Program Structure

Program (Revised in 2015)

1. **Program Title**
   Master of Engineering Program in Electrical and Computer Engineering
2. **Degree Conferred and Major**
   English Title: Master of Engineering (Electrical and Computer Engineering)
   M. Eng. (Electrical and Computer Engineering)
3. **Languages**
   Thai and English.
4. **Philosophy**
   To develop personnel in electrical and computer engineering field who are capable of developing and applying technologies for social, economic, well-being and environmental developments. Moreover, the graduates must be ethical, comply with professional code of conducts, have responsibility for work, and possess skills in communicating and working with international workforce especially from ASEAN region.

   Importance of the Program
   Developing the country to accommodate ever-changing environment is key factor for collaboration in AEC countries while the one who can initiate any development is a person who is specialized in technology especially in the field of electrical and computer engineering upon which modern productions and services are built. Instruction and research in this program, therefore, is required to produce competent researchers and developers as key personnel in Thailand's business and industry sectors.
   1. To produce master degree graduates with full qualifications; having sufficient knowledge to apply it to develop the society and country, being ethical and moral and complying with engineering profession code of conducts.
   2. To produce researchers in electrical and computer engineering field to work with personnel from Thailand and ASEAN industry sector.
   3. To develop engineers who are entrepreneurship-minded and can translate knowledge into business.
   4. To support academic cooperation in sharing knowledge and experiences in instruction and research in national and international levels.

5. **Qualifications of Applicants**
   Eligible applicants must comply with No. 7, Regulation of Thammasat University on Graduate Study of 2010 and must have following qualifications.
   1. Holding bachelor degree or equivalent in electrical engineering, computer engineering, computer science, information technology, industrial education, industrial technology, energy technology or other relevant fields from domestic and overseas institutions which are certified by the University Council.

2. If holding bachelor degree in fields not specified in No. 1, the applicant must have working experiences in electrical engineering, energy, computer, information technology or relevant fields for not less than 2 years.

   An applicant who desires to enter Scheme A1 must have additional qualifications as follows:

   1. Having bachelor degree GPA of not less than 3.00 from 4.00 scale or,
   2. Having working experiences in electrical engineering, energy, computer, information technology or relevant fields for not less than 5 years or,
   3. Having at least 2 articles and over published in academic journals and/or in academic conferences having proceedings. The academic journals and conferences must be accepted by the program committee.

   The applicants desiring to enter Scheme A2 must have additional qualifications as follows:

   1. Having bachelor degree GPA of not less than 2.50 from 4.00 scale. In case the applicant's GPA is less than 2.50, the program committee may consider applicants with outstanding qualifications such as having outstanding academic work or having other qualifications appropriate for this program.

6. Selection of Applicants

1. Applicants must pass written exam and/or interview as defined by regulations of the Faculty of Engineering and Thammasat University.
2. Applicants must submit English proficiency test result as TU-GET or TOEFL or IELTS. The test result's validity period is 2 years until the application closing date.

7. Education Scheme

This program is full-time (day time) which is delivered in Thai and English. All the core courses and some of electives are taught in English for international students. The program is bi-semester having 2 normal compulsory semesters which is First and Second Semesters. A semester contains not less than 15 weeks and there may be summer semester having not less than 8 weeks and additional classes may be added to normal semester. In a necessary case, the faculty may define that summer semester is compulsory semester with approval from the University Council.

8. Graduation Criteria

Scheme A1

1. Gaining accumulated thesis credit of not less than 39.
2. Receiving S (Satisfactory) level in thesis oral exam by committee appointed by dean of the Faculty of Engineering and submitting 2 copies of final version of thesis and electronic full text version to the faculty in the thesis management system to submit to Thammasat University Library as defined by the university regulation.
3. At least two research publications based on the thesis or parts of the work must be published or accepted to publish in academic journal or presented in academic

conferences with proceedings. The academic journals and conferences mentioned above must be accepted by the program committee.

