| USN: | 1 | D | S | 1 | | E | C | | | |
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# Dayananda Sagar College of Engineering

Department of Electronics & Communication Engg.

Continuous Internal Evaluation – III

| | | | |
|---|---|---|---|
| Course Name: **EMBEDDED SYSTEM DESIGN and IOT APPLICATIONS** | | Date: | **06/07 /2022** |
| Course Code: **19EC6DCEA1** | | Day: | ~~Monday~~ Wednesday |
| Semester: **6th A, B, C and D** | | Timings: | **1-2.30 PM** |
| Max Marks: **50 M** | | Duration: | **1½ Hrs.** |

| No. | | Question Description | Mks | CO & Levels |
|---|---|---|---|---|
| Q1 | (a) | The term 'Internet of Things' was coined by _________<br>i) Bill gates ii) Kevin Ashton iii)McDonald iv) Steve jobs | 1 | |
| | (b) | ________is no longer active but is used as a basis for developing other architectures like IoT-RA and RILA.<br>i) IoT-A ii) IoT-RM iii) IoT-CM iv) IoT-RA | 1 | |
| | (c) | The model(s) involved in the IoT Reference model is/are.<br>i) communication ii) domain iii) information iv)all | 1 | |
| | (d) | The RA of IoT-A mainly consists of<br>i) perspectives ii) views iii) both(i) and(ii) iv) none | 1 | |
| | (e) | ISO/IEC/IEEE 42010:2011: "Systems and Software Engineering Architecture Description." is the basis of<br>i) IEEE P2413 ii) IEEE P2143 iii) IEEE P2341 iv) IEEE P2213 | 1 | |
| | (f) | In the CISCO Reference Model, the _____ levels are considered operational technology (OT).<br>i) upper three ii) upper four iii) lower three iv) lower four. | 1 | |
| | (g) | The most common and widely implemented RFID naming standards center on the _____<br>i) MAC-ID ii) WSN iii) EPC iv) Wireless HART | 1 | |
| | (h) | An IoT ________ development platform is a small single electronic circuit board with limited memory and processing power that can be used to create interactive electronic objects.<br>i) software ii) hardware iii) firmware iv) middleware | 1 | |
| | (i) | Hardware platforms for IoT can be programmed via<br>i) an external interface ii) webIDE iii) both iv) none. | 1 | |
| | (j) | ______are usually used for IoT prototyping, for educational purposes, and for use as embedded computer controllers.<br>i) SBCs ii) SoCs iii) USB iv) HDMI | 1 | |
| Q2 | | Describe briefly the RM proposed by IoT-A and its perspectives and views. | 10 | CO4,L2 |
| Q3 | | List and explain IOT hardware development platforms and its applications. | 10 | CO5,L2 |
| Q4 | | Briefly discuss the six layers of RILA. | 10 | CO4,L2 |
| | | **OR** | | |
| Q5 | | Discuss in brief any three issues in organizational integration of IoT systems. | 10 | CO4,L2 |
| Q6 | | Elaborate briefly on the Connectivity and I/O interfaces of IOT hardware platforms in the past, present and future. | 10 | CO5,L2 |
| | | **OR** | | |
| Q7 | | Summarize any five specifications of the Current Microcontroller Boards. | 10 | CO5,L2 |

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( Accredited by National Assessment & Accreditation Council (NAAC) with 'A' grade )


| | | |
|---|---|---|
| Date of test : 06-07-2022 | Embedded Systems and IoT Applications | Max Marks : 50 M. |
| Day : Wednesday | | Sub Mentor : SP |
| Branch : ECE | | Sub Mentor Sign : |
| Semester : 6 | 19EC6DCEAI | Staff i/c of sec : SP,SMR,MRK,NYM |
| | Internal Test | Staffs i/c sign : |
| Section : A,B,C,D | III | HOD Name : Dr. TCM |
| Timings : 2:00 PM TO 3:30 PM | | HOD's sign : |
| Test Duration : 1½ Hrs. | Test Solutions | |

Dr. T. C. Manjunath
Prof. & HOD ECE DSCE

| Q. No. | Test question paper solutions with steps | Marks Allocation |
|---|---|---|
| 1 | | 1x10=10 |
| a. | ii) Kevin Ashton | |
| b. | i) IoT-A | |
| c. | iv)all | |
| d. | iii) both i) and ii) | |
| e. | i) IEEE P2413 | |
| f. | iii) lower three | |
| g. | iii) EPC | |
| h. | ii) hardware | |
| i. | iii) both | |
| j. | i) SBCs | |

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ECE DSCE

**2** — 3+2+5 = 10M

The RM, presented in Figure 1.1, provides a common understanding of the IoT domain by modeling its concepts and their relationships. Similar to the Open Systems Interconnection (OSI) model, the IoT RM by itself does not specify the technical particularities of an IoT system.

