel, distributed multiprocessing. In layman’s term, split up the task between multiple resources and then aggregate them.

Apace Spark, for instance can do many such algorithms, and not just Map reduce.

1. 9 Marks

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As of 2013, Hadoop adoption had become widespread: more than half of the Fortune 50 companies used Hadoop.

1. What architectural pattern studied in this course is used in Hadoop? Why does it perform faster than supercomputers? [2]
2. Draw a diagram to explain this architectural pattern in the above context. [3]
3. Apache Hadoop framework is composed of the following modules: Hadoop Common, Hadoop Distributed File System (HDFS), Hadoop YARN, Hadoop MapReduce, Hadoop Ozone. Explain the working on either two of these in the above context. [4]
4. 9 Marks

On 19 February 2008, Yahoo! Inc. launched what they claimed was the world's largest Hadoop production application. The Yahoo! Search Web map is a Hadoop application that runs on a Linux cluster with more than 10,000 cores and produces data that is used in every Yahoo! web search query. There are multiple Hadoop clusters at Yahoo! and no HDFS file systems or MapReduce jobs are split across multiple data centers. Every Hadoop cluster node bootstraps the Linux image, including the Hadoop distribution. The work that the clusters perform is known to include the index calculations for the Yahoo! search engine. In June 2009, Yahoo! made the source code of its Hadoop version available to the open-source community.

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As of 2013, Hadoop adoption had become widespread: more than half of the Fortune 50 companies used Hadoop.

1. Hadoop handles data and processes. Identify the data and processes required for the above application. Which component handles each of these. [2]
2. Draw a diagram to explain this architectural pattern in the above context. [3]
3. Where is Name Node, Secondary Name Node, Job tracker, Data Node, Task Tracker located and what is their role in the above case. [4]

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**Software Architectures - Second Semester 2015-16 : Comprehensive Exam (EC- 3 Make-up)**

**Birla Institute of Technology & Science, Pilani**

**Work-Integrated Learning Programmes Division**

**Second  Semester 2015-2016**

**Comprehensive Examination**

**(EC-3 Make-up)**

Course No.                    : SS ZG653

Course Title                  : SOFTWARE ARCHITECTURES

Nature of Exam            : Open Book

Weightage                     : 50%

Duration                        : 3 Hours

Date of Exam                : 23/04/2016      (FN) 

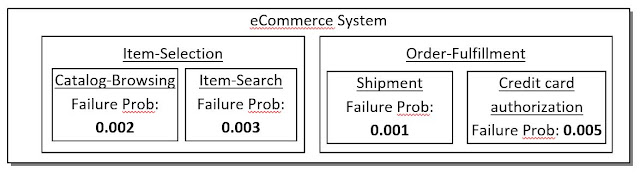
Q.1 (a) Write a short note explaining why Change Propagation Mechanism is required in the case of MVC pattern. Explain use of the publisher-subscriber pattern for this purpose. Explain with a class diagram and a sequence diagram using UML notation.

                                                                                                                                             [2+2+2+2]

Q.1 (b) Consider word processor software that allows to “undo” the “deletion of a paragraph”. To implement this feature, “command pattern” is used. Draw a class diagram to depict this scenario. Briefly explain the methods/data-structure needed to implement this “undo”.

                                                                                                                                         [5]

Q.2.  Consider the following simplified module view of an eCommerce system.

[](https://4.bp.blogspot.com/-85Qc2y1E-iQ/WSeUok9YuVI/AAAAAAAAAB0/imowdtSmix8SY4psAPHlFADzQz75gHa5wCLcB/s1600/eCommerce%2BSystem.JPG)

The Item-Selection module fails only if both its submodules fail. It works if one of the submodules is operational. The Order-Fulfillment module fails only if one of its submodules fails. The system fails if either Item-Selection module or Order-fulfilment module fails. Compute with detailed steps, the failure probability of Item-Selection and Order-Fulfilment and the probability that the system remains operational, given the probability of failure of each sub-module as shown in the diagram.