4. Receiving P (Pass) level in foreign language exam as defined by the university's criteria.

Scheme A2

1. Having completed courses in the program structure and have accumulated credits of not less than 39.
2. Having GPA of not less than 3.00.
3. Receiving P (Pass) level in preliminary course, if required by the committee.
4. Receiving S (Satisfactory) level in seminar courses.
5. Receiving P (Pass) level in foreign language exam as defined by the university's criteria.
6. Receiving S (Satisfactory) level in thesis oral exam by committee appointed by dean of the Faculty of Engineering and submitting 2 copies of final version of thesis and electronic full text version to the faculty in the thesis management system to submit to Thammasat University Library as defined by the university regulation.
7. At least one research publication based on the thesis or parts of the work must be published or accepted to publish in academic journal or presented in academic conferences with proceedings. The academic journals and conferences mentioned above must be accepted by the program committee.

9. Program Structure and Components

Scheme A 1 (Completing only thesis)

Thesis	39 credits
Total	39 credits

Scheme A 2 (Studying and completing thesis)

Preliminary Course	3 credits
	(Not counted)
Core Course	15 credits
Electives	6 credits
Thesis	18 credits
Total	39 credits

Thesis or Research Regulations

1. Brief Descriptions

Creation of research project. Research for advanced knowledge in the field of electrical and computer engineering. Thesis writing and presentation. Writing and publishing research report. Ethics in research and publication.

2. Learning Result Standard

Students have systematic process in collecting and analyzing data and developing directions or methods or process or new knowledge bases which are tested, proved and certified true and reliable.

3. Period

3.1 Scheme A1: registration of thesis starts from the first semester of the first educational year until the research completes. The whole study period must not exceed 4 years.

3.2 Scheme A2: registration of thesis starts from the first semester of the second educational year until the research completes. The whole study period must not exceed 4 years.

4. Credits

Scheme A1	39 credits
Scheme A2	18 credits

5. Thesis Regulations

5.1 Thesis

(1) A student of scheme A1 can register the thesis in the first semester and that of scheme A2 can register the thesis after completing at least 2 normal semesters and earning not less than 12 credits; 9 credits from core courses and 3 credits from electives with GPA not less than 3.00.

(2) A student can choose language for thesis between Thai and English.

(3) After registering the thesis, the student must present thesis proposal to the committee appointed by the dean of Faculty of Engineering.

Student Evaluation Criteria

1. Grading Regulations or Criteria

Grading is in compliance with Regulation of Thammasat University on Graduate Study of 2010 as follows:

1.1 Grading is divided into 9 levels with following names and levels per course.

Grade	A	A-	B+	B	B-	C+	C	D	F
Level	4.00	3.67	3.33	3.00	2.67	2.33	2.00	1.00	0.00

1.2 Credits earned shall be counted only for the courses the students get S level or not less than C level. The courses the students get D or F level whether they

are core courses or electives must be included to calculate grade point for such semester and GPA every time.

1.3 Students who receive U level, D level or F level in any core course of the program can re-enroll for another time and the re-enrolled course must get S level or not less than C level, if not, they will be removed from student record.
For courses receiving the level in the first paragraph, if they are electives, students may re-enroll or select other courses to replace them.
For courses receiving the level not less than C level, the student is not entitled to re-enroll except otherwise provided for as other by the program.

1.4 Evaluation of thesis is 2 levels as S (Satisfactory) and U (Unsatisfactory) of which credits are not included in grade point calculation.

1.5 Evaluation of seminar is 2 levels as S (Satisfactory) and U (Unsatisfactory) of which credits are not included in grade point calculation.

1.6 Evaluation of preliminary courses is 2 levels as P (Pass) and N (Not Pass).

1.7 Foreign language test results are P (Pass) and N (Not Pass).

1.8 Other conditions must comply with Regulation of Thammasat University on Graduate Study of 2010.

Course Description

Preliminary course

LE 500 Fundamentals in Electrical Engineering

Electrical circuit analysis. Basic electronic components. Power systems. Basics of information processing. Introduction to telecommunication engineering. Introduction to computer engineering.

