Course Code	18CSE448T	Course Name	ENERGY MANAGEMENT FOR INTERNET OF THINGS DEVICES	Course Category	E	Professional Elective	L	T	P	C
							3	0	0	3

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Computer Science and Engineering	Data Book / Codes/Standards	Nil		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*	**Learning**			**Program Learning Outcomes (PO)**																	
		1	2	3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15			
CLR-1 :	*Understand the rudiments of energy conservation and IoT*	Level of Thinking (Bloom)	Expected Proficiency (%)	Expected Attainment (%)	Disciplinary Knowledge	Critical Thinking	Problem Solving	Analytical Reasoning	Research Skills	Team Work	Scientific Reasoning	Reflective Thinking	Self-Directed Learning	Multicultural Competence	Ethical Reasoning	Community Engagement	ICT Skills	Leadership Skills	Life Long Learning	PSO - 1	PSO - 2	PSO - 3
CLR-2 :	*Gain the knowledge on various energy conservation schemes in IoT*																					
CLR-3 :	*Utilize the conventional and optimization algorithms for conserving energy in IoT devices*																					
CLR-4 :	*Understand the various techniques of green IoT and impact of conventional techniques of IoT*																					
CLR-5 :	*Gain the knowledge on existing energy efficient architecture for energy conservation and harvesting*																					
Course Learning Outcomes (CLO):	*At the end of this course, learners will be able to:*																					
CO-1 :	*Acquire the knowledge on IoT and energy conservation approaches in IoT*	*2*	*85*	*80*	*2*	*1*	*2*	*1*	-	-	-	-	-	-	-	-	*3*	-	*3*	*1*	*1*	*2*
CO-2 :	*Identify and choose appropriate energy conservation component for real world problems*	*2*	*80*	*75*	*2*	*1*	*2*	*1*	-	-	-	-	-	-	-	-	*3*	-	*3*	*1*	*1*	*2*
CO-3 :	*Design and develop energy conservation algorithms for improving the lifetime of IoT devices*	*3*	*80*	*75*	*2*	*3*	*3*	*1*	*3*	*1*	-	-	-	-	-	-	*3*	-	*3*	*1*	*1*	*2*
CO-4 :	*Compare and contrast of various green IoT techniques and able to design green IoT for real world problems*	*2*	*80*	*70*	*2*	*2*	*2*	*1*	-	-	-	-	-	-	-	-	*3*	-	*3*	*1*	*1*	*2*
CO-5 :	*Design and develop energy efficient architecture for real world problems*	*3*	*75*	*70*	*2*	*3*	*3*	*1*	*3*	*1*	-	-	-	-	-		*3*	-	*3*	*1*	*1*	*2*

Duration (hour)		9	**9**	**9**	**9**	**9**
S-1	**SLO-1**	*Introduction to IoT*	*Energy conservation schemes*	*Static energy efficient algorithms*	*Green IoT an Overview*	*Designing energy efficient IoT based Intelligent Transport System*
	SLO-2	*Architecture of IoT*	*Sleep/wakeup scheme*	*Exact allocation algorithm*	*Smart Homes, Smart Cities*	*Intelligent Transport System*
S-2	**SLO-1**	*Components of IoT*	*Data driven scheme*	*Best Fit Heuristic Algorithm*	*Energy Efficient smart health care*	*Motivations for IoT in Transportation*
	SLO-2	*Applications of IoT*	*Mobility based scheme*	*Dynamic energy efficient algorithms*	*Importance of Green IOT*	*Communication Technology and Related Power Issues*
S-3	**SLO-1**	*Challenges in IOT*	*Load balancing*	*Hardware Level Solution*	*Taxonomy of green IoT techniques*	*Information Extraction and Underlying Power Issues*
	SLO-2	*Energy Management in IoT*	*Working of load balancing*	*Dynamic Voltage Frequency Scaling (DVFS)*	*Various Approaches to Achieve Green IoT*	*Energy Efficiency Challenges and Corresponding Solutions, Further Challenges and Opportunities*
S-4	**SLO-1**	*Energy harvesting*	*Hardware based load balancing*	*Software Level Solution*	*software based green IoT techniques*	*Capacity Estimation of Electric Vehicle Aggregator for Ancillary Services*
	SLO-2	*Block diagram of energy harvesting*	*Software Based Load Balancing*	*First Fit Decreasing algorithm (FFD)*	*Hardware based green IoT techniques*	*Development of Electric Vehicles*
S-5	**SLO-1**	*Various ambient energies*	*Compare hardware and software based load balancing techniques*	*Modified Best Fit Decreasing algorithm (MBFD)*	*Policy based techniques*	*Motivation for Vehicle to Everything (V2X) and V2G Technology*
	SLO-2	*Energy harvesting schemes*	*Load balancing algorithms*	*Genetic Algorithm (GA)*	*Awareness based Approach - Toward Green IoT, Energy Awareness*	*Electric Vehicles and Solar Power Plants in Smart Grid Environment*
S-6	**SLO-1**	*Harvesting modules*		*Particle Swarm Optimization (PSO)*	*IoT Based Smart Metering*	*Potential of EV to Grid Connection, Capacity Estimation of Aggregator*
	SLO-2	*Rectenna Model*	*Static Algorithms, Dynamic Algorithms*	*Ant Colony Optimization (ACO)*	*Communication Technology Creating Awareness About Green Information, PromotingRecycling*	*Battery Management System, Grid Connection and Performance Testing of V2G*
S-7	SLO-1	*Sensing antenna*	*Issues of energy conservation in IoT*	*Simulated Annealing (SA)*	*Habitual Based Techniques*	*Weather monitoring using Bluetooth Low Energy (BLE) in warehouses*

