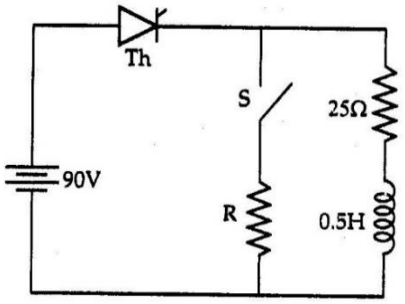
بحث مرجعي 2020

Instructor Dr. Wagih G. Girgis **No of Pages: 8** **No of Questions: 5**

اسم الطالب : الرقم القومي:

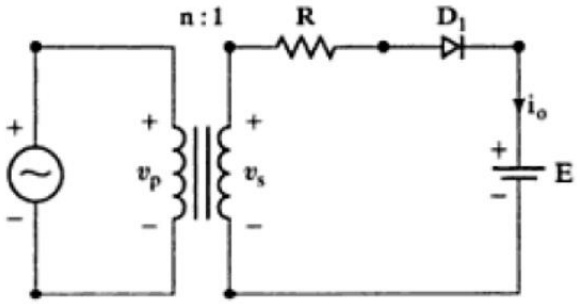
1.a. A thyristor has a capacitive current of 9 mA flowing through the reverse biased junction. If the capacitance of depletion layer is 30 X 10^{-12} F, find dv/dt which can trigger the thyristor.
[5 Points]

1.b. In the thyristor circuit of shown in Fig.
the thyristor latching current is 60 mA and is fired by a pulse of width 50 μs. Supply voltage is 90 V. Find:
(a) If the thyristor will fire with switch S open,
(b) Maximum value of R so that thyristor may turn on When switch S closed.
[15 Points]



2. The battery voltage in Fig. has E = 20V and its capacity is 200Wh.The average charging current should be I_{dc}= 10 A. The primary input voltage is V= 120V,60 Hz, and the transformer has a turns ratio of n = 2:1. Calculate:

(a) The conduction angle of the diode,
(b) The current-limiting resistance R
(c) The power rating P_R of R,
(d) The charging time h in hours,
(e) The rectifier efficiency, and
(f) The peak inverse voltage PIV of the diode. **[25 Points]**



3. A half wave diode rectifier uses a diode with a forward resistance of 400 ohms. The input is 230 V (rms) and full load dc current is 60 mA. Find:
(a) dc voltage at no load, (b) dc voltage at full load, (c) regulation. **[15 Points]**

4. A single phase diode bridge rectifier has a input voltage of 200 V (peak). Load resistance is 10 ohms. Find:

a) Average load voltage,
b) rms load voltage,
c) Ripple factor
d) D.C power
e) AC power
f) Efficiency

[15 Points]

5. The single-phase ac voltage controller of Fig. has a 120-V rms source at 60 Hz and a load resistance of 40Ω. Determine

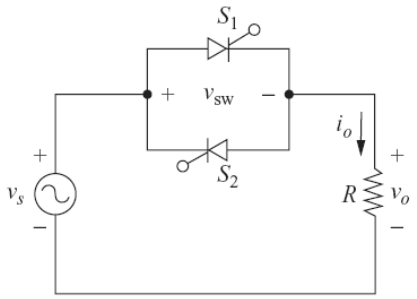
(a) The delay angle α required to deliver 300 W.

(b) The rms source current

© The rms and average currents in the SCR's,

(d) The power factor, and

[25 Points]



Commonly Used Formula

For a= 0 b= π $\int_0^{\pi} \sin x \, dx = 2$ $\int_0^{\pi} sin^2 x \, dx = \frac{\pi}{2}$

For a= α b= π $\int_{\propto}^{\pi} \sin x \, dx = (1 + cos \propto)$ $\int_{\propto}^{\pi} sin^2 x \, dx = \frac{\pi - \alpha}{2} + \frac{sin2\propto}{4}$

For a=α b=π-α

$\int_{\propto}^{\pi-\propto} sin\, x \, dx = 2cos \propto$ $\int_{\propto}^{\pi-\alpha} sin^2 x \, dx = \frac{\pi-2\alpha}{2} + \frac{sin2\propto}{2}$

$$\int_{\alpha}^{\pi-\alpha} (sin\, x - A)^2 \, dx = 0.5 \sin 2\, a - 4A\, cos\, \alpha + (A^2 + 0.5)(\pi - 2\alpha)$$

