

PHYSICS 515B  
**ELECTROMAGNETIC THEORY**  
Prof. Fulvio Melia

*Section VI Problems (due Wednesday, October 30)*

Problem 1: Consider the *stress-energy tensor* for an electromagnetic field

$$T^{\mu\nu} \equiv \frac{1}{4\pi} \left( F^{\mu\alpha} F^{\nu}_{\alpha} - \frac{1}{4} g^{\mu\nu} F^{\alpha\beta} F_{\alpha\beta} \right),$$

where  $F^{\alpha\beta}$  and  $g^{\mu\nu}$  are the electromagnetic field tensor and the metric, respectively.

(a) Show that  $T^{\mu\nu}$  is traceless:  $T^{\mu}_{\mu} = 0$ .

(b) Show that in free space  $T^{\mu\nu}$  is divergenceless:  $\partial_{\nu} T^{\mu\nu} = 0$ .

Problem 2: Jackson 12.1

Problem 3: Jackson 12.2

Problem 4: Jackson 12.14