	SLO-2	*DC-DC Converter*		*Cat Swarm Optimization(CSO)*	*Comparative analysis of different green IoT approaches*	*BLE Introduction*
S-8	SLO-1	*Wireless energy harvesting*	*Basic model of smart home system*	*Hybrid Genetic Algorithm and Cat Swarm Optimization (HGACSO)*	*Case study: impact of smart phones on the environment in present and future trends*	*BLE importance*
	SLO-2	*Near Field Communication, Inductive coupling*	*Energy Conservation in Smart Home and IoT*	*Hybrid Genetic Algorithm, Particle Swarm Optimization and Simulated annealing(HGAPSOSA)*	*Reduce the environmental impact life cycle assesment of smatphones, smart phone emission and selling rate*	
S-9	SLO-1	*Paradigmatic view of energy efficient IoT*	*Automation and Sensors in Smart Home*	*Comparison of dynamic energy efficient algorithms*	*Promoting the Usage of Sensor Cloud: a step toward green IoT.*	*Design weather monitoring using BLE*
	SLO-2	*Pragmatic energy efficient IoT system architecture*	*Case study: energy conservation component for smart home.*	*Compare and contrast static and dynamic energy efficient algorithms*	*Creating Awareness Through Prototyping: A Green IoT-Based Smart*	

Learning Resources	1. *."EnergyConservationforIoTDevicesConcepts,ParadigmsandSolutions",MamtaMittal,Sudeep Tanwar,BasantAgarwal,LalitMohanGoyal,StudiesinSystems,DecisionandControl 206,2019.* 2. *"IOTprojectswithBluetoothLowEnergy-HarnessthepowerofconnectedthingsMadhur*	3. *1Green IoT: An Investigation on Energy Saving Practices for 2020 and Beyond, Rushan Arshad, Saman Zahoor, Munam Ali Shah , Abdul Wahid, and Hongnian Yu, special section on future networks: architectures,protocols,andapplications,2017.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (50% weightage)								Final Examination (50% weightage)	
		CLA – 1 (10%)		CLA – 2 (15%)		CLA – 3 (15%)		CLA – 4 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	20%	-	15%	-	15%	-	15%	-	15%	-
Level 2	Understand	20%	-	15%	-	15%	-	15%	-	20%	-
Level 3	Apply	45%	-	40%	-	40%	-	20%	-	30%	-
Level 4	Analyze	15%	-	15%	-	15%	-	25%	-	20%	-
Level 5	Evaluate	-	-	15%	-	15%	-	25%	-	15%	-
Level 6	Create	-	-	-	-	-	-	-	-	-	-
	Total	100 %		100 %	100 %	100 %	100 %	100 %		20%	

CLA – 4 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
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