

CIRCULAR :-

The Head, Department of Computer Science, The Co-Ordinator, University Department of Information Technology, and the Principals of the affiliated colleges in Science are hereby informed that the recommendation made by the Ad-hoc Board of Studies in Computer Science at its meeting held on 12th October, 2007 has been accepted by the Academic Council at its meeting held on 14th December, 2007 vide item No.4.5 and subsequently approved by the Management Council at its meeting held on 24th December, 2007 vide item No.9 and that, in accordance therewith, the Certificate Course in Sensor Networks has been instituted by the University from the academic year 2007-2008.

Further that, in exercise of the powers conferred upon the Management Council under Section 54(1) and Section 55(1) of the Maharashtra Universities Act 1994, it has made **Ordinance 5732** and **Regulations 5795 and 5796** and syllabus of the Certificate Course in Sensor Networks is as per Appendix and that the same has brought into force with effect from the academic year 2007-2008.

MUMBAI-400 032

3rd April, 2008

for I/c. REGISTRAR

To,

The Head, Department of Computer Science, the Co-Ordinator, University Department of Information Technology and the Principals of the affiliated colleges in Science.

A.C./4.5/14.12.2007

M.C./9/24.12.2007

No.UG/ 131 - A of 2008, MUMBAI-400 032 3rd April, 2008

Copy forwarded with compliments for information to :-

- 1) The Dean.: of Faculty of Science
- 2) The Chairman, Ad-hoc Board of Studies in Computer Science
- 3) The Controller of Examinations,
- 4) The Co-Ordinator, University Computerization Centre,

for I/c. REGISTRAR

Copy to :-

The Director, Board of College and University Development, the Deputy Registrar (Eligibility and Migration Section), the Director of Students Welfare, the Executive Secretary to the Vice-Chancellor, the Pro-Vice-Chancellor, the Registrar and the Assistant Registrar, Administrative sub-center, Ratnagiri for information.

The Controller of Examinations (10 copies), the Finance and Accounts Officer (2 copies), Record Section (5 copies), Publications Section (5 copies), the Deputy Registrar, Enrolment, Eligibility and Migration Section (3 copies), the Deputy Registrar, Statistical Unit (2 copies), the Deputy Registrar (Accounts Section), Vidyvanagari (2 copies), the Deputy Registrar, Affiliation Section (2 copies), the Director, Institute of Distance Education, (10 copies) the Director University Computer Center (IDE Building), Vidyvanagari, (2 copies) the Deputy Registrar (Special Cell), the Deputy Registrar (PRO), the Assistant Registrar, Academic Authorities Unit (2 copies) and the Assistant Registrar, Executive Authorities Unit (2 copies). They are request to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above Circular and that, no separate Action Taken Report will be sent in this connection. the Assistant Registrar Constituent Colleges Unit (2 copies), BUCTI (1 copy), the Deputy Account, Unit V (1 copy), the In-charge Director, Centralize Computing Facility (1 copy), the Receptionist (1 copy), the Telephone Operator (1 copy), the Secretary MUASA (1 copy), the Superintendent, Post Graduate Section (2 copies), the Superintendent, Thesis Section (2 copies)

UNIVERSITY OF MUMBAI

University of Mumbai



Certificate Course in Sensor Networks

(introduced from the academic
year 2007 – 2008)

UNIVERSITY OF MUMBAI

CERTIFICATE COURSE IN SENSOR NETWORKS

Title of the Course

CERTIFICATE COURSE IN SENSOR NETWORKS

R.5732 :- Eligibility

Students studying for B.Sc. & M.Sc. in Computer Science.
B.Sc. and M.Sc. in IT, BE & ME, B.Tech. & M.Tech. in
Computer Engineering or IT, BCA & MCA.

Attendance

It is a part time course with compulsory attendance.

R.5795 :- Duration

The course will consist of 30 hours. It can be conducted in two modes.

1. It can be conducted as a continuous 5 days, 6 hours per day course.
2. It can be conducted once a week for 8/15 consecutive weeks. The mode can be decided by the availability of the participants.

Practical

There will be no practical conducted for the course. However the participants are expected to use the network simulator at the Department/Institute which can be simulate sensor network applications discussed in the course.

R.5796 :- Examination

There will be no examination at the end of course.

Fee Structure

Rs.1000/- for students.

Rs.2000/- for other participants

Teachers

Academic and IT industry Professionals with extensive work in Ad-hoc and Sensor Networks with over 20 years of experience in the field.



