THE BRITISH BROADCASTING CORPORATION ENGINEERING TRAINING DEPARTMENT

GRADE C ENGINEERING EXAMINATION NO. 60

PART I	JUNE 1968	ALL CANDIDATES
Attempt 5 Questions	Full Marks Total 100	Time - 3 Hours

Each question is given a maximum of 20 marks
The marks allocated to each part are indicated in brackets
In descriptive questions marks are awarded
for style and presentation of subject matter

1. The loads connected between the three lines and neutral wire of a 3-phase power supply system are respectively:-

Red phase, 18kW, 0.8 power factor inductive

Yellow phase, 20kW resistive

Blue phase, 15kW resistive.

The maximum kVA rating for each of the three phases is the same and the Red phase is fully loaded.

If the line voltage is 415V find the maximum permissible additional current for a lighting load (u.p.f.) on the Blue phase, and by means of a vector diagram drawn to scale the current in the neutral wire when this additional load is connected. (20)

2. Discuss the limitations of the Avometer Model 8 as a general-purpose indicating instrument. How must the readings be interpreted when used for a.c. and d.c. measurements on electronic equipment? (13)

Explain how such an instrument could be conveniently converted to an electronic voltmeter for use on high-impedance a.c. circuits. (7)

3. The diagrams show two alternative means of changing the voltage gain of an amplifier, in each case by switching from A to B.

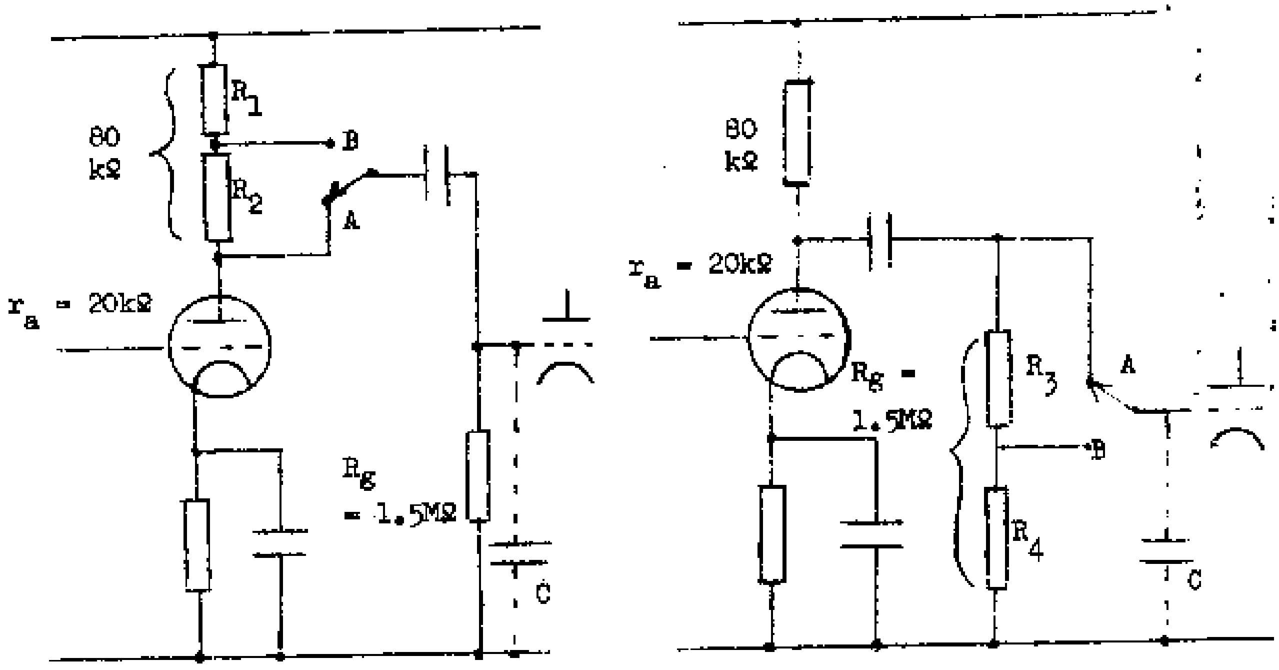


FIG. (i) FIG. (ii)

(a) If the required change in gain is 6dB, find the values of R_1, R_2, R_3 and R_4, utilising suitable approximations. (4)

(b) Show by calculation that if the output voltage for the circuit of Fig. (i), switch position B, at some particular frequency is 3dB down due to shunt capacitance C, the loss for the circuit of Fig. (ii), switch position B, would be intolerable. (8)

