E.G.S. PILLAY ENGINEERING COLLEGE

(Autonomous)

Approved by AICTE, New Delhi | Affiliated to Anna University, Chennai

Accredited by NAAC with 'A' Grade | Accredited by NBA (CSE, EEE, MECH)

NAGAPATTINAM – 611 002

M.E. COMPUTER SCIENCE AND ENGINEERING

Full Time Curriculum and Syllabus

First Year – Second Semester

Course Code	Course Name	L	T	P	C	Maximum Marks		
						CA	ES	Total
Theory Course								
1701CP201	Software Process and Project Management	3	0	0	3	40	60	100
1702CP202	Security In Computing	3	0	0	3	40	60	100
1702CP203	Internet of Things	3	0	0	3	40	60	100
1702CP204	Advanced Databases	3	0	0	3	40	60	100
1702CP205	Machine Learning Techniques	3	0	0	3	40	60	100
	Elective-II	3	0	0	3	40	60	100
Laboratory Course								
1704CP206	Advanced Database Laboratory	0	0	4	2	50	50	100
1704CP207	Technical Seminar	0	0	2	1	100	0	100
1704CP208	Communication Skill Lab II	0	0	2	1	100	0	100

L – Lecture | T – Tutorial | P – Practical | C – Credit | CA – Continuous Assessment | ES – End Semester

1701CP201 SOFTWARE PROCESS AND PROJECT MANAGEMENT

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To elicit, analyze, prioritize, and manage both functional and quality requirements
2. To estimate efforts required, plan, and track the plans
3. To understand and apply configuration and quality management techniques

UNIT I DEVELOPMENT LIFE CYCLE PROCESSES 9 Hours

Overview of software development life cycle – introduction to processes – Personal Software Process (PSP) – Team software process (TSP) – Unified processes – agile processes – choosing the right process Tutorial: Software development using PSP

UNIT II REQUIREMENTS MANAGEMENT 9 Hours

Functional requirements and quality attributes – elicitation techniques – Quality Attribute Workshops (QAW) – analysis, prioritization, and trade-off – Architecture Centric Development Method (ACDM) – requirements documentation and specification – change management – traceability of requirements

UNIT III ESTIMATION, PLANNING, AND TRACKING 9 Hours

Identifying and prioritizing risks – risk mitigation plans – estimation techniques – use case points – function points – COCOMO II – top-down estimation – bottom-up estimation – work breakdown structure – macro and micro plans – planning poker – wideband Delphi

UNIT IV CONFIGURATION AND QUALITY MANAGEMENT 9 Hours

identifying artifacts to be configured – naming conventions and version control – configuration control – quality assurance techniques – peer reviews – Fegan inspection – unit, integration, system, and acceptance testing – test data and test cases – bug tracking

UNIT V SOFTWARE PROCESS DEFINITION AND MANAGEMENT 9 Hours

Process elements – process architecture – relationship between elements – process modeling – process definition techniques – ETVX (entry-task-validation-exit) – process baselining – process assessment and improvement – CMMI – Six Sigma Tutorial: process measurement exercises, process definition using ETVX

TOTAL: 45 HOURS

FURTHER READING:

ETVX deployment
COCOMO model installation

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Explain software development life cycle
CO2: Adopt a suitable process for software development
CO3: Elicit functional and quality requirements
CO4: Analyze, prioritize, and manage requirements
CO5: Perform trade-off among conflicting requirements

REFERENCES:

1. Pankaj Jalote, “Software Project Management in Practice”, Pearson, 2002.
2. Chris F. Kemerer, “Software Project Management – Readings and Cases”, McGraw Hill, 1997.
3. Watts S. Humphrey, “PSP: A self-improvement process for software engineers”, Addison- Wesley, 2005.
4. Watts S. Humphrey, “Introduction to the Team Software Process”, Addison-Wesley, 2000.
5. Orit Hazzan and Yael Dubinsky, “Agile software engineering”, Springer, 2008.

1702CP202	SECURITY IN COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To understand the basics of cryptography.
2. To learn how to learn to find the vulnerabilities in programs and to overcome them
3. To know the different kinds of security threats in networks.