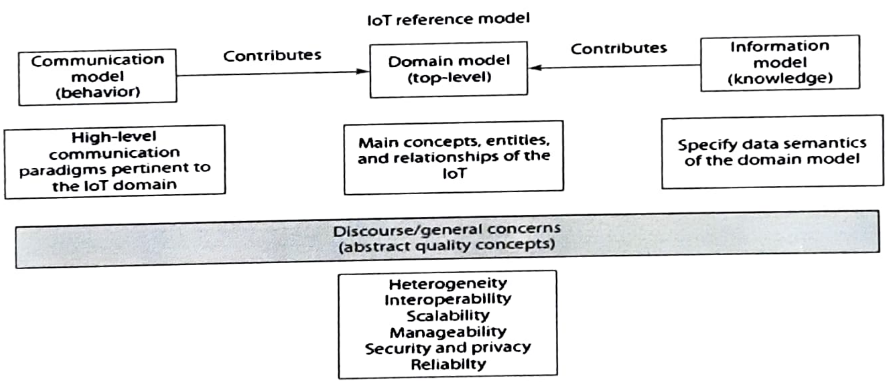


FIGURE 1.1 RM proposed by IoT-A. (Adapted from Bassi, A., et al., *Enabling Things to Talk: Designing IoT Solutions with the IoT Architectural Reference Model*, Springer, Berlin, 2013, 163–211.)

Fig – 3M

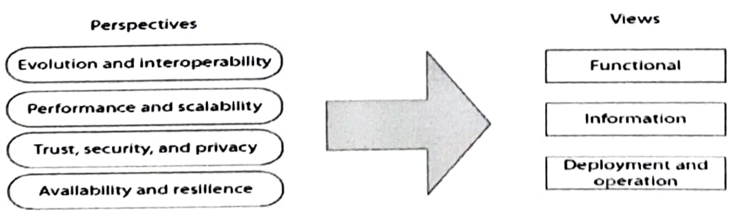


FIGURE 1.2 Perspectives and views of IoT-A. (Adapted from Bassi, A., et al., *Enabling Things to Talk: Designing IoT Solutions with the IoT Architectural Reference Model*, Springer, Berlin, 2013, 163–211.)

