B.Sc. in EEE, 5th Semester

17 May 2023
10:00 am – 01:00 pm

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: EEE 4651
Course Title: Data Communication and Networking 2

Summer Semester, A. Y. 2021-2022
Time: 3 Hours
Full Marks: 150

There are **6 (six)** questions. Answer all **6 (six)** questions. The symbols have their usual meanings. Programmable calculators are not allowed. Marks of each question and corresponding COs and POs are written in the brackets.

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1. Explain why IEEE 802.11 (WiFi) is appropriate for the WLAN (wireless local area network) standard. Justify the WiFi features that aid in adopting the wireless technology in LANs.

   10 (CO1, PO1)

2. Explain the features of the IEEE 802.11 wireless standards, i.e., i) topology, ii) MAC, iii) frame format, iv) scanning, association, v) time synchronization, vi) authentication, vi) energy conservation, and power management.

   15 (CO1, PO1)

3. Briefly explain the roles of the Source, Actuator, and Sink in wireless sensor networks (WSN). Use appropriate illustrations and diagrams

   10 (CO1, PO1)

4. a) Using appropriate illustrations and examples, explain the Internet of Things (IoT), its working principles, and its benefits.

   7 (CO1, PO1)

   b) Explain the Internet of Energy (IoE) and the Energy Network (EN) in the context of the Internet of Things (IoT), smart grids, and intelligent energy management (Energy Cloud).

   8 (CO1, PO1)

5. a) Suppose the United Nations High Commissioner for Refugees (UNHCR) hires you as a network expert. Design a Delay-Tolerant Network (DTN) solution to connect the disconnected communities of the Rohingya refuge area to global resources.

   20 (CO2, CO3, PO2)

   Consider the following scenario of the Rohingya refugee area. As shown in Figure 5 (a), there are three villages that are not connected. People in remote villages lack access to information technology. People can communicate with each other within each village, but not with people in other villages due to the distance constraint of wireless communication. There is adequate Internet connectivity in Cox's Bazar City. There is a mobile vehicle that transports passengers and travels to each village and city on a regular basis.

   In your solution, you plan to launch the "Message Ferry" service, a hybrid solution involving multiple mobile devices carried by movable vehicles or people.

   Your goal is to transfer/deliver digital newspapers, recorded audio messages, recorded YouTube videos, and PDF books on a regular basis among disconnected communities. It should be noted that in disconnected scenarios, real-time audio/video may not be possible.
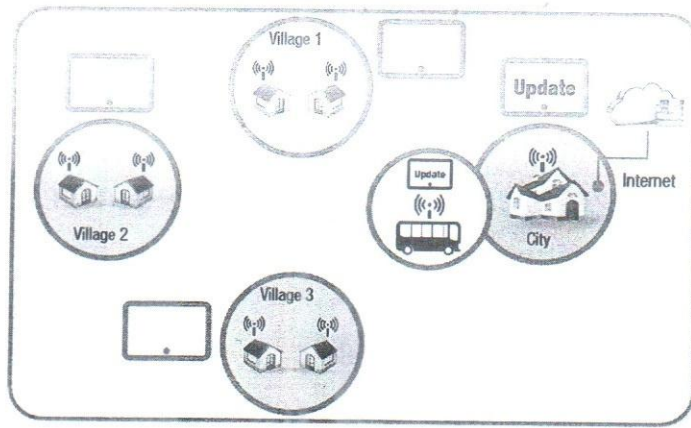
Figure 5(a).

For your above design,

    i)   Explain the DTN architecture and functionality of your design.

    ii)   Identify and resolve any problem associated with your design.

    iii)   Use and apply data flow mechanism techniques, skills, and modern engineering tools in Delay Tolerant Networks (DTN).

b) While designing your network as described above, discuss the following features of DTN for your network designs:

    i) Comparison of DTNs and Traditional Internet,

    ii) Bundle Layer of DTN,

    iii) Store-Carry-Forward technique of DTN,

    iv) Custody transfer mechanism of DTN,

    v) The steps to utilize wireless communication in each village using intelligent devices and DTN,

    vi) The steps to utilize wireless communication in the message ferry using intelligent devices and DTN,

    vii) Ad Hoc network following features:

        o Self-Organization,

        o Heterogeneous and adaptive.

15
(CO2, PO2)

c) Explain the four validation points of sustainable technologies as shown in Figure 5 (c) while designing your DTN solution for connecting the above-mentioned disconnected communities:

i) Technical, ii) Economical, iii) Social, and iv) Policy-making.
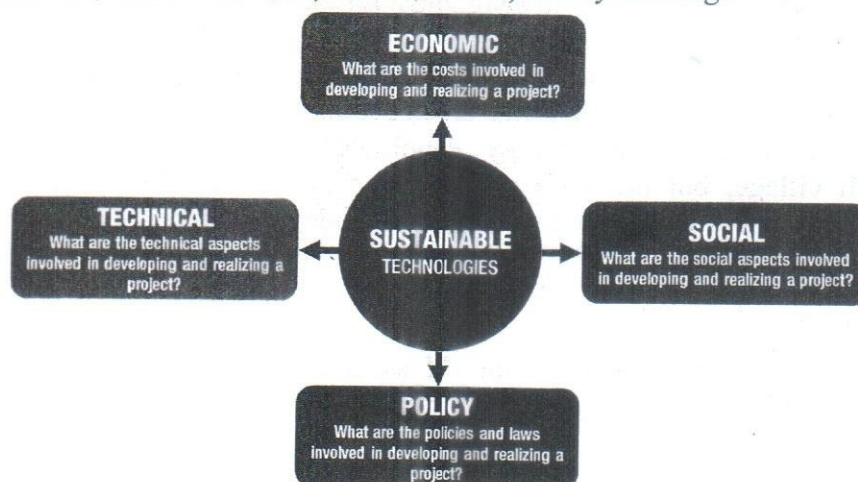
15
(CO2, PO2)

Figure 5(c).

Justify your answer as much as possible with appropriate illustrations, diagrams, tables, and flowcharts.

6. a) As an IoT expert, you are being asked to *design an Internet of Energy (IoE) using intelligent devices to provide a suitable scheduling plan for the efficient utilization of smart home appliances* (such as a light, fan, television, air-conditioning, washing machine, electric oven, hairdryer, refrigerator, and so on) and *intelligent energy equipment* (such as smart meters, smart substations, etc.).

   30 (CO2, CO3, PO2)

   Explain how you consider the following factors when designing the above IoE solutions: i) peak hour and off-peak hour, ii) day and night time, iii) summer and winter seasons, and iv) the number of occupants. Justify your answer with appropriate illustrations, diagrams, tables, and flowcharts.

   For your above design,
   i) Explain the IoE network architecture and functionality of your design.
   ii) Identify and resolve any issues with your design.
   iii) Utilize the techniques, skills, and modern engineering tools of data flow mechanisms in the *Internet of Energy (IoE)*.

   b) To build a real-world sustainable solution as a network engineer, you must complete the five steps listed below for your above design:

   20 (CO2, PO2)

   Step1: Find the problem statement and/or research question and/or research gap,
   Step2: Prepare the objectives and expected outcomes (i.e., goal, expected solution, and hypothesis),
   Step3: Plan the Methodology (technique/method) to achieve the above-prepared objectives for the expected outcomes,
   Step4: Validation (create a simulation model) to prove/validate the results for the expected outcomes,
   Step5: Prototype (create the practical product and show the impact on the community).

   Explain and justify each step by adopting the above five steps for your above IoE solution.