UNIT I ELEMENTARY CRYPTOGRAPHY 9 Hours

Terminology and Background – Substitution Ciphers – Transpositions – Making Good Encryption Algorithms- Data Encryption Standard- AES Encryption Algorithm – Public Key Encryption – Cryptographic Hash Functions – Key Exchange – Digital Signatures – Certificates

UNIT II PROGRAM SECURITY 9 Hours

Secure programs – Non-malicious Program Errors – Viruses – Targeted Malicious code – Controls Against Program Threat – Control of Access to General Objects – User Authentication – Good Coding Practices

UNIT III SECURITY IN NETWORKS 9 Hours

Threats in networks – Encryption – Virtual Private Networks – PKI – SSH – SSL – IPSec – Content Integrity – Access Controls – Wireless Security – Honeypots – Traffic Flow Security – Firewalls – Intrusion Detection Systems – Secure e-mail

UNIT IV SECURITY IN DATABASES 9 Hours

Security requirements of database systems – Reliability and Integrity in databases – Two Phase Update – Redundancy/Internal Consistency – Recovery – Concurrency/Consistency – Monitors – Sensitive Data – Types of disclosures – Inference.

UNIT V SECURITY MODELS AND STANDARDS 9 Hours

Secure SDLC – Secure Application Testing – Security architecture models – Trusted Computing Base – Bell-LaPadula Confidentiality Model – Biba Integrity Model – Graham-Denning Access Control Model – Harrison-Ruzzo-Ulman Model – Secure Frameworks –Security Standards - ISO 27000 family of standards – NIST.

TOTAL: 45 HOURS

FURTHER READING:

Design and Analysis of Algorithm
Advanced Backtracking Techniques

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Apply various cryptographic algorithms
CO2: Analyze different kinds of security threats
CO3: Implement Models and standards of security

REFERENCES:

1. Charles P. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, Fourth Edition, Pearson Education, 2007.
2. Matt Bishop, “Introduction to Computer Security”, Addison-Wesley, 2004.
3. Michael Whitman, Herbert J. Mattord, “Management of Information Security”, Third Edition, Course Technology, 2010.

1702CP203	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

Course Objectives:

1. To introduce the fundamental techniques based on parallel processing.
2. To develop the foundations for analyzing the benefits of design options in computer architecture.
3. To give experience of the application of the various computing techniques.

UNIT I FUNDAMENTALS OF IOT **9 Hours**

Introduction-Characteristics-Physical design - Protocols – Logical design – Enabling technologies – IoT Levels – Domain Specific IoTs – IoT vs M2M.

UNIT II IOT DESIGN METHODOLOGY **9 Hours**

IoT systems management – IoT Design Methodology – Specifications Integration and Application Development.

UNIT III Building Iot With Raspberry Pi **9 Hours**

Physical device – Raspberry Pi Interfaces – Programming – APIs / Packages – Web services.

UNIT IV BUILDING IOT WITH GALILEO/ARDUINO **9 Hours**

Intel Galileo Gen2 with Arduino- Interfaces - Arduino IDE – Programming - APIs and Hacks.

UNIT V CASE STUDIES AND ADVANCED TOPICS **9 Hours**

Various Real time applications of IoT- Connecting IoT to cloud – Cloud Storage for Iot – Data Analytics for IoT – Software & Management Tools for IoT

TOTAL: 45 HOURS

FURTHER READING:

Advanced IOT technologies
IoT with cloud storage

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Design a portable IoT using Arduino/ equivalent boards and relevant protocols.

CO2: Develop web services to access/control IoT devices.

CO3: Deploy an IoT application and connect to the cloud.

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015.
2. Manoel Carlos Ramon, “Intel® Galileo and Intel® Galileo Gen 2: API Features and Arduino Projects for Linux Programmers”, Apress, 2014.
3. Marco Schwartz, “Internet of Things with the Arduino Yun”, Packt Publishing, 2014.

