MASS. RADIO SCHOOL - 18 Boylston St., Boston

FINAL EXAMINATION

BROADCAST - RADIOTELEPHONE OPERATOR'S LICENSE - FIRST CLASS.

Instructions: Place your name at the top of each page in upper right hand corner. Write on one side of paper only. The questions are short but the applicant is expected to state clearly their full knowledge.

DIAGRAM: Draw a neat diagram of a modern crystal controlled master oscillator - power amplifier telephone broadcast transmitter including speech input equipment, source of power and antenna system. State number and type of tubes employed, operating voltages and power output. Include a diagram of a receiver suitable for listening in on 500 K. C. while the transmitter is in operation. (This diagram counts for 10 points on the U. S. Govt. examination when properly and neatly drawn.)

This examination should be returned to the school in sufficient time to have the instructor check it prior to your going to the Custom House for the U. S. Government examination.

The Radio Inspector at the Custom House judges your knoweldge of radio by what you write on the subject.

Keep in mind you must be able to properly express your thoughts and ideas in WRITING, to successfully pass the U. S. Government examinations for radio operators license.

The questions follow.

GENERAL

1. Draw a diagram and explain the operation of the double button microphone. What are its advantages and disadvantages?

2. Draw a diagram and explain the operation of the condenser microphone. Why does not the diaphragm vibrate at its resonant frequency in response to some of the musical notes?

3. Explain how a velocity microphone works. Show by diagram how it is constructed.

4. Over what range of frequencies should a good broadcast microphone respond?

5. Draw a diagram showing how a magnetic phono pickup is constructed. Explain how it operates.

6. Illustrate the construction of a crystal microphone. Explain how it operates.

7. What is a "T" pad (or network)? For what purpose is it used?

8. Under what circumstances would an "L" network be chosen rather than a transformer for impedance matching?

9. Where would an "H" network be used?

10. Draw a diagram and explain the construction of a fader. Where or for what purpose are faders used in broadcast work?

11. Draw a response curve showing the frequency response of a typical telephone line.

12. Show by diagram how an equalizer would be connected into a telephone line. Explain how the equalizer works.

13. Illustrate two types of volume level indicators and explain how each works.

14. Why are loading coils used in connection with telephone lines?

15. What is the purpose of the small amplifier that is often built into the microphone stand or housing? Why isn't this amplifier installed with the others in the control room?

16. Under what circumstances may a simple potentiometer be used as a level control?

17. Draw a diagram of a four-channel mixing panel and explain how it works.

18. What is the function of the speech amplifier of the broadcast transmitter? What two factors determine the power that the speech amplifier must deliver?

19. Draw a diagram of an audio system showing: Microphone mixer, line amplifier, level control, telephone line, equalizer and at least two stages of the main speech amplifier. Do not show the power supply.

20. What is meant by the term "piezo-electric" effect? Name three crystals that possess this property.

21. What are the advantages and disadvantages in the use of (a) the A-cut quartz crystal. (b) The Y-cut quartz crystal.

22. To what extent would the frequency of an X-cut crystal change with an increase in temperature of one degree C.? Would the frequency increase or decrease? How and to what extent would the frequency of a Y-cut crystal change as a result of the same variation of temperature.

23. Draw a diagram showing the construction of a crystal oven or constant temperature chamber. Illustrate two kinds of thermostats used in constant temperature work.

24. Draw a schematic diagram showing the circuits of a temperature control system using mechanical relays to control the flow of heater current. Show by diagram how a vacuum tube may be substituted in place of the mechanical relay. Explain how the latter system works.

25. How would a broadcast station operator know whether or not the temperature control system of the transmitter is functioning properly?

26. Why are not the very high frequencies used in police radio systems generated directly in the crystal oscillator?

27. What is a buffer amplifier? Explain fully.

28. What class of operation (A, B, or C) is usually used in the buffer stage of a broadcast transmitter?

29. What is a frequency doubling amplifier? How does such an amplifier differ from those ordinarily used in radio frequency amplification?

30. How would you adjust the plate and grid potentials of a frequency doubling amplifier for maximum efficiency?

31. Explain the theory of the operation of the frequency doubling amplifier.

32. What is meant by the term "Class A operation" as applied to amplifiers. Under what circumstances would Class A operation be chosen in preference to B or C operation?

33. How would the cost of a class A amplifier installation differ from that of a B or C installation for the same power output?

34. What can you say in regard to the cost of operation of a Class A amplifier as compared to the operating costs of B and C operation?

35. How would you determine whether or not an amplifier is operating Class A?

36. Define Modulation as the term is used in radio work.

37. What is meant by percentage modulation? Given the average maximum and minimum amplitudes of a modulated wave, how would you determine the percentage of modulation?

38. What are the side bands of a radio telephone signal? What is meant by side band frequencies? What range of side band frequencies are required in radio broadcast work?

39. What is meant by the envelope of a modulated wave?

40. What is the source of the power used to generate the carrier way? What is the source of the power used to generate the side band components?

