

**ROY G. PERRY COLLEGE OF ENGINEERING
ELECTRICAL & COMPUTER ENGINEERING
DEPARTMENT
PRAIRIE VIEW A&M UNIVERSITY**

ASSESSMENT REPORT

ELEG 4304 ELECTRONICS II

FALL 2021 SEMESTER

NAME OF INSTRUCTOR: Dr. Mohan Ketkar

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Detailed Course Syllabus
(Distributed to Students at the beginning of the Semester)

Course Description in ABET Format

Please use the following format for the course syllabi (2 pages maximum in Times New Roman 12 point font)

1.	Course number and name:	ELEG 4304 ELECTRONICS - II
2.	Credits and contact hours:	3 credit hours; 3 contact hours
3.	Instructor's or course coordinator's name:	Dr. Mohan Ketkar
4.	Textbook: Title:	MICROELECTRONIC CIRCUITS
	Author:	A.S. Sedra and K.C. Smith
	Publisher, Year & Edition:	Oxford University Press, 8 th Edition
	a. Other Supplemental material	1. J.O. Attia, "Circuits and Electronics: Hands-on learning with Analog Discovery" 2. Handouts 3. Electronics Circuits books in the library
5.	Specific course information	
	a. Brief description of the content of the course (catalog description)	Design and analysis of single and multistage amplifiers, difference amplifier, frequency response of amplifiers. Feedback concepts. Analysis and design using discrete and integrated circuits.
	b. Prerequisites or Co-requisites	<u>ELEG 3304 or ELEG3043</u> Minimum Grade of C
	c. *Indicate whether a required, elective, or selected elective (as per definition provided) course in the program	Required
6.	a. Specific goals for the course specific outcomes of instruction (e.g. The student will be able to explain the significance of current research about a particular topic.) <i>Students will be able to:</i>	b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course. <i>The specific goals for the course specific outcomes listed on the left column will address the following student learning outcomes:</i>
	1. Understand the characteristics of operational amplifiers and should be able to design electronic circuits using operational amplifiers	

	2. Understand the operational characteristics of diodes, MOSFETs, and BJTs	
	3. Be conversant with basic electronic circuits such as rectifiers, inverting amplifiers, non-inverting amplifiers, integrators, differentiators, clipping and clamping circuits.	
	4. Recognize and analyze various MOSFET and BJT amplifier circuits	
	5.	
	6. Use PSPICE or MATLAB to solve electronic circuits' problems	
	7.	
	8. Design, construct, test electronic circuit that satisfies multiple constraints	Outcome 2 An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
7	Brief list of topics to be covered	Review of Electronic devices Transistor Amplifiers Building Blocks of Integrated Circuit Amplifiers Differential and Multistage Amplifiers Output Stages and Power Amplifiers Frequency Response of Amplifiers Feedback Amplifiers

***Required** courses are required of all students in the program, **elective** courses (often referred to as open or free electives) are optional for students, and **selected elective** courses are those for which students must take one or more courses from a specified group



SYLLABUS

ELEG 4304 Electronics – II Fall 2021

General Course Information

Information Item	Information
Instructor:	Dr. Mohan Ketkar
Section # and CRN:	ELEG 4304 P01 CRN 17532
Office Location:	NENR 351
Office Phone:	(936) 261-9847
Email Address:	maketkar@pvamu.edu
Office Hours:	1:30 pm – 4:30 pm R, and 9:30 am – 12:00 pm W via prearranged zoom meeting
Mode of Instruction:	Face to face
Course Location:	NENR 137
Class Days & Times:	9:30 am – 10:50 am T R
Catalog Description:	ELEG 4304 Electronics II: 3 semester hours. Design and analysis of single and multistage amplifiers, difference amplifier, frequency response of amplifiers. Feedback concepts. Analysis and design using discrete and integrated circuits.
Prerequisites:	Undergraduate level <u>ELEG 3304 or ELEG 3043</u> Minimum Grade of C
Co-requisites:	
Required Text(s):	A.S. Sedra and K.C. Smith, 'Microelectronic Circuits', 8 th Edition, Oxford University Press
Recommended Text(s):	1. J.O. Attia, "Circuits and Electronics: Hands-on learning with Analog Discovery" 2. Handouts 3. Electronics Circuits books in the library

General Course Information Table

Student Learning Outcomes:

Upon successful completion of this course, students will be able to:	Program Learning Outcome Alignment	Core Curriculum Outcome Alignment
1. understand the characteristics of operational amplifiers and should be able to design electronic circuits using operational amplifiers		
2. understand the operational characteristics of diodes, MOSFETs, and BJTs		
3. be conversant with basic electronic circuits such as rectifiers, inverting amplifiers, non-inverting amplifiers, integrators, differentiators, clipping and clamping circuits		
4. recognize and analyze various MOSFET and BJT amplifier circuits		
5. use PSpice or MATLAB to solve electronic circuits' problems		
6. design, construct, test electronic circuit that satisfies multiple constraints	2	

Student Learning Outcomes Table

ABET PROGRAM OUTCOMES (ABET Criterion 3, Student Outcome 6)

On completion of course the student should have demonstrated an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

ASSIGNMENTS: Problems on the topics discussed in class will be assigned. Assignments should be completed and uploaded on time. Late homework will not be accepted. The completed homework assignments will not be graded but they should be considered as practice sets that will help you to prepare for tests/exams. Solutions to the homework problems will be provided.

COMPUTER APPLICATION PROBLEMS:

There will computer applications problems that will involve the use of the MATLAB and/or MULTISIM/PSPIICE for solving electronics problems.

