Approved by the Regents
May 18, 2017

PROMOTION RECOMMENDATION
The University of Michigan-Flint
College of Arts and Sciences
Department of Mathematics

Shu-Yi Tu, associate professor of mathematics, with tenure, Department of Mathematics, College of Arts and Sciences, is recommended for promotion to professor of mathematics, with tenure, Department of Mathematics, College of Arts and Sciences.

Academic Degrees:

Ph.D.	1999	University of California, Santa Barbara, California
M.A.	1995	University of California, Santa Barbara, California
B.S.	1993	Tunghai University, Taichung, Taiwan

Professional Record:

2007 – Present	Associate Professor of Mathematics, with tenure, University of Michigan-Flint
2015	Chair, Department of Mathematics, University of Michigan-Flint
2014 – 2015	Visiting Scholar, Tunghai University, Taichung, Taiwan
2012 – 2014	Chair, Department of Mathematics, University of Michigan-Flint
2007 – 2008	Visiting Scholar, Tunghai University, Taichung, Taiwan
2001 – 2007	Assistant Professor of Mathematics, University of Michigan-Flint

Summary of Evaluation:

Teaching – As an applied mathematician, Professor Tu's philosophy embodies a dedication to teaching fundamental concepts, logical reasoning, problem solving, and understanding mathematics. Perhaps more importantly, Professor Tu sets high expectations for students' reading, writing, and critical thinking as these skills are essential in the successful application of disciplinary knowledge within mathematics. Professor Tu's *modus operandi* is to explain the concepts behind the relevant mathematical expressions, provide examples, and model a reasoning process that leads to the correct conclusions. By placing the emphasis of her student-centered pedagogy on the process of mathematical problem solving, Professor Tu ultimately instills within her students both self-esteem and confidence in their ability to succeed. Professor Tu's scholarship in the area of mathematics pedagogy underscores her deep commitment to the assessment of student learning and her willingness to accept the fact that not all individuals are well accommodated by the same methodology. Applied to both her lower-level and upper-division courses, Professor Tu pursues a cooperative approach to learning. In her introductory level courses that must accommodate a wide variety of student needs and capabilities, Professor Tu has her students form groups to discuss the problems and she circulates to hear their concerns and areas of misunderstanding. For her upper-division courses, she emphasizes that the goal of the class is to thoroughly understand the material so that they can apply to real-world problems and applications. Finally, Professor Tu has supervised five undergraduate research projects since her promotion to associate professor and has worked with mathematics students as an academic advisor to both encourage them to think of other

disciplines they are interested in to which they could apply their mathematics skills and to help them align their interests with applicable career plans.

Research – Professor Tu specializes in the areas of undergraduate mathematics and statistics education, statistical applications in material engineering, and security control systems in electrical engineering. Between 2007 and 2010, and then most recently in 2015, Professor Tu's scholarship engaged topics within mathematics pedagogy. In her 2007 paper in *PRIMUS*, Professor Tu and her colleagues provide a new and simpler way to develop the mean value theorem. In her 2008 paper, in the *Proceedings of the American Statistical Association, Section on Statistical Education*, Professor Tu reminds her colleagues of the importance of knowing your student audience and the importance of their placement into mathematics courses. Most recently, Professor Tu and her colleagues have published on the topic of inquiry-based learning of college mathematics in the journal *College Mathematics.* Professor Tu's second area of applied mathematics is in the area of digital watermarking. In her 2013 paper in *Digital Signal Processing*, Professor Tu and her co-authors propose an optimization technique to adjust the quantized wavelet coefficients which allows the embedding and extraction of audio signals in the wavelet domain. Professor Tu and her colleagues demonstrate in their 2014 paper (*Journal of Medical Systems*) how to embed confidential information in a patient's ECG (electrocardiogram) signal and only minimally affecting the ECG signal. Finally, with her 2015 paper in *Sensors*, Professor Tu and her colleagues describe a new method for ECG identification for human beings. Since Professor Tu's promotion in 2007, she has had eight papers published, in four peer-reviewed journals, and four published in refereed conference proceedings. Professor Tu has presented her research at three different international conferences and has been invited by the mathematics departments from two different universities abroad to give a lecture series. Given this record, Professor Tu has clearly established herself within the field of applied mathematics.

