University of Macau

Undergraduate Electromechanical Engineering Program

Coordinating Unit:	Department of Mathematics, Faculty of Science and Technology		
Supporting Unit(s):	Nil		
Course Code:	MATH201	Year of Study:	2
Course Title:	Mathematical Analysis IV		
Compulsory/Elective:	Compulsory		
Course Prerequisites:	MATH102 Mathematical Analysis II and MATH200 Mathematical Analysis III		
Prerequisite Knowledge:	The fundamental theories of calculus, e.g., limits, continuity, derivatives, partial derivatives, integrals, series.		
Duration:	One semester	Credit Units:	4
Class/Laboratory Schedule:	Three hours of lecture and two hours of tutorial per week.		
Laboratory/Software Usage:	Nil		
Course Description:	This course aims at preparing students to study their advanced engineering courses. Topics include ordinary differential equations, Laplace transformation, Fourier series & integrals, and complex variable functions.		
Course Objectives:	1. understand the basic knowledge in engineering mathematics. 2. be able to solve some mathematical problems arising in engineering.		
Learning Outcomes (LOs):	Upon completion of this course, students are expected to: 1. be able to solve the ordinary differential equations; [PO: a] 2. be able to compute Laplace transforms and employ it for solving the initial value problems; [PO: a] 3. be able to calculate Fourier series, and understand the Fourier integrals and transforms; [PO: a] 4. understand the concept of analytic functions of one complex variable. [PO: a]		
Texts & References: (* *recommended textbook*(*s*))	1. *Advanced Engineering Mathematics (9th ed.), E. Kreysizig, John Wiley & Sons, 2006.* 2. Advanced Engineering Mathematics (5th ed.), Peter V. O' Neil, Thomson Leaning, 2003.		
Student Assessment:	• Assignments: 15% • Midterm examination: 40% • Final examination: 45%		
Learning Outcome Assessment:	• assignments, midterm and final examinations		

Pedagogical Methods:	☑ Lecture	☐ Service learning
	☐ Guest speakers	☐ Internship
	☐ Case study	☐ Field study
	☐ Role playing	☐ Company visits
	☐ Student presentation	☐ e-learning
	☐ Project	☐ Independent study
	☐ Simulation game	☐ Others: _____
	☑ Exercises and problems	

Major Assessment Methods: For each Major Assessment Method below, please indicate the specific pedagogical methods involved (by putting a ✓ in the relevant box(es) on the right-hand side).	Case Study	Role Playing	Student Presentation	Individual project/paper	Group project/paper	Simulation Game	Exercises & problems	Service learning	Internship	Field Study	Company visits	Written examination	Oral examination	Others (please specify)
Class Participation/ Discussion (0%)														
Assignments (15%)							✓							
Quizzes (0%)														
Midterm Exam (40%)												✓		
Final Exam (45%)												✓		
Others *(please specify)*														
Course Web: (if any)														

Course Content: (topic outline)

Week no.	Topics	Assignment no.	LO no.
1,2	**First order ordinary differential equations** Basic concepts of first order ODEs, separable equations, exact equations with integrating factors, first order linear ODEs	1,2	1
3,4,5	**Second order linear ODEs** Homogeneous linear equations of 2nd order with constant coefficients, Euler-Cauchy equations, Wronskian, nonhomogeneous linear equations of 2nd order, methods of undetermined coefficients	3,4,5	1
6	**Higher order linear ODEs** Higher homogeneous linear equations with constant coefficients, higher order nonhomogeneous linear equations	6	1
7-8	**Complex number and functions** Complex number, complex plane, polar form of complex number, derivative and analytic function, Cauchy-Riemman equations, Laplace's equations, harmonic equations	7,8	4
9	**Midterm examination**		
10-11	**Laplace transforms** Laplace transforms, inverse Laplace transforms, shifting theorem, transformation of derivatives & integrals, solving ODEs by Laplace transforms, convolution, integral equations	9,10	2
12-14	**Fourier series, integrals, and transforms** Fourier series, half range expansions, Fourier series in complex form, Fourier integrals, Fourier transforms	11,12	3
TBA	**Final Examination**		

TBA: To be arranged by the Registry

Contribution to Program Outcomes:	

