INTEZNITET I DOPPLER

2.9

$W=\frac{1}{2}\rho\omega^2 A^2$,

$I=\frac{1}{2}\rho\omega^2 A^2 v$

$\omega=2\pi f=753.6$

$\rho=\frac{m}{r^2\pi l}=\frac{0.0009}{0.00025^2\pi 1.5}=3057.32\ kg/m^2$

$A=0.03\,m$

$W=7.81\,J/m^3$

$v=\sqrt{\frac{F}{\mu}}=\sqrt{\frac{F}{\frac{m}{l}}}=\sqrt{\frac{Fl}{\mu}}=182.6\,m/s$

$I=1.43\cdot 10^8$

2.10

$L=10\log\frac{I}{I_0}$

$I=I_0\,10^{\frac{L}{10}}$

$S=povrsina\,sfere=4r^2\pi$

$I_0=10^{-12}$

$P=\frac{1}{2}\rho\omega^2 A^2 S=I\,S=I\,4r^2\pi=3.99\,W$

2.11

$I_0=0.15\cdot 10^{-9}\,W/m^2$

$\delta=6\cdot 10^{-4}$

$r=150\text{m}$

$L=50\,dB$

$L=10\log\frac{I}{I_0}$

$I(r)=I_0\,10^{\frac{L}{10}}$

$I_p=intenzitet\,kod\,izvora$

$I(x)=\frac{1}{2}\rho\omega^2 A^2(x)=\frac{1}{2}\rho\omega^2 A_0^2 e^{-2\delta x}=I_p e^{-\delta x}$

$I_p=I(r)e^{2\delta x}$

$P=I_p S=I_p\,4r^2\pi=5.075\,W$

2.12

$\lambda = 650\,nm \qquad v = 0.15\,c$

$f' = f\,\frac{u+v}{v}$

$\frac{v}{\lambda'} = \frac{v}{\lambda}\frac{u+v}{v} = \frac{u+v}{\lambda}$

$\lambda' = \frac{\lambda v}{u} + v = \frac{650\cdot 10^{-9} c}{1.15\,c} = 565\,nm$

- zelena boja

2.13

$v = 72\,km/h = 20\,m/s$

$f = 2 * 10^{9}\,Hz$

- imamo frekvenciju koja dode do automobila

$f_a = f\,\frac{u+v}{v}$

- one se refketira i automobil postaje izvor koji se giba

$f_r = f_a\,\frac{v}{v-u} = f\,\frac{v+u}{v}\,\frac{v}{v-u} = 266.6\,Hz$

2.14

$f_1 = 1.5\cdot 10^{4}\,Hz$

$f_2 = 1000\,Hz$

- izvor se giba
- detekto stoji

1. $f = f_1\,\frac{v}{v+u}$
2. $f = f_2\,\frac{v}{v-u}$

$v = 340\,m/s$

- kad se malo promijesa dobije se izraz

$u = \frac{f_2 - f_1}{f_2 + f_1} v$

$u = 1071\,km/h$

2.15

$f = 500\,Hz$

- detektor se giba
- izvos miruje

$u = 0.9\,v\,m/s$

$f' = f\,\frac{u+v}{v} = 950\,Hz$

2.16

$v_2 + v_1 = \frac{v}{10}$

$v_2 = \frac{v}{20}$ - brzina drugog

$v_1 = \frac{v}{20}$ - brzina prvog

$f = 1000\,Hz$

1. frekvencija koju proizvodi automobil f_{a1} , koju prima drugi f_{a2}

$f_{a1} = f\frac{v}{v+v_1} = f\frac{v}{1.05\,v} = \frac{f}{1.05}$

$f_{a2} = f_{a1}\frac{v-v_2}{v} = 0.95\,f_{a1} = \frac{0.95}{1.05}f = 904.76\,Hz$

2. frekvencija koja dolazi do zida f_z , frekvencija koju prima drugi f_{a2}

$f_z = f\frac{v}{v+v_1} = \frac{f}{1.05}$

$f_{a2} = f_z\frac{v+v_2}{v} = 1.05\,f_z = f = 1000\,Hz$

2.17

– najvece brzine su $u = \pm r\,\omega = \pm 75\,m/s$

$f_{min} = f(\frac{v}{v+u}) = 819\,Hz$

$f_{max} = f(\frac{v}{v-u}) = 1283\,Hz$

MAXWELL-ove jednadžbe

3.1

– gledamo valjak na udaljenosti r

$q = \int_S D\,d\vec{S} = D\,2\pi r\,l$

$D = \frac{q}{2\pi r\,l} = \frac{\rho}{2\pi r}$

$r = \sqrt{3^2+3^2} = 3\sqrt{2}$

$\cos\phi = \sin\phi = \frac{3\sqrt{2}}{3} = \frac{1}{\sqrt{2}}$

$D_X = \frac{\rho}{2\pi r}\cos\phi\,\vec{j} + \frac{\rho}{2\pi r}\sin\phi\,\vec{k}$

$D_Y = \frac{\rho}{2\pi r}\cos\phi\,\vec{i} + \frac{\rho}{2\pi r}\sin\phi\,\vec{k}$

$$D = D_X + D_Y = \frac{\rho}{2\pi r}\frac{1}{\sqrt{2}}(\vec{i}+\vec{j}+2\vec{k}) = 0.053(\vec{i}+\vec{j}+2\vec{k}) = 0.13\frac{(\vec{i}+\vec{j}+2\vec{k})}{\sqrt{6}}$$