                                                                                                                                                 [10]  
  
Q.3. Consider a computer system that has a scanner installed. Assume that the OS (follows a Microkernel architecture), has already detected a scanner and is ready to be used. The OS is a particular flavor of UNIX. Now consider a scenario that a user uses GUI application to scan a document. Identify the essential modules for this problem. Map each module with the components of the Microkernel pattern. Identify the key functionality of each module keeping the role of each microkernel entities in mind. For each component draw a sequence diagram to depict this operation.                                                                                                                                     [2+2+2+3= 9]

Q.4. Consider a financial batch processing application that continuously receives batches of transactions. Each batch of transaction is first sorted based on its account number and the sorted batch is given to the next component that computes various transaction summary results. This summary result data is given to a printing module which eventually passes the summary to the archiving module. The archiving module stores the summary in a datastore. This application requires high throughput and needs to process batches within a short time. Suggest the architectural pattern that’s most appropriate for this system. Identify various components of this application, the data items, and draw a structure diagram depicting these components, their interactions and data-flow.

                                                                                                                                         [1 + 4 = 5] 

Q.5. Case Study: Question paper Correction and Reporting Application

You are designing a system having the following display input and output requirements

Input of the system is a set of answers for multiple choice questions (MCQ). This input is provided in a comma separated format with each line providing the question number and the solution as marked by the person taking the test.

i. This input is processed against the answer template and the following data is made available

* Student ID (which is also the Key), total number of correct and wrong answers for each answer sheet, total number of unmarked answers for each answer sheet, total number of answer sheets validated

ii. Following data is shown on the display in real time

* A bar graph of number of students who have passed and failed the test with two bars. Colour is configurable from the same display window
* Analysis of total number of unanswered questions from each paper in the form of Student ID and total un-answered in a tabular format

Based on the details provided above, answer the following

(a) Identify the modules for this problem that play the roles of M, V and C.

                                                                                                                                                     [2]

(b) Draw a sequence diagram to describe an efficient mechanism of implementing change of color requested for the bar graph

                                                                                                                                                     [5]  
  
Q.6. (a)   Describe in steps how Broker can be used as Service Locator and as intermediary.   
                                                                                                                                                     [3]  
Q.6. (b)   Describe a few benefits and overheads of the Broker pattern.

                                                                                                                                                     [3]

**Software Architectures - Second Semester 2014-15 : Mid-Semester Test (EC- 2 Regular)**

**Birla Institute of Technology & Science, Pilani**

**Work-Integrated Learning Programmes Division**

**Second Semester 2014-2015**

**Mid-Semester Test**

**(EC-2 Regular)**

Course No.                     : SS ZG653

Course Title                   : SOFTWARE ARCHITECTURES

Nature of Exam             : Closed Book

Weightage                      : 35%

Duration                         : 2 Hours

Date of Exam                 : 20/02/2015      (FN)

Q.1. A software system crashed 100 times in the first year and for each crash it needs 10 min to restart. Calculate the availability in percentage in that year.

                                                                                                                                 [4]

**Answer:**

In a year, total minutes is: 365 X 24 X 60 = 525600 min.  
The system failed 100 times, and each time it took 10 min to restart.  
Total time to recover: 100 X 10 = 1000 min.  
Total time of operation: 525600 - 1000 = 524600 min.  
Availability: (524600 / 525600 ) X 100 = 99.809 = **99.81%**

Q.2. Consider a web portal built using J2EE based infrastructure. The system needs to be available 24x7 with small acceptable downtime. To ensure that the application is not choked with too many requests, you have decided to control the number of hits to this portal, if the number of hits exceeds a threshold. You have also decided to monitor the health of the server to ensure the availability. Identify at least 2 availability and 2 performance tactics that are suitable, and explain the reason in one line per tactic.

                                                                                                                                 [8]

**Answer:**

**Availability tactics:**

1. (a) Ping or (b) heartbeat to detect if the application is live in order to take the mitigating action.

2. (a) Active redundancy or (b) passive redundancy is necessary to start a good copy of the application if the main server goes down.  
Since small acceptable downtime is allowed, it is not required to use expensive “Voting” mechanism. Depending on the downtime tolerance limit, one can go for either passive or active redundancy. “Spare-Copy” is not acceptable as it takes quite a bit of time to restart the service.  
  