DESIGN PROJECT:

You will be asked to design an electronic circuit that meets some specifications. You have to select the circuit components, build and test the circuit in the lab (e.g., using Analog Discovery board/development kit). A design project report is also required. The report should include, among other things, the circuit diagram, component values, and design equations, testing methodology, test results and conclusions.

EXAMS/TESTS: There will be three in-class tests and a final examination. Your two highest test scores and the final exam (comprehensive) will count towards the final course grade. The tentative dates for the tests/exams are as follows:

Test #1: Tuesday September 14, 2021*

Test #2: Thursday October 7, 2021*

Test #3: Thursday November 3, 2021*

Final Exam: December 2 – 8, 2021

The dates for the tests* and final exam are subject to change.

Major Course Requirements

Method of Determining Final Course Grade

Course Grade Requirement	Value	Total
1. Class Attendance & Homework (not graded, for practice only)	10	10
2. Course Design Projects / Computer Application Problems	20	20
3. Tests (two best test scores)	20	40
4. Final Exam (Comprehensive)	30	30
Total:		100

Course Grade Requirement Table

Grading Criteria and Conversion:

A = 90 – 100 %

B = 80 – 89 %

C = 70 – 79 %

D = 60 – 69 %

F = 0 – 59 %

Detailed Description of Major Assignments:

Assignment Title	Description
1. Test # 1	Test covering Chapter 7
2. Test # 2	Test covering Chapter 8 and 9
3. Test # 3	Test covering Chapter 9, 12

4.Final Exam	Comprehensive
5.Course Design Project	Based on Chapters 12

Course Procedures or Additional Instructor Policies

Taskstream

Taskstream is a tool that Prairie View A&M University uses for assessment purposes. One of your assignments may be required to be submitted as an "artifact," an item of coursework that serves as evidence that course objectives are met. If applicable, more information will be provided during the semester by your department, but for general information, you can visit Taskstream via the link in eCourses/Canvas.

Semester Calendar	
Week	Description
Week One: Topic Description	Review of Electronic devices, Transistor Amplifiers
Readings:	Chapter 4, 5 and 6. Chapter 7.1
Assignment (s):	
Week Two: Topic Description	Transistor Amplifiers
Readings:	Chapter 7.2, 7.3
Assignment (s):	
Week Three: Topic Description	Transistor Amplifiers
Readings:	Chapter 7.4, 7.5
Assignment (s):	
Week Four: Topic Description	Test # 1 and Building Blocks of Integrated Circuit Amplifiers
Readings:	Chapter 8.1, 8.2
Assignment (s):	
Week Five: Topic Description	Building Blocks of Integrated Circuit Amplifiers
Readings:	Chapter 8.3, 8.4, 8.5
Assignment (s):	
Week Six: Topic Description	Building Blocks of IC Amplifiers and Differential and Multistage Amplifiers
Readings:	Chapter 8.6, 8.7, and 9.1
Assignment (s):	
Week Seven: Topic Description	Differential and Multistage Amplifiers and Test # 2
Readings:	Chapter 9.2, 9.3
Assignment (s):	
Week Eight: Topic Description	Differential and Multistage Amplifiers
Readings:	Chapter 9.4, 9.5, 9.6
Assignment (s):	
Week Nine: Topic Description	Output Stages and Power Amplifiers
Readings:	Chapter 12.1, 12.2, 12.3
Assignment (s):	
Week Ten:	Output Stages and Power Amplifiers

Topic Description	
Readings:	Chapter 12.4, 12.5, 12.6, 12.7
Assignment (s):	
Week Eleven: Topic Description	Test # 3, Computer assignment, and Frequency Response
Readings:	Chapter 10.1, 10.2, 10.3
Assignment (s):	Computer assignment(s) for Taskstream
Week Twelve: Topic Description	Frequency Response
Readings:	Chapter 10.4, 10.5, 10.6, 10.7, 10.8
Assignment (s):	
Week Thirteen: Topic Description	Feedback
Readings:	Chapter 11.1, 11.2, 11.3, 11.4
Assignment (s):	
Week Fourteen: Topic Description	Feedback
Readings:	Chapter 11.5, 11.6, 11.7, 11.8, 11.9, 11.10
Assignment (s):	
Week Fifteen: Topic Description	Review for Final Exam
Readings:	
Assignment (s):	
FINAL EXAM	Comprehensive. Date time according to University Final Exam Schedule

The instructor reserves the right to adjust the syllabus according to lecture progress. NOTE: Scheduling of TESTS may change depending on the progress of the class. At the discretion of the instructor, additional (optional) assignments and or makeup exam may be given for extra credit. The instructor reserves the right to change the grading matrix and/or the grading scale of individual assignments/ tests/make ups based on the continuous class performance.

Student Support and Success

John B. Coleman Library

The John B. Coleman Library's mission is to enhance the scholarly pursuit of knowledge, to foster intellectual curiosity, and to promote life-long learning and research through our innovative services, resources, and cultural programs, which support the Prairie View A&M University's global mission of teaching, service, and research. It maintains library collections and access both on campus, online, and through local agreements to further the educational goals of students and faculty. Website: <https://www.pvamu.edu/library/>; Phone: 936-261-1500

Academic Advising Services

Academic Advising Services offers students a variety of services that contributes to student success and leads towards graduation. We assist students with understanding university policies and procedures that affect academic progress. We support the early alert program to help students get connected to success early in the semester. We help refer students to the appropriate academic support services when they are unsure of the best resource for their needs. Faculty advisors support some students in their respective colleges. Your faculty advisor can be identified in PantherTracks. Advisors with Academic Advising Services are available to all students. We are located across campus. Find your advisor's location by academic major at www.pvamu.edu/advising. Phone: 936-261-5911