Assessment criteria: P (Pass) and N (Not pass).

Required course

LE 600 Research Methodologies for Electrical and Computer Engineering

Meaning and scope of research. Research process consisting of problem definition, literature review, research methodology, interpretation of data, presentation of research results, and writing proposal and report. Ethics in research. Status and trends of research in electrical and computer engineering field.

LE 601 Seminar in Electrical and Computer Engineering I

Seminar on the present research topics in electrical and computer engineering. Participation in seminar events of the Department of Electrical and Computer Engineering. Study of technology and innovation in electrical and computer engineering. Submission of study report.

Assessment criteria: S (Satisfactory) and U (Unsatisfactory).

LE 602 Seminar in Electrical and Computer Engineering II

Seminar on the present research topics in electrical and computer engineering. Literature review of related research articles published in internation journals. Practice of academic presentation. Pratice of writing academic article. Practice of presentation in seminar events of the Department of Electrical and Computer Engineering.

Assessment criteria: S (Satisfactory) and U (Unsatisfactory).

LE 603 Seminar in Electrical and Computer Engineering III

Seminar on the present research topics in electrical and computer engineering. Participation in seminar events of the Department of Electrical and Computer Engineering. Practice of writing research manuscript. Presentation of research works in seminar events.

Assessment criteria: S (Satisfactory) and U (Unsatisfactory).

LE 700 Mathematics for Electrical and Computer Engineering

Algebra systems and algebraic structures. Numerical methods for solving a system of linear equations. Matrix computation. Iterative methods and error analysis. Eigenvalue problems and decomposition. Overview of multivariate calculus. Integral theory. Ordinary and partial differential equations. Application of vector calculus. Analysis of collected data including data collection, categorization, representation and modeling. Descriptive statistics. Variance analysis. Regression model. Probability. Random variables and stochastic processes. Correlation function and spectrum with applications in communications, control, and computer.

LE 701 Computational Tools for Electrical and Computer Engineering

Computational software tools for engineering problems. Data import and manipulation. Vector and matrix calculation. Data visualization in 2D and 3D. Techniques for data analysis. Automating analysis with script and programming. Programming Graphical User Interface. Advance mathematical and numerical techniques for electrical and computer engineering.

LE 702 Optimization for Electrical and Computer Engineering

Optimization in engineering problems. Fundamentals of mathematical programming. Linear programming and its applications. Integer programming. Dynamic programming. Algorithm for solving dynamic programming. Fundamentals and algorithms for global optimization. Software tools for optimization problems.

Selective subjects

LE 704 Selected Topics in Electrical and Computer Engineering I

Topics of current interest and new developments in the field of electrical and computer engineering.

LE 705 Selected Topics in Electrical and Computer Engineering II

Topics of current interest and new developments in the field of electrical and computer engineering.

<u>Electronics major</u>

LE 614 Optics

Wave optics. Introduction to geometrical optics. Linear optical devices. Refraction theory. Gaussian beam theory. Light traveling in multi-level structure. Study of optics using matrix.

LE 615 Optical Communication

Review of optical communication systems. Properties of laser. Characteristics of optical communication. Principles of fiber optics. Light source, modulation and demodulation. Light inventions. Optical communication and its applications.

LE 616 Advanced Optoelectronics

Physics of optical radiation. Interaction between optical radiation and matter. Principles and applications of optoelectronic devices, e.g. sources, detectors, as well as other optical materials, devices, components, and equipment

LE 617 Semiconductor Fabrication Technology

Integrated circuit fabrication technologies: crystal growth, vapor phase epitaxy, liquid phase epitaxy, molecular beam epitaxy, thermal oxidation, thermal diffusion, ion implantation, chemical vapor deposition, metallization, lithography, annealing, assembly and packaging. Future trends.

LE 618 Introduction to Quantum Mechanics

Schrodinger equation. Bound states. Wave packets and uncertainty principles. Scattering of particles by simple barriers. Expectation values and operators. Angular momentum. Hydrogen atom. Expansion principle and matrix formulation. Perturbation theory.

