PG/IS/PHS/107/24

M.Sc. 1st Semester Examination, 2024

PHYSICS

(*Analog Electronics*)

PAPER – PHS-107

Full Marks : 25

Time : 1 hour

Answer **all** questions

The figures in the right hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

GROUP – A

Attempt any **two** of the following questions : 2×2

1. Explain the operation of a duplexer.

2. Define skip distance and tropospheric waves.

3. What do you mean by vestigial side band (VSB) modulation and where it is used ?

4. A 3.0 kilowatt career signal is amplitude modulated (DSB-TC) by a single frequency sinusoidal signal. If the modulation index is 60%, determine the total power of the modulated wave.

GROUP – B

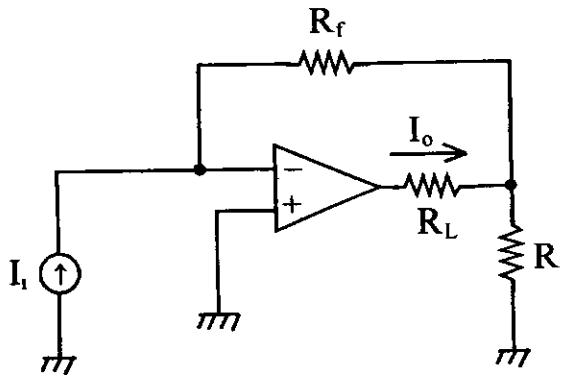
Attempt any **two** of the following questions : 4×2

5. Draw the circuit diagram of a balanced modulator and explain how it can generate DSB-SC signal.

6. Draw the circuit diagram of the input stage of an operational amplifier and derive the expression for its CMRR.

7. Derive RADAR range equation.

8. Find out the expression for I_o/I_i in the following circuit :



GROUP – C

Attempt any **one** of the following questions : 8×1

9. (*i*) Neglecting the effects of Earth's magnetic field and the energy loss, show that the ionosphere behaves as a medium of refractive index

$$\mu = \sqrt{\frac{1-80.8N}{f^2}},$$

where N is electron density per c.c and f is the frequency in KHz. Hence give a

brief account of the effect of the ionosphere on the propagation of sky waves.

(*ii*) Explain how the distance of a fixed target can be found by using two frequency continuous wave (CW) RADAR. 5 + 3

10. (*i*) Suppose a sinusoidal carrier signal of frequency ω_c is frequency modulated by a sinusoidal modulating signal of frequency $\omega_m(\omega_c >> \omega_m)$. Derive the expression for the generated FM signal and hence find out the theoretical bandwidth of FM signal.

(*ii*) State Carson's rule of thumb for the determination of bandwidth of FM signal.

(*iii*) Explain any method of generation of FM signal. 4 + 1 + 3

[Internal Assessment — 5 Marks]
