NAVAL POSTGRADUATE SCHOOL
Monterey, California

EC 3210 FINAL EXAM 12/91Po

- This exam is open book and notes.
- There are five problems; each is equally weighted.
- Partial credit will be given; be sure to do some work on each problem.
- Be sure to include units in your answers.
- Please circle or underline your answers.
- Show *ALL* work.
- Write only your name on this sheet.
- Exams and course grades will be available outside the Optical Electronics Laboratory (Bu 224) on Monday, 23 December.
- Have a good holiday season and enjoy your break!

Course grade: _____

1		4	
2		5	
3			
Total			

Name: _____

1. A Gaussian laser beam ($\lambda = 500$ nm) propagates from left to right. If $w_1 = 6.5$ mm and $R_1 = -20$ m at a location that is 18 m from an arbitrary origin, find the spot size *and* radius of curvature of the phase front at a second location that is located 8 m to the left of the first position.

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2. A mode–locked laser produces pulses that have a peak power of 10 mW. The average power from the laser is 100 μW and the measured pulse–width is 100 ps. Calculate the mirror spacing of the resonator if the index of refraction of the lasing medium is 1.5.

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3. A laser, operating at 1.0 μm, puts out a 10 mW Gaussian beam with a spot size of 1.5 mm. The laser is pressure broadened with a spectral linewidth of 0.01 nm. The index of refraction of the lasing medium is 1.2. The laser mirrors have power reflectivities of 96% and 100% and are spaced25 cm apart. If the unsaturated gain coefficient is 0.30 at a constant (but unknown) pump rate, find the value of the internal loss coefficient α_{int}.

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4. A laser resonator has a mirror spacing of 25 cm. The two mirrors of the resonator have equal power reflectivities of 98%. One mirror has a radius of curvature of 50 cm. For what range of values of radius of curvature of the second mirror will the laser resonator be capable of producing a TEM_{00} wave.

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5. A light wave ($\lambda = 633$ nm), described by the vector

$$\vec{\mathbf{E}}_{\text{in}} = 1\cos(\omega t - kz)\,\vec{\mathbf{a}}_x - 1\sin(\omega t - kz)\,\vec{\mathbf{a}}_y\,,$$

is incident on a waveplate made of ADP with a thickness of 6 μm. (The vectors $\vec{\mathbf{a}}_x$ and $\vec{\mathbf{a}}_y$ are unit vectors in the x and y directions.) The fast axis of the waveplate is oriented along the x–axis. Find an expression for the vector $\vec{\mathbf{E}}_{\text{out}}$ at the output of waveplate.