Battery Charger (half wave)

$\alpha = \sin^{-1} \frac{E}{V_m}$ $A = \frac{E}{V_m}$ $\int_{\alpha}^{\pi-\alpha} (\sin x - A)\, dx = 2\cos \alpha - A(\pi - \alpha)$

$$I_{dc} = \frac{1}{2\pi R}(2\, V_m \cos \alpha + 2E\alpha - \pi E)$$

$$V_{rms}^2 = \frac{V_m^2}{2\pi}\left[\frac{\sin 2\alpha}{2} - \frac{4E}{V_m}\cos\alpha + \left(\left(\frac{E}{V_m}\right)^2 + 0.5\right)(\pi - 2\alpha)\right]$$

$$I_{rms}^2 = \frac{1}{2\pi R^2}\left[V_m^2 \frac{\sin 2\alpha}{2} - 4EV_m \cos\alpha + (E^2 + 0.5V_m^2)(\pi - 2\alpha)\right)$$

Full wave I_{dc}**(full) = 2* I**$_{dc}$**(half)** I_{rms}**(Full) =1.414* I**$_{rms}$**(half)**

Fourier Series

$$v_0(t) = \frac{4V_m}{\pi}\left(\frac{\sin \omega t}{1} + \frac{\sin 3\omega t}{3} + \frac{\sin 5\omega t}{5} + \cdots\right)$$ Square Wave

$$v_0(t) = \frac{V_m}{\pi} + \frac{V_m}{2}\sin(\omega_0 t) - \frac{2V_m}{3\pi}\cos 2\omega t - \frac{2V_m}{15\pi}\cos 4\omega t - \frac{2V_m}{35\pi}\cos 6\omega t - \cdots$$ Half Wave

$$v_0(t) = \frac{2V_m}{\pi} - \frac{4V_m}{3\pi}\cos 2\omega t - \frac{4V_m}{15\pi}\cos 4\omega t - \frac{4V_m}{35\pi}\cos 6\omega t - \cdots$$ Full Wave

Half Wave

$$V_o = \frac{1}{2\pi}\int_{\alpha}^{\pi} V_m \sin(\omega t)\, d(\omega t) = \frac{V_m}{2\pi}(1 + \cos\alpha)$$

$$V_{\text{rms}} = \frac{V_m}{2}\sqrt{1 - \frac{\alpha}{\pi} + \frac{\sin(2\alpha)}{2\pi}}$$

Full Wave

$$V_o = \frac{1}{\pi}\int_{\alpha}^{\pi} V_m \sin(\omega t)\, d(\omega t) = \frac{V_m}{\pi}(1 + \cos\alpha)$$

$$V_{\text{rms}} = V_m\sqrt{\frac{1}{2} - \frac{\alpha}{2\pi} + \frac{\sin(2\alpha)}{4\pi}}$$

For uncontrolled rectifier α = 0

Rectifier RL load: Full Wave Fourier

$$v_0(t) = \frac{2V_m}{\pi} - \frac{4V_m}{3\pi}\cos 2\omega t - \frac{4V_m}{15\pi}\cos 4\omega t - \frac{4V_m}{35\pi}\cos 6\omega t - \cdots$$

$$I_0 = \frac{V_0}{R} \qquad I_n = \frac{V_n}{Z_n} = \frac{V_n}{|R + jn\omega L|}$$

$$V_o = \frac{2V_m}{\pi} \qquad I_0 = \frac{V_0}{R} \qquad I_{\text{rms}} = \sqrt{\sum I_{n,\text{rms}}^2} \qquad \text{pf} = \frac{P}{S} = \frac{P}{V_{s,\text{rms}} I_{s,\text{rms}}}$$

$$P = I_{\text{rms}}^2 R \qquad I_{D,\text{avg}} = \frac{I_o}{2} \qquad I_{D,\text{rms}} = \frac{I_{\text{rms}}}{\sqrt{2}}$$

