Кандидат-студентски изпит

за Магистърски програми:
Безжични мрежи и устройства, Аерокосмическо инженерство и комуникации
Комуникации и физична електорника

Формули

Константи: елементарен електрически заряд: $e = 1{,}6.10^{-19}\,\mathrm{C}$
земно ускорение: $g = 10\,\mathrm{m/s}^2$
диелектрична проницаемост на вакуума: $\varepsilon_0 = 8{,}85.10^{-12}\,\mathrm{F/m}$
магнитна проницаемост на вакуума: $\mu_0 = 4\pi.10^{-7}\,\mathrm{H/m}$

Механикиа: ускорение на центростемителна сила: $a_c = v^2/r$

Електрично поле: Кулонова сила: $\vec{F} = \dfrac{q_1 q_2}{4\pi\varepsilon_0 r^2}\hat{r}$, където $\hat{r}$ е единичен вектор; Капацитет на плосък кондензатор: $C = \dfrac{A\varepsilon_0\varepsilon_r}{d}$; Енергия на зареден кондензатор: $W = \dfrac{CU^2}{2}$; Плътност на енергията на електр. поле: $W = \dfrac{\varepsilon_0\varepsilon_r E^2}{2}$.

Магнитно поле: Магнитна сила действаща върху заряд: $\vec{F}_L = q\vec{E} + q\vec{v}\times\vec{B}$.

Сила на проводник по който тече ток: $\mathrm{d}\vec{F} = I\displaystyle\int_M^N \mathrm{d}\vec{L}\times\vec{B}$.

Закон на Био-Савар: $\mathrm{d}\vec{F} = \dfrac{\mu_0\mu_r}{4\pi}\displaystyle\int \dfrac{I\mathrm{d}\vec{L}\times\vec{r}}{r^2}$.

Индукция на магнитно поле в центъра на кръгов проводник $B = \dfrac{\mu_0\mu_r I}{2R}$.

Индукция на магнитно поле в прав проводник $B = \dfrac{\mu_0\mu_r I}{2\pi a}$.

Електромагнитни вълни: $\mathcal{E}_{ind} = -\dfrac{\mathrm{d}\Phi}{\mathrm{d}t}, \quad i = -\dfrac{1}{R}\dfrac{\mathrm{d}\Phi}{\mathrm{d}t}, \quad c = \dfrac{1}{\sqrt{\varepsilon_0\mu_0}}, \quad v = \dfrac{1}{\sqrt{\varepsilon_0\varepsilon_r\mu_0\mu_r}}$

$v = \dfrac{\omega}{k}, \quad k = \dfrac{2\pi}{\lambda}, \quad n = \sqrt{\varepsilon_r\mu_r}$

Комплексни числа: $z = a + bi, \quad |z| = \sqrt{a^2+b^2}, \quad \varphi = \arg(z) = \mathrm{atan}\dfrac{b}{a}, \quad \mathrm{e}^{\pm i\varphi} = \cos\varphi \pm i\sin\varphi$.

Производни: $\dfrac{\mathrm{d}}{\mathrm{d}x}x^n = nx^{n-1}, \quad \dfrac{\mathrm{d}}{\mathrm{d}x}\sin(x) = \cos(x), \quad \dfrac{\mathrm{d}}{\mathrm{d}x}\cos(x) = -\sin(x),$

$$(f(x)g(x))' = f'(x)g(x) + f(x)g'(x), \quad \left(\frac{f(x)}{g(x)}\right)' = \frac{f'(x)g(x) - f(x)g'(x)}{g^2(x)}, \quad (f(g(x)))' = f'(g)g'(x).$$

Интеграли: нека $F'(x) = f(x) : \displaystyle\int f(x)\mathrm{d}x = F(x) + C, \quad \int_a^b f(x)\mathrm{d}x = F(b) - F(a)$

Линейна Алгебра: $\mathbf{A} = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \quad \Delta = \det(\mathbf{A}) = |\mathbf{A}| = ad - bc, \quad \mathbf{A}^{-1} = \dfrac{1}{\Delta}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$

