ELEKTRIKA:

$$I = \frac{de}{dt}$$

$$\int I \cdot dt = \Delta e$$

$$F = \frac{e_1 e_2}{4\pi\varepsilon_0 r^2} = e_0 \vec{E}$$

$$U = \vec{E} \cdot \vec{s} = \frac{A_e}{e}$$

$$\sigma_e = \frac{e}{S}$$

$$E = \frac{\sigma}{2\varepsilon_0}$$

$$\oint D dS = e$$

$$e = CU,,, e_p = CU_p$$

$$C = \frac{\varepsilon_0 S}{l} = \frac{2\pi\varepsilon l}{\ln r_2/r_1}$$

$$W_e = \frac{CU^2}{2} = \frac{e^2}{2C}$$

$$W_p = qV$$

$$\Delta W_p + \Delta W_{kin} = 0$$

$$w_e = \frac{W_e}{V} = \frac{\varepsilon_0 E^2}{2}$$

$$U = RI$$

$$P = UI = RI^2 = \frac{U^2}{R}$$

$$R = \frac{\xi \cdot l}{S_0}$$

$$A = \int F \cdot ds = \int M d\varphi = \int P dt = \Delta W$$

$$U_g = U_0 - IR_n$$

$$I_k = \frac{U_0}{R_n}$$

$$Q = A = \int U \cdot de = \int U \cdot I \cdot dt = \int RI^2 \cdot dt = \int$$

$$Q = m \cdot c \cdot \Delta T$$

Kapacitivnosti:

- naelektrena ploskev

$$C = \frac{\varepsilon A}{d}$$

- valjasti kondenzator (koaks)

$$C = \frac{2\pi\varepsilon l}{\ln \frac{r_2}{r_1}}$$

- kroglasti kondenzator:

$$C = \frac{4\pi\varepsilon r_2 r_1}{r_2 - r_1}$$

Praznjenje kondenzatorja:

$$U_c = U_0 \cdot e^{-\frac{t}{RC}}$$

$$I_c = I_0 \cdot e^{-\frac{t}{RC}}$$

Polnjenje kondenzatorja:

$$U_c = U_g (1 - e^{-\frac{t}{RC}})$$

$$I_c = \frac{U_g}{R} e^{-\frac{t}{RC}}$$

Admitanca kondenzatorja:

$$Z_C = \frac{1}{\omega C}$$

RLC vezje:

$$U_0 = I \cdot \sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$$

Krožna zanka:

$$V = \frac{e}{4\pi\varepsilon_0 \sqrt{r^2 + z^2}}$$

$$E = \frac{e \cdot z}{4\pi\varepsilon_0 (r^2 + z^2)^{3/2}}$$

MAGNETIZEM:

$$F = IBl \cdot \sin\alpha$$

$$\vec{F} = e \cdot \vec{v} \times \vec{B}$$

$$B = \mu_0 H = \frac{\mu_0 I}{2\pi r} = \frac{\mu_0 NI}{l}$$

$$M = NISB \sin\alpha = J\alpha$$

$$U_i = \frac{d\Phi_m}{dt} = -BS\omega \cdot \sin(\omega t) = \vec{v} \cdot (\vec{B} \times$$

$$\Phi_m = \int B dS = BS \cdot \cos(\omega t) = [Vs]$$

$$d\Phi_m = S dB$$

$$L = \frac{\mu_0 N^2 S}{l} = \frac{\Phi}{I}$$

$$W_m = \frac{LI^2}{2} = p_m B \cos\varphi$$

$$p_m = NIS$$

$$w_m = \frac{B^2}{2\mu_0} = \frac{HB}{2}$$

Biot-Savartov zakon:

$$dB = \frac{\mu_0 I (r \times dl)}{4\pi r^3}$$

Nihajni čas mag. igle ali tuljave

p_m – mag. moment

$$t_0 = 2\pi \sqrt{\frac{J}{p_m B}}$$

Zakon o mag. pretoku:

$$\oint \vec{B} d\vec{S} = 0$$

Zakon o mag. napetosti (Amperov zakon):