**Performance tactics:**

**1. Main tactic category:**Reduce #of events: In this context it is the number of hits.

**a) Manage event rate:**Using this tactic it will be possible to either explicitly deny the service in a graceful manner if it exceeds threshold (by showing some user-friendly page)

**b) Control sampling freq:** Don’t even register the new request.

**2. Main tactic category:**Controlling resource usage

**a) Bound exec time:** Execution time of each request can be bounded so that it does not impact others

**b) Bound queue size:** Requests aren’t piled up beyond certain point. These are discarded if the queue is full.

Q.3. Propose the priority of quality attributes when considered for architecture and implementation for an Automated Teller Machine (ATM). Justify your choice of priority. Use Security, Testability, Availability, Modifiability, Performance, and Usability quality attributes.

                                                                                                                                [5]

**Answer:**

My choice of priority :

**1. Security**

**2. Availability**

**3. Usability**

**4. Performance**

**5. Modifiability**

**6. Testability**

**Justification:**

* At all times the top three attributes form the important ones to be taken care of for an ATM.
* **Security** to make sure that the system is secure at all times as the data and transactions which the system manages could mean major loss to users if not handled correctly.
* **Availability** forms a key attribute (second to security) as this system will be used by users who would not like to spend more time at the ATM (rather an optimum time at ATM); additionally would need the system available 24 x 7 x 365.
* System needs to be simple as the class of users is anyone who is a bank account holder and thus system cannot assume any technical knowledge or a level apart from simple steps to make use of the ATM to complete transactions. (**Usability**)
* Other attributes (**Performance**, **Modifiability** and **Testability**) lower in priority than the others.
* ATM steps for all transactions are typical and thus **performance** does not form a comparable attributes.
* Systems do not change as often hence **modifiability** and **testability** can be at the lowest priority.

Q.4. During architecture review it is found that the account management module invokes system logging through an intermediate component. The logging is done frequently. Identify at least two quality attributes that are +vely or –vely impacted by this approach. Explain the reason for each in one line.

                                                                                                                                [4]

**Answer:**

**Modifiability is impacted +vely.** This is a clear example of using the tactic: Use of intermediary between modules to prevent ripple effect, when the logging component is changed or upgraded.

**Performance is impacted –vely.** One common tactic to improve the performance is to reduce overhead – by removing the intermediaries. The given design clearly violates this tactic.

Q.5. What are the dependencies that need to be taken care to avoid ripple effect in modifiability tactics?

                                                                                                                                [8]  
**Answer:**

If Module A is changed to accomplish particular modification, then Module B is changed only because of change in Module A, B has to be modified because it depends, in some sense, on A.

**8 types :**

**a.  Syntax**

**i.  Syntax of data:** For B to compile (or execute) correctly, the type of the data that is   
                  produced by A and consumed by B must be consistent with the type of data assumed by B

**ii.  Syntax of service:** For B to compile and execute correctly, the signature of services   
                  provided by A and invoked by B must be consistent with the assumption of B

**b.  Semantic of**

**i.  Semantics of data:**For B to execute correctly, the semantics of the data produced by A   
                  and consumed by B must be consistent with the assumptions of B  
             **ii.  Semantics of service:** For B to execute correctly, the semantics of the service produced   
                  by A and used by B must be consistent with the assumptions of B  
     **c.  Sequence of**  
**i.  Sequence of data:** For B to execute correctly, it must receive the data produced by A in a  
                  fixed sequence. Ex: a data packet’s header precede its body.   
             **ii. Sequence of control:** For B to execute correctly, A must have executed previously within   
                 certain timing constraints. Ex: A must have executed no longer than 5ms before B   
                 executes  
     **d.  Identity of an interface of A:** A may have multiple interfaces. For B to compile and execute   
          correctly, the identity of the interface must be consistent with the assumptions of B   
     **e.  Location of A (runtime):** For B to execute correctly, the runtime location of A must be   
          consistent with the assumptions of B   
      **f.  Quality of service/data provided by A:** For B to execute correctly, some property involving   
           the  quality of the data or service provided by A must be consistent with the assumption of B.    
           Ex: data provided by a particular sensor must have a certain accuracy in order for the   
           algorithm of  B to work correctly.   
     **g.  Existence of A:** For B to execute correctly, A must exist.   
     **h.  Resource behavior of A:** For B to execute correctly, the resource behavior of A must be   
          consistent with B’s assumptions

Q.6. Identify at least three differentiating features with examples between “Architectural Pattern” and a “Design Pattern”.

