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**EXAM ID NUMBER: \_\_\_\_\_**

**COURSE NUMBER: EE 208**

**PROBLEM: 1**

**Q1:**

- (a) List three advantages and three disadvantages of diode lasers as compared to gas or solid-state lasers. [6 points]
- (b) Why are III-V materials better than Si for LEDs and lasers? [4 points]
- (c) Discuss advantages and disadvantages of Fabry-Perot edge-emitting laser and vertical-cavity surface emitting laser (VCSEL). [6 points]
- (d) Pick a niche application for VCSEL and discuss why edge-emitting laser is not a preferred device for such application. [4 points]

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**PROBLEM: 2**

**Q2:**

This question is about the edge emitting InGaN/GaN semiconductor lasers.

- a. Design a practical InGaN/GaN based semiconductor emitting at 450nm?  
Please include detailed material and device structures in your design.  
[8 points]
- b. Why the use of quantum-well structure is essential for room temperature lasing in InGaN/GaN lasers? Comment.  
[4 points]
- c. Explain how do you extract (i) slope efficiency (external quantum efficiency), internal quantum efficiency ( $\eta_i$ ), mirror loss ( $\alpha_m$ ), internal loss ( $\alpha$ ), threshold gain ( $g_{th}$ ),  $\Gamma g_o$ , transparency current ( $J_t$ ), and threshold current density at infinite length ( $J_o$ ) from Fabry-Perot lasers with different lengths.  
[8 points]