104 學年度四技二專第五次聯合模擬考試
電機與電子群　專業科目(一)　詳解

104-5-03-4、104-5-04-4

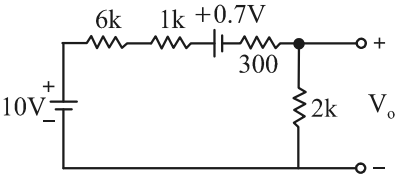
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
C	B	D	A	B	C	A	C	A	D	B	C	A	D	B	C	A	C	B	A	D	C	A	B	B
26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
B	A	D	C	C	A	B	D	B	D	A	C	A	B	D	C	B	A	C	A	B	C	D	C	D

第一部分：電子學

1. (C) 價電子位於原子核之最外層軌道上，當變成爲自由電子時，爲吸收能量

2. $\frac{i_{o_2}}{i_{o_1}} = 2^N = 2^{\frac{1}{2}} = \sqrt{2}$ ($\because N = \frac{\Delta T}{10} = \frac{5}{10} = \frac{1}{2}$)

3. $V_o = (10-0.7)\times\frac{2}{6+1+2+0.3} = \cancel{9.3}\times\frac{2}{\cancel{9.3}} = 2$ V



4. $V_{2m} = \frac{50\sqrt{2}}{10} = 5\sqrt{2}$ V

$\therefore V_{RL} = \frac{5\sqrt{2}}{\pi}\times\frac{2}{0.5+2} = 1.8$ V

$\therefore P_L = \frac{{V_{RL}}^2}{R_L} = \frac{1.8^2}{2\text{ k}} = 1.62$ mW

5. $PIV = 2V_{2m}' = 10\sqrt{2}$ V

$\therefore V_{2m}' = 5\sqrt{2}$ V $\Rightarrow V_{2m} = 2V_{2m}' = 10\sqrt{2}$

$\therefore \frac{V_{im}}{V_{2m}} = \frac{5}{1} \Rightarrow V_{im} = 5\times 10\sqrt{2} = 50\sqrt{2}$

$\therefore V_i(t) = 50\sqrt{2}\sin\omega t$

6. $V_i = -5$ V $\Rightarrow D_2$ on, D_1 off

$V_o = (-5+2)\times\frac{5}{10+5} + (-2)$

$= (-3)\times\frac{1}{3} - 2 = -1-2 = -3$ V

7. (A) 降低基極寬度與<u>提高</u>射極雜質濃度，可提高電晶體放大倍率

8. $\beta = \frac{\alpha}{1-\alpha} = \frac{0.98}{1-0.98} = 49$

$\beta' = \frac{0.96}{1-0.96} = 24$

$\Delta\beta = 49-24 = 25$

9. $V_{CE} \approx 0.2$ V

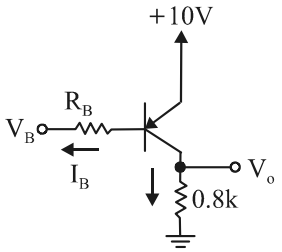
10. ① $R_B = 40\text{ k} // 10\text{ k} = 8\text{ k}\Omega$

$V_B = 10\times\frac{10}{40+10} = 2$ V

② $I_B = \frac{10-0.7-2}{8}$

$\fallingdotseq 0.91$ mA

$I_{C(sat)} = \frac{10-0.2}{0.8} = 12.25$ mA



$I_{B(min)} = \frac{I_{C(sat)}}{50} = 0.245$ mA

$\because I_B > I_{B(min)}$ ，$\therefore$BJT 飽和，$\therefore I_C = I_{C(sat)} = 12.25$ mA

11. ① $(12-0.7) = (1+100)I_B\times 2 + 150I_B + (1+100)I_B\times 1$

$\Rightarrow I_B = \frac{11.3}{453} \fallingdotseq 0.025$ mA

$\therefore r_\pi = \frac{V_T}{I_B} = \frac{25}{0.025} = 1\text{ k}\Omega$

② $\frac{V_o}{V_i} = \frac{V_o}{V_b}\times\frac{V_b}{V_i} = -100\times\frac{(75//2)}{1}\times\frac{(75//1)}{(75//1)+1.5}$

$\fallingdotseq -100\times 2\times 0.4 = -80$

12. $A_i = \frac{I_o}{I_i} = \frac{I_o}{i_C}\times\frac{i_C}{i_b}\times\frac{i_b}{I_i}$

$= 1\times 150\times\frac{(36//4)}{(36//4)+2} \fallingdotseq 150\times 0.64 = 96$

