Assignment 8

The due date for submitting this assignment has passed.

Due on 2021-03-17, 23:59 IST.

As per our records you have not submitted this assignment.

Instructions:

1. Answer all questions; all questions carry equal mark.
2. All symbols have their usual meanings.
3. Only one of the options is correct.
4. Take care of the units in numerical problems, to match with the units given in the options (of MCQs), and the units in which answers have to be entered (in *fill in the blank* type of questions).
5. In the *fill in the blank* type of questions, only the numerical values have to be entered.

NOTE: You can see the correct answers after the last date of submission. Marks obtained in this quiz will be counted towards your final score. You can take the quiz and submit it any number of times, and the latest submitted answers will be taken as your final submission.

1) State whether the following statement is TRUE or FALSE: ***1 point***

The magnitude of the resonator loss is represented as a horizontal line in the gain spectrum of a laser because the loss is almost constant over the wavelength range of the laser transition.

- TRUE
- FALSE

No, the answer is incorrect.
Score: 0
Accepted Answers:
TRUE

2) A particular laser, oscillating in one longitudinal mode, when operated at pump powers of P^x_{pump} and P^y_{pump} gives steady-state output powers of P^x_{out} and P^y_{out} respectively. Given that $P^x_{pump} > P^y_{pump} > P^{th}_{pump}$ (threshold pump power). What is the relationship between their gain-coefficients at the lasing wavelength in steady-state? ***1 point***

- $\gamma^x > \gamma^y > \gamma^{th}$
- $\gamma^x < \gamma^y < \gamma^{th}$
- $\gamma^x > \gamma^y < \gamma^{th}$
- $\gamma^x = \gamma^y = \gamma^{th}$

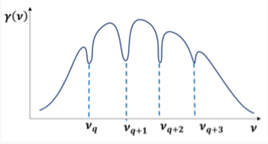
No, the answer is incorrect.
Score: 0
Accepted Answers:
$\gamma^x = \gamma^y = \gamma^{th}$

3) Which of the following correctly represents the order of the time taken during the evolution of gain profile in a laser, when the laser pump is switched ON at time t = 0? (t_{so} is the *switch-on time*, t_t is the time at which the gain reaches the *transparency* and t_{th} is the time at which gain reaches the *threshold* for the first time; t_d is the time at which the gain in the medium reaches its peak value) ***1 point***

- $t_{so} > t_t > t_{th} > t_d$
- $t_{so} > t_t > t_d > t_{th}$
- $t_{so} > t_{th} > t_d > t_t$
- $t_{so} > t_d > t_{th} > t_t$

No, the answer is incorrect.
Score: 0
Accepted Answers:
$t_{so} > t_d > t_{th} > t_t$

4) Which of the following cannot be inferred from the *spectral gain profile* of a Laser shown in the figure below? ***1 point***



- Only 4 longitudinal modes are lasing.
- The gain at different frequencies is contributed by different groups of atoms
- A horizontal line joining the dips would represent the threshold gain coefficient
- The intensity of the longitudinal mode at ν_{q+1} is less than that at ν_q

No, the answer is incorrect.
Score: 0
Accepted Answers:
The intensity of the longitudinal mode at ν_{q+1} is less than that at ν_q

5) The 2D transverse gain profile (in the *x-y* plane) of the gain medium in a high-power laser which is oscillating only in the TEM_{31} mode is measured. The number of peaks observed in the gain profile would be ___ .

(Write your answer as an integer)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Numeric) 8

1 point

6) Which one of the following phenomena will least affect the photon density in the cavity mode of a simplified equivalent 2-level laser system (assume $N_1 \approx 0$)? ***1 point***

- Spontaneous emission into the cavity mode
- Stimulated emission into the cavity mode
- Stimulated absorption from the cavity mode
- Spontaneous emissions from the cavity.

No, the answer is incorrect.
Score: 0
Accepted Answers:
Stimulated absorption from the cavity mode

7) A particular laser oscillating at the resonant wavelength of 1 μm has a *M* value of 10^{10}. The photon number in the cavity at the threshold pumping rate is ____.

(Write the Answer as an integral number without using exponents)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 99990,100010

1 point

8) In Q.7 above, if the length and radius of the cross-section of the cavity are 10 cm and 0.5 cm, respectively, and the threshold pumping rate (R_t) is 10^{18} $m^{-3}s^{-1}$, then the cavity lifetime is __ ms.

(Write your answer up to 3 decimal places)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 1.173,1.373

1 point

9) The output powers from the laser in Q. 8 at a pumping rate of $2x10^{18}$ $m^{-3}s^{-1}$ and $3x10^{18}$ $m^{-3}s^{-1}$ are P_1 and P_2, respectively. The ratio P_1/P_2 is ____.

(Write your answer up to 2 decimal places)

No, the answer is incorrect.
Score: 0
Accepted Answers:
(Type: Range) 0.45,0.55

1 point

10) State whether the following statement is TRUE or FALSE: ***1 point***

The output power from a CW laser, operating above the threshold, suddenly drops down if the reflectivity of the output mirror is reduced below a certain value. This is because the cavity loss exceeds the gain at this point.

- TRUE
- FALSE

No, the answer is incorrect.
Score: 0
Accepted Answers:
TRUE