The University Tutoring Center

The University Tutoring Center (UTC) offers free tutoring and academic support to all registered PVAMU students. The mission of the UTC is to help provide a solid academic foundation that enables students to become confident, capable, independent learners. Competent and caring staff and peer tutors guide students in identifying, acquiring, and enhancing the knowledge, skills, and attitudes needed to reach their desired goals. Tutoring and academic support are offered face-to-face in the UTC, in virtual face-to-face sessions (<https://www.pvamu.edu/student-success/sass/university-tutoring-center/>), and through online sessions (<https://www.pvamu.edu/pvplace/>). Other support services available for students include Supplemental Instruction, Study Break, Academic Success Workshops, and Algebra Study Jam. Location: J. B. Coleman Library, Rm. 307; Phone: 936-261-1561; Email: pvtutoring@pvamu.edu; Website: <https://www.pvamu.edu/student-success/sass/university-tutoring-center/>

Writing Center

The Writing Center provides well-trained peer tutors to assist students with writing assignments at any stage of the writing process. Tutors help students with various writing tasks from understanding assignments, brainstorming, drafting, revising, editing, researching, and integrating sources. Students have free access to Grammarly online writing assistance. Grammarly is an automated proofreading and plagiarism detection tool. Students must register for Grammarly by using their student email address. In addition, students have access to face-to-face and virtual tutoring services either asynchronously via email or synchronously via Zoom. Location: J. B. Coleman Library, Rm. 209; Phone: 936-261-3724; Website: <https://www.pvamu.edu/student-success/writing-center/>; Grammarly Registration: <https://www.grammarly.com/enterprise/signup>

Academic Early Alert

Academic Early Alert is a proactive system of communication and collaboration between faculty, academic advisors, and PVAMU students that is designed to support student success by promptly identifying issues and allowing for intervention. Academic Early Alerts help students by providing a central location to schedule advising appointments, view advisor contact information, and request assistance. Students who recognize that they have a problem that is negatively affecting their academic performance or ability to continue school may self-refer an Academic Early Alert. To do so, students will log in to PV Place and click on Academic Early Alert on the left sidebar. Phone: 936-261-5902; Website: <https://www.pvamu.edu/student-success/early-alert/>

Student Counseling Services

The Student Counseling Services unit offers a range of services and programs to assist students in maximizing their potential for success: short-term individual, couples, and group counseling, as well as

crisis intervention, outreach, consultation, and referral services. The staff is licensed by the State of Texas and assists students who are dealing with academic skills concerns, situational crises, adjustment problems, and emotional difficulties. Information shared with the staff is treated confidentially and in accordance with Texas State Law. Location: Hobart Taylor, 2nd floor; Phone: 936-261-3564; Website: <https://www.pvamu.edu/healthservices/student-counseling-services/>

Office of Testing Services

Testing Services serves to create opportunities by offering a suite of exams that aid in the students' academic and professional success. Currently, we administer entrance (HESI A2), college readiness (TSI assessment), Prior Learning (CLEP, DSST), and proctored exams. Location: Wilhelmina Delco, 3rd Floor, Rm. 305; Phone: 936-261-3627; Email: aetesting@pvamu.edu; Website: www.pvamu.edu/testing

Office of Diagnostic Testing and Disability Services

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, contact the Office of Disability Services. As a federally-mandated educational support unit, the Office of Disability Services serves as the repository for confidential disability files for faculty, staff, and students. For persons with a disability, the Office develops individualized ADA letters of request for accommodations. Other services include learning style inventories, awareness workshops, accessibility pathways, webinars, computer laboratory with adapted hard and software, adapted furniture, proctoring non-standardized test administrations, ASL interpreters, ALDs, digital recorders, Livescribe, and a comprehensive referral network across campus and the broader community. Location: Hobart Taylor, Rm. 1D128; Phone: 936-261-3583; Website: <https://www.pvamu.edu/disabilityservices/>

Center for Instructional Innovation and Technology Services (CIITS)

Distance Learning, also referred to as Distance Education, is the employment of alternative instructional delivery methods to extend programs and services to persons unable to attend college in the traditional manner. The Center for Instructional Innovation and Technology Services (CIITS) supports student learning through online, hybrid, web-assist, and 2-way video course delivery. For more details and contact information, visit:

<https://www.pvamu.edu/dlearning/distance-learning-2-2/students-2/>; Phone: 936-261-3283

Veteran Affairs

Veterans Services works with student veterans, current military and military dependents to support their transition to the college environment and continued persistence to graduation. The Office coordinates and certifies benefits for both the G.I. Bill and the Texas Hazlewood Act. Location: Evans Hall, Rm. 102; Phone: 936-261-3563; Website: <https://www.pvamu.edu/sa/departments/veteranaffairs/>

Office for Student Engagement

The Office for Student Engagement delivers comprehensive programs and services designed to meet the co-curricular needs of students. The Office implements inclusive and accessible programs and services that enhance student development through exposure to and participation in diverse and relevant social, cultural, intellectual, recreational, community service, leadership development, and campus governance. Location: Memorial Student Center, Rm. 221; Phone: 936-261-1340; Website: <https://www.pvamu.edu/studentengagement/>

Career Services

Career Services supports students through professional development, career readiness, and placement and employment assistance. The Office provides one-on-one career coaching, interview preparation, resume and letter writing, and career exploration workshops and seminars. Services are provided for students at the Northwest Houston Center and College of Nursing in the Medical Center twice a month or on a requested basis. Distance Learning students are encouraged to visit the Career Services website for

information regarding services provided. Location: Anderson Hall, 2nd floor; Phone: 936-261-3570; Website: <https://www.pvamu.edu/careerservices/>

University Rules and Procedures

Academic Misconduct

Academic dishonesty is defined as any form of cheating or dishonesty that has the effect or intent of interfering with any academic exercise or fair evaluation of a student's performance. The college faculty can provide additional information, particularly related to a specific course, laboratory, or assignment.