Ако $\mathbf{A}\mathbf{v} = \lambda\mathbf{v}$, където $\mathbf{v}$ е собствен вектор, λ е собствена стойност на $\mathbf{A}$,
характеристичното уравнение е $|\mathbf{A} - \lambda\mathbf{I}| = 0$

Векторни полета: $\vec{a} = a_x\hat{x} + a_y\hat{y} + a_z\hat{z}$, $\vec{b} = b_x\hat{x} + b_y\hat{y} + b_z\hat{z}$, където $\hat{x}$, $\hat{y}$ $\hat{z}$ - единични вектори

$$c = \vec{a}\cdot\vec{b} = a_x b_x + a_y b_y + a_z b_z, \quad \vec{c} = \vec{a}\times\vec{b} = \begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ a_x & a_y & a_z \\ b_x & b_y & b_z \end{vmatrix}$$

$$\nabla = \begin{bmatrix} \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \end{bmatrix}^T, \quad \mathrm{grad}f = \nabla f = \begin{bmatrix} \frac{\partial f}{\partial x} & \frac{\partial f}{\partial y} & \frac{\partial f}{\partial z} \end{bmatrix}, \quad \mathrm{div}\vec{\mathbf{B}} = \nabla\cdot\vec{\mathbf{B}}, \quad \mathrm{rot}\vec{\mathbf{B}} = \nabla\times\vec{\mathbf{B}}.$$

Тейлър: $f(x) = \displaystyle\sum_{n=0}^{\infty}\dfrac{f^{(n)}(x_0)}{n!}(x-x_0)^n$. **Фурие:** $f(t) = \displaystyle\sum_{n=-\infty}^{\infty} c_n\mathrm{e}^{i2\pi nf_0 t}$, като $c_n = \dfrac{1}{T}\displaystyle\int_{-T/2}^{T/2} f(t)\mathrm{e}^{i2\pi nf_0 t}\mathrm{d}t$

Entrance Exam Formulas

for the master's degree program
"Aerospace Engineering and Communications"

Constants: Elementary charge: $e = 1{,}6.10^{-19}\,\mathrm{C}$
Earth's gravity acceleration: $g = 10\,\mathrm{m/s^2}$
Dielectric permittivity of vacuum: $\varepsilon_0 = 8{,}85.10^{-12}\,\mathrm{F/m}$
Magnetic permeability of vacuum: $\mu_0 = 4\pi.10^{-7}\,\mathrm{H/m}$

Mechanics: Centrifugal force acceleration: $a_c = v^2/r$

Electric field: Coulomb force: $\vec{F} = \dfrac{q_1 q_2}{4\pi\varepsilon_0 r^2}\hat{r}$, where $\hat{r}$ is a unit vector; Capacity of flat capacitor: $C = \dfrac{A\varepsilon_0\varepsilon_r}{d}$;
Energy of charged capacitor: $W = \dfrac{CU^2}{2}$; Energy density of the electric field: $W = \dfrac{\varepsilon_0\varepsilon_r E^2}{2}$.

Magnetic field: Magnetic force acting on a charge: $\vec{F}_L = q\vec{E} + q\vec{v}\times\vec{B}$.
Force acting on a straight current carrying conductor: $\mathrm{d}\vec{F} = I\displaystyle\int_M^N \mathrm{d}\vec{L}\times\vec{B}$.

Biot-Savart law: $\mathrm{d}\vec{F} = \dfrac{\mu_0\mu_r}{4\pi}\displaystyle\int \dfrac{I\mathrm{d}\vec{L}\times\vec{r}}{r^2}$.

Magnetic field intensity at the center of a round conductor: $B = \dfrac{\mu_0\mu_r I}{2R}$.

Magnetic field intensity around a straight conductor: $B = \dfrac{\mu_0\mu_r I}{2\pi a}$.