(c) To improve the frequency response, R_g in Fig. (ii) is reduced to 100k and that in Fig. (i) to correspond. Find without approximation the new values of R_1 and R_2 required to give the 6dB change on switching from A to B. (8)

4. Draw circuit diagrams with typical component values to illustrate the use of

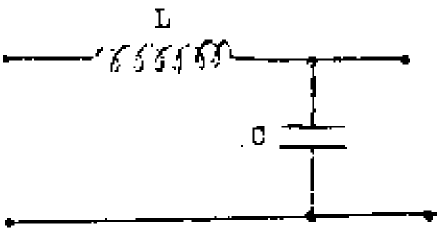
a) a p.n.p. transistor connected in common base, common collector and common emitter, as a simple resistance-capacitance coupled amplifier,

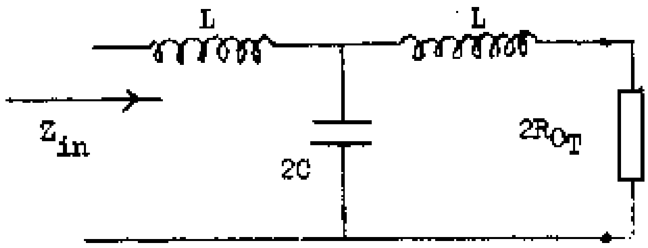
b) a Zener diode,

c) a variable capacitance ("varactor") diode.

Make brief notes on the significant characteristics and applications of each circuit. (20)

5.





Derive formulae for the "T" image impedance, Z_{OT}, and the cut-off frequency, $f_{c.o.}$, for the low-pass L-section illustrated. Indicate the difference between Z_{OT} and the design resistance R_{OT}. (4)

Hence show that for the T-section terminated in 2 R_{OT}, Z_{in} is $\frac{1}{4}R_{OT}$ when $f = \frac{1}{\sqrt{2}} f_{c.o.}$ and find the voltage attenuation at this frequency. (16)

6. (a) Explain the meaning of 'Q' in relation to a coil and briefly why the value of Q for an r.f. tuning coil does not vary to any significant extent over the frequency range for which it is used. (5)

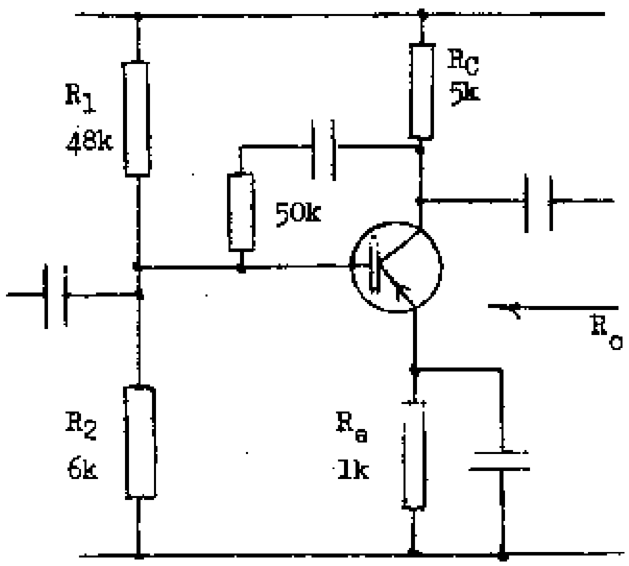
(b) Explain the operation of the Q-meter and indicate how it may be used to measure the stray capacitance of an inductor and the effective resistance of a resistor at a given radio frequency. Indicate the calculations necessary in each case. (15)

7. (a) By reference to simple circuit drawings explain how the factors affecting the choice of an a.c. load line are more critical in transistor circuits than in valve circuits. (6)

(b) Describe those particular features of a transistor which enable it to be used as a switch and illustrate with a simple application. (7)

(c) Briefly explain the forms of power loss in ferromagnetic cores of inductors and measures taken to reduce them. (7)

8.