Recent and Significant Scholarly Activity:

Peer-Reviewed Journal Articles

Tseng, Kuo-Kun, Huang, Huang-Nan, Zeng, Fufu and Tu, Shu-Yi (2015). "ECG Sensor Card with Evolving RBP Algorithms for Human Verification." *Sensors*, Volume 15, pp. 20730-20751.

Han, Shu-Ping, Lu, Bin, Tu, Shu-Yi and Zhong, Jianyuan (2015). "Inquiry-Based Learning in College Mathematics in the US, Its Past and Present." *College Mathematics*, Volume 31, No. 5, pp. 53-59 (in Chinese).

Chen, Shuo-Tsung, Guo, Yuan-Jie, Huang, Huang-Nan, Kung, Woon-Man, Tseng, Kuo-Kun and Tu, Shu-Yi (2014). "Hiding Patients Confidential Data in the ECG Signal via a Transform-Domain Quantization Scheme." *Journal of Medical Systems*, Volume 38, Issue 6, pp. 54-61.

Chen, Shuo-Tsung, Huang, Huang-Nan, Chen, Chur-Jen, Tseng, Kuo-Kun and Tu, Shu-Yi (2013). "Adaptive Audio Watermarking via the Optimization Point of View on the Wavelet-Based Entropy." *Digital Signal Processing*, 23, pp. 971-980.

Wang, J.T. and Tu, S.Y. (2008). "Who Gets Better Grades in the Introductory Statistics Course?" *2008 Proceedings of the American Statistical Association, Section on Statistical Education*, Alexandria, Virginia, pp. 1747-1750.

Yang, Hansheng, Lu, Bin and Tu, Shu-Yi (2008). "Another Note on the Mean Value Theorem." *PRIMUS*, Volume 18, Issue 2, pp. 215-219.

Conference Presentations

Chen, He, Tseng, Kuo-Kun, Zeng, Fufu, Huang, Huang-Nan and Tu, Shu-Yi (2012). "A New ECG Identification with Neural Network." *HIS 2012 (12th International Conference on Hybrid Intelligent Systems)*, pp 427-430.

Zeng, Fufu, Tseng, Kuo-Kun, Huang, Huang-Nan, Tu, Shu-Yi and Pan, Jeng-Shyang (2012). "A New Statistical-Based Algorithm for ECG Identification." *2012 Intelligent Information Hiding and Multimedia Signal Processing (IIH-MSP), The Eighth International Conference*, pp 301-304

He, Xialong, Tseng, Kuo-Kun, Huang, Huang-Nan, Chen, Shuo-Tsung and Tu, Shu-Yi (2012). "Wavelet-Based Quantization Watermarking for ECG Signals." *Proceeding of 2012 International Conference on Computing Measurement Control and Sensor Network*, pp 233-236.

Chen, He, Zeng, Fufu, Tseng, Kuo-Kun, Huang, Huang-Nan and Tu, Shu-Yi (2012). "ECG Human Identification with Statistical Support Vector Machines." *Proceeding of 2012 International Conference on Computing Measurement Control and Sensor Network*, pp 237-240.

Service – Since her promotion to associate professor in 2007, Professor Tu has established a significant service record by assuming key leadership roles within the university and her professional community. Within the Department of Mathematics, Professor Tu's most visible and substantive position of leadership was her service as the chair from fall 2012 through winter 2014 and again in winter semester 2015. In addition to fulfilling her vitally important duties in writing two- and four-year reviews and contract renewal letters, Professor Tu also led searches for five lecturers, hired two in 2012-2013 and three in 2013-2014. Professor Tu's commitment to assessment and student learning is evidenced by her initiative as chair to meet monthly with the department's lecturers to ensure there was consistency in content coverage in MTH 090 (Intermediate Algebra) and MTH 111 (College Algebra). These meetings also provided Professor Tu with an opportunity to support her lecturers as situations and questions arose.