1702CP204	ADVANCED DATABASES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To learn the modeling and design of databases.
2. To acquire knowledge on parallel and distributed databases and its applications.
3. To study the usage and applications of Object Oriented database
4. To understand the principles of intelligent databases.

UNIT I PARALLEL AND DISTRIBUTED DATABASES 9 Hours

Database System Architectures: Centralized and Client-Server Architectures – Server System Architectures – Parallel Systems- Distributed Systems – Parallel Databases: I/O Parallelism – Inter and Intra Query Parallelism – Inter and Intra operation Parallelism – Design of Parallel Systems- Distributed Database Concepts - Distributed Data Storage – Distributed Transactions – Commit Protocols – Concurrency Control

UNIT II OBJECT AND OBJECT RELATIONAL DATABASES 9 Hours

Concepts for Object Databases: Object Identity – Object structure – Type Constructors – Encapsulation of Operations – Methods – Persistence – Type and Class Hierarchies – Inheritance – Complex Objects – Object Database Standards– Relational Systems: Object Relational features in SQL/Oracle – Case Studies.

UNIT III INTELLIGENT DATABASES 9 Hours

Active Databases: Syntax and Semantics (Starburst, Oracle, DB2)- Taxonomy- Applications- Design Principles for Active Rules- Temporal Databases: Overview of Temporal Databases- TSQL2- Deductive Databases: Logic of Query Languages – Datalog- Recursive Rules-Syntax and Semantics of Datalog Languages- Implementation of Rules and Recursion

UNIT IV ADVANCED DATA MODELS 9 Hours

Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models -Concurrency Control - Transaction Commit Protocols- Multimedia Databases- Information Retrieval- Data Warehousing- Data Mining- Text Mining.

UNIT V EMERGING TECHNOLOGIES 9 Hours

XML Databases: XML-Related Technologies-XML Schema- XML Query Languages- Storing XML in Databases-XML and SQL- Native XML Databases- Web Databases- Cloud Based Databases: Data Storage Systems on the Cloud- Cloud Storage Architectures-Cloud Data Models- Query Languages- Introduction to Big Data-Storage-Analysis

TOTAL: 45 HOURS

FURTHER READING:

1. DB2 technologies
2. Big data analysis

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Select the appropriate high performance database like parallel and distributed database
CO2: Model and represent the real world data using object oriented database
CO3: Design a semantic based database to meaningful data access
CO4: Embed the rule set in the database to implement intelligent databases
CO5: Represent the data using XML database for better interoperability
CO6: Handle Big data and store in a transparent manner in the cloud

REFERENCES:

1. R. Elmasri, S.B. Navathe, “Fundamentals of Database Systems”, Fifth Edition, Pearson Education/Addison Wesley, 2007.
2. Thomas Cannolly and Carolyn Begg, “Database Systems, A Practical Approach to Design, Implementation and Management”, Third Edition, Pearson Education, 2007.
3. Henry F Korth, Abraham Silberschatz, S. Sudharshan, “Database SystemConcepts”, Fifth Edition, McGraw Hill, 2006.
4. C.J.Date, A.Kannan and S.Swamynathan, ”An Introduction to Database Systems”, Eighth Edition, Pearson Education, 2006.
5. Raghu Ramakrishnan, Johannes Gehrke, “Database Management Systems”, McGraw Hill, Third Edition 2004.

1702CP205 MACHINE LEARNING TECHNIQUES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

1. To understand the machine learning theory
2. To implement linear and non-linear learning models
3. To implement distance-based clustering techniques
4. To build tree and rule based models
5. To apply reinforcement learning techniques

UNIT I FOUNDATIONS OF LEARNING **9 Hours**

Components of learning – learning models – geometric models – probabilistic models – logic models – grouping and grading – learning versus design – types of learning – supervised – unsupervised – reinforcement – theory of learning – feasibility of learning – error and noise – training versus testing – theory of generalization

UNIT II LINEAR MODELS **9 Hours**

Linear classification – univariate linear regression – multivariate linear regression – regularized regression – Logistic regression – perceptrons – multilayer neural networks – learning neural networks structures – support vector machines – soft margin SVM – going beyond linearity – generalization and overfitting – regularization – validation