$$\oint \vec{H} \cdot d\vec{s} = I$$

$$B = \mu_0 H$$

H okoli vodnika in dolge tuljave:

$$H = \frac{I}{2\pi r} = \frac{NI}{l}$$

Pojemanje toka in napetosti skozi tuljavo:

$$\tau = L/R$$

$$I(t) = I_0 \cdot e^{-t/\tau}$$

$$U_R = -I_0 \cdot R \cdot e^{-t/\tau}$$

$$U_L = I_0 \cdot R \cdot e^{-t/\tau}$$

Naraščanje toka in napetosti skozi tuljavo:

$$I(t) = \frac{U_0}{R}(1 - e^{-t/\tau})$$

$$U_R = -U_0 (1 - e^{-t/\tau})$$

$$U_L = -U_0 \cdot e^{-t/\tau}$$

Impedanca tuljave:

$$Z_L = \omega L$$

Izmenični tok:

$$I_{ef} = \sqrt{\frac{1}{T}\int_0^T I^2 \cdot dt} = \frac{I_0}{\sqrt{2}}$$

$$U_{ef} = \sqrt{\frac{1}{T}\int_0^T U^2 \cdot dt} = \frac{U_0}{\sqrt{2}}$$

$$I = I_0 \cdot \sin(\omega t)$$

$$U = U_0 \cdot \sin(\omega t + \delta)$$

Električni nihajni krog:

Idealni: (tuljava, kondenzator → zaporedno)

$$\frac{e}{C} - L\frac{dI}{dt} = 0 - kirchoff; I = -\frac{de}{dt}$$

$$\frac{d^2 e}{dt^2} + \frac{1}{LC} e = 0 - diferencia\ln a$$

$$\text{Re}\,\check{s}itev:$$

$$e(t) = e_0 \cdot \cos\omega_0 t$$

$$\omega_0 = \sqrt{\frac{1}{LC}};$$

$$I(t) = \omega_0 \cdot C \cdot U_0 \cdot \sin\omega_0 t$$

$$W_C = \frac{e^2}{2C} = \frac{CU_0^2}{2}\cos^2\omega_0 t$$

$$W_L = \frac{LI^2}{2} = \frac{CU_0^2}{2}\sin^2\omega_0 t$$

$$W_C + W_L = \frac{CU_0^2}{2}$$

Z dušenjem: (kondenzator tuljava,upor → zaporedno)

$$\frac{e}{C} - IR - L\frac{dI}{dt} = 0 - kirchoff; I = -\frac{de}{dt}$$

$$\frac{d^2 e}{dt^2} + \left(\frac{R}{L}\right)\cdot\frac{de}{dt} + \left(\frac{1}{LC}\right)e = 0 - diferen$$

$$\text{Re}\,\check{s}itev:$$

$$e(t) = e_0 \cdot e^{-\beta t} \cdot \cos\omega' t$$

$$\beta = \frac{R}{2L}$$

$$\omega' = \sqrt{\omega_0^2 - \beta^2}$$

$$\omega_0 = \sqrt{\frac{1}{LC}};$$

Vsiljeno nih.: (tuljava, kondenzator upor, generator → zaporedno)

$$I(t)=I_0\cdot\sin\omega t$$
$$U_G=U_0\cdot\sin(\omega t+\delta)$$
$$U_0^{\,2}=(U_L-U_C)^2+U_R^{\,2}$$
$$U_R=R\cdot I_0$$
$$U_C=\left(\frac{1}{\omega C}\right)\cdot I_0$$
$$U_L=(\omega\cdot L)\cdot I_0$$
$$I_0=\frac{U_0}{\sqrt{(\omega\cdot L-\frac{1}{\omega\cdot C})^2+R^2}}=\frac{U_0}{Z}$$
$$Fazni\_premik:$$
$$tg\delta=\frac{U_L-U_C}{U_R}=\frac{\omega\cdot L-\left(\frac{1}{\omega\cdot C}\right)}{R}$$
$$\check{C}e\_je:(\omega=\omega_0)\,je(\delta=0)in\_je:$$
$$\overline{P}=U_{EF}\cdot I_{EF}\cdot\cos\delta->maksima\ln a$$