Fig - 2M

| | | | |
|---|---|---|---|
| | The *domain model* considers a top-level description of the concepts and entities (physical entities, devices, resources, and services) that represent particular aspects of the IoT domain, and defines their relations. Therefore, the domain model can also be used as a taxonomy of the IoT.<br>The *information model* specifies the data semantics of the domain model; that is, it refers to the knowledge and behavior of the entities considered in the domain model, since they are responsible for either keeping track of certain information or performing specific tasks (it describes which type of information the entities are responsible for).<br>The *communication model*, in turn, addresses the main communication paradigms necessary for connecting entities, ensuring interoperability between heterogeneous networks. The proposed communication model is structured in a seven-layer stack and describes how communication has to be managed, by each layer, in order to achieve the interoperability features required in the IoT. It also describes the actors (communicating elements) and the channel model for communication in IoT.<br>The RA of IoT-A mainly consists of "views" and "perspectives," which vary depending on the requirements of each specific application. Figure 1.2 illustrates that the perspectives "evolution and interoperability," "performance and scalability," "trust, security, and privacy," and "availability and resilience" are applied to all the views: the "functional" view, the "information" view, and the "deployment and operation" view, respectively.<br>While applying perspectives to views, not every view is impacted by the perspectives in the same manner or grade. For example, the perspectives have a high impact when applied to the operation view.<br><br>Explanation – 5M | |
| 3 | IOT hardware development platforms and its applications....10M<br><br>-Microcontroller based<br>-System on chip<br>-Single board Computers<br>Eg:Arduino<br>Beagle boards<br>Rasberry Pi<br>----with detailed Explanation..............................6M<br><br>Applications:<br><br>Zigbee<br>WIFI<br>............Explanation--------------------------------4M | 6+4 = 10M |
| 4 | RILA consists of six layers, as depicted in Figure 1.6. Besides these layers, there are two cross section layers, "security" and "management," that affect all other layers.<br>The *device integration layer* includes all the different types of devices, receives their measurements, and communicates actions. This layer can be seen as a translator that speaks many languages (Karzel et al., 2016). The output of the sensors and tags, as well as the input of the actuators, depends on the protocol they implement.<br>The *device management layer* is responsible for receiving device registrations and sensor measurements from the device integration layer, and for communicating status changes for actuators to the device integration layer. Then, the device integration layer checks if the status change (i.e., the action) conforms with the respective actuator and translates the status change to the actuator. The device management layer controls the devices that are connected to the system; every change to a device's registration, as well as new measurement data, should be communicated from the device integration layer to the device management layer, so the information can be updated and stored.<br>Normally, the *data management layer* is a central database (but it can also be a data warehouse or even a complete data farm, in the case of larger IoT systems) that stores all data of a thing. Thus, the implementation of the data management layer strongly depends on the use case (Karzel et al., 2016).<br>The *context management layer* defines the central business logic and is responsible for tasks like defining the goals of the thing, consuming and producing the context situations of the things, evaluating the context situation toward the goals, triggering actions that will help to fulfill the goal according to the evaluated rules, and finally, publishing context situations for other things.<br>The *thing integration layer* is responsible for finding other things to communicate, verifies if communication with the new thing is possible, and is responsible for a registration mechanism.<br>The *application integration layer* connects the user to the thing, being considered the service layer, or even a simple user interface. The concrete implementation of the layer depends on the use case.<br><br>Explanation – 6M | 6+4 = 10M |

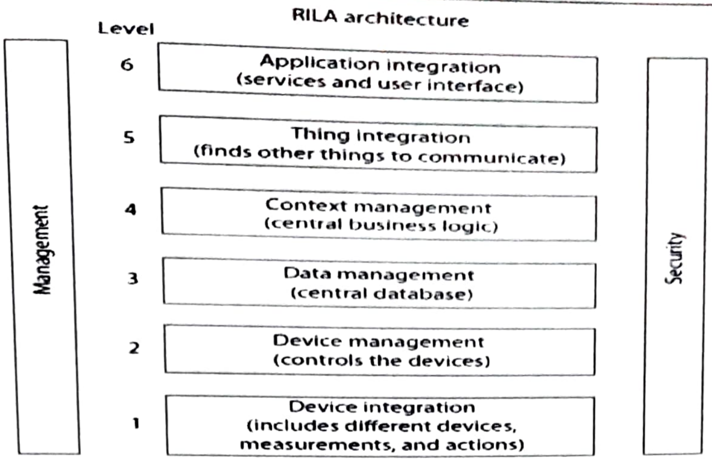


FIGURE 1.6 Reference IoT layered architecture. (Adapted from Karzel, D., et al., A reference architecture for the Internet of things, January 29, 2016, https://www.infoq.com/articles/internet-of-things-reference-architecture.)

Figure – 4M

**OR**

5 Issues in organizational integration of IoT systems — 3+3+4 =10M

Interoperability
Standards
Privacy
Security
Trust ………………………………. Any 3 With detail explanation 3+3+4M