LE 619 Advanced Electromagnetic Field Theory

Maxwell's equations. Constitutive relationships, boundary conditions. Wave equation. Solution of wave equation in multilayer media. Vector potential and electromagnetic from fundamental sources. Theory and concepts in electromagnetic.

Signal processing major

LE 624 Advanced Signal Processing and Applications

Principles of continuous and discrete-time signal analysis. Spectral analysis of both continuous and discrete-time signals. Analog and digital filter design. Fundamentals of time- and frequency-domain analysis. Short-time Fourier transform. Continuous and discrete wavelet transform. Engineering applications.

LE 625 Statistical Signal Processing

Random vectors, sequences, and functions. Linear transformations, second moment theory, spectral densities, correlation detection. Linear minimum mean-square-error estimation.

LE 626 Speech and Natural Language Processing

Review of digital signal processing. MATLAB functionality for speech processing. Fundamentals of speech production and perception. Basic techniques for digital speech processing including short-time energy, magnitude, autocorrelation, short-time Fourier analysis, spectrogram, homomorphic (convolutional) methods, and linear predictive methods. Speech estimation methods including speech/non-speech detection, voiced/unvoiced/non-speech segmentation/classification, pitch detection, formant estimation. Applications of speech signal processing including speech coding, speech synthesis, speech enhancement, and speech recognition/natural language processing.

LE 627 Advanced Pattern Recognition

Computerized pattern analysis and recognition. Decision theory and classification. Parameter estimation and machine learning for parametric and non-parametric approaches. Cluster analysis. Image processing and analysis for pattern recognition. Heuristic methods and syntax learning.

LE 628 Artificial Neural Networks

Concepts in artificial neural networks. Multilayer neural networks and back-propagation. Stochastic neural networks. Supervised and unsupervised learning. Self-organizing maps and vector quantization. Artificial neural network applications

LE 629 Advanced Digital Image Processing and Applications

Computer-based image acquisition and analysis. Development of vision systems for robots. Image generation and recognition. Image segmentation. Edge detection and shape recognition. Pattern recognition. Compression, format and programming using advanced computer vision techniques.

<u>Power system engineering major</u>

LE 634 Power System Modeling

Structure of power systems. Concepts of power system modeling. Dynamic modeling of synchronous machine, transformer, transmission line and load.

LE 635 Power System Engineering

Network equations. Analysis of symmetrical and asymmetrical faults. Power flow analysis. Stability analysis. Control of electrical power systems.

LE 636 Power System Dynamic

State-space method. Linear and nonlinear system analysis. Review of power system models. Governor and excitation control system. Angle and voltage stability. Analysis of small and large disturbances.

LE 637 Advanced Power System Operation

Economic dispatch. Policy-based power generation. Configuration of power system security. State estimation. Optimal power distribution. Power generation control.

LE 638 High-Power Electronic Circuits

High-power switching devices. Multi-phase rectifier. Phase-shifting transformer. Voltage source inverter. Multi-level inverter. Current source converter.

LE 639 Electric Machine Control and Drives

Equations of AC machine. Permanent-magnet AC motor drive. Induction motor drive. Vector control of induction motor drive. Switched reluctance motor drive. Efficiency of electrical drive.

Power system management major

LE 644 Renewable Energy Electrical Power System

Power generation using photovoltaic methods. Types of solar cell. Electrical properties of solar cell. Types and features of battery. Standalone and grid-connected photovoltaic systems. Applications of power electronics for solar energy. Maximum power transfer. Features of wind turbine. Wind turbine's power and energy computation. Applications of power electronics for wind energy.

LE 645 Reliability Assessment of Power Systems

Probaility analysis. Reliability theory. Assessment of power system reliability.

LE 646 Electrical Energy Economics and Planning

Optimal planning and development of limited electrical power. Viewpoints of energy consumption. Management and assessment of electricity demand. Energy efficiency. Energy conservation. Energy and environmental management. Government and private agencies. Ownership. Financial control. Pricing. Plan development for energy suppliers. Transmission line. Sellers and consumers in developing countries.

