SRM Institute of Science and Technology
College of Engineering and Technology

DEPARTMENT OF ECE

SRM Nagar, Kattankulathur – 603203, Chengalpattu District, TamilNadu

Mode of Exam
OFFLINE
SET A

Academic Year: 2021-2022 (EVEN)

Test: CLAT- 2 **Date:** 25-5-2022
Course Code & Title: 18ECE322T – OPTOELECTRONICS **Duration:** 12:30 – 2:15 PM
Year & Sem: 2nd Year / 4th Sem **Max. Marks:** 50

Course Articulation Matrix with PI:

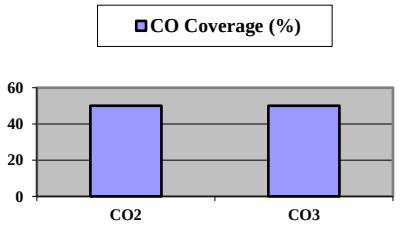
	18ECE322T- Optoelectronics		Program Outcomes (POs)																								PSO		
COs	Course Outcomes	BL	1	PI	2	PI	3	PI	4	PI	5	PI	6	PI	7	PI	8	PI	9	PI	10	PI	11	PI	12	PI	1	2	3
CO-1:	Define the basic concepts of optics and semiconductor optics.	1	3	1.4.1	-		-		-																				1
CO-2:	Demonstrate the working principle of various photonic sources and display devices.	3	3	1.2.1	3	2.1.2	-		2	4.1.1																			3
CO-3:	Analyze the principle and operation of various detectors and noise associated with it.	4	-		3	2.1.3	2	3.1.1	3	4.1.2																			3
CO-4:	Interpret the various optoelectronic modulators, switches, and interconnects.	3	3	1.3.1	2	2.2.1	3	3.2.1	-																				2
CO-5:	Apply the concepts of integrated optoelectronic components and its application in various fields.	3	3	1.4.1	-		3	3.2.2	3	4.2.1																			3

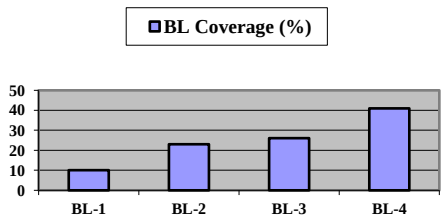
Part - A
(10 x 1 = 10 Marks)
Instructions: Answer ALL the Questions

Q. No	Question	Marks	BL	CO	PO	PI
1	In characteristic luminescence materials, the excitation and emission of light radiation occurs very rapidly in less than _____ sec (a) 10^{-4} (b) 10^{-6} (c) 10^{-7} (d) 10^{-8}	1	1	2	1	1.2.1
2	For N elements, the number of external wiring connections required for coordinate connected matrix display method is (a) N+1 (b) N-1 (c) N^2 (d) $\sqrt{N}$	1	2	2	2	2.1.2
3	The band gap of red, blue, and green LEDs is E_r, E_b, and E_g, respectively. Which of the following is true? (a) $E_r > E_b > E_g$ (b) $E_b > E_r > E_g$ (c) $E_b > E_g > E_r$ (d) $E_g > E_b > E_r$	1	2	2	2	2.1.2
4	In the Population Inversion (a) The number of electrons in ground state and higher energy state are same (b) The number of electrons in ground energy state is more than the higher state (c) The number of electrons in higher energy state is more than the ground state (d) None of these.	1	1	2	1	1.2.1
5	The distance between planes having the same director direction is called _____ (a) Radial space (b) Energy band gap (c) Pitch (d) Directors	1	1	2	1	1.2.1
6	The phototransistor construction normally allows the incident radiation to be absorbed in the _____ junction space charge layer. (a) base–collector (b) Emitter–collector (c) Base–emitter (d) Both (b) and (c)	1	1	3	3	3.1.1
7	The responsivity of a given p-i-n diode is 0.5A/W for a wavelength of 850nm. What is the output photocurrent when optical power of 0.2 µW is incident on it? (a) 0.1 µA (b) 1 µA (c) 10 µA (d) 0.01 µA	1	4	3	2	2.1.3
8	The basic building block of a Charge-Coupled Device (CCD) is called (a) Light emitting diode (b) Field effect transistor (c) Metal - oxide semiconductor capacitor (d) P-N junction diode	1	1	3	3	3.1.1
9	Which of the following is an inherent property of an optical signal and cannot be eliminated even in principle? (a) Thermal noise (b) Shot noise (c) Environmental noise (d) Background noise	1	1	3	3	3.1.1
10	If the external photocurrent is due to more than one electron flow per absorbed photon, then it is termed as _____. (a) Avalanche Multiplication (b) photoconductive gain (c) photomultiplier gain (d) photovoltaic gain	1	1	3	3	3.1.1
	Part – B **(4 x 10 = 40 Marks)**					
	SECTION B1 **Instructions: Answer ANY 2 Questions**					
11	(a) Differentiate phosphorescence and fluorescence. Calculate penetration depth of an electron beam (with energy = 10 keV) on a ZnS screen that produce cathodoluminescence. (Note: For ZnS, K = 1.2×10^{-4}, b = 1.75).	4	4	2	2	2.1.2
	(b) Explain the construction and working of Plasma Display and a.c. electroluminescent device.	6	2	2	1	1.2.1
12	(a) Explain the optical feedback and threshold condition for laser oscillation.	6	3	2	4	4.1.1
	(b) An injection laser has active cavity losses of 25 cm^{-1} and the reflectivity of each laser facet is 30%. Determine the laser gain coefficient for the cavity having a length of 500µm.	4	4	2	2	2.1.2
13	(a) Consider a particular green LED based on InGaN MQW active region. The emission wavelength is 528 nm. At an LED current of 350 mA, the forward voltage is 3.4 V. The emitted luminous flux is 92 lm. Find the power conversion efficiency, external quantum efficiency, luminous efficacy, and the emitted optical power (radiant flux)	8	4	2	2	2.1.2