Mg. Polje tč. naboja:
$$B=\frac{v\times E}{c^2}$$
Mg polje ravnega vodnika:
$$B=\frac{\mu_0 I}{2\pi a}$$
Mg polje v dolgi ravni tuljavi:
$$B=\frac{\mu_0 NI}{l}$$
Mg polje v svitku:
$$B=\frac{\mu_0 NI}{2\pi r}$$
Zakon o el. nap. (Faradejev zakon):
$$\int E\cdot ds=-\frac{d(\int B\cdot dS)}{dt}$$
Induktivnost:

$\Phi_m=L\cdot I$ – lastna induktivnost

$L=\frac{\mu_0 NS}{l}$ Dolga ravna tuljava

$L=\frac{\mu_0 N^2 h\ln(b/a)}{2\pi}$ Svitek

$L=\frac{\mu_0 l\cdot\ln(b/a)}{2\pi}$ Koaks

$U_i=-\frac{L\cdot dl}{dt}$ v smeri toka velja

Magnetna upornost:
$$R_m=\frac{l}{\mu_r\mu_0\cdot S}$$
SEVANJE:

a – albeda ali odbojnost

j – gostota energ. Toka.
$$P_{ABS}=(1-a)\,jS$$
$$P_{IZS}=(1-a)\sigma T^4 S$$
C – toplotna kapaciteta [J/K]
$$-dQ=j^* Sdt$$
$$-CdT=\sigma T^4 Sdt$$

- Stefanov zakon (sevanje črnega telesa):
$$\lambda_m\cdot T=k_w$$
$$j_{\check{c}}{}^*=\sigma\cdot T^4$$
- λ_m - val. dolžina. pri kateri telo največ seva
- kw = 2.9 mm

FOTOMETRIJA:

Svetlobni tok:
$$P=\frac{dW}{dt}=[W]$$
Gostota svetlobnega toka:
$$j=\frac{dP}{dS}=\frac{P}{4\pi r^2}=\left[\frac{W}{m^2}\right]$$
Svetilnost:
$$I=\frac{dP}{d\Omega}=\left[\frac{W}{sr}=\frac{lm}{sr}=cd\right]$$
$$I=r^2\cdot j=BS_0\cos\varphi$$
$$dI=B\cdot dS\cdot\cos\vartheta$$
Svetlost:
$$B=\frac{dI}{dS_0^{'}}=\left[\frac{W}{sr\cdot m^2}=\frac{cd}{m^2}=nit\right]$$
Osvetljenost:
$$E=\frac{dP}{dS}=\left[\frac{W}{m^2}=\frac{lm}{m^2}=lx\right]$$
$$E=j\cdot\cos\varphi$$
$$dE=\frac{dI\cdot\cos\vartheta}{r^2}$$
GEOMETRIJSKA OPTIKA:

Odboj in lom svetlobe:

Lomni količnik:
$$n=c_0/c$$
Lomni zakon:
$$n_1\sin\alpha=n_2\sin\beta$$
Totalni odboj:
$$\sin\beta_t=\frac{n_1}{n_2}$$
Gorišče:

f – goriščna razdalja

a – razdalja predmeta od zrcala

b – razdalja slike od zrcala

d - dioptrija
$$\frac{1}{f}=\frac{1}{a}+\frac{1}{b}$$
$$d=a+b=a_1+a_2=b_1+b_2$$
Gor. razdalja zbiral. krogelnega zrcala:

r – radij krogle ali krivinski polmer
$$f=\frac{r}{2}$$
Povečava:
$$N=b/a$$
Bikonveksna leča:
$$\frac{1}{f_1}=\left(\frac{n}{n_1}-1\right)\frac{2}{r}$$
Sestavi nerazmaknjenih leč:
$$\frac{1}{f}=\frac{1}{f_1}+\frac{1}{f_2}$$
1/f – lomnost; enota je dioptrija [1/m]

Povečava lupe:

