

Electronics

1. An one-transistor circuit is shown in Figure 1. If the transistor has its $h_{fe} = 120$, $V_{CC} = 30\text{ V}$, $V_s = 0.5\text{ V(ac)}$, find the followings.
 - (a) Sketch the dc load line of this circuit;
 - (b) Calculate I_C at operating condition;
 - (c) Point out the Q point at this operating condition;
 - (d) Sketch the amplification of ac sinewave input and ac output at appropriate place on the figure.
 - (e) If the operating frequency is 120 Hz to 20 KHz, find C_b and C_e with proper value. (15%)

2. In Figure 1, the transistor can be equivalent to a H-parameter circuit in common-emitter basis.
 - (a) Sketch an equivalent H-parameter circuit by showing proper footnotes as b, c, e, for all terms;
 - (b) Using circuit concept, how to measure "Output Admittance" term by a simple multi-meter; please also specify proper unit. (7%)

3. Figure 2 shows an R-C circuit, a switch K is set "on" at $t=0$:
 - (a) Find V_1 at $t=0^+$, if $V_s = 10\text{V dc}$;
 - (b) Write the state equation to solve V_1 and V_2 . (8%)

4. Compare the functions of the inductor filters and that of the capacitor filters used in the general power supply rectifying circuits. (15%)

5. What transformer turns ratio is required to match a 16Ω speaker load to an amplifier so that the effective load resistance is 10 K . (15%)

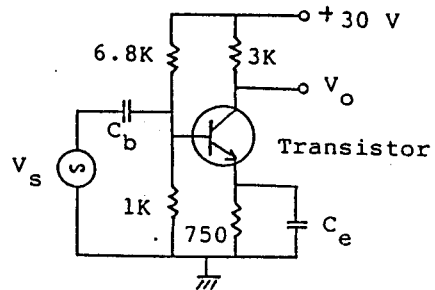
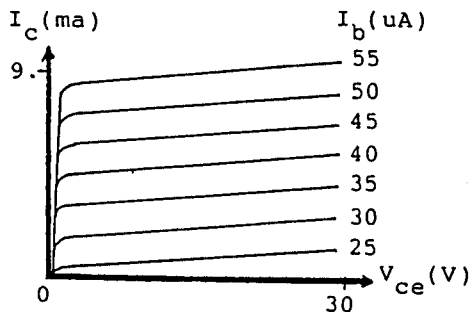


Figure 1. One-transistor circuit.

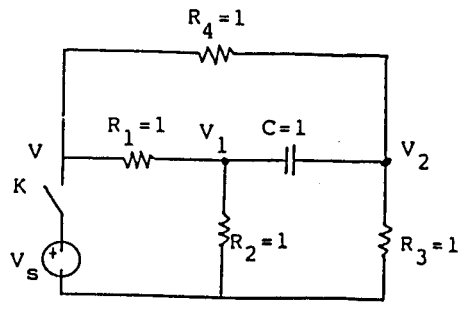


Figure 2. A simple R-C circuit.

Dynamics

6. A U-shape tube has uniform cross-section area A , contains liquid of density ρ with length L , as shown in Figure 3. Considering the gravity g , state the motion equation of liquid from its equilibrium position to x in length change. Assume there is no friction in this tube. (10%)

7. A 2-Kg body and a 3-Kg body are moving along the same x axis. At instant $t=0$, the 2-Kg body is 1.0 M from the origin with its velocity of 3 M/s. The 3-Kg body is 2 M from the origin with its velocity -1 M/s.
 - (a) Find the position and velocity of the center of mass of these two bodies;
 - (b) Find the total momentum. (10%)

8. A circular racing track of radius R is banked at an angle β . For what car velocity will the driver be sitting perpendicular to the seat? (10%)

9. A space station circulating the earth orbit is constructed with two donut-shaped ring structures connected by four radial channels. An astronaut is trying to move from the inner ring area to the outer ring through one of the radial channel as shown in Fig. 4. Assume the station is spinning with an angular velocity ω . Show in your answer what is the force the astronaut feels on his way of movement? (Make whatever assumptions you would need for your Answer.) (10%)

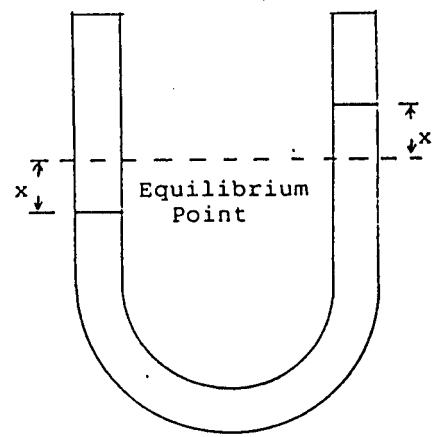


Figure 3. A uniform U shape tube.

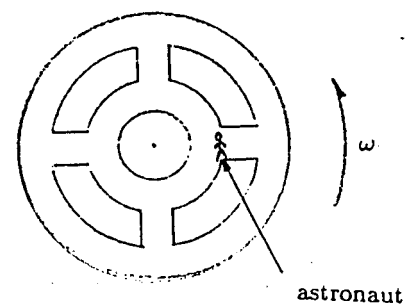


Fig. 4.