INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

ELECTRONICS AND COMMUNICATIONENGINEERING

COURSE DESCRIPTOR

Course Title	**WIRELESS SENSOR NETWORKS AND ARCHITECTURE**				
Course Code	**AEC526**				
Programme	B.Tech				
Semester	V	ECE			
Course Type	Professional Elective				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	-	3	-	-
Chief Coordinator	Mr. K Chaitanya, Asst Prof., Department of ECE				
Course Faculty	Mr. K Chaitanya, Asst Prof., Department of ECE				

I. COURSE OVERVIEW:

WSNs are beginning to be organized in an enhanced step. It is not awkward to expect that in 10 to 15 years that the world will be protected with WSNs with entree to them via the Internet. This can be measured as the Internet becoming a physical n/w. This technology is thrilling with infinite potential for many application areas like medical, environmental, transportation, military, entertainment, homeland defense, crisis management and also smart spaces. The most common WSN architecture follows the OSI architecture Model. The architecture of the WSN includes five layers and three cross layers. Mostly in sensor n/w we require five layers, namely application, transport, n/w, data link & physical layer.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AIT003	V	Computer Networks	4
UG	AEC524	VI	Wireless Communications And Networks	3

III. MARKSDISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Wireless Sensor Networks And Architecture	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for continuous internal assessment (CIA) and 70 marks for semester end examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	2	Lectures, Assignments, Exercises
PO 3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.	2	Design Exercises
PO 5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.	1	One minute videos
PO 12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.	1	Lectures

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional Skills:** An ability to understand the basic concepts in electronics & communication engineering and to apply them to various areas, like electronics, communications, signal processing, VLSI, embedded systems etc., in the design and implementation of complex systems.	2	Lectures and Seminars
PSO 2	**Problem-Solving Skills:** An ability to solve complex Electronics and communication Engineering problems, using latest hardware and software tools, along with analytical skills to arrive cost effective and appropriate solutions.	-	-
PSO 3	**Successful Career and Entrepreneurship:** An understanding of social awareness & environmental-wisdom along with ethical responsibility to have a successful career and to sustain passion and zeal for real-world applications using optimal resources as an Entrepreneur.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES (COs):

The course should enable the students to:	
I	Understand the basic WSN technology and supporting protocols, with emphasis placed on standardization basic sensor systems and provide a survey of sensor technology.
II	Understand the medium access control protocols and address physical layer issues.
III	Learn key routing protocols for sensor networks and main design issues.
IV	Learn transport layer protocols for sensor networks, and design requirements.
V	Understand the Sensor management, sensor network middleware, operating systems.

IX. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Describe the overview of wireless sensor networks and enabling technologies for wireless sensor networks	CLO 1	Understand the challenges for wireless sensor networks.
		CLO 2	Analyze the characteristic requirements of wireless sensor networks.
		CLO 3	Understand the enabling technologies for wireless sensor networks.
		CLO 4	Understand the Advantages of sensor networks and applications.

COs	Course Outcome	CLOs	Course Learning Outcome
CO 2	Understand the architectures, operating systems, execution environments and network architecture gateway concepts.	CLO 5	Understandthe single-node architecture, hardware components.
		CLO 6	Analyze the energy consumption of sensor nodes.
		CLO 7	Understand the operating systems and execution environments, network architecture.
		CLO 8	Analyze the Network scenarios, optimization goals and figures of merit, gateway concepts.
CO 3	Explore the networking sensors physical layer and transceiver design considerations assignment of MAC addresses.	CLO 9	Illustrate the Physical layer and transceiver design considerations
		CLO 10	Analyze the MAC protocols for wireless sensor networks.
		CLO 11	Understand the mediation device protocol, wakeup radio concepts, address and name management.
CO 4	Understand the infrastructure establishment, topology control and joint routing and information aggregation.	CLO 12	Understand the topology control.
		CLO 13	Analyze the localization and positioning, sensor tasking and control.
		CLO 14	Determine the joint routing and information aggregation.
CO 5	Understand the sensor network platform and tools state-centric programming.	CLO 15	Understand the Sensor node hardware
		CLO 16	Understand the node-level software platforms.
		CLO 17	Understand the state-centric programming.