	(b) Why silicon is not preferrable for the fabrication of optical sources. Justify your answer.	2	2	2	1	1.2.1
SECTION B2 Instructions: Answer ANY 2 Questions						
14	(a) Briefly explain the operation of a phototransistor.	4	2	3	3	3.1.1
	(b) A Si APD has a QE of 70 % at 830 nm in the absence of multiplication, (M =1). The APD is biased to operate with a multiplication of 100. If the incident optical power is 10 nW, what is the photocurrent?	4	4	3	2	2.1.3
	(c) Define Noise EquivalentPower (NEP) and detectivity of a photodetector with relevant expression.	2	3	3	3	3.1.1
15	(a) Briefly discuss the construction and working of Avalanche photodiode (APD).	5	3	3	3	3.1.1
	(b) With a neat diagram explain the concept of charge coupled device (CCD) in detail.	5	3	3	3	3.1.1
16	(a) Consider an InGaAs pin photodiode used in a receiver circuit with a load resistor of 27 kΩ. The total capacitance of the detector and the input of the amplifier together is 16 pF. The photodiode has a dark current of 2 nA. The incident radiation is 5 nW at 1550 nm where the responsivity is 0.8 A/W. Assuming that the amplifier is noiseless, calculate the SNR at 300K.	8	4	3	2	2.1.3
	(b) Explain in brief about metal-semiconductor-metal (Schottky) photodetector.	2	2	3	3	3.1.1

Course Outcome (CO) and Bloom's level (BL) Coverage in Questions





Approved by the Course Coordinator **Signature of the Question paper setter**

Evaluation Sheet

Name of the Student: **Register No.:**

Part- A (10 x 1= 10 Marks)					
Q. No	**CO**	**PO**	**Maximum Marks**	**Marks Obtained**	**Total**
1	**CO2**	**PO1**	**1**		
2	**CO2**	**PO2**	**1**		
3	**CO2**	**PO2**	**1**		
4	**CO2**	**PO1**	**1**		
5	**CO2**	**PO1**	**1**		
6	**CO3**	**PO3**	**1**		
7	**CO3**	**PO2**	**1**		
8	**CO3**	**PO3**	**1**		
9	**CO3**	**PO3**	**1**		
10	**CO3**	**PO3**	**1**		
Part- B (4 x 10= 40 Marks)					
11(a)	**CO2**	**PO2**	**4**		
11(b)	**CO2**	**PO1**	**6**		
12(a)	**CO2**	**PO4**	**6**		
12(b)	**CO2**	**PO2**	**4**		
13(a)	**CO2**	**PO2**	**8**		
13(b)	**CO2**	**PO1**	**2**		
14(a)	**CO3**	**PO3**	**4**		
14(b)	**CO3**	**PO2**	**4**		
14(c)	**CO3**	**PO3**	**2**		
15(a)	**CO3**	**PO3**	**5**		
15(b)	**CO3**	**PO3**	**5**		
16(a)	**CO3**	**PO2**	**8**		
16(b)	**CO3**	**PO3**	**2**		

Consolidated Marks:

CO	Maximum Marks	Marks Obtained
4	**35**	
5	**35**	
Total	**70**	

1	**11**	
2	**31**	
3	**22**	
4	**6**	
Total	**70**	

PO	Maximum Marks	Marks Obtained

Signature of the Course Teacher

Signature of the Course Coordinator **Signature of the Academic Advisor**