I. Assessment Outcomes from the Course Syllabus

☒ (A) Ability to apply knowledge of mathematics, science and engineering.
☒ (B) Ability to design and conduct experiments as well as analyze and interpret data.
☒ (C) Ability to design a system, component, or process to meet desired needs.
☐ (D) Ability to function on multidisciplinary teams.
☐ (E) Ability to identify, formulate, and solve engineering problems.
☒ (F) An understanding of professional and ethical responsibility.
☐ (G) Ability to communicate effectively in written and oral formats.
☐ (H) A broad education necessary to understand the impact of engineering solutions in global, economic, and societal context.
☒ (I) Recognize the need for, and have the ability to engage in life long learning.
☒ (J) Have a broad education and knowledge of contemporary issues.
☒ (K) Ability to use techniques, skills and modern engineering tools necessary for engineering practices.

II. List of Course Topics from the Course Syllabus

1. Waves on Transmission Lines
2. Smith Chart.
3. Impedance Matching Networks.
4. S-parameters and Microwave Network Analysis.
5. Signal Flow Graph.
6. Lumped Element RF Filters.
7. Transmission Line Filters.
8. Mixers and Modulators.
9. Noise Figure and Noise Temperature.
11. RF Amplifier Design and Gain Circles.
14. Voltage Controlled Oscillator and Phase Lock Loops.
15. Transceiver Design.

### III. Course Assessment Summary Table: one row of the table should be devoted to each of the checked outcomes in part I.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Topics</th>
<th>Specific Measures (Samples should be available in the course materials file for inspection.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) Ability to apply knowledge of mathematics, science and engineering.</td>
<td>1-15</td>
<td>All exam, homework, lab report</td>
</tr>
<tr>
<td>(B) Ability to design and conduct experiments as well as analyze and interpret data.</td>
<td>6,7,8,11,12,13,14,15</td>
<td>All exam, homework, lab report</td>
</tr>
<tr>
<td>(C) Ability to design a system, component, or process to meet desired needs.</td>
<td>6,7,8,9,10,11,12,13,14,15</td>
<td>All exam, homework, lab report</td>
</tr>
<tr>
<td>(F) An understanding of professional and ethical responsibility.</td>
<td>Professional and ethical responsibility.</td>
<td>Homework, quiz and exam were used to check their ethical responsibility</td>
</tr>
<tr>
<td>(I) Recognize the need for, and have the ability to engage in life long learning.</td>
<td>The need for, and have the ability to engage in life long learning.</td>
<td>Usage of a new circuit design tool, measurement instruments to effectively design and measure circuits after learning cycle</td>
</tr>
<tr>
<td>(J) Have a broad education and knowledge of contemporary issues.</td>
<td>Broad education and knowledge of contemporary issues.</td>
<td>Question and answer session based on the lecture on the topic</td>
</tr>
<tr>
<td>(K) Ability to use techniques, skills and modern engineering tools necessary for engineering practices.</td>
<td>Skills and modern engineering tools necessary for engineering practices.</td>
<td>Circuit design homework and lab components based on the state of the art circuit simulation tool</td>
</tr>
</tbody>
</table>

### IV. Using the table as a guide, for each outcome summarize your evaluation of the students' achievement of that outcome; cite student performance on the identified measures as evidence to support your conclusions.

(A) Ability to apply knowledge of mathematics, science and engineering.  
Most of the homework quizzes and exams measured this ability, so I feel the final grade can be a reasonable measure of this outcome. There were eight (8) “A”, eight (8) “A-”, five (5) “B+”, two (2) “B”, and two (2) “C”, grades. The students did quite well in their application of basic science and math to RF engineering problems. The lab components cover both circuit design and hands-on measurement experience. Most of students were well prepared for following up the lectures, performing lab and solving homework assignments. The students in the class did a good job in applying their knowledge of mathematics, science, and engineering to RF and microwave circuit and system problems. Homework, quizzes and exams were designed for measuring this ability
and the grade showed this class satisfies the requirement of ABET 3(A) which is an ability to apply knowledge of mathematics, science, and engineering.

(B) Ability to design and conduct experiments as well as analyze and interpret data.

EE431 has a laboratory component. My assessment of criteria 3(B) is based on my observations while supervising the labs. About two thirds of the students demonstrated an ability to perform experiments effectively in an laboratory. The rest required some help from TA to perform the measurement and analysis of the measured data. In their lab write-ups, almost all students were able to analyze and interpret the data. I participated in the circuit design and measurement lab with TA to observe these criteria. The lab had circuit design assignments and measurement of RF and microwave components and system. Lab reports after their lab showed that all students clearly understand the purpose of the lab and how they analyze the measured data.