α – kot pod katerim vidimo predmet z lupo

α_0 – kot pod katerim vidimo predmet z prostim očesom

$$N=\frac{\tan\alpha}{\tan\alpha_0}=\frac{a_0}{f}$$
Povečava mikroskopa:

f – gorišče objektiva

f' – gorišče okularja

x' – razdalja med goriščema (tubus)

a_0 – normalna zorna razdalja
$$N=\frac{\tan\alpha}{\tan\alpha_0}=\frac{a_0\cdot x'}{f\cdot f'}$$
$$\tan\alpha_0=\frac{y}{a_0}$$
$$\frac{y'}{y}=\frac{b}{a},,,\tan\alpha=\frac{y'}{f_2}$$
Daljnogled:
$$N=\frac{\tan\alpha}{\tan\alpha_0}=\frac{f}{f'}$$
Daljnovidnost:

-zbiralna leča
$$\frac{1}{f_{\min}}=\frac{1}{a_{\min}}+\frac{1}{b}$$
$$\frac{1}{a_0}+\frac{1}{b}=\frac{1}{f_{\min}}+\frac{1}{f_{o\check{c}\check{c}a}}$$
$$f_{o\check{c}\check{c}a}=\frac{a_0\cdot a_{\min}}{a_{\min}-a_0}$$
Kratkovidnost:

-razpršilna leča
$$\frac{1}{f_{\max}}=\frac{1}{a_{\max}}+\frac{1}{b}$$
$$\frac{1}{\infty}+\frac{1}{b}=\frac{1}{f_{\max}}+\frac{1}{f_{o\check{c}\check{c}a}}$$
$$f_{o\check{c}\check{c}a}=-a_{\min}$$
POSEBNA TEORIJA RELATIVNOSTI

Transofmacija za hitrosti:
$$v'_x=\frac{v_x-v_0}{\left(1-\frac{v_0v_x}{c_0^2}\right)}$$
$$v'_y=\frac{v_y}{\gamma_0\left(1-\frac{v_0v_x}{c_0^2}\right)}$$
$$v'_z=\frac{v_z}{\gamma_0\left(1-\frac{v_0v_x}{c_0^2}\right)}$$
Obratna transformacija:

$$v_x = \frac{v'_x + v_0}{\left(1 + \frac{v_0 v'_x}{c_0^2}\right)}$$

$$v_y = \frac{v'_y}{\gamma_0 \left(1 + \frac{v_0 v'_x}{c_0^2}\right)}$$

$$v_z = \frac{v'_z}{\gamma_0 \left(1 + \frac{v_0 v'_x}{c_0^2}\right)}$$

Skrčenje dolžin:

Palica miruje v sistemu S:

$$x_2 - x_1 = L$$

Dogodek 1:

$$t_1 = 0 \qquad x_1 = 0$$

Dogodek 2:

$$t_2 = \frac{v_0 L}{c_0^2} \quad x_2 = L$$

Lorentzova transformacija

Sistem S':

Dogodek 1:

$$t'_1 = 0 \qquad x'_1 = 0$$

Dogodek 2:

$$t'_2 = 0 \qquad x'_2 = \frac{L}{\gamma_0}$$

$$x'_2 - x'_1 = \frac{L}{\gamma_0} = L'$$

Podaljšanje časa

1. dogodek: mesto x, čas t_1
2. dogodek: mesto x, čas t_2

$$\Delta t = t_2 - t_1$$

Lorentzova transformacija:

$$t'_1 = \gamma_0 \left(t_1 - \frac{v_0 x}{c_0^2}\right)$$

$$t'_2 = \gamma_0 \left(t_2 - \frac{v_0 x}{c_0^2}\right)$$

$$t' = t'_2 - t'_1 = \gamma_0 (t_2 - t_1) = \gamma\tau$$

$$\Delta t' = \gamma_0 \Delta t$$

$$t_1 = \gamma(t_1^{'} + \frac{v \cdot x'_1}{c^2}$$

$$t_2 = \gamma(t_2^{'} + \frac{v \cdot x'_2}{c^2}$$

$$x'_1 = \gamma(x_1 - v t_1)$$

$$x'_2 = \gamma(x_2 - v t_2)$$

$\Delta t' \geq \Delta t$ => za gibajočega opazovalca dogodki potekajo počasneje kot za opazovalca, ki miruje ob dogodkih.