13. $\alpha = \frac{49}{1+49} = 0.98$ ， $r_e = \frac{1.5\text{ k}}{1+49} = 30\ \Omega$

$\therefore A_V = \alpha\times\frac{Z_L}{r_e} = 0.98\times\frac{(10\text{ k}//90\text{ k})}{30} = 294$

16. $20\text{ dBm} = 10\log\frac{P_o}{1\text{ m}} \Rightarrow P_o = 100$ mW

$\Rightarrow 100\text{ m} = {I_o}^2\times 10 \Rightarrow I_o = 0.1$ A

18. ① $V_{GS} = 16\times\frac{1.5}{4.5+1.5} - 2I_D = (4-2I_D)$

② $I_D = 4\times(1-\frac{4-2I_D}{-2})^2 = 4\times(3-I_D)^2$

$\Rightarrow 4{I_D}^2 - 25I_D + 36 = 0$

$\Rightarrow I_D = 2.25$ mA 或 4 mA (不合)

$\therefore V_D = 16 - 2.25\times 4 = 7$ V

19. ① $V_{GS} = V_{DS} = 5 - 5I_D$

② $I_D = 0.6\times(5-5I_D-1)^2$

$\Rightarrow I_D = 0.6$ mA 或 1.06 mA (不合)

③ $g_m = 2\times0.6\times[(5-5\times0.6)-1] = 1.2$ mA/V^2

④ $A_V = \dfrac{V_o}{V_S} = -g_m\times(R_D \,//\, R_L) = -1.2\times(5\,//\,5) = -3$

20. 當 $R_1 = 10$ k ，$R_2 = 15$ k

$V_o = 7.5\text{ V} = (\dfrac{R_2}{R_1})\times(10-5)$ ，$\therefore \dfrac{R_2}{R_1} = 1.5$

21. ① $t = 0\sim2$ ms

$V_o = -(0.1\,\mu\times5\text{ k})\times\dfrac{20}{2\text{ ms}} = -5$ V

② $t = 2\sim4$ ms

$V_o = -(0.1\,\mu\times5\text{ k})\times\dfrac{0-20}{(4-2)\text{ ms}} = +5$ V

③ $V_{o(p-p)} = 5-(-5) = 10$ V

22. ① $V_H = 2\times V_{sat}\times\dfrac{R_2}{R_1}$

$\Rightarrow 12 = 2\times V_{sat}\times\dfrac{5}{10} \Rightarrow V_{sat} = 12$ V

② $V_{UT} = 10.5 = V_R\times\dfrac{10+5}{10}+\dfrac{5}{10}\times12 \Rightarrow V_R = 3$ V

24. $f = \dfrac{1}{2\cdot R\cdot C\times\ln(1+\dfrac{2R_2}{R_1})}$

$= \dfrac{1}{2\times10\text{ k}\times1\,\mu\text{F}\times\ln(1+\dfrac{2\times10}{5})} = 31.25$ Hz

25. $V_{UT} = +15\text{ V}\times\dfrac{R_2}{R_1+R_2} = 15\times\dfrac{10}{10+5} = 10$ V

第二部分：基本電學

26. $I = \dfrac{Q}{t} = \dfrac{5\times10^5\times1.6\times10^{-19}}{1\times10^{-9}} = 8\times10^{-5}$ A

$P = I^2\times R = (8\times10^{-5})^2\times100\text{ k} = 0.64$ mW

27. $W = Pt = Q\times V$

$\Rightarrow t = \dfrac{Q\times V}{P} = \dfrac{50\times3600\times2\times12}{20}$

$= 216000$ s $= 60$ hrs

28. $R' = \rho\cdot\dfrac{\frac{1}{2}\ell}{(\frac{2}{1.6})^2\text{ A}} = \dfrac{1}{2}\times\dfrac{16}{25}\rho\cdot\dfrac{\ell}{A} = \dfrac{8}{25}R$

