EEE473 - Microwave Sources

Course Code	Course Name	Semester	
EEE473	Microwave Sources	Fall ☐ Spring ☒ Summer ☐	
Hours		**Credit**	**ECTS**
Theory	**Practice** / **Lab**	0	7
3	0 / 0		

Course Details	
Department	Electrical and Electronics Engineering
Course Language	English
Course Level	Undergraduate ☐ Graduate ☒
Mode of Delivery	Face to Face ☒ Online ☐ Hybrid ☐
Course Type	Compulsory ☐ Elective ☒
Lecturer(s)	Prof. Dr. Volodymyr Yurchenko
Course Objectives	The objective is to introduce the students to physics and operation principles of typical microwave and millimeter wave radiation sources.
Course Content	The course explains physics, design, and operation of basic microwave and millimeter wave sources including klystrons, traveling wave tubes (TWT), backward wave oscillators (BWO), magnetrons, gyrotrons, Gunn and IMPATT diodes, microwave transistors, and THz devices.
Course Method/ Techniques	Lecture ☒ Question & Answer ☒ Presentation ☐ Discussion ☐
Prerequisites/	PHYS102, PHYS205, EEE224, EEE305

Corequisites	
Work Placement(s)	Room 826

Textbook/References/Materials

- [1] A. D. Grigoriev, V. A. Ivanov, S. I. Molokovsky, *Microwave Electronics*, Springer, 2018, 554 pp.
- [2] A. S. Gilmour, *Klystrons, Traveling Wave Tubes, Magnetrons, Crossed-Field Amplifiers, and Gyrotrons*. Boston, MA: Artech House Inc, 2011, 883 pp.
- [3] T. G. Roer, *Microwave Electronic Devices*. Microwave Technology Series. Springer US, 1994, 340 pp. doi: 10.1007/978-1-4615-2500-4
- [4] N. C. Luhmann, *Modern Microwave and Millimeter-Wave Power Electronics*, in ed. by N. C. Luhmann, J. H. Booske, R. J. Barker. Wiley, 2005, 872 pp.
- [5] R. A. Lewis, *Terahertz Physics*, Cambridge Univ. Press, UK, 2012, 275 pp.

Course Category				
Mathematics and Basic Sciences	☐		Education	☒
Engineering	☒		Science	☐
Engineering Design	☒		Health	☐
Social Sciences	☐		Profession	☐

Weekly Schedule

No	Topics	Materials/Notes
1	Motion of Charge Particles in an Electromagnetic Field	[1] Ch. 1 - 3, [2] Ch. 2 - 4
2	Coupling of Electron Beams with Electromagnetic Fields	[1] Ch. 4 - 5, [2] Ch. 2 - 4
3	Microwave Devices with Quasi-Static Control	[1] Ch. 6, [2] Ch. 5 - 9
4	O-type Microwave Devices. Klystrons	[1] Ch. 7.1-7.2, [2] Ch. 10 - 11
5	Travelling Wave Tubes and Backward-Wave Oscillators	[1] Ch. 7.3-7.5, [2] Ch. 12 - 15
6	M-type Microwave Electron Devices. M-type TWT and BWO	[1] Ch. 8.1-8.3, [2] Ch. 16 - 18
7	M-type Microwave Devices. Multi-Cavity Magnetron	[1] Ch. 8.4, [2] Ch. 19, [3] Ch. 2
8	Midterm Exam	
9	Gyro-Resonant Devices	[1] Ch. 9, [2] Ch. 21 - 22
10	Relativistic Microwave Devices	[1] Ch. 10, [2] Ch. 19.10.8
11	Semiconductor Microwave Devices. Operation Principles	[1] Ch. 11, [3] Ch. 3 - 4
12	Diodes with Positive Dynamic Resistance	[1] Ch. 12, [3] Ch. 5, 10
13	Diodes with Negative Dynamic Resistance	[1] Ch. 13, [3] Ch. 5, 10
14	Microwave Transistors	[1] Ch. 14, [3] Ch. 6, 10
15	Terahertz Sources	[4]
16	Final Exam	