Prerequisites
In order to appreciate the course on sensor networks, the student must have taken a course on data communications and networking as part of their syllabus or from any other recognized academic, industry or government institute

COURSE OBJECTIVES

The intention of this course is to start from very basics of Cellular system to Wireless Ad hoc and Sensor networks for individuals with academic, industry, or government background. It targets not only researchers and engineers, but also those who would like to have a deep yet easy coverage of this growing field, and the current state of research in this area. It comes to fill in the gap of existing literature on ad hoc and sensor networks by providing a comprehensive coverage of the subject matter. This course has been prepared with great care to address the need of those who seek not only detailed knowledge of this important field, but also the breadth. This area is poised to be a key component of future communication networks and likely to have an undaunted impact on our daily lives. Most existing presentations on ad hoc and sensor networks often focus on a specific aspect of the technology in isolation, fail to provide critical insights on cross-layer interdependencies, and hence leave major questions in the minds of the participants. The experience in dealing with students, professionals, and researchers working on ad hoc and sensor networks have reveals the need for a course that covers the many interrelated aspects of these networks and which can also clearly pinpoint iterative interactions between different layers. The study of ad hoc and sensor networks is very peculiar and intriguing, and to be able to fully understand this area it is not only enough to understand specific solutions individually, but also their many interdependencies and cross-layer interactions. This knowledge will allow participants to firmly grasp this topic, understand its intricacies, and stimulate creativity.

This is in essence the approach for this course. From the physical up to the application layer, the course provides a detailed investigation of ad hoc and sensor networks to date. In addition, wherever applicable, the discussion of these topics will be closely followed by their impact on other layers of the network protocol stack. With this explanatory model, The ultimate goal is to provide a superior experience that opens up new horizons and the approach

taken together with its vast and extensive coverage of topics, will enable the participants to not only understand and position themselves in this cutting edge area of ad hoc and sensor networks, but will also allow them to develop new capabilities, enhance skills, share expertise, consolidate knowledge and encourage further development of the area by identifying key problems, analyzing them and designing new and innovative solutions and applications.

TOPICS TO BE COVERED

The course will cover the following topics. The detailed syllabus at the end serves more as a guideline than the details of the course

- Basics of Cellular, Ad hoc and Sensor Networks
- Introduction to the course
- Routing in Ad hoc Networks
- Broadcasting, Multicasting and Geocasting
- Wireless LANs
- Wireless PANs
- Directional Antenna Systems
- TCP over Ad Hoc Networks
- Wireless Sensor Networks
- Data Retrieval in Sensor Networks
- Security
- Integrating MANETs, WLANs and Cellular Networks

DETAILED SYLLABUS

1. Basics of Cellular, Ad hoc and Sensor Networks

Cellular System Infrastructure, Ad hoc Networks (MANETs), Applications of MANETs
Routing, Table-Driven Routing, Source-initiated on-demand routing, Hybrid routing,
Comparison of routing protocols, Wireless Sensor Network, Introduction to Routing in
sensor network

2. Introduction to Ad hoc and Sensor Networks

Introduction, The Communication Puzzle, Applications of MANETs, Challenges
Scalability, Quality of Service, Client-Server Model Shift, Security, Interoperation with the
Internet, Energy Conservation, Node (MH) Cooperation, Interoperation

3. Routing in Ad hoc Networks
Introduction, Topology-Based versus Position-Based Approaches, Topology-Based Routing Protocols, Proactive Routing Approach, Reactive Routing Approach, 3 Hybrid Routing Approach, Comparison, Position-Based Routing, Principles and Issues, Location Services, Forwarding Strategies, Comparisons, Other Routing Protocols, Signal Stability Routing, Power Aware Routing, Associativity-Based Routing, QoS Routing, Future Directions

4. Broadcasting, Multicasting and Geocasting
Introduction, The Broadcast Storm, Broadcasting in a MANET, Flooding-Generated Broadcast Storm, Redundancy Analysis, Rebroadcasting Schemes Multicasting Issues in Providing Multicast in a MANET, Multicast Routing Protocols, Comparison, Geocasting, Geocast Routing Protocols, Comparison

5. Wireless LANs
Introduction, Why Wireless LANs, Transmission Techniques Wired and Wireless Medium Access Control Protocol Issues, Hidden Terminal Problem Reliability Collision Avoidance Congestion Avoidance, Congestion Control, Energy Efficiency Other MAC Issues, The IEEE 802.11 Standard for Wireless LANs, Network Architecture The Physical Layer, The MAC Layer, Security, System Design Considerations An Overview of Past and Present IEEE 802.11 Efforts, The IEEE 802.11e MAC Protocol Enhancement to IEEE 802.11 MAC, Power Control, Spatial Reusability, QoS Provisioning The HIPERLAN/2 Standard for Wireless LANs, Physical Layer, MAC Layer

6. Wireless PAN'S
Introduction, Why Wireless PANs, The Bluetooth Technology, History and Applications, Technical Overview, The Bluetooth Specifications, Piconet Synchronization and Bluetooth Clocks, Master-Slave Switch, Bluetooth Security, Enhancements to Bluetooth Bluetooth Interference Issues, Intra and Inter Piconet Scheduling, Bridge Selection Traffic Engineering, QoS and Dynamic Slot Assignment, Scatternet Formation The IEEE 802.15 Working Group for WPANs, The IEEE 802.15.3, The IEEE 802.15.4 Comparison between WPAN Systems : Range, Data Rate, Support for Voice Support for LAN Integration, Power Management, Comparison and Summary of Results WLANs versus WPANs