                                                                                                                                [3]

**Answer :**

|  |  |
| --- | --- |
| **Architectural Pattern** | **Design Pattern** |
| An architectural pattern is a highest level of Design of a system | A design pattern is a medium level of design of a system |
| An Architectural Pattern expresses a fundamental structural organization schema for a software system | A design pattern provides a scheme for refining the subsystems or components of a software system |
| It provides a set of predefined subsystems, specifies their responsibilities and includes and rules and guidelines for organizing relationships between them | It describes a commonly-recurring structure of communicating components that solves a general design problem within a particular context |

Q.7. Describe essential aspects of Security.

                                                                                                                                [3]

**Answer :**

**Three main aspects**  
  
**1. Confidentiality :** prevention of the unauthorized disclosure of information. E.g. Nobody except you should be able to access your income tax returns on an online tax-filing site.  
  
**2. Integrity :** prevention of the unauthorized modification or deletion of information. E.g. your grade has not been changed since your instructor assigned it.  
  
**3. Availability :** prevention of the unauthorized withholding of information – e.g. DoS attack should not prevent you from booking railway ticket  
  
  
**Other Important aspects of Security**

**Non repudiation ::** An activity (say a transaction) can’t be denied by any of the parties involved. E.g. you cannot deny ordering something from the Internet, or the merchant cannot disclaim getting your order.

**Assurance ::** Parties in an activities are assured to be who they purport to be. Typically done through authentication. E.g. if you get an email purporting to come from a bank, it is indeed from a bank.

**Auditing ::** System tracks activities so that it can be reconstructed later  
  
**Authorization ::**grants a user the privileges to perform a task. For example, an online banking system authorizes a legitimate user to access his account.

### Software Architectures - Second Semester 2015-16 : Mid-Semester Test (EC- 2 Regular)

**Birla Institute of Technology & Science, Pilani**

**Work-Integrated Learning Programmes Division**

**Second Semester 2015-2016**

**Mid-Semester Test**

**(EC-2  Regular)**

Course No.                  : SS ZG653  
Course Title                : SOFTWARE ARCHITECTURES  
Nature of Exam          : Closed Book  
Weightage                   : 35%  
Duration                      : 2 Hours  
Date of Exam              : 27/02/2016    (FN)

Q.1.   A real-time system, through expected to be running all the time, needs to be stopped 5 times a day due to massive data-collection that requires cleaning and backup. The system needs to be restarted after 10 minutes interval each time. Compute the % availability of the system in a day. Clearly write any assumption that you taken.

                                                                                                                                         [4]

Q.2.   Consider a web portal built using J2EE based infrastructure. The system needs to be available 24x7 with small acceptable downtime. To ensure that the application is not choked with too many requests, you have decided to control the number of hits to this portal, if the number of hits exceeds a threshold. You have also decided to monitor the health of the server to ensure the availability. Identify at least 2 availability and 2 performance tactics that are suitable, and explain the reason in one line per tactic.

                                                                                                                                        [8]

Q.3.    A camera based sensor module continuously tracks moving object's positions and streams the data to a robot control module. The robot control module triggers an action only if the image quality is reasonable and the different between the received position data and the recently registered data is > a threshold. Describe the module dependency structure and the component and hardware allocation structure for this problem. The structure should be described using UML. Explain what should be correct dependency on the sensor.

                                                                                                                          [2+3+2=7]

Q.4.   Identify at least three differentiating features with examples between "Architectural Pattern" and a "Design Pattern".

                                                                                                                                       [3]

Q.5.   Explain the terms (i) Architectural Pattern, (ii) Reference Model and (iii) Reference Architecture. How they are related with each other?

                                                                                                                                       [6]

Q.6.   Explain   the various step(s) required to implement a Layered Architectural pattern. Explain an efficient variation of the layer pattern where the client call to a layered system can be responded faster.

                                                                                                                               [5+2=7]

**Software Architectures - Second Semester 2013-14 : Mid-Semester Test (EC- 2 Regular)**

**Birla Institute of Technology & Science, Pilani**

**Work-Integrated Learning Programmes Division**

**Second Semester 2013-2014**

**Mid-Semester Test**

**(EC-2  Regular)**

**Course No.                  : SS ZG653**  
**Course Title                : SOFTWARE ARCHITECTURES**  
**Nature of Exam          : Closed Book**  
**Weightage                   : 35%**  
**Duration                      : 2 Hours**  
**Date of Exam              : 15/02/2014    (FN)**

Q.1. Differentiate with examples between “Architectural Pattern” and a “Design Pattern”.