$\therefore R' = \dfrac{8}{25}\times2.5 = 0.8\ \Omega$

29. $R = 20\times10^3\ \Omega\pm10\% \Rightarrow R_{max} = 22\text{ k}\Omega$

$\therefore P_{max} = (10\times10^{-3})^2\times R_{max} = 2.2$ W

30. 令 $R_1 = 2R$ ，$R_2 = 3R$ ，$R_3 = 6R$

$\therefore I_{R3} = \dfrac{2\times R_2}{R_3} = \dfrac{2\times3R}{6R} = 1$ A

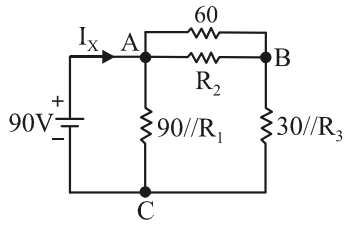
$\Rightarrow I_T = I_{R1} = 2+1 = 3$ A

$\therefore R_T = \dfrac{120\text{V}}{I_T} \Rightarrow R_1+(R_2\,//\,R_3) = \dfrac{120}{3}$

$\Rightarrow 4R = 40 \Rightarrow R = 10$

$\therefore P_{R3} = {I_{R3}}^2\times R_3 = 1^2\times(6\times10) = 60$ W

31. 原圖



$R_1 = \dfrac{60\times30+60\times20+20\times30}{20} = \dfrac{3600}{20} = 180\ \Omega$

$R_2 = \dfrac{3600}{30} = 120\ \Omega$ ，$R_3 = \dfrac{3600}{60} = 60\ \Omega$

$I_X = \dfrac{90}{90\,//\,R_1\,//\,[(60\,//\,R_2)+(30\,//\,R_3)]} = \dfrac{90}{30} = 3$ A

32. $P_{5\Omega} = (\dfrac{12-6}{5})^2\times5 = 7.2$ W

33. ① $R_L = 1+(6\,//\,12) = 5\ \Omega$

②2 A 開路：$I' = \dfrac{36}{12+(6\,//\,6)}\times\dfrac{6}{6\times6} = \dfrac{6}{5}$ A

③36 V 短路：$I'' = (-2)\times\dfrac{(6\,//\,12)}{6+(6\,//\,12)} = -\dfrac{4}{5}$ A

$\therefore I = I'+I'' = \dfrac{2}{5}\text{ A} = 0.4$ A

34. ① $C_T = \dfrac{600\times(100+200)}{600+(100+200)} = 200\ \mu\text{F}$

② $Q_T = 100\ \mu\times100+200\ \mu\times50 = 20000\ \mu\text{C}$

$V = \dfrac{Q_T}{C_T} = 100$ V

35. $W = \dfrac{1}{2}\times C_T\times50^2 = \dfrac{1}{2}\times200\ \mu\text{F}\times2500$

$= 2500\times10^{-4} = 0.25$ J

36. (B) $L' = \dfrac{\mu A\cdot(\frac{1}{2}N)^2}{\frac{1}{2}\ell} = \dfrac{1}{2}\dfrac{\mu A\cdot N^2}{\ell} = \dfrac{1}{2}\times L = 5$ H

(C) $L' = \dfrac{\mu\times(2A)\cdot(2N)^2}{\ell} = 8\dfrac{\mu A\cdot N^2}{\ell} = 8\times L = 80$ H

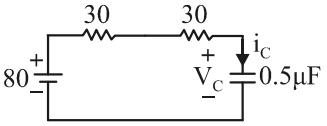
(D) $L' = \dfrac{\mu(\frac{1}{2}A)\cdot(\frac{1}{2}N)^2}{\ell} = \dfrac{1}{8}\dfrac{\mu A\cdot N^2}{\ell} = \dfrac{1}{8}\times L = 1.25$ H

37. ① $L_A = N_A\cdot\dfrac{\phi_A}{I_A} \Rightarrow 8 = N_A\times\dfrac{8\times10^{-1}}{10} \Rightarrow N_A = 100$ 匝

② $K = \dfrac{5\times10^{-1}}{8\times10^{-1}} = \dfrac{5}{8}$ ，$M = N_B\times\dfrac{5\times10^{-1}}{10}$

③ $N_B\times\dfrac{5\times10^{-1}}{10} = \dfrac{5}{8}\times\sqrt{8\times72} = 15$ ，$\therefore N_B = 300$ 匝

38. 原圖



① $\tau = (30+30)\times 0.5\ \mu = 30\ \mu s$

② $V_C(t) = 80\times(1-e^{-\frac{t}{30\mu}})$

$\Rightarrow V_C(60\ \mu s) = 80\times(1-0.135) = 69.2\ V$

③ $i_C(60\ \mu s) = \dfrac{80-V_C(60\ \mu s)}{60} = 0.18\ A$

39. 原圖(S→①)

