2017

M.Sc. Part–I Examination

PHYSICS

PAPER—IV

Full Marks : 75

Time : 3 Hours

The figures in the margin indicate full marks.

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

Illustrate the answers wherever necessary.

Use separate Answerscripts for Gr. A & Gr. B.

Group—A

[Marks—35]

Attempt Q. No. *1, 2, 3* and any *two* from the rest.

1. Answer any *five* questions :   5×2

   (a) What is a duplexer and where is it used ?

   (b) Draw the circuit diagram of a Foster Seeley discriminator.

(Turn Over)

(c) Compute the length of a half wave dipole antenna for reception of FM signal at frequency 100 MHz.

(d) Calculate the characteristic impedance of a transmission line having a resistance of 6.5 ohms/km, a capacitance of .0052 μF/km, an inductance if 2.25 mH/km and a inductance of .5 micro-mho/km at a frequency of 800 Hz.

(e) Define voltage standing wave ratio and reflection coefficient of a transmission line.

(f) Draw the circuit diagram of a constant-k band pass fitter and write down the expressions for its two cut-off frequencies.

(g) Find the characteristic impedance of the following π−network.
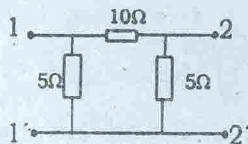
(h) Explain 'duct propagation' in connection with propagation of radio waves.

2. Answer any *two* questions : 2×3

(a) What is Carson's rule of thumb for the determination of bandwidth of practical FM signal. Why FM sound is much reacher than AM sound ?

(b) The transfer function of a JFET is given by

$$I_D = I_{DSS}\left(1 - \frac{V_{Gs}}{V_p}\right)^2$$

where I_{DSS} is the value of the drain current for gate voltage $V_{Gs} = 0$ and V_p is the pinch-off voltage. Show that the transconductance g_m is given by the relation

$$g_m = g_{m_o}\left(1 - \frac{V_{GS}}{V_p}\right)$$ where g_{mo} is the value of g_m for V_{Gs}

= 0. (symbols have their usual menaings)

(c) Explain the opeation of a photo transistor as a light sensor.

3. Answer any *one* question : 1×4

(a) Discuss the method of generation of DSM–SC signal with necessary circuit diagram and theory.

(b) Write a note on the application of antenna in communication system.

4. Derive telegrapher's equations and solve it to find the expressions for voltage and current in a transmission line tesminated by a load Z_L. Hence find out the input impedance of transmission line at any point on its length.

8+2

5. (a) Derive the expression for CMRR of an emitter coupled differential amplifier and hence explain the need for realisation of a current mirror circuit at the input stage of an OP-Amp.

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(b) Draw the circuit diagram of a current mirror circuit using low-β transistors and show that it will behave as a current mirror circuit with necessary derivation.
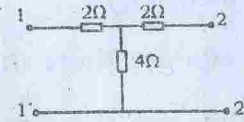
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(c) With a neat figure describe the construction of thermistor.

2

6. (a) Convert the following T-network into its equivalent π form and derive the necessary theory.

2+4

(b) Synthesize a shunt type Foster network to give a driving point impedance of $+j100\Omega$ at $w = 10^6$ radians/sec. There is to be a zero at $w = 3 \times 10^6$ radians/sec. and poles at $w = 2 \times 10^6$ radians/sec and 4×10^6 radians per sec.

4

Group—B

[Marks—40]

Attempt Q. No. *1, 2* and any *two* from the rest.

1. Answer any *three* questions :   3×2

(a) Prove the identity of the following Boolean expression

$$\overline{AB} + \overline{A} + AB = 1$$

(b) Simplify the Boolean function

$$f(A, B, C) = \sum m(1, 2, 5, 6) \text{ by using Karnaugh map.}$$

(c) In a (8K × 8) memory IC

   (i) how many bits are there in data bus ?

   (ii) how many bits are there in address bus ?

   (iii) What is the capacity in byte ?

(d) Realise the following cricuit using NAND gata only

(e) What is sampling theorem in digital communication?

2. Answer any *three* :   3×3

(a) Convert DFF into TFF.

(b) Give the logic diagram of a serial in parallel-out 4 bit shift register and explain its operation.

(c) Draw the circuit of 4 bit ring counter and mention the different output state.

(d) Show briefly the data bus, address bus and control bus of 8085 μp.

(e) Desing a 4 : 1 multiplexer and give its truth table.

3. (a) Describe the process of data shifting in 4 bit SISO register.

(b) Mention the use of SIPO nad PISO register.

(c) In a 4 bit BCD input system output goes high only when the LSB and MSB are in same phase. Write down the truth table and draw the circuit with basic gate.   4+2+4

4. (a) Design 3 bit asynchronous up/down counter with a select input.

   What is the advantages of synchrounous counter ?

(b) What is memonics ? What do you mean by ORI 05 and MOV BC ?

(c) Expand the memory (4×4) IC to (8×8).   3+1+3+3

5. (a) Write logical steps to add the following two Hex numbers. Both the number should be saved for future use. Save the sum of the accumulator

   Numbers A2H and 18H

(b) Transtate the program in question 3(a) into the 8085 assembly language

(c) Define opcode and operand and specify the opcode and the operand in the instruction MOVH, L.

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