(C) Ability to design a system, component, or process to meet desired needs.

Based on component circuit level study, students were exposed to the system level analysis for overall wireless communication systems such as heterodyne receiver.

My observation of criteria 3(C) is based on homework assignments and lab components to characterize the performance of RF communication components and receiver subsystem. Most of the students could understand wireless communication components, receiver and transmitter architectures. In addition to that, they could understand which components will cause linearity, efficiency and dynamic range problems in the overall receiver system. Lab reports after their lab and homework assignments showed that all students clearly understand the system dynamic range, sensitivity, linearity of overall wireless communication systems. In addition, students could design a simple RF sub components including amplifier, filters, mixers and oscillators for PLL applications. For improving the system and circuit components, students could design better impedance matching and changing the specification of each component in the communication receiver system.

(F) An understanding of professional and ethical responsibility.

It is the responsibility of the instructor to encourage an environment where students can learn and your accomplishments will be rewarded fairly. Any behavior, which compromises the basic rules of academic honesty was not tolerated in the class. Any cheating would result in a failing grade for the course and be reported to the department for appropriate action. Homework, quiz and exam were used to check their ethical responsibility. There was nobody to have the ethical responsibility. This observation can tell the students could understand of professional and ethical responsibility in the class.

(I) Recognize the need for, and have the ability to engage in lifelong learning.

All students in EE431 need to use the state of the art circuit simulation tools and have to use measurement instruments for their lab components. All students are encouraged to learn new simulation tools and lab instruments. Lab TA is assigned to teach students these tools to perform lab and simulation homework assignments. Most of students could recognize the need for, and have the ability to engage in lifelong learning cycle.

(J) Have a broad education and knowledge of contemporary issues.

There was one special lecture this semester. This 50-minute presentation focused on the contemporary issues about business and long-term challenge facing the RF and high speed data communication industry. We may have one guest lecture also in the future by industries. This presentation provide students a broad education and knowledge of contemporary issues.

(K) Ability to use techniques, skills and modern engineering tools necessary for engineering practices.
In a laboratory component and homework assignment, students were required a modern simulation tool such as ADS and CADENCE for their circuit and system simulation. My assessment of criteria 3(K) is based on my observations while grading circuit and system design homeworks. Most of the students demonstrated an ability to use techniques, skills and modern engineering tools necessary for engineering practices. The rest required some help from TA to perform the measurement and analysis of the measurement data. In their lab write-ups, almost all students were able to analyze and interpret the data at some level.

V. Qualitative Assessment of Student Performance: using the arguments above and other data support the claim that students who completed this course with a grade of C or better have achieved each of the intended outcomes of this course.

The class started with 25 students and 25 students took the final examination. Weekly homework assignments and biweekly quizzes were given to students on Friday class and the homework due was the following Friday. This motivated students to attend class and pay attention to the lecture. Three midterm examinations and final examination were given to students in the semester. The attendance in the class was usually more than 95%. There were two 10 hour TAs, one is for the lab and the other one for the lecture. Weekly office hours were assigned to both TAs to help students who might have questions about homework assignments and quizzes. I had open door policy for my office hour instead of having specific time to give students more freedom, which was well appreciated by most of students. I would like to maintain the open door policy for the future. The final examination was used as an assessment tool of student’s performance. The highest score was 99, the average score was 86.52, the lowest score was 75, and the standard deviation was 6.361. This is a visible improvement over Spring 2005, in which the highest score was 97, the average was 77.52, the lowest score was 61, and the standard deviation was 9.71. The instructor believes this result comes from strict prerequisite requirement for this class. Most of students were well prepared for following up the lectures, performing lab and solving homework assignments.

VI. Concerns: state any concerns you may hold about this class – were the students adequately prepared coming into it? Are there topics or outcomes where (some) students were weak after completing the course? Other concerns? Were there any comments on students’ course evaluations that should be addressed in future instances of the course? This section is very important for improving our program; it provides critical input to the curriculum committee for identifying areas requiring attention.

In Spring 2006, students who meet prerequisite requirement have all fundamental concepts for the Smith Chart and Microstrip Line design. However, the instructor still needed to review all fundamentals. It is continuously recommended that homework assignment or topical quiz for the Smith Chart and Microstrip Line within the first two weeks be necessary to equip students with those concepts for EE431 lecture and lab assignments. It is also recommended that more system level simulation and measurement be assigned to help students understand wireless communication systems clearly.

Signature ____________________________________________ Date: ________________________

Please email a copy of the completed form to Patricia Arnold, patricia@eeecs.wsu.edu and deliver a signed hardcopy to her mailbox.