You are expected to practice academic honesty in every aspect of this course and all other courses. Make sure you are familiar with the *University Administrative Guidelines on Academic Integrity*, which can be found on the [Academic Integrity webpage](#). Students who engage in academic misconduct are subject to university disciplinary procedures. As listed in the *University Administrative Guidelines on Academic Integrity*, the University Online Catalog, and the Student Code of Conduct, the following are examples of prohibited conduct. This list is not designed to be all-inclusive or exhaustive. In addition to academic sanctions, any student found to have committed academic misconduct that is also a violation of criminal law may also be subject to disciplinary review and action by the Office of Student Conduct (as outlined in the Student Code of Conduct).

Forms of Academic Dishonesty:

1. Cheating: Deception in which a student misrepresents that he/she has mastered information on an academic exercise that he/she has not learned, giving or receiving aid unauthorized by the instructor on assignments or examinations. Examples: unauthorized use of notes for a test; using a "cheat sheet" on a quiz or exam; any alteration made on a graded test or exam which is then resubmitted to the teacher;
2. Plagiarism: Careless or deliberate use of the work or the ideas of another; representation of another's work, words, ideas, or data as your own without permission or appropriate acknowledgment. Examples: copying another's paper or answers, failure to identify information or essays from the internet and submitting or representing it as your own; submitting an assignment which has been partially or wholly done by another and claiming it as yours; not properly acknowledging a source which has been summarized or paraphrased in your work; failure to acknowledge the use of another's words with quotation marks;
3. Collusion: When more than one student or person contributes to a piece of work that is submitted as the work of an individual;
4. Conspiracy: Agreeing with one or more persons to commit an act of academic/scholastic dishonesty; and
5. Multiple Submission: Submission of work from one course to satisfy a requirement in another course without explicit permission. Example: using a paper prepared and graded for credit in one course to fulfill a requirement and receive credit in a different course.

Nonacademic Misconduct

The university respects the rights of instructors to teach and students to learn. Maintenance of these rights requires campus conditions that do not impede their exercise. Campus behavior that interferes with either (1) the instructor's ability to conduct the class, (2) the inability of other students to profit from the instructional program, or (3) campus behavior that interferes with the rights of others will not be tolerated. An individual engaging in such disruptive behavior may be subject to disciplinary action. The Office of Student Conduct will adjudicate such incidents under nonacademic procedures.

Sexual Misconduct

Sexual harassment of students and employees at Prairie View A&M University is unacceptable and will not be tolerated. Any member of the university community violating the university's sexual harassment policy will be subject to disciplinary action. In accordance with the Texas A&M University System guidelines, your instructor is obligated to report to the Office of Title IX Compliance (titleixteam@pvamu.edu) any instance of sexual misconduct involving a student, which includes sexual assault, stalking, dating violence, domestic violence, and sexual harassment, about which the instructor becomes aware during this course through writing, discussion, or personal disclosure. The faculty and staff of PVAMU actively strive to provide a learning, working, and living environment that promotes respect that is free from sexual misconduct, discrimination, and all forms of violence. If students, faculty, or staff would like assistance or have questions, they may contact the Title IX Coordinator at 936-261-2144 or titleixteam@pvamu.edu. More information can be found at www.pvamu.edu/titleix, including confidential resources available on campus.

Pregnancy, Pregnancy-related, and Parenting Accommodations

Title IX of the Education Amendments of 1972 prohibits sex discrimination, which includes discrimination based on pregnancy, marital status, or parental status. Students seeking accommodations related to pregnancy, pregnancy-related conditions, or parenting (reasonably immediate postpartum period) are encouraged to contact Student Disability Services or the Dean of Students' Office for additional information and to request accommodations.

Non-Discrimination Statement

Prairie View A&M University does not discriminate on the basis of race, color, sex, religion, national origin, age, disability, genetic information, veteran status, sexual orientation, or gender identity in its programs and activities. The University is committed to supporting students and complying with The Texas A&M University System non-discrimination policy. It seeks to establish an environment that is free of bias, discrimination, and harassment. If you experience an incident of discrimination or harassment, we encourage you to report it. If you would like to speak with someone who may be able to afford you privacy or confidentiality, there are individuals who can meet with you. The Director of Equal Opportunity & Diversity has been designated to handle inquiries regarding the non-discrimination policies and can be reached at Harrington Science Building, Suite 109 or by phone at 936-261-1744 or 1792.

Class Attendance Policy (See the University Online Catalog for Full Attendance Policy)

Prairie View A&M University requires regular class attendance. Attending all classes supports the full academic development of each learner, whether classes are taught with the instructor physically present or via distance learning technologies such as interactive video and/or the internet. Excessive absenteeism, whether excused or unexcused, may result in a student's course grade being reduced or in the assignment of a grade of "F." Absences are accumulated beginning with the first day of class during regular semesters and summer terms. Each faculty member will include the University's attendance policy in each course syllabus.

Student Academic Appeals Process

Authority and responsibility for assigning grades to students rest with the faculty. However, in those instances where students believe that miscommunication, errors, or unfairness of any kind may have adversely affected the instructor's assessment of their academic performance, the student has a right to appeal by the procedure listed in the University Online Catalog and by doing so within thirty days of receiving the grade or experiencing any other problematic academic event that prompted the complaint.

