EET368 HOMEWORK #4 KEY

MILLER CHAPTER 2 CH2 QUESTIONS 23-32,34-39,41,44,45,48

20 POINTS TOTAL (1 PER QUESTION). ALL WORK MUST BE SHOWN.

23. Two possible ways that a transistor can be used to generate an AM signal include COLLECTOR and EMITTER modulation. BASE modulation is also possible.

    In **COLLECTOR modulation**, the information signal is injected into the collector circuit. This is typical for class C amplifiers, as compliance is controlled by the average collector voltage.

    In **EMITTER modulation**, the information signal is injected into the emitter circuit. This is useful for small-signal class A modulators, where the injected signal alters the emitter current and thus the transconductance of the active device (1/ r'e).

    A third method is also possible. The information signal can also be injected into the **base** circuit. In this case, the effect is similar to that obtained using emitter modulation.

24. LOW-LEVEL MODULATION describes a modulation process taking place BEFORE the last or "final" stages of a transmitter. The modulation circuit is typically at a low power level (50 mW or less).

25. HIGH-LEVEL MODULATION describes a modulation process taking place at the LAST stage of the transmitter; the power level is considerable, depending on the rating of the transmitter.

26. Relative merits of HIGH and LOW-LEVEL modulation schemes:

    HIGH LEVEL:
    + Can use efficient class C amplifiers for RF amplification
    - Can only do AM mode; SSB not possible
    - High-power audio amp required for modulator drive

    LOW LEVEL:
    + Only a small audio amplifier is needed; mW power level
    + Can do any modulation mode, AM, FM, PM, etc.
    - Requires less-efficient class AB RF power amplifiers

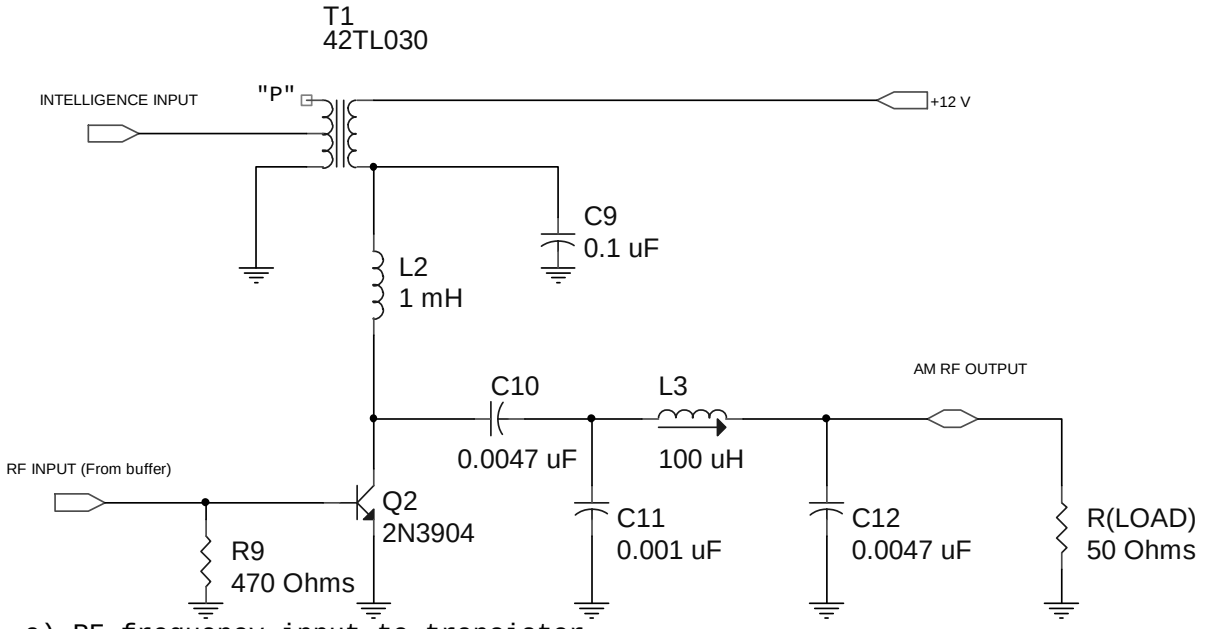
27. NEUTRALIZATION is necessary in order to prevent some RF amplifiers from OSCILLATING. **Murphy's law** of RF amplifier states: "If you design it to Amplify, it will tend to oscillate; if you want to oscillate, it won't."

28. Self-oscillation at the circuit's design frequency usually causes severe interference with the signals being amplified, because the oscillation is within the intended **frequency passband** of the amplifier. On the other hand, self-oscillation can be **outside the passband** and in this case, it may or may not directly interfere with or distort the main signal being amplified. These **parasitic oscillations** are frequencies generated within the amplifier that do not belong, and may cause interference to other stations if the amplifier is part of a transmitter.

29. A **parasitic oscillation** is one that takes place by **accident**, rather than by design. It is usually caused by “accidental” output-to-input coupling in a circuit (for example, the interelectrode capacitances of an active device such as a JFET or BJT).

30. **Self-oscillation** will occur in any circuit if there is sufficient gain (and positive feedback). Most circuits have **parasitic feedback paths** as discussed in question 29; **neutralization** is sometimes necessary to “cancel” the effect of an undesired feedback path.