3 = High; 2 = Medium; 1 = Low

X. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEC526.01	CLO 1	Understand the challenges for wireless sensor networks.	PO 1	2
AEC526.02	CLO 2	Analyze the characteristic requirements of wireless sensor networks.	PO 1	2
AEC526.03	CLO 3	Understand the enabling technologies for wireless sensor networks.	PO 1 PO 5	1

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AEC526.04	CLO 4	Understand the Advantages of sensor networks and applications.	PO 1 PO 5	1
AEC526.05	CLO 5	Understand the single-node architecture, hardware components.	PO 3	3
AEC526.06	CLO 6	Analyze the energy consumption of sensor nodes.	PO 3	1
AEC526.07	CLO 7	Understand the operating systems and execution environments, network architecture.	PO 3	2
AEC526.08	CLO 8	Analyze the Network scenarios, optimization goals and figures of merit, gateway concepts.	PO 1 PO 5	2
AEC526.09	CLO 9	Illustrate the Physical layer and transceiver design considerations	PO 5	1
AEC526.10	CLO 10	Analyze the MAC protocols for wireless sensor networks.	PO 1	3
AEC526.11	CLO 11	Understand the mediation device protocol, wakeup radio concepts, address and name management.	PO 1 PO 12	2
AEC526.12	CLO 12	Understand the topology control.	PO 12	1
AEC526.13	CLO 13	Analyze the localization and positioning, sensor tasking and control.	PO 1 PO 3	2
AEC526.14	CLO 14	Determine the joint routing and information aggregation.	PO 1 PO 3	2
AEC526.15	CLO 15	Understand the Sensor node hardware	PO 3	1
AEC526.16	CLO 16	Understand the node-level software platforms.	PO 3	1
AEC526.17	CLO 17	Understand the state-centric programming.	PO 1 PO 3	2

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XI. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES:

Course Outcomes (COs)	Program Outcomes (POs)				Program Specific Outcomes (PSOs)
	PO 1	PO 3	PO 5	PO 12	PSO 1
CO 1	2			1	2
CO 2	1	3	2	1	1
CO 3	1	1			

Course Outcomes (COs)	Program Outcomes (POs)				Program Specific Outcomes (PSOs)
	PO 1	PO 3	PO 5	PO 12	PSO 1
CO 4		3	1		1
CO 5	2		1	1	2

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XII. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

(CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	2												1		
CLO 2	2												1		
CLO 3	1				1										
CLO 4			2												
CLO 5			3												
CLO 6			1												
CLO 7			2												
CLO 8	2				2								2		
CLO 9					1								1		
CLO 10	3														
CLO 11	2											2	1		
CLO 12												1			
CLO 13	2		2										3		
CLO 14			1												
CLO 15			1										3		
CLO 16	2												1		
CLO 17	2												1		

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XIII. ASSESSMENT METHODOLOGIES–DIRECT:

CIE Exams	PO1, PO3, PO5, PO12, PSO1	SEE Exams	PO1, PO3, PO5, PO12, PSO1	Assignments	PO 1 PO 3	Seminars	PO 1

Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO1, PO3, PO5, PO12, PSO1						

XIV. ASSESSMENT METHODOLOGIES–INDIRECT:

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XV. SYLLABUS:

UNIT - I	OVERVIEW OF WIRELESS SENSOR NETWORKS	Classes: 10
Challenges for wireless sensor networks, characteristic requirements of wireless sensor networks, enabling technologies for wireless sensor networks, advantages of sensor networks, sensor network applications.		
UNIT - II	**ARCHITECTURES**	**Classes: 09**
Single-node architecture, hardware components, energy consumption of sensor nodes, operating systems and execution environments, network architecture, sensor network scenarios, optimization goals and figures of merit, gateway concepts.		
UNIT - III	**NETWORKING SENSORS**	**Classes: 08**
Physical layer and transceiver design considerations, MAC protocols for wireless sensor networks, low duty cycle protocols and wakeup concepts-S-MAC, the mediation device protocol, wakeup radio concepts, address and name management. Assignment of MAC addresses, naming and addressing, routing protocols, energy-efficient routing, geographic routing.		
UNIT - IV	**INFRASTRUCTURE ESTABLISHMENT**	**Classes: 08**
Topology control, clustering, hierarchical networks by clustering time synchronization, localization and positioning, sensor tasking and control, joint routing and information aggregation.		
UNIT - V	**SENSOR NETWORK PLATFORM AND TOOLS**	**Classes: 10**
Sensor node hardware, Berkeley motes, programming challenges, node-level software platforms, node-level simulators, state-centric programming.		