3.2

- imamo površinu okruženo vodičem
- zanima nas tok kroz površinu
- po definiciji tok magnetskog polja je

$$\phi = \int_S \vec{B}\, d\vec{S} \qquad d\vec{S} = dS\,\vec{m}$$

- za naš slučaj $\vec{m} = \vec{k}$

$$\vec{B} = 0.05\cos\left(10^3 t\right)\frac{\vec{j}+\vec{k}}{\sqrt{2}}$$

$$\phi = -0.05\sin\left(10^3 t\right)\frac{\vec{j}+\vec{k}}{\sqrt{2}}\cdot\vec{k}\,S$$

$$\phi = -0.05\sin\left(10^3 t\right)\frac{S}{\sqrt{2}}$$

$$\varepsilon = \frac{-d\phi}{dt}$$

$$\varepsilon = \frac{0.05\cdot S}{\sqrt{2}}\cdot 10^3\cos\left(10^3 t\right) = 23\sin\left(10^3 t\right)$$

3.3

AMPEROV ZAKON

$$\oint \vec{H}\, d\vec{l} = I$$

a) $\oint \vec{H}\, d\vec{l} = I$

$$H\, 2\pi r = I$$

$$\vec{H} = \frac{I}{2\pi r}\vec{a}_\phi$$

b)

$$\int \vec{H}\, d\vec{l} = I_{kruga}$$

$$\vec{H} = \frac{I_{kruga}}{2\pi r}\vec{a}_\phi$$

$$\frac{I_{kruga}}{I} = \frac{\pi r^2}{\pi a^2}$$

$$\vec{H}=\frac{r^2}{a^2}\frac{I}{2\pi r}\vec{r}_\phi=\frac{I r}{2\pi a^2}\vec{a}_\phi$$

- drugi nacin je

$$\vec{J}=\frac{I}{a^2\pi}$$

$$\oint \vec{H}\,d\vec{l}=\int_S \vec{J}\,d\vec{S}$$

…

3.4

- u stacionarnom stanju imamo moment sile torzije

$M=D\theta$

- on je jednak momentu sile koji urokuje rotaciju
- imamo par sila a njihov moment jednak je umnosku jedne sile sa njihovom udaljenoscu

$M=F\,a$ - a je duljina stranice, odnosno udaljenost vodica

- gornji I doljnji okvur djeluju sa silama prema dolje odnosno prema gore pa ne utjecu na rotaciju

- pošto kad se zakrene sila koja uzrokuje zakretanje djeluje pod nekim kutem, tocnije $90-\theta$,
  $F=F_0\sin(90-\theta)=F_0\cos\theta$

$D\theta=F_0\sin\theta\,a$

$$F_0=\frac{D\theta}{\sin\theta}$$

- sila na vodic je

$F_0=100\cdot I\,B\,l=100\,I\,B\,a$ - jer ima 100 navoja, vrijedi superpozicija

$B=\frac{F_0}{100\,I\,a}=\frac{D\theta}{100\,I\,a^2\cos\theta}=3\cdot10^{-2}\,T$ - θ se unosi u stupnjevima jer je D zadan tako

3.5

l N $i=at^2$

- prema amperovom zakonu

$$\oint \vec{B}\,d\vec{l}=\mu_0\int_S \vec{J}\,d\vec{S}=\mu_0 J r^2\pi \qquad I=\int_S J\,d\vec{S}=J R^2\pi \qquad J=\frac{I}{R^2\pi}$$

$$2Br\pi=\frac{\mu_0 I}{R^2\pi}r^2\pi$$

$$B = \frac{\mu_0 a t^2}{2 R^2 \pi} r$$

- promjena struje uzrokuje promjenu magnetskog toka, promatramo promjenu magnetskog toka kroz ravninu presjeka

$$\phi = \int_S B \, dS = \int_S \frac{\mu_0 a t^2}{2 R^2 \pi} r = \frac{\mu_0 a t^2}{2 R^2 \pi} r \cdot R^2 \pi = \frac{\mu_0 a t^2}{2} r$$

$$\oint E \, dl = \frac{d\phi}{dt} = \frac{d}{dt} \frac{\mu_0 a t^2}{2} r = \mu_0 a t r$$

$$E l = \mu_0 a t r$$

$$E = \frac{\mu_0 a t}{l} r$$

3.6

a) $l = 1\text{m}$

$\omega = 20 \, s^{-1}$

$B = 0.05$

$$\varepsilon = B l v \qquad v(r) = \omega r$$

$$\varepsilon_S = \int_0^l B l \omega r = B \frac{l^3}{2} \omega = 0.5$$

b) površina kroz koju se mijenja tok je jednaka $S \cos\phi(t)$

$$\phi = \int_S \vec{B} \, d\vec{S} = B S \cos\phi$$

$$\varepsilon = \frac{d\phi}{dt} = B S \sin\phi \frac{d\phi}{dt} = B S \sin\phi \, \omega$$

- napon se inducira na svakoj od cetvrtina puta rotacije pa je
- imamo 100 zavoja I vrijedi superpozicija

$$\varepsilon_Z = 100 \int_0^{\frac{\pi}{2}} B S \sin\phi \, \omega = 100 \, B S \, \omega = 1$$

$$\frac{\varepsilon_S}{\varepsilon_Z} = \frac{1}{2}$$