UNIT III DISTANCE-BASED MODELS **9 Hours**

Nearest neighbor models – K-means – clustering around medoids – silhouttes – hierarchical clustering – k-d trees – locality sensitive hashing – non-parametric regression – ensemble learning – bagging and random forests – boosting – meta learning

UNIT IV TREE AND RULE MODELS **9 Hours**

Decision trees – learning decision trees – ranking and probability estimation trees – regression trees – clustering trees – learning ordered rule lists – learning unordered rule lists – descriptive rule learning – association rule mining – first-order rule learning

UNIT V REINFORCEMENT LEARNING **9 Hours**

Passive reinforcement learning – direct utility estimation – adaptive dynamic programming – temporal-difference learning – active reinforcement learning – exploration – learning an actionutility function – Generalization in reinforcement learning – policy search – applications in game playing – applications in robot control

TOTAL: 45 HOURS

FURTHER READING:

Advanced Network Requirements

Wireless Network Technologies

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Explain theory underlying machine learning
CO2: Construct algorithms to learn linear and non-linear models
CO3: Implement data clustering algorithms
CO4: Construct algorithms to learn tree and rule-based models
CO5: Apply reinforcement learning techniques

REFERENCES:

1. Y. S. Abu-Mostafa, M. Magdon-Ismail, and H.-T. Lin, “Learning from Data”, AMLBook Publishers, 2012.
2. P. Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge
3. University Press, 2012.
4. K. P. Murphy, “Machine Learning: A probabilistic perspective”, MIT Press, 2012.
5. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2007.
6. D. Barber, “Bayesian Reasoning and Machine Learning”, Cambridge University Press, 2012.

1704CP206 ADVANCED DATABASE LABORATORY

L	T	P	C
0	0	4	2

COURSE OBJECTIVES:

1. To study and implement the basic SQL commands.
2. To implement the database design in PL/SQL.
3. To store different types of data in a database and retrieve it from a front end.

LIST OF EXPERIMENTS:

DISTRIBUTED DATABASE

1. Consider a distributed database for a bookstore with 4 sites called S1, S2, S3 and S4. Consider the following relations:
   Books (ISBN, primary Author, topic, total Stock, price)
   Book Store (store No, city, state, zip, inventoryValue)
   Stock (store No, ISBN, Qty)
   Total Stock is the total number of books in stock and inventory Value is the total inventory value for the store in dollars. Consider that Books are fragmented by price amounts into:
   F1: Books: price up to $20
   F2: Books: price from $20.01 to $50
   F3: Books: price from $50.01 to $100
   F4: Books: price $100.01 and above
   Similarly, Book Stores are divided by ZIP codes into:
   S1: Bookstore: Zip up to 25000
   S2: Bookstore: Zip 25001 to 50000
   S3: Bookstore: Zip 50001 to 75000
   S4: Bookstore: Zip 75001 to 99999

   Task: Write SQL query for the following
   (a) Insert and Display details in each table.
   (b) Find the total number of books in stock where price is between $15 and $55.
   (c) Update the book price of book No=1234 from $45 to $55 at site S3.
   (d) Find total number of book at site S2.

2. Implement deadlock detection algorithm for distributed database using wait-for graph and test with the following information. Consider five transactions T1, T2, T3, T4 and T5 with T1 initiated at site S1 and spawning an agent at site S2 T2 initiated at site S3 and spawning an agent at site S1 T3 initiated at site S1 and spawning an agent at site S3 T4 initiated at site S2 and spawning an agent at site S3 T5 initiated at site S3.

   The locking information for these transactions is shown in the following table

Transactions	Data items locked by transactions	Data items transaction is waiting for	Site involved in operations
T1	X1	X8	S1
T1	X6	X2	S2
T2	X4	X1	S1
T2	X5	-	S3
T3	X2	X7	S1
T3	-	X3	S3
T4	X7	-	S2
T4	X8	X5	S3
T5	X3	X7	S3

   Produce local wait for graph for each of the sites and construct global wait for graph and check for dead lock.