LE 647 Electricity Supply Industries under Competitive Environments

Generation, transmission and distribution of electricity under competition. Topics include engineering and economical analysis, market status and policy. Operation planning and governmental control.

Computer engineering major

LE 654 Discrete Mathematics

Logic, set and function. Algorithm complexity. Applications of number theory. Mathematical reasoning. Counting, relation, graph, and tree. Algebraic structures. Finite field and computability. Applications in electrical and computer engineering.

LE 655 Advanced Operating Systems

Operating system architecture. Multitasking. Process and thread models. Interprocess communication. Filesystems. Memory management. Hardware and device driver. Security and system protection. Operating system APIs. Design and implementation of operating systems for embedded systems, real-time systems or distributed systems.

LE 656 Design of Embedded Computer Systems

Embedded computer systems. Embedded processor. Firmware architecture. Power management. System communication. Principles of embedded system design. Concepts of hardware/software co-design. Introduction to System-on-Chip design.

LE 657 Data Mining

Topics of data mining including data selection, data processing and data clustering. Examples of practical applications in applied science and computer science. Machine learning topics such as classification, prediction, and clustering.

Computer security major

LE 664 Computer Network Security

Models in computer network security. Cryptographic techniques. Access control for information and systems. Encryption and protocols for network security. Threats of computer systems and networks. Techniques and tools for system protection, e.g. IPsec, Kerberos, PGP, computer network attack, firewall and etc.

LE 665 Cryptography and Computer Security

Applications of communication security theory. Topics including symmetrical and asymmetrical security theory. Proof of system security using reductive proof theory. Measurable security. Types of block ciphers such as AES and DES. Random function. Random number generation. Asymmetric and symmetric encryption. Computational number

theory. RSA and discrete logarithm systems. Information authentication. Electronic signature. Key distribution and key management.

LE 666 Design and Analysis of Cryptographic Protocols

Design and analysis of secure communication protocols including SSH, SSL, TLS. Authentication protocols. Private key exchange protocols. Protocols for anonymity. Design and analysis of simple protocols for specific purpose.

Computer network major

LE 674 Computer Networks and Protocols

Structure of computer networks. Multilayered network architecture. Communication model of TCP/IP. Communication mechanisms in network layers. Protocols on the Application Transport Network Data Link layers. Computer network management.

LE 675 Computer Networks Management

Design of computer networks for small businesses, independent branch office, data centers and cloud computing. Networks for service providers. Switch/router configuration. Network management. Routing protocols. Network management planning. IP management for IPv4 and IPv6.

LE 676 Wireless Networks and Mobile Systems

Wireless local area networks. Communication models: client-server, peer-to-peer and ad hoc. 802.11 and Bluetooth protocols. Medium Access Protocol for wireless local area network (WLAN). Data transmission and routing for MANET. IP and IP protocol for wireless devices. Nomadic wireless services. DHCP protocol. NAT technology. Virtual Private Network (VPN). Applications of TCP protocol in wireless networks. Security of wireless networks and wireless local area network (WLAN). Location-aware and context-aware pervasive computing.

LE 677 Cloud Computing and Virtualization Architectures

Concepts and principles of cloud computing and virtual architecture. Distributed architecture Design principles. Template architecture. Fault-tolerance design. Design for performance computing. Performance and cost metrics. Management of cloud resources. Parallel programming. MapReduce DHT Distributed file system. Case studies and applications in the enterprise architecture.

LE 678 Mobile Ad hoc and Wireless Sensor Networks

Wireless ad hoc and sensor networks. Design, device performance and effects from limitations of ad hoc and sensor networks. Comparison with IEEE 802.11 standard.

Thesis

LE 804 Thesis

Creation of research project. Research for knowledge in the field of electrical and computer engineering. Thesis writing and presentation. Writing and publishing research report. Ethics in research and publication.

LE 805 Thesis

Creation of research project. Research for advanced knowledge in the field of electrical and computer engineering. Thesis writing and presentation. Writing and publishing research report. Ethics in research and publication.