Technical Considerations

Minimum Recommended Hardware and Software:

- Intel PC or Laptop with Windows 10 or later version; Mac with OS High Sierra*
- Smartphone or iPad/Tablet with Wi-Fi*
- High-speed Internet access
- 8 GB Memory

- Hard drive with 320 GB storage space
- 15" monitor, 800x600, color or 16 bit
- Sound card w/speakers
- Microphone and recording software
- Keyboard & mouse
- Most current version of Google Chrome, Safari, or Firefox

Note: Be sure to enable Java & pop-ups in the Web browser preferences

* Smartphones, Google Chrome books, and Android tablets may not be supported. iPads are the only tablets supported.

Participants should have a basic proficiency of the following computer skills:

- Sending and receiving email
- A working knowledge of the Internet
- Microsoft Word (or a program convertible to Word)
- Acrobat PDF Reader
- Windows or Mac OS
- Video conferencing software

Netiquette (online etiquette)

Students are expected to participate in all discussions and virtual classroom chats as directed. Students are to be respectful and courteous to others on discussion boards. Foul or abusive language will not be tolerated. Do not use ALL CAPS for communicating to others AS IT CAN BE INTERPRETED AS YELLING. Avoid slang terms such as "wassup?" and texting abbreviations such as "u" instead of "you." Limit and possibly avoid the use of emoticons. Be cautious when using humor or sarcasm as tone is sometimes lost in an email or discussion post, and the message might be taken seriously or sound offensive.

Video Conferencing Etiquette

When using Zoom, WebEx, or other video conferencing tools, confirm the visible area is tidy, clear of background clutter, inappropriate or offensive posters, and other distractions. Ensure you dress appropriately and avoid using high traffic or noisy areas. Stay muted when you are not speaking and avoid eating/drinking during the session. Before the class session begins, test audio, video, and lighting to alleviate technology issues.

Technical Support

Students should go to <https://mypassword.pvamu.edu/> if they have password issues. The page will provide instructions for resetting passwords and contact information if login issues persist. For other technical questions regarding eCourses, call the Center for Instructional Innovation and Technology Services at 936-261-3283 or email ciits@pvamu.edu.

Communication Expectations and Standards

Emails or discussion postings will receive a response from the instructor, usually in less than 48 hours. Urgent emails should be marked as such. Check regularly for responses.

Discussion Requirement

Online courses often require minimal to no face-to-face meetings. However, conversations about the readings, lectures, materials, and other aspects of the course can occur in a seminar fashion. The use of the discussion board will accomplish this. The instructor will determine the exact use of discussion boards.

It is strongly suggested that students type their discussion postings in a word processing application such as Word and save it to their PC or a removable drive before posting to the discussion board. This is important for two reasons: 1) If for some reason your discussion responses are lost in your online course, you will have another copy; 2) Grammatical errors can be greatly minimized by the use of the spell-and-

grammar check functions in word processing applications. Once the post(s) have been typed and corrected in the word processing application, copy and paste to the discussion board.

COVID-19 Campus Safety Measures [NOTE: Delete this section when the COVID-19 pandemic is over]

To promote public safety and protect students, faculty, and staff during the coronavirus pandemic, PVAMU has adopted policies and practices to limit virus transmission.

- **Self-monitoring** - Students should follow CDC recommendations for self-monitoring. Students who have a fever or exhibit symptoms of COVID-19 should participate in class remotely and should not participate in face-to-face instruction.
- **Face Coverings** - Face coverings (cloth face covering, surgical mask, etc.) are recommended in classrooms, teaching laboratories, common spaces such as lobbies and hallways, public study spaces, libraries, academic resource, and support offices, and outdoor spaces where 6 feet of physical distancing is challenging to maintain reliably.
- **Physical Distancing** - Physical distancing should be maintained between students, instructors, and others in course and course-related activities where possible.
- **Personal Illness and Quarantine** - Students required to quarantine are to participate in courses and course-related activities remotely and must not attend face-to-face course activities. Students should notify their instructors of the quarantine requirement. Students under quarantine are expected to participate in courses and complete graded work unless they have symptoms that are too severe to participate in course activities. Students experiencing personal injury or illness that is too severe for the student to attend class qualify for an excused absence. To receive an excused absence, students must provide appropriate documentation to the Office for Student Conduct, studentconduct@pvamu.edu.

End of Semester Course Assessment Report

This summary contains the following Information

1. Performance Statistics

- **Total number of students in class**
- **The class average performance (stated as %) in each course outcome assessed in this class and the two previous times course was assessed.**
- **The acceptable class average for the class in each outcome area as set by your Department. You cannot use any number of your choice**
- **Percentage of students who scored below the expected average in each outcome.**

2. Implementation Summary

- **Brief summary of plans implemented during the semester based on last assessment report**

3. Perceived Problems

- **Instructor's critical evaluation of perceived problems that affected students' performance. Realistic problems should be identified throughout the semester and summarized in this section of the report.**

4. New Plans for Addressing Problems

- **Instructor's plans for addressing the perceived problems the next time the class is taught. These should be specific enough for another instructor to implement. Most of these should be things that, you, the instructor can implement to help students to improve. Be creative.**

5. Overall Trend over last three assessment periods

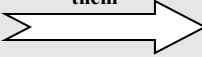
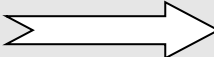
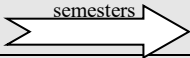
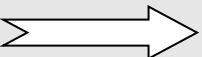
- **Instructor's summary of overall performance trend for each outcome measured over the last three periods.**

5. Were Expectations Met?

Answer YES if the class average was above the expected average and the stated percentage of students scored at or above the expected average, else answer NO.

