Calculus for Electronics, Problems 10-2, Differentials:

1. An electron (whose mas is m_e) moves at a speed v. Its momentum is $p = mv$. Find a formula for the approximate change dp in momentum resulting from a small increase dv in speed.

2. The low-frequency inductance of a single-layer solenoid is approximately $L = KDn^2$, where K is a form factor, D is the diameter in centimeters, and n is the number of turns. Find a formula for the approximate change dL in the inductance resulting from the addition of a small part of a turn dn.

3. The power in a circuit was $p = t - 5$ watts. What was the approximate energy dw in joules expended from $t = 4$ to $t = 4.002$ seconds.

4. The induced voltage in an 8-henry inductor varied according to $Vind = 3t^2 - t$. About how much change di occurred in the inductor current from $t = 2$ to $t = 2.01$ seconds?

5. The power in a circuit is given by $p = ri^2$ watts, where $r = 100\Omega$ and i is the current in amperes. If i changes from 12 to 12.005 amps, approximately what change dp occurs in watts?

6. The current i amperes in a circuit varied with time t seconds according to $i = t^2 + 3t$. About what current change di occurred as t changed from . 98 to 1 second?

7. The intensity J of the heat radiation from a transmitting tube plate varies with its absolute temperature according to $J = \vartheta T^4$ where ϑ is a constant and T is the temperature in $°C$. If $J = 50$ units when $T = 1200°C$, approximately what change dJ in J results from a change in T to $1205°C$?

8. If the resistance r ohms in a circuit varies with time t seconds according to $r = 100 + t^{\frac{1}{2}}$, what approximate change dr in r occurs as t changes from 4 to 4.001 seconds?

9. A right circular cone used in constructing a broadband antenna has a volume $v = \pi r^2 h$, where r is the radius of the base and h is the altitude of the cone. If $r = 10$ centimeters and $h = 24$ centimeters, what approximate change dv in the volume occurs when r changes to 10.052 centimeters?

10. An increase in the apparent mass ma of a moving particle occurs in accord with $ma = \frac{mo}{[1-\left(\frac{v}{c}\right)^2]^{\frac{1}{2}}}$ where mo is the mass of the particle at rest, v is its speed, and c is the speed of light in a vacuum. What approximate change dma occurs in the apparent mass as a result of a small change dv in the speed of the particle? Express your answer as a formula.