inductance X**L** = jω L ω = 2πf f = frequency
Capacitance X**c** = 1/jωC
For **RLC** $Z_n = R + j\,X_n = R + j\,n\omega L - j(1/n\omega C)$ $X_n = (n\omega L - (1/n\omega C))$

$$|Z| = \sqrt{R^2 + X^2} = \sqrt{R^2 + (\omega L - 1/\omega C)^2}$$

AC Voltage Controller

$$V_{o,\text{rms}} = \frac{V_m}{\sqrt{2}}\sqrt{1 - \frac{\alpha}{\pi} + \frac{\sin(2\alpha)}{2\pi}} \qquad I_{o,\text{rms}} = \frac{V_{o,\text{rms}}}{R}$$

$$I_{\text{SCR,avg}} = \frac{V_m}{2\pi R}(1 + \cos\alpha) \qquad I_{\text{SCR,rms}} = \frac{I_{o,\text{rms}}}{\sqrt{2}}$$

$$P = \frac{V_{o,\text{rms}}^2}{R} \qquad \text{pf} = \sqrt{1 - \frac{\alpha}{\pi} + \frac{\sin(2\alpha)}{2\pi}}$$

1	0	0.9956	20	0.9667	40	0.8969	60	0.7810	80	0.6245	100	0.4422	120	0.2559	140	0.0939	160
1.0000	1	0.9949	21	0.9643	41	0.8922	61	0.7741	81	0.6158	101	0.4327	121	0.2470	141	0.0870	161
1.0000	2	0.9942	22	0.9617	42	0.8874	62	0.7670	82	0.6071	102	0.4233	122	0.2381	142	0.0803	162
1.0000	3	0.9933	23	0.9591	43	0.8825	63	0.7599	83	0.5983	103	0.4138	123	0.2293	143	0.0738	163
1.0000	4	0.9924	24	0.9564	44	0.8774	64	0.7526	84	0.5895	104	0.4044	124	0.2205	144	0.0675	164
0.9999	5	0.9915	25	0.9535	45	0.8722	65	0.7453	85	0.5806	105	0.3950	125	0.2119	145	0.0613	165
0.9999	6	0.9904	26	0.9505	46	0.8670	66	0.7378	86	0.5716	106	0.3855	126	0.2033	146	0.0553	166
0.9998	7	0.9893	27	0.9474	47	0.8615	67	0.7303	87	0.5626	107	0.3761	127	0.1948	147	0.0495	167
0.9997	8	0.9881	28	0.9443	48	0.8560	68	0.7226	88	0.5536	108	0.3667	128	0.1864	148	0.0440	168
0.9996	9	0.9868	29	0.9409	49	0.8504	69	0.7149	89	0.5445	109	0.3573	129	0.1780	149	0.0386	169
0.9994	10	0.9855	30	0.9375	50	0.8446	70	0.7071	90	0.5353	110	0.3479	130	0.1698	150	0.0335	170
0.9993	11	0.9840	30	0.9340	51	0.8388	71	0.6992	91	0.5262	111	0.3386	131	0.1617	151	0.0286	171
0.9990	12	0.9825	32	0.9303	52	0.8328	72	0.6912	92	0.5169	112	0.3292	132	0.1537	152	0.0240	172
0.9988	13	0.9808	33	0.9266	53	0.8267	73	0.6832	93	0.5077	113	0.3199	133	0.1457	153	0.0196	173
0.9985	14	0.9791	34	0.9227	54	0.8205	74	0.6750	94	0.4984	114	0.3106	134	0.1379	154	0.0156	174
0.9981	15	0.9773	35	0.9187	55	0.8142	75	0.6668	95	0.4891	115	0.3014	135	0.1303	155	0.0119	175
0.9977	16	0.9754	36	0.9146	56	0.8078	76	0.6585	96	0.4797	116	0.2922	136	0.1227	156	0.0085	176
0.9973	17	0.9734	37	0.9103	57	0.8012	77	0.6501	97	0.4704	117	0.2831	137	0.1153	157	0.0055	177
0.9968	18	0.9712	38	0.9060	58	0.7946	78	0.6416	98	0.4610	118	0.2740	138	0.1080	158	0.0030	178
0.9962	19	0.9690	39	0.9015	59	0.7879	79	0.6331	99	0.4516	119	0.2649	139	0.1009	159	0.0011	179