END OF SEMESTER COURSE OUTCOME ASSESSMENT REPORT
ELEG 4043 ELECTRONICS II
FALL 2021 SEMESTER

Report Prepared by: Dr. Mohan Ketkar
Report Date: December 15, 2021

Semester	Analysis Type	Number of Students	Outcome 2 An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factor.			
			Expected Class Average	Expected Percent of students at or above average	Class Average	% Students meeting Expected Average
Fall 2021	Direct	22	75	70	78.2	86
Fall 2019	Direct	20	75	70	80.3	95
Implementation Summary	Items implemented from previous report or after meeting previous instructor		There is no data from previous year's report since the criteria have changed.			
Perceived Problems	Perceived problems are directly related to the PC and the sub items under them 		This was the semester with face-to-face mode of operation after three semesters of online operation. Major problems were inability to gather relevant information and cite references. The time given for the project completion was little short. Students were unable to complete analysis on software and building and optimizing the performance. Project based on topics from initial chapters will give students enough time.			
Plans for Addressing Problems	Plans for address specific measures to address PC and their sub areas 		All of the plans suggested for the sub-outcomes will address the problems encountered for this outcome.			
Overall Trend over Periods	Ascertain if there were improvements over previous semesters 		Students' performance was above the expected average.			
Were Expectations Met?			YES			

Grade sheet showing student and class performance in outcome

	Student's Name	ABET Outcome '2'
1		90
2		82
3		95
4		82
5		80
6		82
7		75
8		80
9		70
10		90
11		60
12		85
13		90
14		80
15		85
16		80
17		82
18		0
19		84
20		83
21		85
22		80
	Average	78.2
	% Above target of 70	86

**ELECTRICAL & COMPUTER ENGINEERING
OUTCOMES SPECIFIC ASSIGNMENT COVER SHEET**

ELEG4304 ELECTRONICS II

FALL 2021

Instructor: Dr. Mohan Ketkar

Title of Assignment

Design of Class AB Power Amplifier

Outcome Measured Using this Assignment

Outcome 2

An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factor

Check the engineering design characteristics related to this assignment

X	Involves identifying the specific needs to be met by defining/understanding the problem and developing plans for the project to satisfy the need
X	Involves conducting a review of the literature and performing preliminary design by generating alternative ideas/solutions and applying creativity
X	Involves performing detailed engineering design leading to specification and fabrication/selection of components for system being designed.
	Involves consideration of one or more of the following (Please check those involved in this assignment.)
	☐ Public health
	X Safety and welfare
	☐ Global factors
	☐ Cultural factors
	☐ Social factors
	☐ Environmental factors
	X Economic factors
	Involves fabrication and testing of model or prototype

Brief justification of the suitability of assignment for the outcome

Students will select circuit configuration from the various circuits studied and expected performance. Implementation of Safety and protection features are required. Students will design the amplifier to meet given specifications. Utilize circuit simulation to evaluate performance such as power level, distortion, and frequency response. Students will also perform a sensitivity analysis

ELEG 4304 Fall 2021
Course Design Project

In this project you are going to design a Class AB audio power amplifier to meet desired specifications. Once you have designed, you will need to run simulation using MultiSim and optimize your design. You will need to refer to Ch 12 of the text and other references to design your circuit which has additional safety features.

Your project report should include the design, schematics, figures, tables, pictures, simulation results, conclusions, and references. Length of the report should not be less than 12 pages including cover sheet.

You must upload your report on Canvas and Taskstream by November 23rd midnight.

Class AB Audio Power Amplifier specifications:

Design a Class AB Audio Power Amplifier with following specifications. The additional requirements are safety, environmental impact, and economical aspects of your design. Choice of design/selection of parts should include short circuit protection and thermal runaway and minimal impact on environment when parts get recycled.

Power Output: At least 5 Watts in $6.2\ \Omega$ fixed load.

Overall Efficiency greater than 50%

Distortion must be less than 0.5 %

Use dual power supply (e.g., $\pm 6\text{ V}$). Specify the power supply rating you selected.

Transistors available 2N3904, 2N3906, TIP31C, TIP 32C

Op-Amp available LM 741.

Diodes: 1N4001, 1N4148

Sensitivity: Input signal $100\text{ mV}_{\text{RMS}}$ across $10\text{ k}\Omega$ for full output power.

Frequency range: 20 Hz to 20 kHz

Note you may need to use multistage configuration. Search the literature to come with most economical configuration.

Run simulations on your design using MultiSim. Redesign to meet or exceed the expectations.

Present your design with specifications of each component. Please estimate the cost the amplifier based on retail prices of each part.

Extra Credit: To build your design and test. Parts will be made available.

ELEG4304 ELECTRONICS II
FALL 2021

John Barrett

GRADING SCHEME FOR ASSIGNMENT

Item	Points achieved	Maximum Points
1. <i>Design objectives and constraints</i> • Plan of the project • Involve safety and economic features	30	30
2. <i>Literature review and preliminary design</i> • Simulation results	5	5
3. <i>Circuit design</i> • Calculations and simulations • Include safety and economic considerations	15	15
4. <i>Conduct experiments and/or simulation</i> • Collect data to show that your designed circuit meets the design specifications	15	20
5. <i>Analysis and interpretation of results</i> • Present data in tabular form or graphical form. • Use of appropriate statistical method to analyze the results.	15	15
6. <i>Discussion of results and Conclusions</i> • Draw appropriate conclusions	10	10
7. <i>General write-up of report</i> Grammar and adequacy of graphs and figures Proper labeling of graphs and figures Proper references	5	5
8. <i>Composite Grade</i>	95	100

95
100

Excellent Report
Multiple designs to decide
final design

Prairie View A&M College
of Electrical & Computer Engineering



Electronics II

ELEG 4304

Course Design Project ✓

Fall 2021

By: John Barrett ✓

Prof: Mohan Ketkar

Design of a class AB Audio Amplifier

Design Criteria:

Operational Range
Efficiency
Power Delivery
Distortion

20 Hz – 20 kHz
50% or greater
Minimum of 5 Watts to a 6.2 ohm load
Less than 0.5%

The design must also include short circuit protection and thermal runaway prevention.