Electromagnetic waves: $\mathcal{E}_{ind} = -\dfrac{\mathrm{d}\Phi}{\mathrm{d}t}$, $\quad i = -\dfrac{1}{R}\dfrac{\mathrm{d}\Phi}{\mathrm{d}t}$, $\quad c = \dfrac{1}{\sqrt{\varepsilon_0\mu_0}}$, $\quad v = \dfrac{1}{\sqrt{\varepsilon_0\varepsilon_r\mu_0\mu_r}}$

$v = \dfrac{\omega}{k}$, $\quad k = \dfrac{2\pi}{\lambda}$, $\quad n = \sqrt{\varepsilon_r\mu_r}$

Complex numbers: $z = a + bi$, $\quad |z| = \sqrt{a^2 + b^2}$, $\quad \varphi = \arg(z) = \operatorname{atan}\dfrac{b}{a}$, $\quad \mathrm{e}^{\pm i\varphi} = \cos\varphi \pm i\sin\varphi$.

Derivatives: $\dfrac{\mathrm{d}}{\mathrm{d}x}x^n = nx^{n-1}$, $\quad \dfrac{\mathrm{d}}{\mathrm{d}x}\sin(x) = \cos(x)$, $\quad \dfrac{\mathrm{d}}{\mathrm{d}x}\cos(x) = -\sin(x)$,

$$(f(x)g(x))' = f'(x)g(x) + f(x)g'(x), \quad \left(\frac{f(x)}{g(x)}\right)' = \frac{f'(x)g(x) - f(x)g'(x)}{g^2(x)}, \quad (f(g(x)))' = f'(g)g'(x).$$

Integrals: if $F'(x) = f(x)$: $\displaystyle\int f(x)\mathrm{d}x = F(x) + C$, $\quad \displaystyle\int_a^b f(x)\mathrm{d}x = F(b) - F(a)$

Linear Algebra: $\mathbf{A} = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ $\quad \Delta = \det(\mathbf{A}) = |\mathbf{A}| = ad - bc$, $\quad \mathbf{A}^{-1} = \dfrac{1}{\Delta}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$

If $\mathbf{Av} = \lambda\mathbf{v}$, where $\mathbf{v}$ is a eigenvector, λ is a eigenvalue of $\mathbf{A}$,
the characteristic equation is $|\mathbf{A} - \lambda\mathbf{I}| = 0$

Vector Fields: $\vec{a} = a_x\hat{x} + a_y\hat{y} + a_z\hat{z}$, $\vec{b} = b_x\hat{x} + b_y\hat{y} + b_z\hat{z}$, where $\hat{x}$, $\hat{y}$ $\hat{z}$ - unit vectors

$$c = \vec{a}\cdot\vec{b} = a_x b_x + a_y b_y + a_z b_z, \quad \vec{c} = \vec{a}\times\vec{b} = \begin{vmatrix} \hat{x} & \hat{y} & \hat{z} \\ a_x & a_y & a_z \\ b_x & b_y & b_z \end{vmatrix}$$

$$\nabla = \begin{bmatrix} \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \end{bmatrix}^T, \quad \mathrm{grad}f = \nabla f = \begin{bmatrix} \frac{\partial f}{\partial x} & \frac{\partial f}{\partial y} & \frac{\partial f}{\partial z} \end{bmatrix}, \quad \mathrm{div}\vec{\mathbf{B}} = \nabla\cdot\vec{\mathbf{B}}, \quad \mathrm{rot}\vec{\mathbf{B}} = \nabla\times\vec{\mathbf{B}}.$$

Taylor: $f(x) = \displaystyle\sum_{n=0}^{\infty}\frac{f^{(n)}(x_0)}{n!}(x - x_0)^n$. **Fourier:** $f(t) = \displaystyle\sum_{n=-\infty}^{\infty} c_n\mathrm{e}^{i2\pi nf_0 t}$, and $c_n = \dfrac{1}{T}\displaystyle\int_{-T/2}^{T/2} f(t)\mathrm{e}^{i2\pi nf_0 t}\mathrm{d}t$