OBJECT ORIENTED DATABASE:

3. A University wants to track persons associated with them. A person can be an Employee or Student. Employees are Faculty, Technicians and Project associates. Students are Full time students, Part time students and Teaching Assistants.

a. Design an Enhanced Entity Relationship (EER) Model for university database.
   Write OQL for the following
   i. Insert details in each object.
   ii. Display the Employee details.
   iii. Display Student Details.
   iv. Modify person details.
   v. Delete person details.

b. Extend the design by incorporating the following information.
   Students are registering for courses which are handled by instructor researchers (graduate students). Faculties are advisors to graduate students. Instructor researchers' class is a category with super class of faculty and graduate students. Faculty are having sponsored research projects with a grant supporting instruction researchers. Grants are sanctioned by different agencies. Faculty belongs to different departments. Department is chaired by a faculty. Implement for the Insertion and Display of details in each class.

PARALLEL DATABASE:

4. Consider the application for University Counseling for Engineering Colleges. The college, department and vacancy details are maintained in 3 sites. Students are allocated colleges in these 3 sites simultaneously. Implement this application using parallel database [State any assumptions you have made].

5. There are 5 processors working in a parallel environment and producing output. The output record contains college details and students mark information. Implement parallel join and parallel sort algorithms to get the marks from different colleges of the university and publish 10 ranks for each discipline.

ACTIVE DATABASE:

6. Create triggers and assertions for Bank database handling deposits and loan and admission database handling seat allocation and vacancy position. Design the above relational database schema and implement the following triggers and assertions.
   (a) When a deposit is made by a customer, create a trigger for updating customers account and bank account
   (b) When a loan is issued to the customer, create a trigger for updating customer's loan account and bank account.
   (c) Create assertion for bank database so that the total loan amount does not exceed the total balance in the bank.

   When an admission is made, create a trigger for updating the seat allocation details and vacancy position.

DEDUCTIVE DATABASE:

7. Construct a knowledge database for kinship domain (family relations) with facts. Extract the following relations using rules.
   Parent, Sibling, Brother, Sister, Child, Daughter, Son, Spouse, Wife, husband, Grand parent, Grandchild, Cousin, Aunt and Uncle.

QUERY PROCESSING

8. Implement Query Optimizer with Relational Algebraic expression construction and execution plan generation for choosing an efficient execution strategy for processing the given query. Also design employee database and test the algorithm with following sample queries.
   (a) Select empid, empname from employee where experience > 5
   (b) Find all managers working at London Branch

XML

9. Design XML Schema for the given company database

   Department (deptName, deptNo, deptManagerSSN, deptManagerStartDate, deptLocation)

Employee (empName, empSSN, empSex, empSalary, empBirthDate, empDeptNo, empSupervisorSSN, empAddress, empWorksOn) Project (projName, projNo, projLocation, projDeptNo, projWorker)

10. Implement the following queries using XQuery and XPath
    a. Retrieve the department name, manager name, and manager salary for every department'
    b. Retrieve the employee name, supervisor name and employee salary for each employee who works in the Research Department.
    c. Retrieve the project name, controlling department name, number of employees and total hours worked per week on the project for each project.
    d. Retrieve the project name, controlling department name, number of employees and total hours worked per week on the project for each project with more than one employee working on it.

    Implement a storage structure for storing XML database and test with the above schema.

TOTAL: 60 HOURS

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Work on distributed databases
CO2: Create and work on object oriented databases
CO3: Create and work with parallel database
CO4: Experiment on active database
CO5: Explore the features of deductive database
CO6: To work on weka tool for clustering and classification
CO7: Represent the database using XML and work on it

1704CP208	**COMMUNICATION SKILLS LAB II** (Common to all M.E Progarmmes)	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

COURSE OBJECTIVES:

1. To acquire skills for using English in business environment.
2. To communicate appropriately in business contexts.
3. To prepare students for taking BEC Vantage level examination conducted by the Cambridge English Language Assessment (CELA).