ZAKONI GIBANJA

Gibanje delca

dt – čas, ki ga izmeri opazovalec, ki opazuje gibanje točkastega telesa

dτ – lastni čas, ki ga izmeri opazovalec, ki se giblje skupaj z delcem

$$dt = \gamma d\tau$$

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c_0^2}}},,, \gamma^2 = \frac{v^2\gamma^2}{c^2} + 1$$

$$v = \sqrt{1 - \frac{1}{\gamma^2}} \cdot c$$

GIBALNA KOLIČINA

E – polna energija

m_0 ali mc^2 – mirovna masa

p – gibalna količina

$$E = mc^2 = \left[\frac{eV}{c^2}\right]$$

$$E = W_k + m_0 c^2$$

$$E = \sqrt{p^2 c^2 + m_0^2 c^4}$$

$$W_k = mc^2(\gamma - 1) = [eV]$$

$$p = \gamma m v = e_0 E t = \left[\frac{eV}{c}\right]$$

$$p = \sqrt{\frac{W_k^2 + 2 W_k mc^2}{c^2}}$$

De Broglijeva val dolžina:

Fotoni:

$$P = t \cdot k = \frac{h}{\lambda}$$

$$W = t \cdot \omega$$

$$t = \frac{h}{2\pi}$$

$$k = \frac{2\pi}{\lambda}$$

Elektroni:

$$\lambda_B = \frac{h}{P} = \frac{h}{m \cdot v}$$

OSTALO:

-Sevanje črnega telesa

$$E = mc^2$$

$$E = 4\pi r^2 \sigma T^4 \cdot t - okroglo\_telo(sonce)$$

-Fotoni

$$W_\gamma = h\nu = \frac{hc}{\lambda}$$

$$I = \frac{de}{dt} = \frac{d(N_e \cdot e_0)}{dt} ==> N_e = N_\gamma / 2($$

$$P = \frac{dW}{dt} = \frac{d(N_\gamma \cdot h\nu)}{dt}$$

-Sevanje žičke

$$P_{el} = P_{izs}$$

$$I^2 R = \sigma T^4 S$$

$$R = \frac{\xi \cdot l}{\pi \cdot r^2}$$

$$S = 2\pi r l --> S\_žice$$

-Leče in lomni količniki

$$\frac{1}{f_1} = (\frac{n}{n_1} - 1)\frac{2}{R}$$

-Svteloba

$$P_s = f \cdot \int \frac{dP}{d\lambda}(\lambda) \cdot \eta_{rbo} \cdot d\lambda$$

$$f = 683 \, lm/W$$

η_{rbo}(λ = nm):

λ <= -∞ - 1 => žarki x

λ = 1 – 380 => UV svetloba

λ = 380 – **396** – 439 => vijolična

λ = **440** – 509 => modra

λ = **510** – 579 => zelena

λ = **580** – 599 => rumena

λ = **600** – 619 => oranžna

λ = 620 – **645** – 779 => rdeča

λ = 780 - ∞ => infrardeča

Zrcala in leče:

- *Ravno zrcalo* – slika je navidezna in nastane na drugi strani zrcala na enaki razdalji kot predmet, kjer se sekajopodaljški žarkov
- *Zbiralno zrcalo* – vbočeno – predmet preslika v sliko

$$\frac{1}{a} + \frac{1}{b} = \frac{1}{f} = \frac{2}{r} => f = \frac{r}{2}$$

- *Razpršilno zrcalo* – slika je vedno navidezna, pokončna in pomanjšana, ker se nahaja na drugi strani zrcala

$$\frac{1}{a} + \frac{1}{b} = \frac{1}{f} = -\frac{2}{|r|} => f = -\frac{|r|}{2}$$

- *Zbiralna leča* – r**(|)**r' – slika je na drugi strani pomanjšana in obrnjena, ter pokončna

$$\frac{1}{a} + \frac{1}{b} = \frac{1}{f} -> \frac{1}{f} = (n-1)\left(\frac{1}{r} + \frac{1}{r'}\right) ->$$

- *Razpršilna leča* - r**)|(**r' – veljajo iste enačbe kot za zbiralno lečo