Subject Description Form

Subject Code	EE4014A / EE4014B / EE4014D
Subject Title	Intelligent Systems Applications in Electrical Engineering
Credit Value	3
Level	4
Pre-requisite/ Co-requisite/ Exclusion	Nil
Objectives	To introduce students to the fundamentals of intelligent systems and their applications in Electrical Engineering including electrical power systems, control and utilization.
Subject Intended Learning Outcomes	Upon completion of the subject, students will: a. Have acquired a good understanding of the fundamental concepts and characteristics and methodologies of intelligent systems. b. Be able to appreciate the power and usefulness of intelligent techniques. c. Be able to know the design of artificial intelligence systems, evolutionary computation algorithms, uncertainty representation and reasoning mechanisms. d. Be able to integrate the intelligent system approaches in real-life electrical engineering problems and control problems. e. Have acquired skills in presentation and interpretation of mini-project results and communicate in written form
Subject Synopsis/ Indicative Syllabus	1. ***Knowledge-based intelligent systems*:** Concepts and theory. Knowledge representation techniques. Structure of a rule-based expert system. Forward and backward chaining inference techniques. 2. ***Fuzzy systems*:** Concepts of Fuzzy reasoning. Membership Functions and Fuzzy sets. Fuzzy rules. Defuzzification methods. Fuzzy inference. Building a fuzzy expert system. 3. ***Artificial neural networks (ANN)*:** Concepts of ANN. Neuron and perception. Multilayer neural networks. Forward and Backward Propagation. Neural Network Training. Hopfield network. 4. ***Evolutionary computation*:** Concepts of Evolutionary computing. Genetic algorithms. Chromosomes, fitness function, cross-over and mutation. Evolutionary Programming. 5. ***Hybrid algorithms*:** Simulated Annealing. Combined Genetic Algorithm and Simulated Annealing. Fuzzy Neural Systems. Fuzzy Genetic Algorithm. 6. ***Applications of intelligent systems*:** Applications in Control and Utilization – Intelligent process control. Intelligent robot control and Utilization. **Mini-project:** Performance of intelligent systems including GA, Fuzzy systems and ANN comparing to traditional control system such as PID control **Case study:** To study the performance of genetic algorithm on solving different functions such as De Jong problems and Colville problems. To investigate the effects of parameter setting on the performance of genetic algorithm. To investigate the effect of solution acceleration technique on the performance of genetic algorithm. To apply genetic algorithm to different Electrical Engineering problems.

Teaching/Learning Methodology	Lectures and tutorials are the primary means of conveying the basic concepts and theories. Experiences on system analysis, design and practical applications are given through mini-projects, in which the students are expected to solve the electrical engineering problems using intelligent techniques with critical and analytical thinking. Mini-projects are designed to supplement the lecturing materials so that the students are encouraged to take extra readings and to look for relevant information.

Teaching/Learning Methodology	Outcomes				
	a	b	c	d	e
Lectures	✓	✓	✓	✓	
Tutorials	✓	✓	✓	✓	
Mini-projects		✓			✓

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed				
		a	b	c	d	e
1. Examination	60%	✓	✓	✓		
2. Class Test	20%	✓	✓	✓		
3. Mini-project Report and Presentation	20%	✓			✓	✓
Total	100%					

The outcomes on concepts, design and applications are assessed by the usual means of examination, test, Mini-projects and written report assess those on analytical skills, problem-solving techniques and practical considerations of intelligent technique applications, as well as technical reporting, teamwork and presentation skill.

Student Study Effort Expected		
	Class contact:	
	▪ Lecture/Tutorial	33 Hrs.
	▪ Mini-project presentation	6 Hrs.
	Other student study effort:	
	▪ Mini-project preparation/report	12 Hrs.
	▪ Self-study	45 Hrs.
	Total student study effort	96 Hrs.

Reading List and References

Reference books:

1. K.Y. Lee and M.A. El-Sharkawi, Modern Heuristic Optimization Techniques: Theory and Applications to Power Systems, Wiley-IEEE Press, 2008
2. M. Negnevitsky, Artificial Intelligence-A Guide to Intelligent Systems, Addison-Wesley, 2011
3. K. Warwick, A. Ekwue and R. Aggarwal, Artificial Intelligence Techniques in Power Systems, IEE Power Engineering Series 22, UK, IEE Press, 1997
4. Sunnersj Staffan, Intelligent computer systems in engineering design, SpringerLink ebooks, Springer, 2016
5. Handbook of research on advanced hybrid intelligent techniques and applications, InfoSci-Books, Hershey, PA: Information Science Reference 2016
6. Selected reference papers in IEEE Transactions and IEE Proceedings