Within the College of Arts and Sciences, Professor Tu has served on numerous committees since 2007, including the college's Nominating, LEO Major Review, Summer Interim I, Academic Standard Committees and the Committee on Admissions and Scholarships. At the university level, Professor Tu has served on the Committee on Economic Status of the Faculty, the Chancellor's Advisory Committee for Budget and Strategic Planning (as a sabbatical replacement), the DPS Oversight Committee, and the Graduate Board. Professor Tu has also provided her experience and insights to pre-tenured faculty and first-year students through her involvement in the university's Faculty Mentoring Program and the Invest in Your Success programs. For the greater Flint community, Professor Tu has served tirelessly as the director of the Math Field Day for the past nine years, and has worked collaboratively with her colleagues at Mott Community College and the Department of Public Health and Health Sciences at UM-Flint in a National Institute of Health Bridges to Baccalaureate program. Finally, Professor Tu has devoted a significant amount of time and effort providing service and leadership to her profession. Since her promotion to associate professor, Professor Tu has been invited to serve multiple times on the Professional Readiness Examination, Bias Review, and Test Development Committees for the Michigan Test for Teacher Certification (MTTC). In addition to serving as a reviewer for journals and textbooks, Professor Tu has served in 2014 as the international advisory chair for the Second International Conference

on Computing, Measurement, Control, and Sensor Network (CMCSN). In short, Professor Tu has been consistently recruited for leadership and service within her department, college, university, and professional community.

External Reviewers:

Reviewer (A): "Shu-Yi Tu's research output consists of a good combination of more fundamental contributions – for example in journals such as *SIAM Mathematical Analysis* or the *Proceeding of the American Statistical Association* – and applied research, published in venues such as *Digital Signal Processing*, *Sensors*, to name but a few."

Reviewer (B): "[Regarding her publication in *PRIMUS*] I view this paper as a good example of scholarship that contributes to better teaching: a paper such as this one helps our instructors understand their subject more deeply and from new perspectives, thus being better prepared to lead students to better understanding."

Reviewer (C): "Her studies of student performance in an introductory statistics class are particularly appropriate for a teaching-oriented faculty member… Her more recent work on watermarking audio and ECG wave forms is very important and highly innovative."

Reviewer (D): "There are three papers numbered as DigSignProcessing-2013, MedSystem-2014, and Sensors-2015 are quite promising results and all these papers are appeared in very high ranking journals in the field of Signal Processing, medical system, and electrical engineering."

Reviewer (E): "…I would consider that Professor Tu's work on quantization based digital watermark encryption technology to be outstanding based on my experience in vibration signal processing. They proposed a quantization watermarking scheme to embed the watermark into the ECG signal. This method is more imperceptible with a minimum change in the amplitude of the ECG signals. This research provides an efficient and useful scheme for information protection of the ECG signals."

Reviewer (F): "…she has integrated her teaching experience into her research… My overall evaluation of the promotion package of Dr. Tu is that she is intellectually and professionally mature…"

Reviewer (G): "Good Professional and Teaching Experience."

Reviewer (H): "In her paper 'Hiding Patients Confidential Data in ECG Signal Via a Transform-Domain Quantization Scheme,' published in the *Journal of Medical System*, she and her collaborators studied how to embed patient's confidential information in ECG signals through watermarking technology… In my opinion, this is an outstanding work."

Summary of Recommendation:

Professor Tu is an applied mathematician who specializes in the areas of undergraduate mathematics and statistics education, statistical applications in material engineering, and security control systems in electrical engineering. Professor Tu's research in the area of digital watermarking has been published in high impact factor journals and has been characterized important and innovative. Similarly, Professor Tu's work in mathematics pedagogy has appeared in such prestigious publications as the *Proceedings of the American Statistical Association.* Professor Tu also is an accomplished teacher who is dedicated to enhancing student learning through her setting of high expectations for students' reading, writing, and critical thinking as these skills that are essential in the successful application of the disciplinary knowledge within mathematics. Finally, Professor Tu has firmly established a record of visible service at the department, college, university, and community level that displays leadership and breadth. With enthusiasm and great pride, I recommend that Shu-Yi Tu be promoted to professor of mathematics, with tenure, Department of Mathematics, College of Arts and Sciences.

Recommended by:

Susan Gano-Phillips

Susan Gano-Phillips, Dean
College of Arts and Sciences

Recommendation endorsed by:

Douglas G. Knerr, Provost and
Vice Chancellor for Academic Affairs

Susan E. Borrego

Susan E. Borrego, Chancellor
University of Michigan-Flint

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