Assessment Methods and Criteria		
In-term studies	**Quantity**	**Percentage**
Attendance		
Lab		
Practice		
Fieldwork		
Course-specific internship		
Quiz/Studio/Criticize		
Homework	2	10
Presentation / Seminar		
Project	1	20
Report		
Seminar		
Midterm Exam	1	10
Final Exam	1	60
	Total	**100%**
Contribution of Midterm Studies to Success Grade		40
Contribution of End of Semester Studies to Success Grade		60
	Total	**100%**

ECTS Allocated Based on Student Workload			
Activities	**Quantity**	**Duration (Hrs)**	**Total Workload**
Course Hours	16	3	48
Lab			
Practice			
Fieldwork			
Course-specific Work Placement			
Out-of-class study time	14	6	84
Quiz/Studio/Criticize			
Homework	2	6	12
Presentation / Seminar			
Project	1	41	26
Report			
Midterm Exam and Preparation for Midterm	1	20	20
Final Exam and Preparation for Final Exam	1	20	20
Total Workload			**210**
Total Workload / 30			**7**
ECTS Credit			**7**

Course Learning Outcomes	
No	**Outcome**
L1	Knowledge of physical effects which produce microwave radiation
L2	Knowledge of design and operation principles of vacuum electronic microwave sources
L3	Knowledge of operation principles and characteristics of solid-state microwave oscillators
L4	Knowledge of application areas and operation parameters of microwave radiation sources
L5	Ability to follow new developments in microwave technology, creative way of thinking

Contribution of Course Learning Outcomes to Program Competencies/Outcomes

Contribution Level: 1: Very Slight, 2: Slight, 3: Moderate, 4: Significant, 5: Very Significant

	P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**	**P8**	**P9**	**P10**	**P11**					**Total**
L1	5	5	4	3	4	4	5	5	4	3	2					-
L2	5	5	4	3	4	4	4	4	4	3	2					-
L3	5	5	4	4	4	4	4	4	3	2	1					-
L4	5	5	4	4	4	4	4	4	3	2	1					-
L5	5	5	5	5	5	4	5	5	3	2	1					-
															Total	-

i. Sufficient knowledge in the fields of mathematics, natural sciences, and related engineering disciplines; the ability to apply theoretical and practical knowledge in solving complex engineering problems.

ii. The ability to identify, formulate, and solve complex engineering problems; the ability to select and apply appropriate analysis and modeling methods for this purpose.

iii. The ability to design a complex system, process, device, or product to meet specific requirements under realistic constraints and conditions; the ability to apply modern design methods for this purpose.

iv. The ability to select and use modern techniques and tools required for the analysis and solution of complex problems encountered in engineering applications; the ability to effectively use information technologies.

v. The ability to design experiments, conduct experiments, collect data, analyze results, and interpret findings for the investigation of complex engineering problems or discipline-specific research topics.

vi. The ability to work effectively in intra-disciplinary and multidisciplinary teams; the ability to work independently.

vii. The ability to communicate effectively both orally and in writing; proficiency in at least one foreign language; the ability to write effective reports, understand written reports, prepare design and production reports, make effective presentations, and give and receive clear and understandable instructions.

viii. Awareness of the necessity of lifelong learning; the ability to access information, track developments in science and technology, and continuously renew oneself.

ix. Acting in accordance with ethical principles, knowledge of professional and ethical responsibilities, and the standards used in engineering applications.

x. Knowledge of business practices such as project management, risk management, and change management; awareness of entrepreneurship and innovation; knowledge of sustainable development.

xi. Knowledge of the impact of engineering practices on health, environment, and safety at global and societal levels, and awareness of contemporary engineering issues; awareness of the legal consequences of engineering solutions.