31. The student should have drawn a picture of a CLASS C COLLECTOR-INJECTED MODULATOR. The following elements should be present:

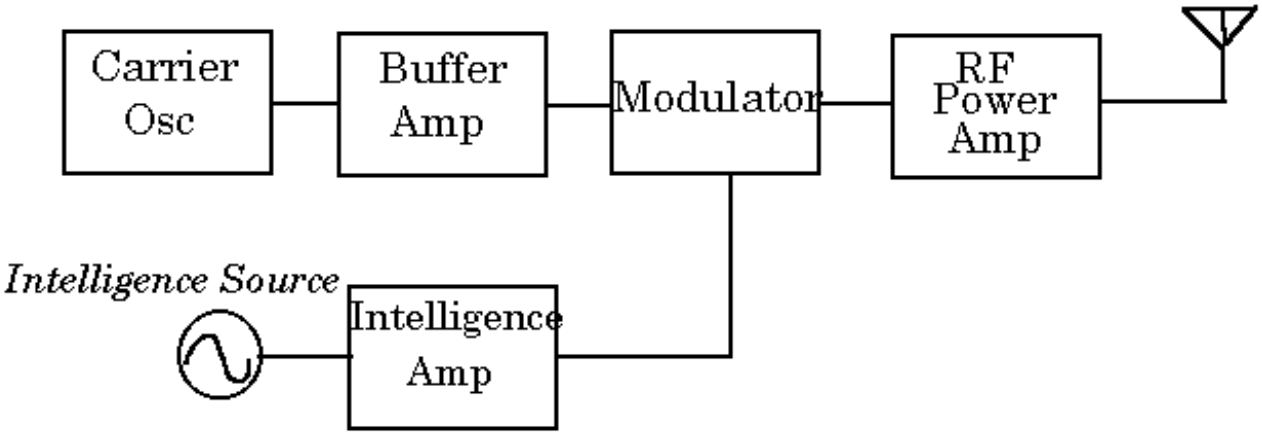


a) RF frequency input to transistor
b) AF frequency input - transformer coupled in series with stage DC supply
c) Tuned "tank" circuit (or impedance-matching network) for coupling modulated wave to load.

32. The principle advantage of a class C amplifier is its **high efficiency**. Most of the DC input power is converted into RF output.

34. The function of a **QUARTZ CRYSTAL** in a radio transmitter is to act as a high-stability **frequency reference**. A crystal provides much better frequency stability than a discrete LC tank can provide.

35. Draw a block diagram of an AM transmitter. A low-level transmitter is shown below:

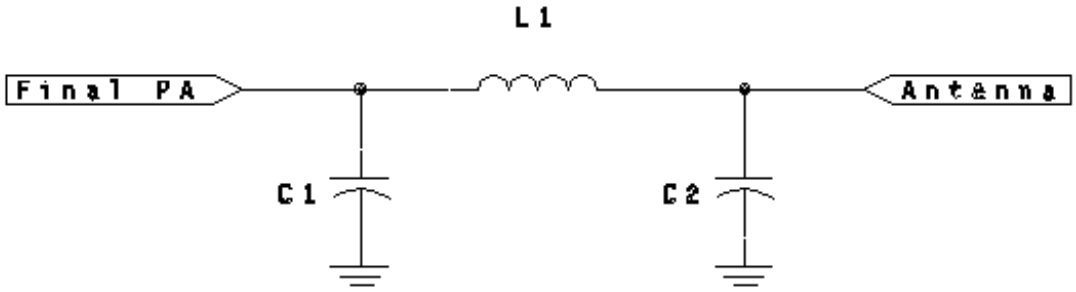


36. The purpose of a BUFFER AMPLIFIER is to **ISOLATE** the carrier oscillator from any possible load changes. This prevents the oscillator from shifting off frequency.

37. "Describe the means by which the transmitter shown in Figure 2-19 is modulated."

    The transmitter of figure 2-19 (pp.80) is **collector modulated**. The Information signal is superimposed on the DC voltage supplying the collectors of the **driver** (MPS8000) and **final** (MPSU31) amplifier transistors. This causes their output compliance to vary, thus causing a direct change in output voltage amplitude; in other words, amplitude modulation occurs.

38. The student will be drawing, most likely, a PI network (two capacitors and an inductor) as a the coupling network. LCC and other networks are also possible for coupling a final power amplifer to a load. The textbook mentions the "double-pi" configuration which is also known as a "halfwave" filter.



39. The functions of an antenna coupler are many:

    1. **Impedance transformation** of the LOAD to the proper value needed by the amplifier stage.

    2. **Harmonic suppression**; the network acts as a low-pass filter which suppresses harmonic energies.

    3. In a class-C amplifier, the coupling network may also double as the "tank" circuit for **reconstruction of the carrier sine wave**.

41. A **tune-up procedure** is a set of steps where the various tuned-circuits of a transmitter or receiver are each set to the correct frequency for operation. Usually, this is the same as the transmitter's frequency, but in modern designs this is not always so. Matching networks such as an **antenna coupler** may also be adjusted during this procedure to obtain the specified power output into a load.

44. The signal given looks like this:

```
                  1V
        0.5V       |        0.5V
         |         |         |
   ------------------------------------------> f(KHz)
        958       960       962
```

    This signal is most likely to be an **AM transmission** with Fc=960 KHz and Fm=2 KHz.

45. **SPUR** is an abbreviation for **SPURIOUS frequency**. A SPUR is any undesired frequency that comes from a transmitter or system.

48. A **DUMMY ANTENNA** or **DUMMY LOAD** is high-power RF resistor that is used to take the place of an antenna during transmitter adjustment and troubleshooting. This prevents a signal from going out on the air, but still provides a proper load termination for the transmitter.