

NAVAL POSTGRADUATE SCHOOL
Monterey, California

EC 4210

MIDTERM EXAM I

2/14/92 Po

- This exam is open book and notes.
- There are three 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.
- Do not do any work on this exam sheet.

1	
2	
3	
Total	

Name: _____

1. Consider a longitudinal electro-optic irradiance modulator made of KD*P that is 2 cm wide by 2 cm high by 8 cm long that operates at 600 nm. The modulator uses a quarterwave plate to provide the proper bias condition. At a certain unknown voltage, it is observed that 25% of the incident power is transmitted by the modulator.
 - (a) Find the unknown voltage of the observation.
 - (b) Find the electric field vector $\vec{E}_{x'}$ along the longitudinal axis of the crystal.

2. Measurements of a graybody emitter ($\epsilon = 0.90$) at an unknown wavelength show that the spectral radiant power emittance is $0.036 \text{ W}\cdot\text{cm}^{-2}\cdot\mu\text{m}^{-1}$ and that the spectral radiant photon emittance is $1.087 \times 10^{18} \text{ photons}\cdot\text{s}^{-1}\cdot\text{cm}^{-2}\cdot\mu\text{m}^{-1}$.
 - (a) Find the unknown wavelength of the measurements.
 - (b) Find the temperature of the source.

3. A photomultiplier tube has a quantum efficiency of 1% at an operating wavelength of $1 \mu\text{m}$ and has negligible dark current. The device is operated with a gain of 10,000 and is operated into a 50Ω load resistance with a 400 K noise temperature.

Calculate the signal-to-noise ratio (**in dB**) for direct detection of a $1 \mu\text{m}$ -wavelength test signal with an unmodulated power of 1.8 nW, a modulation index of 1, and a signal frequency f_s of 750 MHz. The noise bandwidth is 100 MHz.