Text Books:

1. Holger Karl, Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 1st Edition, 2005.
2. Sudhakar, Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", Elsevier, 1st Edition 2007.
3. Jun Zheng, Abbas Jamalipour, "Wireless Sensor Networks- A Networking Perspective‖, John Wiley & Sons, 1st Edition, 2009.

Reference Books:

1. Kazem Sohraby, Daniel Minoli, & Taieb Znati, –Wireless Sensor Networks Technology, Protocols, And Applications‖, John Wiley, 1st Edition 2007.
2. Anna Hac, –Wireless Sensor Network Designs‖, John Wiley, 1st Edition 2003.
3. Waltenegus Dargie , Christian Poellabauer, –Fundamentals of Wireless Sensor Networks‖, John Wiley & Sons, 1st Edition, 2010.

XVI. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1-2	Overview of wireless sensor, networks challenges for wireless sensor networks.	CLO 1	T1-4.1-0.2
3-7	Characteristic requirements of wireless sensor networks, enabling technologies for wireless sensor networks.	CLO 2	T1-4.2-4.3
8-10	Advantages of sensor networks, sensor network Applications.	CLO 3	T1-4.3-4.4
11	Introduction to architectures.	CLO 3	T1-4.5-4.6
12-13	Single-node architecture, hardware components.	CLO 3	T1-4.6-4.7
14-16	Energy consumption of sensor nodes, operating systems introduction.	CLO 4	T1-4.7-4.8 R2- 6.8-6.9
17-20	Different types of execution environments, Network architecture and sensor network scenarios.	CLO 5	R2- 6.8-6.9 T2-2.1-2.3
21-23	Networking sensors, physical layer and transceiver design considerations.	CLO 6 CLO 7	T2-2.4-2.5 R2- 6.9-6.10
24-25	MAC protocols for wireless sensor networks, low duty cycle protocols and wakeup concepts-S-MAC	CLO 8	T2-2.5-2.6
26-27	The mediation device protocol, wakeup radio concepts, addresses and name management.	CLO 9	T2-2.6-2.7
28-31	Assignment of MAC addresses, naming and addressing, routing protocols, energy-efficient routing, geographic routing.	CLO 10	T3-2.1-2.3
32-35	infrastructure establishment topology control, clustering, hierarchical networks	CLO 11	T3 – 2.6-2.7 R2- 7.1-7.3
36-37	Introduction to localization and positioning	CLO 11	T1 - 9.4.2-9.4.3
38-40	Sensor tasking and control, joint routing and information aggregation.	CLO 12	T1-9.5-9.7
41-43	Sensor network platform and tools sensor node hardware.	CLO 13	T1-10.1-10.1.1
44-47	Berkeley motes, programming challenges	CLO 14	T1-10.1.1-10.1.2
48-49	Node-level simulators, state-centric programming	CLO 15	T1-7.1-7.3

XVII. GAPS IN THE SYLLABUS - TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S NO	Description	Proposed actions	Relevance with POs	Relevance with PSOs
1	Real time operating system concepts which applicable to advanced systems.	Seminars / NPTEL	PO 1	PSO 1
2	Working Process of Networking Devices	Work Shops/ Laboratory Practices	PO 5	PSO 1
3	Data Communication	Seminars / Guest Lectures / NPTEL	PO 1, PO 3	PSO 1

Prepared by:

Mr. K Chaitanya, Asst Prof., Department of ECE

HOD, ECE