6 Connectivity and I/O interfaces of IOT hardware platforms — 10M

- Yun:built-in Ethernet and Wi-Fi support.
- Arduino: digital I/O pins and analog pins with USB ports and feature other hardware I/O and communication interfaces.
- Diecimila, Uno, Duemilanove: USB port, 14 GPIO digital pins, and 6 analog input pins, SPI, I2C/TWI, and UART hardware I/O and communication interfaces.
- Due: 2 USB ports, 54 GPIO digital pins, 12 analog input pins, and 2 DAC analog output pins, 4 UART ports, 1 SPI header, 1 I2C, and 2 TWI headers.
- Yun: 2 USB ports, 20 GPIO digital pins, and 12 analog input pins, 1 UART port,1 ICSP header, SPI and I2C/TWI I/O communications.
- BeagleBoard has no onboard Ethernet port, communication interfaces including I2C, I2S, and SPI for serial communication, Digital Visual Interface (DVI)-D and S-Video for video display. But BeagleBoard-xM has an onboard Ethernet jack.
- PandaBoard is not Internet enabled, ES version has Ethernet and Wi-Fi and Bluetooth connectivity. Both boards include some communication interfaces, such as DVI, HDMI, camera expansion header, audio I/O, USB, serial/RS-232, and two USB host ports, as well as a 14-pin Joint Test Action Group (JTAG) GPIO, UART, I2C.
- A13-OlinuXino has a Video Graphics Array (VGA), Universal EXTension (UEXT) connector, asynchronous, I2C, and SPI, Internet connectivity is optional, OLinuXino-MINI-Wi-Fi version has built-in Wi-Fi connectivity.
- RaspberryPi 1 model A has one USB port, no Ethernet port, The SBC features HDMI, composite video a 15-pin MIPI, camera interface, 26 GPIO pins, UART, I2C, SPI, and I2S.
  - Model B has an Ethernet port and two USB ports, along with the other peripherals that are on model A.
- Intel Galileo has an Ethernet port, a USB port, and USB host ports, in addition UART and the RS-232 serial port.
- RIoTboard has an Ethernet port, two USB hubs, a mini-USB, HDMI,

----------10M

**OR**

7

| Specification Highlights | Arduino 101 | Arduino MKR1000 | Adafruit Feather M0 Wi-Fi | Tessel 2 | Particle Photon | Particle Electro |
|---|---|---|---|---|---|---|
| Processor architecture | 2 cores: x 86 (Intel Quark) core and 32-bit ARC core | SAMD21 Cortex-M0+ 32-bit low power ARM MCU | ATSAMD21G18 ARM Cortex-M0 MCU | Atmel SAMD21G14A-MU Cortex M0+ MCU | 32-bit STM32 ARM Cortex-M3 MCU | 32-bit STM32 ARM Cortex M3 MCU |
| Processor speed | Both cores clocked at 32 MHz | 48 MHz | 48 MHz | 48 MHz | 120 MHz | 120 MHz |
| Memory (RAM) | 24 KB of SRAM | 32 KB of SRAM | 32 KB of SRAM | 15 KB of SRAM | 128 KB of RAM | 128 KB of RAM |
| Onboard storage | 196 KB of flash | 256 KB of flash | 256 KB of flash | 2 KB of flash, 64 MB of DDR2 system memory 32 MB flash for firmware | 1 MB of flash memory | 1 MB of flash memory |
| Onboard connectivity | BLE | IEEE 802.11b/g/n Wi-Fi | IEEE 802.11g or n Wi-Fi | 10/100 Mbit/s Ethernet and IEEE 802.11b/g/n Wi-Fi | IEEE 802.11b/g/n Wi-Fi | 2 models: U-blox SARA U260 for 2G and U-blox SARA G350/U270 for |
| Peripheral interfaces | Micro-USB | Micro-USB | Micro-USB | 2 USB ports, 1 micro-USB | Micro-USB | Micro-USB |
| GPIO low-level peripherals | 14 digital I/O pins (of which 4 are PWM), 6 analog input pins | 8 digital I/O pins, 12 PWM pins, 7 analog input pins, 1 UART, 1 SPI, 1 I2C | 8 PWM pins, 10 analog input pins, and 1 analog output pin, I2C, SPI | 15 GPIO pins on 2 primary ports, A and B | 18 digital I/O pins, 8 analog (ADC) inputs, 2 analog (DAC) outputs, 9 PWM output pins, 2 SPI, 1 I2S, 1 I2C | 28 GPIOs and TX/RX |
| OS support | Open-source RTOS | — | — | — | FreeRTOS | — |
| Power consumption | — | 396 mW | 481 and 81 mW when unneeded parts shut down | Not specified | 40 mW and 40 μW during deep sleep | 900mW to 9W |
| Size: L×W or L×W×H (mm) | 68.6×53.4 | 65×25×6 | 53.65×23×8 (without headers soldered) | Not specified | 36.58×20.32×6.86 (with headers), 36.58×20.32×4.32 (without) | 50.8×20.32×12.7 (with headers), 50.8×20.32 (without) |
| Cost ($) | 30 | 34.99 | 34.99 | 35 | 19 | 49 for 2G, 69 for 3G |
| Encryption chips | — | ECC508, WINC1500 | ATWINC1500 | — | On the MCU | — |
| Release date | January 2016 | April 2016 | March 2016 | April 2016 | March 2015 | February 2016 |

5x2=10M

2x5 = 10M