                                                                                                                                        [4]  
  
  
Q.2. What are the three parts of the Pattern Schema? Briefly describe each of them with respect to pipes and filters.

                                                                                                                                        [5]  
  
  
Q.3. Propose the priority of quality attributes when considered for architecture and implementation for the following two systems. Justify your choice of priority. Please use following quality attributes for prioritization:

* Security
* Testability
* Availability
* Modifiability-Performance
* Usability

(a) Automated Teller Machine (ATM)

                                                                                                                                        [5]

(b) Web based Management Information System

                                                                                                                                        [5]  
  
  
Q.4. Identify two quality attributes which may have conflicting requirements from design and implementation perspective. Justify your answer with 2 distinct aspects which conflict with an example for each.

                                                                                                                                        [8]

Q.5. Answer the following:  
(a) Write a short note on: Outputs of ATAM

                                                                                                                                        [4]  
(b) Differentiate between ATAM and CBAM

                                                                                                                                        [4]

### Software Architectures - Second Semester 2013-14 : Comprehensive Exam (EC- 3 Regular)

**Birla Institute of Technology & Science, Pilani**

**Work-Integrated Learning Programmes Division**

**Second  Semester 2013-2014**

**Comprehensive Examination**

**(EC-3 Regular)**

Course No.                    : SS ZG653

Course Title                  : SOFTWARE ARCHITECTURES

Nature of Exam            : Open Book

Weightage                     : 50%

Duration                        : 3 Hours

Date of Exam                : 05/04/2014      (FN)   
  
  
  
Q.1. Differentiate between  
(a) Interactive Systems and Adaptable Systems

                                                                                                                                   [5]  
(b) MVC Pattern and PAC Pattern

                                                                                                                                   [5]  
  
  
Q.2. Write a short note on  
       (a) Documenting Architecture with a focus on Views.

                                                                                                                                   [5]  
       (b) Microkernel Pattern with a specific focus on adaptability to evolving hardware and software.

                                                                                                                                   [5]

Q.3   (a) Security is a one of the most important quality attribute. Take an example of a remote proxy that performs the function of protection and firewall, to explain the implementation of security tactics. List suitable examples.

                                                                                                                                    [5]

Q.3 (b) For the same proxy take an example of a client accessing the external data (over the network) (Hint: Use of proxy pattern). For the scenarios (i) Connect with original to get the latest data when the data in proxy is stale (ii) Provide the data to the client from the proxy as the data in the proxy is not stale, draw only an Message Sequence Charts to depict the scenarios.

                                                                                                                                    [5]

Q.4. Case Study: Lift car and Lift Control System

A single lift control system (LCS) controls more than one lifts. This control system consists of all of algorithms to control the electrical input to control and manage the movement of lift cars (LC). A communication bus is used to send in commands and receive data from the lift car.

Every lift car can carry varying number of passengers i.e. laden weight of the lift may vary across different models. Each car does have its maximum speed which can be reached or allowed Example: A service lift is a slow speed lift whereas passenger lifts are higher speed when compared to service lift. Lift car has a user interface which shows the present floor, present weight of the lift, speed of the lift and shows time-of-day. An input interface is present which allows certain inputs from the users for floor request, alarm and internal light switch on/off. An emergency light is installed which switches on when the power fails. This light is controlled by the lift control system.

An auto rescue device may be installed on the lift. This is configured in the LCS as well as lift car. This is a mechanical device which gets the LC to the nearest floor in case of power failure and also can detect as to which floor the lift is at. Thus makes it easier to reset the position which otherwise will have the lift to be brought to the lowest floor to reset the position in case of power failure.

An LCS has control algorithms to control the speed, soft start and stop of the lifts and has all the data pertaining to the movement, speed, position and other status of the LC. This is displayed on the Graphical User Interface of the LCS. A keyboard can be connected to the system to configure and control the system.

Questions:  
  
(a) Create required class diagrams/Block diagram so as to demonstrate that the functionalities so depicted covers all requirements

                                                                                                                                [10]  
(b) Create Message Sequence Diagrams for the following scenarios  :  
                   -  Power failure scenario for LCS

                                                                                                                                  [5]  
                   -  Power failure scenario for LC

                                                                                                                                  [5]