Parts Available:

Transistors: 2N3904, 2N3906, TIP31C, TIP32C

Op-amps: LM 741

Diodes: 1N4001, 1N4148

Resistors: Any

Thermal Runaway:

Thermal runaway occurs when the heat generated causes electrical parameters to change in such a way that even more heat is produced, leading to a positive feedback loop of heat. To stop thermal runaway in this amplifier circuit two resistors of very low value are placed at the outputs of the power transistors (see figure 1).

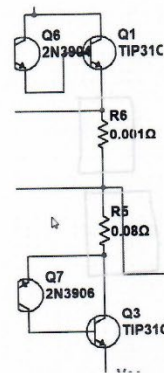


Figure 1:
Thermal Run-
away Preven-
tion Resistors

Short-Circuit Protection:

To protect the circuit in case the output is accidentally short circuited to ground. A voltage sensing transistor is placed across the thermal runaway resistor (see figure 2). This is so that when the large current is drawn during the short circuit scenario a large voltage is then produced between the emitter and the base. This causes the transistor to start conducting which then lowers the current at the base of the darlington pair output. This is essentially acting as a current limiting device.

Protection/Safety

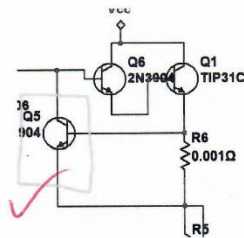


Figure 2: Short-Circuit Protection Transistor

Design 1:

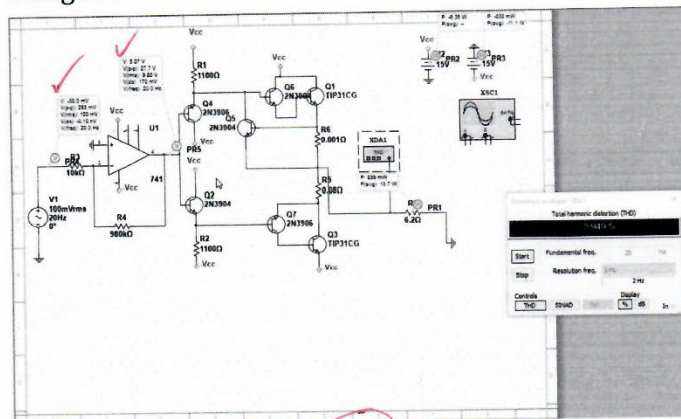


Figure 3: Design 1 Operating at 20 Hz

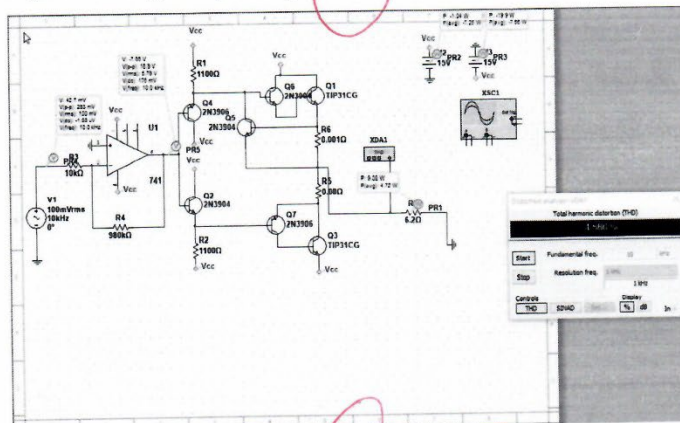


Figure 4: Design 1 Operating at 10 kHz

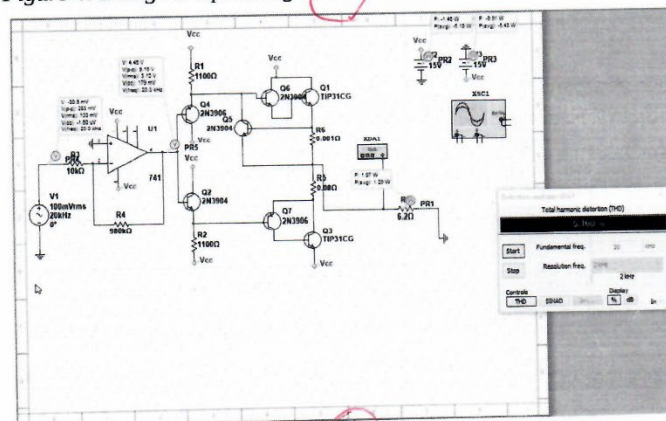


Figure 5: Design 1 Operating at 20 kHz

Results:

Table 1: *Results gathered using a 6.2 ohm load*

Frequency (Hz)	P(supply) (W)	P(load) (W)	Efficiency (%)	Distortion (%)
20	21.7	13.7	63.13	0.949
10k	14.81	4.72	31.87	4.56
20k	10.59	1.29	12.18	5.16

Should have checked for more frequencies

Discussion:

In design 1 the amplifier does not get below 0.949% distortion and then gets more and more distorted as the frequency increases. This same picture of the amplifier getting worse the higher the frequency can also be seen in the efficiency of the amplifier. As the problem seems to get worse the higher the frequency, it points to something not being able to keep up with the higher frequency switching. The most likely culprit is the op-amp. So in design 2 switching the op-amp out with a high speed switching transistor, in a common emitter voltage amplifier form as the pre-amp stage, the 2N3904, will perform better.

