

**Title (Units):**           **COMP7090 Ubiquitous Computing (3,2,2)**

**Course Aims:**           This course discusses the concepts of ubiquitous/pervasive computing. This includes location-based services provided by the ubiquitous environment, positioning techniques for localization, and networks & systems issues for the design and implementation of ubiquitous/pervasive computing systems and applications. Students need to understand the key components, devices & technologies involved and recognize research issues in ubiquitous computing. This course also provides an opportunity for students to gain hands-on experiences in building applications that realize the usefulness of ubiquitous computing.

**Prerequisite:**           Research Postgraduate Student Standing

**Learning Outcomes (LOs):**

Upon successful completion of this course, students should be able to:

No.	Learning Outcomes (LOs)
	<b>Knowledge</b>
1	Describe the concept of ubiquitous/pervasive computing and mobile wireless networks
2	Recognize the research issues in ubiquitous computing
3	Appreciate positioning techniques and in depth understanding on location-based services and applications
	<b>Professional Skill</b>
4	Manage Wireless LANs and design/implement location-aware systems & applications to realize ubiquitous computing
5	Design and enhance algorithms for localization based on existing positioning techniques and platforms
	<b>Attitude</b>
6	Recognize the important issues and concerns on security and privacy

**Calendar Description:** This course discusses the concepts of ubiquitous/pervasive computing. This includes location-based services provided by the ubiquitous environment, positioning techniques for localization, and networks & systems issues for the design and implementation of ubiquitous/pervasive computing systems and applications. Students need to understand the key components, devices & technologies involved and recognize research issues in ubiquitous computing. This course also provides an opportunity for students to gain hands-on experiences in building applications that realize the usefulness of ubiquitous computing.

**Assessment:**

No.	Assessment Methods	Weighting	Remarks
1	Continuous Assessment	50%	Written and laboratory assignments are designed to evaluate students' understanding on the principles and practice of device level programming, as well as the design and implementation of ubiquitous systems and applications.
2	Examination	50%	Final examination questions are designed to assess students understanding of the methodology, characteristics, techniques, issues and concerns about ubiquitous computing and its applications

**Rubrics:**

	Excellent (A)	Good (B)	Satisfactory (C)	Fail (F)
Describe the basic concepts and principles for ubiquitous/pervasive computing	<ul style="list-style-type: none"><li>Fully understand all the concepts and principles</li></ul>	<ul style="list-style-type: none"><li>Understand most of the concepts and principles</li></ul>	<ul style="list-style-type: none"><li>Sufficiently understand the concepts and principles</li></ul>	<ul style="list-style-type: none"><li>Do not understand most of the concepts and principles</li></ul>
Understand the concept of Wireless LANs, PAN, Mobile Networks, and Sensor Networks	<ul style="list-style-type: none"><li>Fully understand all the concepts and principles</li></ul>	<ul style="list-style-type: none"><li>Understand most of the concepts and principles</li></ul>	<ul style="list-style-type: none"><li>Sufficiently understand the concepts and principles</li></ul>	<ul style="list-style-type: none"><li>Do not understand most of the concepts and principles</li></ul>

