MODULE DESCRIPTION FORM

Module Information					
Module Title	**Laser Physics**			**Module Delivery**	
Module Type	**Core**			☑ Theory ☑ Lecture ☑ Lab ☐ Tutorial ☐ Practical ☐ Seminar	
Module Code	**LAER222**				
ECTS Credits	5				
SWL (hr/sem)	**125 H/Sem.**				
Module Level	2		**Semester of Delivery**	4	
Administering Department	Laser and optoelectronics Eng.		**College**	College of Engineering	
Module Leader	Zina kareem H		**e-mail**	zina.kareem@alayen.edu.iq	
Module Leader's Acad. Title	Asst. lec		**Module Leader's Qualification**	Msc	
Module Tutor	Bilal Majeed Kadhim		**e-mail**	Bilal.Majeed@alayen.edu.iq	
Peer Reviewer Name			**e-mail**		
Scientific Committee Approval Date			**Version Number**	1.0	

Module Aims, Learning Outcomes and Indicative Contents	
Module Objectives	**Understand laser resonator structures and stability criteria.** **Analyze laser gain, losses and threshold condition.** **Study spectral line width and broadening mechanisms.** **Evaluate methods of reducing laser bandwidth and achieving single mode operation.** **Analyze continuous and pulsed laser outputs and calculate related parameters.** **Study different types of lasers and their operating principles.**

Module Learning Outcomes	Knowledge	A2	A2.1 Define basic components of laser systems and resonator types. A2.2 Explain Fabry–Perot resonator and stability condition ($0 \leq g_1g_2 \leq 1$). A2.3 Derive laser oscillation and threshold gain condition. A2.4 Describe homogeneous and inhomogeneous broadening mechanisms. A2.5 Explain techniques for bandwidth reduction and single mode lasers. A2.6 Classify types of lasers (solid-state, gas, semiconductor, fiber, dye, free-electron).
		A3	A3.1 Analyze gain, losses and loop gain mathematically. A3.2 Calculate Doppler linewidth and collision broadening. A3.3 Compute peak power, average power, duty cycle, fluence and intensity.
	skills	B1	B.1.1 Function efficiently as an individual B.1.2 Function as a member of multidisciplinary and multicultural teams.
	Ethics	C1	C.1.1 Define professional and ethical responsibilities C.1.2 Demonstrate diversity in their commitment to ethical responsibilities.
Indicative Contents	Part A – Laser Resonators ,Basic components of laser system ,Optical resonators and cavity geometry ,Fabry–Perot resonator ,Stability condition (g_1g_2 criterion). Part B – Laser Oscillation ,Gain and losses ,Loop gain ,Threshold condition ,Power emitted by laser. Part C – Spectral Linewidth ,Spectral width (FWHM) ,Homogeneous broadening (collision, natural) ,Inhomogeneous broadening (Doppler) ,Critical population inversion. Part D – Bandwidth Reduction & Single Mode ,Cavity length reduction, Prism, grating, birefringent filter ,Etalon and single mode laser.		

	Part E – Laser Output ,Continuous wave (CW) lasers ,Pulsed lasers ,Peak power, average power ,Duty cycle, fluence, intensity. Part F – Types of Lasers ,Solid-state lasers (Ruby, Nd:YAG, Ti:Sapphire) ,Gas lasers (He–Ne, CO_2, Argon-ion) ,Semiconductor lasers ,Fiber lasers ,Dye lasers Free electron lasers.