7. Directional Antenna Systems

Introduction, Antenna Concepts, Gain Radiation Pattern, Beam Width Evolution of Directional Antenna Systems, Sectorized Antenna Systems Diversity Antenna Systems, Smart Antenna Systems, Advantages of using directional Antennas, Directional Antennas for Ad Hoc Networks, Antenna Models, protocols Issues on the Use of Directional Antennas, Directional Neighborhood, New Types of Hidden Terminal Problems, Deafness Broadcasting, Broadcasting Protocols, Medium Access Control, Single Channel, Multi-Channel, Other Protocols, Routing Protocols

8. TCP over Ad Hoc Networks
Introduction, TCP Protocol Overview, Designed and Fine-Tuned to Wired Networks TCP Basics, TCP Header Format, Congestion Control, Round-Trip Time Estimation TCP and MANETs, Effects of Partitions on TCP, Impact of Lower Layers on TCP Solutions for TCP over Ad Hoc - Mobility-Related - Fairness-Related

9. Wireless Sensor Networks
Introduction, The Mica Mote, Sensing and Communication Range Design Issues, Challenges Energy Consumption Clustering of Sensors, Regularly placed sensors, Heterogeneous WSNs, Mobile Sensors Applications, Habitat Monitoring, A Remote Ecological Micro-Sensor Network Environmental Monitoring, Drinking Water Quality, Disaster Relief Management Soil Moisture Monitoring, Health Care Monitoring, Building, Bridge and Structural Monitoring Smart Energy and Home/Office Applications, DARPA Efforts towards Wireless Sensor Networks, Body Area Network

10. Data Retrieval in Sensor Networks
Introduction, Classifications of WSNs, Architecture of Sensor Networks, Network Architecture Physical Layer, MAC Layer, Design Issues, MAC Protocols, Link Layer, Routing Layer Network Structure Based, Flat versus Hierarchical, Multipath-based Routing Query-based Routing, Location-based Routing, Transport Layer High-Level Application Layer Support, Distributed Query Processing, Sensor Databases Distributed Applications, In-Network Processing, Security Adapting to the Inherent Dynamic Nature of WSNs

11. Security
Introduction, Distributed Systems Security, Security in Ad Hoc Networks, Requirements Security Solutions Constraints, Challenges, Authentication, Key Management, Conceptual Background, Diffie-Hellman Key Agreement, N-Party Diffie-Hellman Key Agreement, The Ingemarsson Protocol, The Burmester and Desmedt Protocol The Hypercube Protocol, The Octopus Protocol, The CLIQUES Protocol Suite The Tree-based Generalized Diffie-Hellman Protocol, Secure Routing, Problems Affecting Secure Ad Hoc Routing, Secure Routing Protocols, The Wormhole Attack Cooperation in MANETs, CONFIDANT, Token-Based, Wireless Sensor Networks WSN Security, Key Distribution and Management, Intrusion Detection Systems, Overview Unsuitability of Current IDS Techniques, An IDS Architecture for Ad Hoc Networks Anomaly Detection

12. Integrating MANETs, WLANs and Cellular
Introduction, Ingredients of a Heterogeneous Architecture, Mobile User Stations Base Station and Access Point, Core IP Network (CN), Possible Communication Scenarios, Design Factors, Protocol Stack, The Physical Layer, The Data Link Layer The Network Layer, Transport Layer, Application Layer Mobility and Connection Management, Comparison of the Integrated Architectures

Recommended Books and Literature

1. Introduction to Wireless and Mobile Systems by Dharma Prakash Agarwal and Oing-An Zeng, Publisher: Thompson Brooks/Cole
2. Wireless and Mobile Network Architecture by Y. B. Lin and I. Chlamtac, Publisher: John Wiley and Sons
3. Wireless Communications, by Andrea Goldsmith, Publisher: Cambridge University Press
4. Mobile Communications by Jochen Schiller, Publisher: Pearson Education
5. Ad-Hoc and Sensor networks, Theory and Applications by Carlos de Moraes Corderio and Dharma Prakash Agarwal, Publisher: World Scientific Publishing Co Pvt. Ltd
6. A Survey of sensor Networks, Ian F. Akyildiz, Weilian Su, Yogesh Sankarasubramaniam and Erdal cayirci, IEEE Communication Magazine, August 2002, pp 102-114
7. Survey of Sensor Networks by Limin Wang, Michigan State University
8. A Short Survey of wireless sensor networks by Hilger Karl, andreas Willig, TKN, Technical Report Series
9. A Survey of sensor Network Applications, by Ning Xu, University of South Carolina
10. Routing Techniques in Wireless Sensor Networks: A survey, by Jamal N. Al-Karaki and ahmed E. Kamal, Iowa State University