(1) $t = 0\ s$ ，S→②， $i_L(0^+) = \dfrac{48}{4+6} = 4.8\ A$

(2) $I = 4.8\times\dfrac{12}{12+6} = 3.2\ A$

40. $F.F_{三角波} = \dfrac{2}{\sqrt{3}} \fallingdotseq 1.16$

$F.F_{正弦波} = \dfrac{\pi}{2\sqrt{2}} \fallingdotseq 1.11$

$F.F_{方波} = 1$

41. ① $\overline{V}_1 = \dfrac{20}{\sqrt{2}}\angle 60°$ ， $\overline{V}_2 = \dfrac{20}{\sqrt{2}}\angle 120°$

② $\overline{V}_A = \overline{V}_1 + \overline{V}_2 = j\dfrac{20}{\sqrt{2}}\times\sqrt{3}$

$\Rightarrow V_A(t) = 20\sqrt{3}\sin(314t+90°) = 20\sqrt{3}\cos 314t$

③ $\overline{V}_B = \overline{V}_1 - \overline{V}_2 = \dfrac{20}{\sqrt{2}} \Rightarrow V_B(t) = 20\cdot\sin 314t$

42. $i_C(t) = \sqrt{2}\cdot\sin(500t+67°) \Rightarrow \bar{I}_C = 1\angle 67° = \bar{I}$

$\overline{Z} = \dfrac{\overline{V}_S}{\bar{I}} = \dfrac{100\angle 30°}{1\angle 67°} = 100\angle -37°$

$= 80 - j60 = 80 + j100 - jX_C$

$\Rightarrow X_C = 160\ \Omega = \dfrac{1}{500\times C} \Rightarrow C = 12.5\ \mu F$

43. ① $\bar{I}_1 = 5\angle -53°\times\dfrac{j30}{40+j30} = 3\angle 0° = 3$

② $\bar{I}_2 = \dfrac{10}{\sqrt{2}}\angle 37°\times\dfrac{-j4}{4-j4} = 5\angle -8°$

③ $\dfrac{|I_1|}{|I_2|} = \dfrac{3}{5} = 0.6$

44. $\overline{V} = \dfrac{100}{\sqrt{2}}\angle -30°$ ， $\bar{I} = \dfrac{50}{\sqrt{2}}\angle 30°$ 超前

$P_{max} = VI\cdot(\cos 60° + 1) = 3750\ W$

45. ① $\overline{Z} = j50 + (50+j50)\ //\ (50-j50)$

$= 50 + j50 = 50\sqrt{2}\angle 45°\ \Omega$

② $I_{dc} = \dfrac{200}{50} = 4\ A$ (C→開路，L 短路)

③ $\bar{I}_{AC} = \dfrac{\frac{200}{\sqrt{2}}\angle 0°}{50\sqrt{2}\angle 45°} = 2\angle -45°\ A$

$\Rightarrow i_{ac}(t) = 2\sqrt{2}\sin(100t-45°)\ A$

④ $i_{(t)} = 4 + i_{ac}(t) = 4 + 2\sqrt{2}\sin(100t-45°)\ A$

46. $\bar{I}_1 = \dfrac{120\angle 0°}{6+j8} = 12\angle -53°\ A$

$\bar{I}_2 = \dfrac{120\angle 0°}{8-j6} = 12\angle +37°\ A$

$Q_L = I_1^2\times 8$ ， $Q_C = I_2^2\times 6$

$\therefore Q_T = Q_L - Q_C = 12^2\times(8-6) = 288\ VAR$

47. $X_{Lo} = 2\pi f_o L = 10$ ， $Q = \dfrac{X_{Lo}}{R} = \dfrac{10}{2.5} = 4$

$\therefore BW = \dfrac{f_o}{Q} = \dfrac{\frac{10^3}{2\pi}}{4} = \dfrac{125}{\pi}\ Hz$

48. (A) RLC 串並聯諧振電路中，Q 爲電抗功率與平均功率之比值

(B) $Q = \dfrac{1}{R}\times\sqrt{\dfrac{L}{C}}$

(C) 成反比

49. $V_P = \dfrac{V_\ell}{\sqrt{3}} = \dfrac{150}{\sqrt{3}}\ V$

$I_P = \dfrac{V_P}{30+j40} = \dfrac{\frac{150}{\sqrt{3}}}{50\angle 53°} = \sqrt{3}\angle -53°\ A$

$Q_T = 3V_P\cdot I_P\cdot\sin 53° = 3\times\dfrac{150}{\sqrt{3}}\times\sqrt{3}\times\dfrac{4}{5} = 360\ VAR$

50. $PF = \cos 53° = 0.6$ 滯後