Learning and Teaching Strategies

Strategies	• **Lectures & Presentations** • **Problem Solving Sessions** • **Numerical Assignments** • **Discussions** • **Research & Reporting**

Student Workload (SWL)

Structured SWL (h/sem)	93	**Structured SWL (h/w)**	6.2
Unstructured SWL (h/sem)	32	**Unstructured SWL (h/w)**	2.1
Total SWL (h/sem)	125		

Delivery Plan (Weekly Syllabus)

المنهاج الاسبوعي النظري

	Material Covered	LOs
Week 1	Basic Components of Laser System	A2.1 B1 C1
Week 2	Optical Resonators and Types of Resonators	A2.1 B1
Week 3	Stability of Laser Resonator	A2.2 A3
Week 4	Fabry–Perot Resonator	A2.2
Week 5	Gaussian Beam Propagation	A2.3 A3.1
Week 6	Standing Waves and Laser Modes	A2.1
Week 7	Beam Waist and Radius of Curvature	A2.2 A3.2
Week 8	Laser Oscillation and Gain	A2.3
Week 9	Loop Gain and Threshold Condition	A2.2 A3.1
Week 10	Spectral Linewidth	A2.4
Week 11	Broadening Mechanisms	A2.5
Week 12	Reducing Laser Bandwidth	A2.5 A3.2

Week 13	Single Mode Laser	A2.5
Week 14	Laser Output (CW & Pulsed)	A2.6 A3.3
Week 15	Types of Lasers	A2.6
Week 16	Final Exam + Preparatory week	

Delivery Plan (Weekly Lab. Syllabus) المنهاج الاسبوعي للمختبر		
	Material Covered	
Week 1	Pre-Lab: Laser Terms and Laser Safety	
Week 2	Laser Beam Divergence Angle	A3.1 B1
Week 3	Spectrum of Light	A3.1 B1
Week 4	Laser Beam Diffraction	A3.2 B1
Week 5	Measuring the Wavelength of Laser (Ruler Method)	A3.1 B1
Week 6	Measuring Wavelength using Diffraction Phenomenon	A3.1 B1
Week 7	Measuring Laser Bandwidth using OSA	A3.3 B1
Week 8	Gaussian Distribution of Laser Beam	A3.2 B1
Week 9	Adjusting and Starting the He-Ne Laser System	A3.1 B1 C1
Week 10	Laser Power vs Discharge Current	A3.1 B1
Week 11	Michelson Interferometer	A3.1 B1
Week 12	Q-Switching Experiment	A3.2 B1
Week 13	Polarization of Light	A3.3 B1
Week 14	Lab Report Discussion	B1

Module Evaluation

تقييم المادة الدراسية

		Time/Number	Weight (Marks)	Week Due	Relevant Learning Outcome
Formative assessment	Quizzes	5	10% (10)	2,3,5,9 and 10	A2
	Assignments	3	10% (10)	2, 4,6,8,10,12 and 14	A2
	Classroom interaction	ALL	10% (10)	ALL	A2
	Report / Lab	ALL	10% (10)	ALL	A2 B1 C1
Summative assessment	Midterm Exam	1hr	10% (10)	7	A2
	Final Exam	3hr	50% (50)	15	A2
Total assessment			100% (100 Marks)		

Learning and Teaching Resources

مصادر التعلم والتدريس

	Text	Available in the Library?
Required Texts	1. O. Svelto – Principles of Lasers 2. A.E. Siegman – Lasers 3. William T. Silfvast, Laser Fundamentals, Cambridge University Press.	Yes
Recommended Texts		
Websites		

Grading Scheme

مخطط الدرجات

Group	Grade	التقدير	Marks (%)	Definition
Success Group	A - Excellent	امتياز	90 - 100	Outstanding Performance

(50 - 100)	**B** - Very Good	جيد جدا	80 - 89	Above average with some errors
	C - Good	جيد	70 - 79	Sound work with notable errors
	D - Satisfactory	متوسط	60 - 69	Fair but with major shortcomings
	E - Sufficient	مقبول	50 - 59	Work meets minimum criteria
Fail Group	**FX** – Fail	راسب (قيد المعالجة)	(45-49)	More work required but credit awarded
(0 – 49)	**F** – Fail	راسب	(0-44)	Considerable amount of work required

Note: Marks Decimal places above or below 0.5 will be rounded to the higher or lower full mark (for example a mark of 54.5 will be rounded to 55, whereas a mark of 54.4 will be rounded to 54. The University has a policy NOT to condone "near-pass fails" so the only adjustment to marks awarded by the original marker(s) will be the automatic rounding outlined above.