Subject Description Form

Subject Code	ME34002
Subject Title	Engineering Thermodynamics
Credit Value	3
Level	3
Pre-requisite/ Co-requisite/ Exclusion	Pre-requisite: AP10005 Physics I, and AMA2111 Mathematics I Exclusion: ME34001 Engineering Thermodynamics
Objectives	To provide fundamental knowledge of steam and gas power cycles and refrigeration cycle, and air-conditioning, combustion and heat transfer processes.
Intended Learning Outcomes	a. Formulate and solve thermodynamic problems relating to steam power, gas power and refrigeration cycles; and air-conditioning, combustion and heat-transfer processes by applying knowledge in engineering thermodynamics, air-conditioning, combustion, heat-transfer and mathematics. b. Complete a given task such as a design project in thermodynamics by applying knowledge acquired in the subject and information obtained through literature search. c. Analyze and interpret data obtained from experiments in engineering thermodynamics, combustion and heat transfer. d. Present effectively in completing written reports of laboratory work and the given task.
Subject Synopsis/ Indicative Syllabus	***Review of Basic Concepts of Thermodynamics*** - Thermal properties. Ideal gas. First law of thermodynamics. Non-flow and steady-flow processes. Second law of thermodynamics. ***Second Law of Thermodynamics*** - Kelvin-Planck and Clausius statements. Reversible and irreversible processes. Carnot cycle. Thermodynamic temperature scale. Inequality of Clausius. Entropy. The second law for a control mass/control volume. Isentropic efficiency. ***Power and Refrigeration Cycles*** - Vapour cycles: Carnot cycle and Rankine cycle. Superheat and reheat. Air standard engine cycles: Otto cycle and Diesel cycle. Gas turbine cycles. Carnot efficiency. Refrigerator and heat pump. Vapor compression cycle. Coefficient of Performance. ***Psychrometry and Air Conditioning*** - Psychrometry. Psychrometric chart. Introduction to air conditioning. ***Combustion*** - Hydrocarbon fuels. Combustion equations. Stoichiometric air fuel ratio. Lean and rich mixture. ***Review of Fundamental Heat Transfer*** - Mechanisms and governing equations of conduction, convection and radiation. ***Convection Heat Transfer*** - Forced, free and mixed convection. Hydrodynamic and thermal boundary layers. Use of non-dimensional parameters: Reynolds number;

	Nusselt number; Prandtl number; Grashof number and Richardson number. Application of convective heat transfer correlations to solve convective heat transfer problems. **Laboratory Experiment** There are two 2-hour laboratory sessions with the typical experiments: 1. Refrigeration system 2. Diesel engine test-bed 3. Convection heat transfer 4. Combustion
Teaching/Learning Methodology	Lectures are used to deliver the fundamental knowledge in relation to thermodynamics and heat transfer (outcomes a and b). Tutorials are used to illustrate the application of fundamental knowledge to practical situations (outcomes a, b and d). Experiments are used to relate the concepts to practical applications and students are exposed to hand-on experience, proper use of equipment and application of analytical skills on interpreting experimental results (outcomes c and d).

Teaching/Learning Methodology	Outcomes			
	a	b	c	d
Lecture	√	√		
Tutorial	√	√		√
Experiment			√	√

Assessment Methods in Alignment with Intended Learning Outcomes

Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)			
		a	b	c	d
1. Examination	60%	√	√		
2. Tests	20%	√	√		
3. Thermal Design Project	10%	√	√		√
4. Laboratory Work/Reports	10%			√	√
Total	100%				

Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:

Overall Assessment:

$0.6 \times$ End of Subject Examination + $0.4 \times$ Continuous Assessment

Examination is adopted to assess students on the overall understanding and the ability of applying the concepts and knowledge. It is supplemented by the tests (usually two), design project (and report) and laboratory work (and reports) which provide timely feedbacks to both lecturers and students on various topics of the syllabus.

Student Study Effort Expected	Class contact:	
	▪ Lecture	33 Hrs.
	▪ Tutorial / Experiment	6 Hrs.
	Other student study effort:	
	▪ Course work	40 Hrs.
	▪ Self-study and Literature Search	38 Hrs.
	Total student study effort	117 Hrs.
Reading List and References	1. R.E. Sonntag, C. Borgnakke and G.J.V. Wylen, Fundamentals of Thermodynamics, John Wiley and Son, latest edition. 2. T.D. Eastop and A. McConkey, Applied Thermodynamics for Engineering Technologists, Pearson, latest edition. 3. K. Wark, and D. Richards, Thermodynamics, McGraw-Hill, latest edition. 4. K.D. Hagen, Heat Transfer with Applications, Prentice Hall, latest edition. 5. F.D. Incropera, and D.P. Dewitt, Introduction to Heat Transfer, Wiley, latest edition.	

Revised July 2018