Using the simplified equivalent circuit for the transistor draw the circuit of the given amplifier stage as it appears to a.c. signals. (4)

Classify the type of negative feedback employed. (2)

Derive an expression for the a.c. output resistance R_o. (8)

Making appropriate approximations, calculate the value of R_o if

$h_{i_e} = 1.5k$, $1/h_{o_e} = 50k$, $h_{f_e} = 70$. (4)

If the circuit shown were to form the second stage of an amplifier, explain by reference to the formula how the output resistance of the first stage would affect the output resistance of the second. (2)

A.W. Harris/VM
11th June 1968

BRITISH BROADCASTING CORPORATION

ENGINEERING TRAINING DEPARTMENT

C ENGINEERING EXAMINATION No. 65

197

PART II | JANUARY 1970 | COMMUNICATIONS

Attempt 5 Questions | Full Marks Total 100 | Time: 3 Hours

Each question is given a maximum of 20 marks. The marks allocated to each part are indicated in brackets. In descriptive questions marks are awarded for style and presentation of subject matter.

1. Fig. 1 shows a basic transistor configuration used as a voltage amplifier in a video-frequency amplifier.

   Explain the particular merits of this type of connection. (6)

   Using this as a basis, draw a complete video-frequency amplifier circuit having the following features:-

   (a) An input circuit which provides d.c. bias and increases the value of the input impedance. (6)

   (b) An output circuit which introduces negative feedback, gain control and a desired value of the output impedance from three separate outputs. (8)

   Describe the circuit operation in each case.

2. Fig. 2 shows the circuit of a shunt half-section equaliser for use in a 600-ohm circuit. Draw the circuit diagram of the full-section bridged-T equivalent. Include all the component values. (8)

   Obtain values for the resonance frequency, L/C ratio and basic loss of the equaliser. (9)

   What type of equaliser is it and for what purpose would such a circuit be used? (3)

3. With the aid of diagrams describe the principles of operation of:-

   (a) A four-wire terminating set using two transformers. (Give details of the various impedances and turns ratios). (10)

   (b) A voice-frequency ringer. (10)

4. (a) What are the advantages to be obtained from using f.m. rather than a.m. on an s.h.f. vision link? (8)

   (b) Explain why it is necessary to reduce the a.m. transmitted by an s.h.f. link to a minimum and describe how the amount of a.m. transmitted can be checked. (6)

   (c) What is meant by the term *Fresnel Clearance* when applied to a proposed s.h.f. link path? (6)

5. Fig. 3 shows sections A and B of the field divider used in a synchronising-pulse generator.

Explain the operation of section B when the free input of the OR gate is switched:

(i) to the 0 state

(ii) to the 1 state (8)

For the two positions of the switch it is arranged for section A to have two different division ratios. Quote these values and hence explain the reason for including the switch. (4)

Briefly explain the use made of each output. (8)

6. State where in the transmission chain black-level clamping should be applied to a television signal. (3)

Explain the action of a feedback clamp, showing how a high loop gain can be achieved with freedom from the drift that would otherwise be experienced with a high-gain direct-coupled amplifier. Show how the reduction in errors in blanking level and the rate of correction are related to the loop gain. (14)

Discuss the limitations of clamping in removing distortions from a video signal. (3)

7. (a) Sketch the circuit of a transistorised output video amplifier feeding the cathode of the picture tube in a 625-line receiver, incorporating the following features:-

i) Sound rejection;

ii) Beam limiting in the event of loss of received signal;

iii) Line and field flyback blanking;

iv) Protection of the circuit in the event of an internal flash-over in the cathode ray tube. (10)

(b) Describe the circuit action of two of the above features. (10)

8. Draw the mid-band a.c. circuit of the microphone amplifier type AM9/5 shown in Fig. 4. Assume the input to be fed from a 300-ohm source and the output to be terminated in a 600-ohm load with the gain control set to maximum. (5)

Show on your diagram the polarities of input, output and a.c. feedback voltages, also the directions of the signal currents in all branches. (8)

Discuss the features which contribute to a low noise output from the first stage. (3)

Assuming that the gain is determined by negative feedback, calculate its value. (4)