Program Outcomes	Contribution to POs[#] 5 ----------> 1 Significant Least				
	5	4	3	2	1
(a) apply knowledge of mathematics, science, and engineering	✓				
(b) design and conduct experiments, and analyze data					
(c) design components, systems or processes in presence of constraints					
(d) Function in a multi-disciplinary team					
(e) Engineering problem solving					
(f) Understand professional and ethical responsibility					
(g) Communicate effectively					
(h) Understand the impact of engineering solutions to the society					
(i) Recognize the need and have the ability for lifelong learning					
(j) Have knowledge of contemporary issues					
(k) Apply the skills, techniques, modern engineering tools					
(l) Use the computer/IT tools relevant to the discipline					
# Note 5: Significant contribution; 4: Supporting contribution; 3: Moderate contribution; 2: Marginal support; 1: Least support					

Course Instructor(s):	Prof. Haiwei Sun and Dr. Ieng-Tak Leong

Appendix: **Rubric for the Program Outcome Assessment**

5 (100-80%): Excellent; 3 (80-60%): Average; 1 (<60%): Poor

Rubric for (a)	5 (Excellent)	3 (Average)	1 (Poor)
Understand the theoretic background	Students understand theoretic background and the limitations of the respective applications.	Students have some confusion on some background or do not understand theoretic background completely	Students do not understand the background or do not study at all
Use a correct model and formulation correctly	Students choose a model correctly and properly apply correct techniques	Students choose a wrong model sometime, use a wrong formula, or a different technique	Students use a wrong model and wrong formula, or do not know how to model
Compute the problem correctly	Students use correct techniques, analyze the problems, and compute them correctly	Students sometime solve problem mistakenly using wrong techniques	Students do not know how to solve problems or use wrong techniques completely

Rubric for (b)	5 (Excellent)	3 (Average)	1 (Poor)
Conduct experiments	Student successfully completes the experiment, records the data, analyzes the experiment's main topics, and explains the experiment concisely and well.	Student successfully completes the experiment, records the data, and analyzes the experiment's main topics.	Student either does not complete the experiment successfully, or completes it successfully but does not record the correct data.
Design experiments	Student understands what needs to be tested and designs an appropriate experiment that takes into account the limitations of the equipment and measurement accuracy.	Student understands what needs to be tested and designs an appropriate experiment, but may not fully understand the limitations of the measurements.	Student does not understand what needs to be tested and/or does not design an appropriate experiment.

Rubric for (c)	5 (Excellent)	3 (Average)	1 (Poor)
Design capability and design constraints	Student understands very clearly what needs to be designed and the realistic design constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.	Student understands what needs to be designed and the design constraints, but may not fully understand the limitations of the design constraints	Student does not understand what needs to be designed and the design constraints.
Process to meet desired needs	Student understands very clearly the process of the design	Student understands what the needs of the process design, but may not fully understand the limitations of the design constraints	Student does not understand the process.

Rubric for (d)	5 (Excellent)	3 (Average)	1 (Poor)
Ability to work in teams	Performance on teams is excellent with clear evidence of equal distribution of tasks and effort as well as frequent meetings of the team members.	Performance on teams is acceptable with one or more members carrying a larger amount of the effort as well as infrequent meetings of the members or one or more members being absent from several meetings.	Performance on teams is poor to unacceptable with one or two members clearly carrying the majority of the effort as well as inadequate team meeting or one or more members missing the majority of the meetings.
Multi-disciplinary teams	Team consists of members from two or more different engineering/science/business fields (this could contain some	Team consists of members from two or more concentrations within the Department of Electrical and	Team consists of members from the same concentration within the Department of Electrical and Computer

	members not actually enrolled in the course but interacting as part of a competition, collaboration, etc.)	Computer Engineering	Engineering

Rubric for (e)	5 (Excellent)	3 (Average)	1 (Poor)
Identify applications in engineering systems	Students understand problem and can identify fundamental formulation	Students understand problem but cannot apply formulation, or cannot understand problem	Students cannot identify correct terms for engineering applications
Modeling, problem formulation and problem solving	Students choose and properly apply the correct techniques	Students model correctly but cannot select proper technique, or model incorrectly but solve correctly accordingly	Students at loss as to how to solve a problem