Design 2:

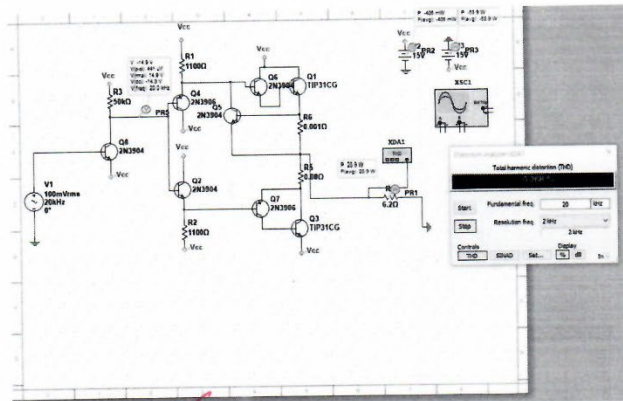


Figure 6: Design 2 Operating at 20 kHz

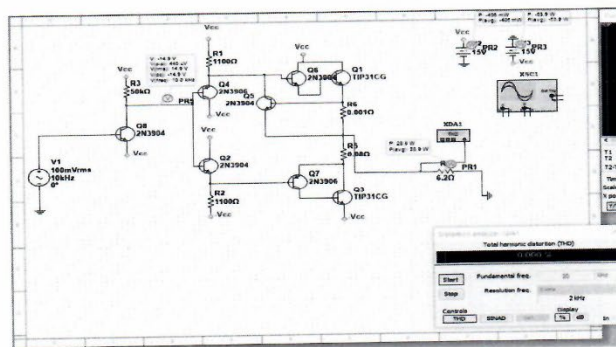


Figure 7: Design 2 Operating at 10 kHz

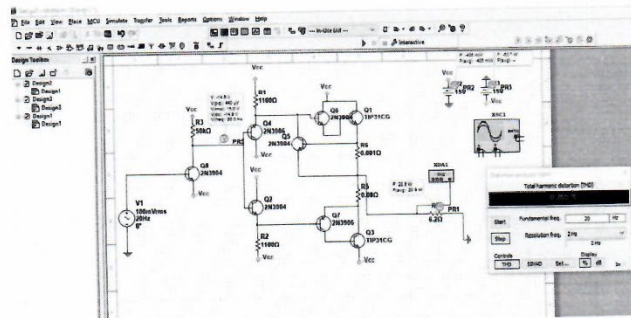


Figure 8: Design 2 Operating at 20 Hz

Results:

Table 2: *Results gathered using a 6.2 ohm load*

Frequency (Hz)	P(supply) (W)	P(load) (W)	Efficiency (%)	Distortion (%)
20	54.306	28.9	53.217	0.265
10k	54.306	28.9	53.217	0.000
20k	54.306	28.9	53.217	0.268

Discussion:

Just changing the op-amp out from design #1, to the 2N3904 high speed switching transistor, improved the overall performance to such a degree that it does not just meet the design minimums but exceeds them in every category. Design #2 delivers almost six times the minimum required power to the 6.2 ohm load. Design #2 maintains a 53% efficiency across the operational range. Design #2 never exceeds a distortion greater than 0.268% over its operational range.

Conclusion:

As predicted the LM 741 was not able to keep up with the high speed switching. Replacing it with the 2N3904 in a common emitter voltage amplifier configuration made the amplifier work as needed. The resistors in the pre-amp stage and the biasing stage are common values, this means they are cheap and easy to get. However the values for the thermal runaway resistors are more uncommon and thus are more expensive. The thermal runaway resistors need to have as small a value as possible so that they do not absorb power that should be going to the load. Therefore, even though they are more expensive they can't really be replaced. The cost of the working design (design 2) comes out to be:

Part	Part #	Number Required	Price per part for order of 100
50 ohm resistor	<u>RC0402JR-0750RL</u>	1	\$0.007
1.1 kohm resistor	<u>ERJ-UP3F1101V</u>	2	\$0.086
1 mohm resistor	<u>PML100HZPJV1L0</u>	1	\$0.575
80 mohm resistor	<u>ERJ-B2CFR082V</u>	1	\$0.20
2N3904	<u>2N3904TF</u>	3	\$0.167
2N3906	<u>2N3906TF</u>	2	\$0.161
TIP31C	<u>TIP31C</u>	2	\$0.489
Total:			\$2.791

Design Methodology:

I took a practical approach to designing this amplifier circuit. Firstly I took the theory such as voltage/power amplification, short circuit protection, thermal runaway prevention methods and laid them out in the order that they would be required. Then I started with an approximate value of the resistors, this gets around where the amplifier needs to be performing. An example would be from design 1 I knew that I needed to start with at least a 62-65x amplification on the pre-amp stage. After getting roughly where you need to be then you start tuning the amplifier by adjusting the resistors until the distortion, power delivery, and efficiency are where you can accept them. This makes the design process less easier as some of the values that are helpful in calculations are not easily obtained from the data sheets available for the parts. An example of this is the current gain on the 2N3904 you must interpolate the approximate value from a logarithmic graph, this is really unhelpful as it is for only one value of I_B .

Sources:

- [1] <https://www.mouser.com/>
Mouser helped me find the prices for the various components so that I could take into consideration the price of each component.
- [2] ON Semiconductor, "General Purpose Transistors," 2N3906 datasheet, Rev. 4, Feb. 2010.
- [3] ON Semiconductor, "General Purpose Transistors," 2N3903 & 2N3904 datasheet, Rev. 9, Aug. 2021.
- [4] STMicroelectronics, "Power Transistors," TIP31C datasheet, Rev. 1, Apr. 2006.
- [5] STMicroelectronics, "Power Transistors," TIP32C datasheet, Rev. 2, Nov 2006.
- [6] National Semiconductor, "Operational Amplifier," LM741 datasheet, Aug 2000.

Very Good references