41. Draw a diagram of a simple radio telephone transmitter using Heising modulation. Explain how the carrier wave is modulated.

42. What plate efficiency can be expected in a class C plate modulated amplifier? What plate efficiency can be expected of the modulator if: (a) it is operated class A? (b) it is operated class B?

43. What is meant by overmodulation? What would cause overmodulation?

44. Why is a high percentage of modulation desirable?

45. Why does a square law detector cause distortion when responding to a highly modulated wave? What percentage of Harmonic distortion should be expected when such a detector is responding to a wave modulated 100%? What percentage of harmonic distortion should be expected when the same detector is responding to a wave modulated only 50%?

46. Explain how and WHY the percentage of modulation of a signal that is being amplified by a class C amplifier can be changed by changing the grid bias on the amplifier tube.

47. What is the relationship between the modulator output and the Class C plate power input necessary to bring about 100% modulation?

48. How would you use a "scope" to measure percentage of modulation?

49. How could you tell by observing the antenna ammeter whether or not the signal radiated from your station is modulated 100%?

50. How does the power on the modulation peaks compare with the normal carrier power when the carrier is modulated 100%?

51. To what extent does the average carrier power increase during 100% modulation?

52. What are three methods of preventing the radiation of harmonics from broadcast transmitters?

53. How would you change the wavelength at which a broadcast transmitter operates? Explain fully.

54. What is a frequency monitor? Explain how the device would be used.

55. What is meant by "shot effect" as the term is used in high gain amplifier work?

56. State the advantages and disadvantages in the use of: (a) the thermeonic rectifier type of power supply. (b) the motor generator type of power supply.

57. What are some of the characteristics and properties of the high vacuum type of rectifier tube?

58. What are some of the characteristics and properties of the mercury vapor type of rectifier tube?

59. Why would not the high vacuum type of rectifier tube chosen as a rectifier in a power supply intended for use with a class B amplifier?

60. What is meant by "inverse peak voltage" as the term is used in connection with rectifier tubes?

61. What is meant by a flashback in a rectifier tube? What would cause such a flash back?

62. What is the function of the filter in a rectifier tube of power supply?

63. Draw a diagram of a filter suitable for use in a power supply and explain how it operates.

64. Why is heavy insulation used at the low voltage filament transformers of a rectifier type of power supply?

65. Draw a circuit diagram of a three phase-half wave rectifier.

66. What protective devices are used in the power supply circuits of a broadcast transmitter?

67. Where and for what purpose are delayed action relays used in the power supply circuits of the broadcast transmitter?

68. What is meant by the voltage regulation of a power supply system?

69. What effect would poor voltage regulation have on the output of a broadcast transmitter?

70. What type of rectifier is noted for its fine voltage regulations?

71. What must be done to keep a rectifier type of power supply in good operating condition?

72. What is meant by "positive modulation" and "negative modulation as the terms are used in connection with the cathode ray modulation meter?

73. How would you measure percentage modulation using a vacuum tube peak voltmeter?

74. In selecting tubes for the broadcast transmitter, what power would you allow for the excitation of the grids of the power amplifier tubes?

75. What would cause the antenna ammeter to show a decreased antenna current during modulation?

76. Draw a circuit diagram of a receiver suitable for maintaining the watch on 600 meters in the immediate vicinity of a broadcast transmitter.

77. Explain the theory of the operation of: (a) the grid detector (b) the plate detector.

78. Why does the square law detector cause bad distortion of highly modulated signals? What percentage of distortion should be expected at the output of a square law detector when the input signal is modulated 100%?

79. How is plate circuit to grid circuit coupling through the power supply prevented in receiving equipment?

80. Explain the theory of heterodyne reception.

81. Why will a sharply tuned receiver cause distortion of a modulated signal?

82. What is a tetrode? What advantages has the tetrode over the triode in R. F. amplification?

83. What are the functions of the following parts of the superheterodyne receiver? (a) The first detector. (b) The oscillator. (c) The intermediate amplifier. (d) The second detector.

84. What is meant by "pseudo image" as the term is used in superheterodyne work?

85. What is the law regarding the rebroadcasting of programs?

86. What is the law regarding the use of a broadcast station by candidates for public office?

87. What is an experimental relay broadcast station? On what frequencies do such stations operate? What is a municipal police station? What is a special emergency station? What is a marine fire station?

88. Explain both the direct and the indirect methods of determining the operating power of a broadcast station as set forth by the Communications Commission.

89. Between what limits must the frequency of a broadcast station be maintained?

90. What is the program log? What is the operating log? List some of the items that must be entered in each of these logs.

91. What is the minimum percentage of modulation permissable in the broadcast service?

92. What is meant by frequency tolerance? State the permissable tolerances for several of the radio services.

93. What are the Commission's rules in regard to the broadcasting of mechanical reproductions?

94. What penalties may be imposed upon a person found guilty of malicious interference with the service of other stations?

95. What penalty is provided for the violation of any section of the Radio Act of 1934?

96. What penalty does the Radio Act of 1934 provide for the violation of any of the rules of the Convention of Madrid?