Wien Bridge Oscillator

It is required to design a Wien Bridge Oscillator with the following specifications:

- Oscillation frequency : programmable in N÷2N [KHz] range;
- Output load impedance (N/5) [kΩ];
- The gain of the internal amplifier is automatically adjusted by using a FET;
- The output amplitude may be adjusted in (0÷((N/5)) [V_{p-p}] range .

,where N is the index from the catalog of each student.

The circuit will be practically implemented on a PCB. There are two options:

a. SMT & PCB technology (maximum points = 100)
b. THD/SMD (perfo-board) technology (maximum points = 80)

a. For SMT & PCB technology, the following requirements should be met:

- PCB dimmensions: 40mm x 40mm;
- Board is double sided, FR4, copper width 35 μm, board width 1,6mm;
- All components are placed on the TOP side;
- It will be used only SMD passive components from 0805 series;
- It will be used only SMD FET, MOSFET and bipolar transistors (SOT-23, D-PAK cases)
- Circular test points (maximum 5) – justified by the test plan
- The interconnection structure may contain 0Ω resistors SMD1206, the maximum number of 0 ohms resistors is 5;
- The origin (0,0) is placed in the bottom left corner of the PCB, all coordinates have positive values;
- A clearance of 50 mil will be kept from the margins of the board;
- The silkscreen should not appear on the pads of the components;
- A mechanical layer will be generated. This will contain the board outline, the drill drawing, the drill chart/table, drill legend, the layer stack-up and mechanical information for PCB manufacturing.
- The dimension quotes of the PCB shouldn't appear on the TOP side. If these quotes exist, they should appear on a non-electrical mechanical layer;
- The board will be provided with identification information about the designer (Last Name, First Name, Group, PDCE I 2016-2017).

The Gerber files-274x standard should contain the following informations:

- board outline;
- electrical layer TOP;
- electrical layer BOTTOM;
- non-electrical layer Silk Screen Top;
- non-electrical layer Solder Mask Top;
- non-electrical layer Solder Paste Top;
- the aperture list and the drilling file

The following widths are recommendend for the routing layers:

- 1A current – 40 mils;
- Few hundreds mA currents - 32 mils;
- Signal - 20 mils
- Spacing 12 mils.
- The via hole diameter is 0.4mm

The OrCAD program – Lite version (available for download http://www.cetti.ro/v2/orcad16.php) with imposed limitations will be used for circuit simulation and layout design.

The components which may be used for the project are listed in Annex 1.

Deadlines:

1. Examination - max. 60 pct.

Until the end of the Vth week will be accomplished:

- Analytical calculation and the simmulations of the chosen circuit diagram.

Until the end of the VIIth week will be accomplished:

- The Gerber files for the layout (274x standard)
- Bill of Materials (BOM) file.

If the above requests are fully met with no deadline extension, a mark of maximum 60 points will be granted. If the requests are not fully met, the student will not qualify for practical design – in this situation the final mark for Project 1 will be lower than 6.

2. Final examination - max. 40 pts.

It will be accomplished in the last 2 weeks of the semester. The project in final form will be delivered (paper form and electronic form, on a CD – containing the document, calculations and simulations). The practical design remains in the faculty property.

b. For THD/SMD (perfo-board) technology (maximum points = 80), the following requirements should be accomplished:

Deadlines:

1. Examination - max. 60 pct.

Until the end of the VIIth week will be accomplished:

- Analytical calculation and the simmulations of the chosen circuit diagram.

Until the end of the VIIIth week will be accomplished:

- Bill of Materials (BOM) file.

If the above requests are fully met with no deadline extension, a mark of maximum 60 points will be granted. If the requests are not fully met, the student will not qualify for practical design – in this situation the final mark for Project 1 will be lower than 6.

2. Final examination - max. 20 pts.

It will be accomplished in the last 2 weeks of the semester. The project in final form will be delivered (paper form and electronic form, on a CD – containing the document, calculations and simulations). The practical design remains in the faculty property.

The minimal content of the project (if one of the requirements 1-3 are not fulfilled, the student will not pass the exam!):

1. The block diagram of the circuit

2. The detailed schematic diagram and the calculations for each functional block and each component.

- *The passive components will have standard values*
- *The semiconductor parameters will not exceed the values from the datasheets*
- *The choice of a certain component will be justified by calculation*
- *It will be demonstrate a reliable operation for each component. (for example, for a bipolar transistor it will be justified that the maximum absolute values from the datasheet are not reached - I_{CMAX}, V_{CEMAX}, P_{dMAX},)*
- *The calculus should demonstrate that the imposed specifications of the design are fulfilled.*

3. PSPICE simulations (.CIR files, the waveforms, bias points, etc.)

4. PCB Layout (including all layers).

5. The TOP image of the designed PCB.

6. The BOTTOM image of the designed PCB.

7. The Silk screen TOP layer;

8. The Solder Mask TOP layer;

9. The Solder Paste TOP layer.

10. The mechanical layer.

11. Experimental results and measurements.

12. A chapter which includes a short form of a user manual for the designed circuit for potential customers.

13. Power Point presentation of the Project (10 minutea)

Bibliography:

1. P. R. Gray, P. J Hurst, S. H. Lewis, R. G. Meyer, *Analysis and Design of Analog Integrated Circuits*, J. Wiley & Sons, 2001.

2. A. M. Manolescu, A. Manolescu, *Analog Integrated Circuits*, Ed. Electronica 2000, Bucureşti, 2011.
3. D. Self , *Audio Power Amplifier Design Handbook*, Fourth edition, Newnes, 2006.
4. G. A. Rincon-Mora, *Voltage References – from Diodes to Precision High-Order Bandgap Circuits*, John Wiley, 2001.
5. **L. Teodorescu**, http://wiki.dcae.pub.ro/images/3/34/Signal_generator.pdfhttp://wiki.dcae.pub.ro/index.php/Project_1_-_Electronic_Devices_and_Circuits
6. **L. Teodorescu**, http://wiki.dcae.pub.ro/images/7/79/Linear_regulator.pdf
7. **L. Teodorescu**, Project 1 - Electronic Devices and Circuits, http://wiki.dcae.pub.ro/index.php/Project_1_-_Electronic_Devices_and_Circuits
8. T.L. Floyd, *Electronic Devices- Electron Flow Version*, 9th edition, Prentice Hall, 2012;
9. C.G. Fonstad, *Microelectronic Devices and Circuits*, McGraw-Hill, 1994
10. B. Razavi, *Fundamentals of Microelectronics*, 2nd edition, Wiley Global Education, 2013