Rubric for (f)	5 (Excellent)	3 (Average)	1 (Poor)
Design	Understand how to critique and analyze design tradeoffs and constraints with respect to safety, liability, and integrity of data, and context of use	Have knowledge of safety, liability, and integrity of data, and context of use but cannot analyze thoroughly	No awareness of importance of safety, liability, and integrity of data, and context of use
Professional Engineering Practice	Understand how to critique and analyze tradeoffs and constraints with respect to research issues of credit and authorship, integrity of data, and informed consent	Have knowledge of credit and authorship, integrity of data, and informed consent but cannot completely identify ownership in practical	No awareness of credit and authorship, integrity of data, and informed consent
Group Relations	Understand how to critique and analyze tradeoffs and constraints with respect to conflict of interest, bribery, professional dissent, authorship, and discrimination	Have partial knowledge of conflict of interest, bribery, professional dissent, authorship, discrimination but cannot apply it in practice correctly	No awareness of conflict of interest, bribery, professional dissent, authorship, and discrimination

Rubric for (g)	5 (Excellent)	3 (Average)	1 (Poor)
Professional Impact	Student's/Team's/Group's document(s)/presentation(s) is/are considered to be of professional quality	Student's/Team's/Group's document(s)/presentation(s) is/are considered acceptable for college level work	Student's/Team's/Group's document(s)/presentation(s) is/are considered unacceptable for college level work
Written Component	Document is nearly error free with sophisticated use of vocabulary, formatted properly, with well developed concise sentences and paragraphs	Document contains some errors with a somewhat colloquial vocabulary, minor formatting issues, with some organizational issues that do not interfere with communication	Document contain many errors, very colloquial vocabulary, with severe organizational issues that interfere with communication. Document would be considered unacceptable.
Oral Component	Presentation is consistent, uniform, clear, direct, complete and captivating with very clear fonts and graphics with an excellent layout that clearly presents the technical content	Presentation is somewhat inconsistent between speakers, occasionally difficult to hear, with an acceptable layout containing acceptable fonts and graphics that adequately presents the technical content	Presentation is very inconsistent between speakers, difficult to hear with a poor layout containing illegible fonts and graphics that poorly presents the technical content. Would be considered unacceptable

Rubric for (h)	5 (Excellent)	3 (Average)	1 (Poor)
Scope of Content	Students will demonstrate material, items, or topics characterized by a sophisticated array of information, insight, and understanding.	Students demonstrate significance reflecting an acceptable degree of perception and thoughts.	Students have limited abilities to relate, incorporate, or demonstrate knowledge of subject with a dynamic breadth.
Impact of Process	Students will employ techniques, designs, ideas, and knowledge demonstrating a profound ability to improve and possess broad applications with a keen a series of actions, changes, or functions	Techniques, designs, ideas, and knowledge present some understanding and ability to demonstrate progression, significance, and influence.	Techniques, designs, ideas, and knowledge present limited progression, significance, and influence

Rubric for (i)	5 (Excellent)	3 (Average)	1 (Poor)
Research/ Gathering Information	Comprehensive collection of information on a subject, including state-of-the-art and background	Collects adequate information on a subject	Collects minimal information on a subject
Analysis/ Evaluation	Detailed analysis accounting for all the information, conclusions are well supported	Some analysis done but somewhat shallow; some supporting evidence	Analysis simply involves restating gathered information; claims not supported by evidence

Rubric for (j)	5 (Excellent)	3 (Average)	1 (Poor)
Relevance to the Present Time	Student displays an understanding of the theoretical or practical impact and an ability to correlate a subject, perception, communication, association and reasoning from a global and societal perspective.	Student is able to display an understanding of current topics and issues with some knowledge regarding their impact in a bigger global and societal sense.	Student has difficulty demonstrating an awareness or familiarity with current topics and issues relevant to most current global and societal affairs.

Rubric for (k)	5 (Excellent)	3 (Average)	1 (Poor)
Use modern software tools in engineering practice	Student uses the software to correctly model and analyze engineering problems, and understands the limitations of the software.	Student uses the software to correctly model and analyze engineering problems.	Student does not use the software correctly and/or does not correctly interpret the results.
Use modern hardware tools in engineering practice	Student uses the hardware to measure and analyze engineering designs correctly, and understands the limitations of the hardware.	Student uses the hardware to measure and analyze engineering designs correctly.	Student does not use the hardware correctly and/or does not correctly interpret the results.

Rubric for (l)	5 (Excellent)	3 (Average)	1 (Poor)
Use computer/I.T. tools relevant to the discipline	Student uses computer/I.T. tools relevant to the engineering discipline, and understands their limitations.	Student uses computer /I.T. tools relevant to the engineering discipline.	Student does not use computer/I.T. tools relevantly, and does not understand their limitations.

-End-