M.Sc.

2011

4th Semester Examination

ELECTRONICS

PAPER—EL-2201

Full Marks : 40

Time : 2 Hours

The figures in the right-hand margin indicate full marks.

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

Illustrate the answers wherever necessary.

Answer *Q. No. 1* and any *three* from the rest.

1. Answer any *five* questions : 2×5

(a) Why TRAPATT diode is preferred to an IMPATT diode?

(b) What is the purpose of helix in a TWT device?

(c) If P_1 = input power,
P_2 = output power
P_3 = power in coupled port
P_4 = power in isolated port

Write down the formula for insertion loss of the directional coupler.

(d) Why GaAS is preferred over Si for Gunn diode fabrication ?

(e) Write expressions for the characteristic impedance and effective dielectric constant of a microstrip line.

(f) The rated drift region length and carrier drift velocity of an IMPATT are 6 μm and 2×10^7 cm/s respectively for a given operating voltage. Calculate the frequency of generated microwave.

2. (a) Distinguish between Klystron amplifier and TWTA.

(b) In a magnetron oscillator, Find an expression of cut-off magnetic flux density and cut-off voltage.

(c) A pulsed cylindrical magnetron is operated with the following parameters.

Anode voltage = 25 KV.

Beam current = 25A

Magnetic density = 0.34 wb/m^2.

Radius of cathode cylinder = 5 cm

Radius of anode cylinder = 10 cm.

Calculate

(i) The angular frequency;

(ii) The cut-off voltage;

(iii) The cut-off magnetic flux density. 3+4+3

3. (a) Draw the equivalent circuit of a circular cavity resonator.

(b) S how that the Q-value of such a cavity resonator can be given by

$$Q = \frac{\omega \mu V}{2R_s S}$$

where symbols have their usual meanings.

(c) A cavity of intrinsic Q 400 is coupled to an external circuitry of Q-value 200. Find the loaded Q of the cavity after derivation of necessary formula.

1+4+5

4. (a) A circular cylindrical air-filled cavity with radius 3 cm and length 10 cm is excited in TE_{111} mode. The 3 dB band with is 2.5 MHz. Calculate the resonant frequency and the Q.

(b) Derive the formula you use.

(c) Write an expression for the resonance frequency of a semicircular cavity resonator for TM npq mode.

4+4+2

5. (a) How a slot line differs from a microstrip line?

(b) Discuss the role of dielectric in the design of microstrip. Derive Q of a micro strip line.

(c) In a microstrip line alumina used as a dielectric substrate ($\varepsilon_r = 9.7$) and operating at a frequency of 10 GHz and if the line has an attenuation of 20 dB, Calculate Q of the microstrip line. 2+(2+2)+4

6. (a) Draw the schematic diagram of a GaAs MESFET and its small signal equivalent circuit. Find expression for maximum operations frequency in saturation region. Draw I_d vs V_{dS} characteristics.

1+2+2+1

(b) The S-parameters of a transistor at 5 GHz for a conjugate matched transistor amplifier are given by

$S_{11} = 0.9 \angle -100°$, $\angle 90°$, $S_{21} = 2.4$, $S_{12} = 0$,

$S_{22} = 0.8 \angle 40°$.

Find the maximum gain. 4