D.G. Enoch/JMD
4th December 1969

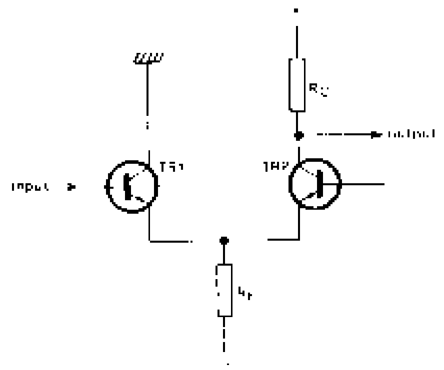


FIG 1

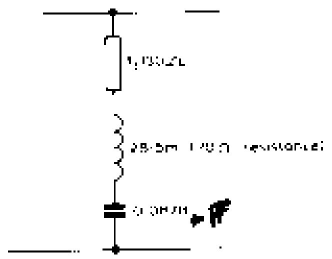


FIG 2

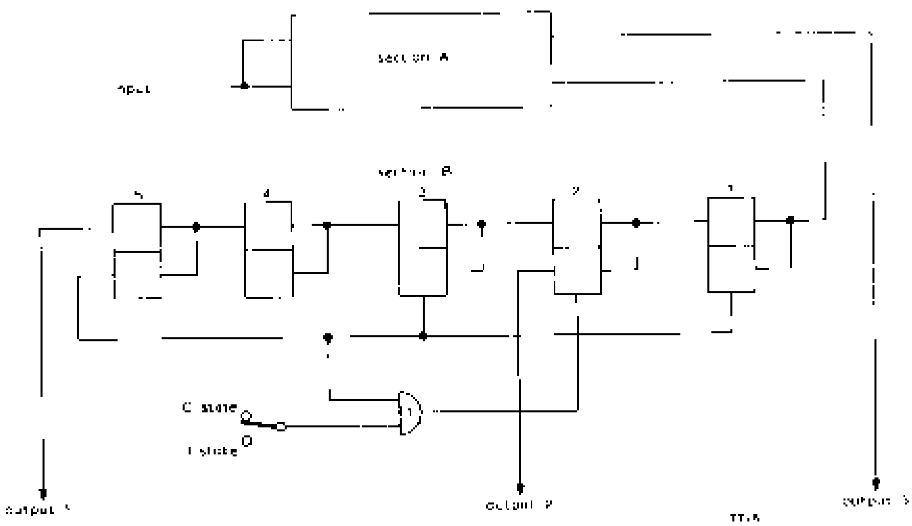


FIG 3

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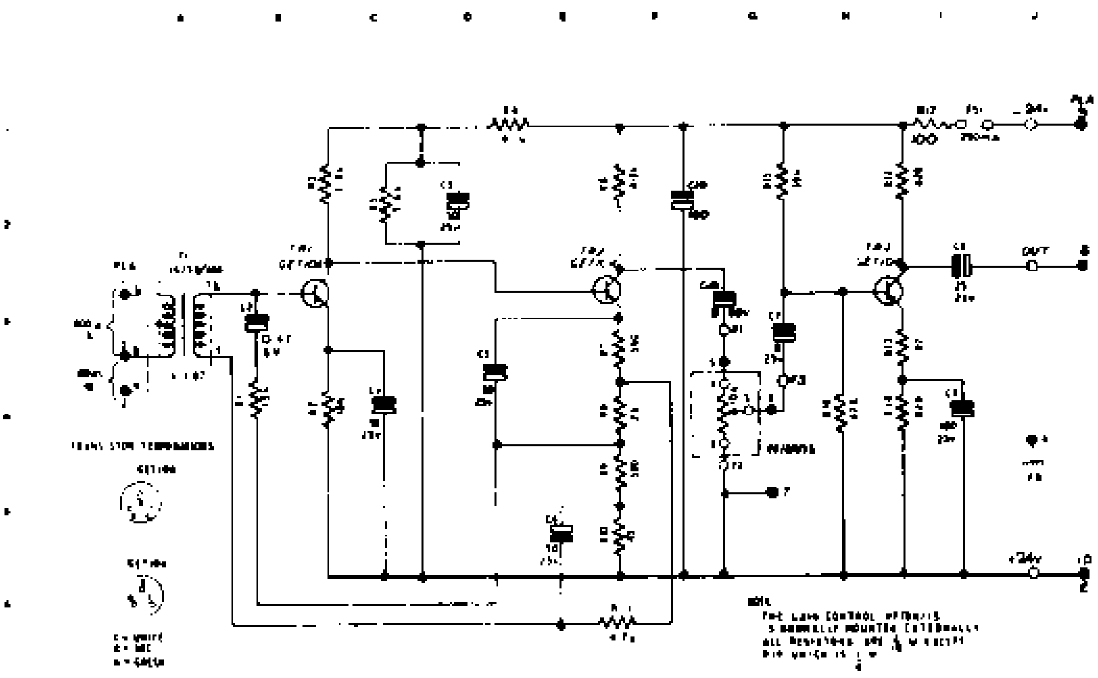

MICROPHONE AMPLIFIER AM9/5: CIRCUIT

FIG 4