SPEAKING

Non-verbal communication – agreeing / disagreeing, reaching decisions, giving and supporting opinions – making mini presentations – extending on conservations – collaborative task – tongue twisters.

WRITING

Business letters – fax – Shorter Documents: e-mail - memo – message - note – report writing – formal / informal styles.

TOTAL: 15 HOURS

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: To enable students to acquire business terms for communication.

CO2: To use English confidently in the business contexts.

CO3: To be able to take part in business discussion and write formal and informal business correspondences.

REFERENCES:

1. Guy Brook-Hart, "BEC VANTAGE: BUSINESS BENCHMARK Upper-Intermediate – Student's Book", 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Cambridge Examinations Publishing, "Cambridge BEC VANTAGE – Self-study Edition", Cambridge University Press, UK, 2005.
3. Swets, Paul. W. 1983. The Art of Talking So That People Will Listen: Getting
4. The Process of Writing: Planning and Research, Writing, Drafting and Revising

1703CP016	ADHOC MOBILE WIRELESS NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

1. To learn about the issues in the design of ad hoc and wireless sensor networks
2. To understand the working of protocols in different layers of ad hoc and sensor networks
3. To expose the students to different aspects in ad hoc and sensor networks
4. To understand various standards and applications in ad hoc and sensor networks

UNIT I FUNDAMENTALS 9 Hours

Introduction to ad hoc networks- Differences between cellular and ad hoc wireless networks- Challenges and issues in ad hoc networks-Introduction to WSN-Single node architecture-Network architecture- Localization and positioning-Operating systems for WSN.

UNIT II MAC AND LINK MANAGEMENT 9 Hours

Fundamentals of wireless MAC protocols- Classification of MAC protocols for ad hoc networks-MAC for WSN-Low duty cycle protocols and wakeup concepts- Contention and schedule based protocols-WSN link layer-Error control-Framing-Link management.

UNIT III ROUTING 9 Hours

Design issues of routing protocols for ad hoc networks- Classification of routing protocols-Proactive, Reactive and Hybrid routing protocols-Routing in WSN-Naming and addressing-Gossiping and agent based unicast forwarding- Energy efficient unicast- Broadcast and multicast- Geographic routing-Data-centric and content-based networking.

UNIT IV TRANSPORT LAYER AND QOS 9 Hours

Challenges of transport layer protocol in wireless environments- TCP‟s challenges and design issues in ad hoc networks-Transport protocols for ad hoc networks-Transport control protocols for WSNs-Issues and challenges in providing QoS in ad hoc networks-Network layer QoS solutions- QoS Model- QoS in wireless sensor networks-Congestion control in network processing.

UNIT V STANDARDS AND APPLICATIONS 9 Hours

Wireless sensor network standards-Standards on wireless mesh networks-Applications of ad hoc and WSNs-Case study: Building military border area surveillance system, Forest fire detection system and tsunami early warning system with wireless sensor networks.

TOTAL: 45 HOURS

FURTHER READING:

Digital Image Processing

Image Compression Techniques

COURSE OUTCOMES:

On the successful completion of the course, students will be able to

CO1: Identify different issues in wireless ad hoc and sensor networks

CO2: To analyze the protocols developed for ad hoc and sensor networks

CO3: To identify and discuss the standards and applications of ad hoc and sensor networks

REFERENCES:

1. Subir Kumar Sarkar, T.G.Basavaraju, C Puttamadappa,“Ad Hoc Mobile Wireless Networks”, Auerbach Publications, 2008.
2. C. Siva Ram Murthy, B. S. Manoj, “Ad Hoc Wireless Networks- Architectures and Protocols”, Pearson Education, 2004.
3. Kazem Sohraby, Daniel Minoli, TaiebZnati, “Wireless Sensor Networks-Technology, Protocols, and Applications”, John Wiley & Sons, 2007.
4. Waltenegus Dargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks”, John Wiley & Sons, 2010.
5. Holger Karl, Andreas Willig, “Protocols and Architectures for Wireless Sensor Networks”, John Wiley & Sons, 2005.