	<b>Excellent (A)</b>	<b>Good (B)</b>	<b>Satisfactory (C)</b>	<b>Fail (F)</b>
Recognize the research issues in ubiquitous computing	<ul style="list-style-type: none"> <li>Fully understand all the research issues in ubiquitous computing</li> </ul>	<ul style="list-style-type: none"> <li>Understand most of the research issues in ubiquitous computing</li> </ul>	<ul style="list-style-type: none"> <li>Sufficiently understand the research issues in ubiquitous computing</li> </ul>	<ul style="list-style-type: none"> <li>Do not understand most of the research issues in ubiquitous computing</li> </ul>
Understand positioning techniques and location-based services and applications	<ul style="list-style-type: none"> <li>Fully understand all the concepts and principles on positioning techniques and location-based services and applications</li> </ul>	<ul style="list-style-type: none"> <li>Understand most of the concepts and principles on positioning techniques and location-based services and applications</li> </ul>	<ul style="list-style-type: none"> <li>Sufficiently understand the concepts and principles on positioning techniques and location-based services and applications</li> </ul>	<ul style="list-style-type: none"> <li>Do not understand most of the concepts and principles on positioning techniques and location-based services and applications</li> </ul>
Describe the important issues and concerns on security and privacy	<ul style="list-style-type: none"> <li>Fully understand all the issues and concerns on security and privacy</li> </ul>	<ul style="list-style-type: none"> <li>Understand most of the issues and concerns on security and privacy</li> </ul>	<ul style="list-style-type: none"> <li>Sufficiently understand the issues and concerns on security and privacy</li> </ul>	<ul style="list-style-type: none"> <li>Do not understand most of the issues and concerns on security and privacy</li> </ul>
Design and implement algorithms and applications to realize location-aware computing	<ul style="list-style-type: none"> <li>Able to design and implement new &amp; complex algorithms and applications to realize location-aware computing</li> </ul>	<ul style="list-style-type: none"> <li>Able to design and implement enhanced algorithms and applications to realize location-aware computing</li> </ul>	<ul style="list-style-type: none"> <li>Able to design and implement most of the common algorithms and typical applications to realize location-aware computing</li> </ul>	<ul style="list-style-type: none"> <li>Not able to design or implement algorithm and applications for location-aware computing</li> </ul>
Acquire the knowledge to administrate and to maintain a Wireless LAN	<ul style="list-style-type: none"> <li>Capable to administrate and to maintain a WLAN</li> </ul>	<ul style="list-style-type: none"> <li>Capable to handle most of the cases when administrating a WLAN</li> </ul>	<ul style="list-style-type: none"> <li>Capable to handle a WLAN except for some special cases</li> </ul>	<ul style="list-style-type: none"> <li>Not able to administrate a WLAN</li> </ul>

### Learning Outcomes and Weighting:

<b>Content</b>	<b>LO No.</b>
I. Concepts in Ubiquitous/Pervasive Computing	1
II. The Concept of Wireless and Mobile Networks	1, 6
III. Positioning Techniques on Different Networks	3
IV. Research Issues on Mobility and Ubiquity	2
V. Wireless LAN Management	1, 4
VI. Device-level Programming & System Integration	4, 5
VII. Research Studies on Location-based Services and Applications	2, 3

### References:

Asoke K. Talukder, Roopa R. Yavagal, *Mobile Computing Technology, Applications, and Service Creation*, McGraw-Hill, 2007.

Gordon L. Stüber. *Principles of Mobile Communication*, 3rd Edition. Springer, 2012.

D. P. Agrawal and Q.-A. Zeng, *Introduction to Wireless and Mobile Systems*, 4th Edition, Cengage Learning, 2015.

J. Iversen and M. Eierman, *Learning Mobile App Development: A Hands-on Guide to Building Apps with iOS and Android*, Addison-Wesley, 2013.

Jingyu Zhou, Feilong Tang, Yao Shen, and Minyi Guo. *Pervasive Computing: Concepts, Technologies and Applications*. CRC Press, 2017.

André Perez. *Mobile Networks Architecture*. Wiley-ISTE, 2013.

### Course Content in Outline:

### **Topic**

- I. Concepts in Ubiquitous/Pervasive Computing
  - A. Network Centric Approach
  - B. Data Centric Approach
- II. The concept of Wireless and Mobile Networks
  - A. Wireless LAN & Ad Hoc Networks
  - B. Personal Area Networks
  - C. Mobile Phone Networks
  - D. RFID and Sensor Networks
- III. Positioning Techniques on Different Networks
  - A. Signal Strength Based Location Estimation Algorithms
  - B. Propagation Models and Probabilistic Models
  - C. Triangulation, and Trilateration
  - D. Finger Print and Pattern Recognition
- IV. Research Issues on Mobility and Ubiquity
  - A. Location and Mobile Data Management
  - B. Location Cloaking, Privacy and Security Issues
- V. Wireless LAN Management
  - A. Setting up the WLAN and Router Configuration
  - B. Network Performance Fine Tuning
  - C. Security Concerns and WLAN Administration
- VI. Device-level Programming & System Integration
  - A. Programming for Java Enabled Device
  - B. Programming for Symbian Device
  - C. Programming on Windows Mobile Platform
  - D. Programming / Interfacing with RFID & Sensor Systems, WLAN, Bluetooth and GPS Device
- VII. Research Studies on Location-based Services and Applications
  - A. Location Estimation Algorithms
  - B. Limitations and Concerns in Location-based Services