TKN/KS/16/5916

Bachelor of Science (B.Sc.) (Physics) Semester–VI

(C.B.S.) Examination

ELECTRONICS FIBER OPTICS,

COMMUNICATION AND DIGITAL ELECTRONICS

Paper—2

Time—Three Hours] [Maximum Marks—50

N.B. :— (1) **All** questions are compulsory.

(2) Draw neat diagrams wherever necessary.

EITHER

1. (A) What is an electronic oscillator ? Draw the circuit diagram and explain the working of the Hartley oscillator. State the condition for sustained oscillations and write the expression for the frequency of oscillation. 5

(B) (i) What is an Op-Amp ? Explain the use of Op-Amp as adder. 3

OR

(C) State and prove DeMorgan's theorem. 2½

(D) What is full subtractor ? Explain it with logic diagram and truth table. 2½

(E) Using Boolean algebraic technique, simply the following expression :

$$Y = ABC + \bar{A}BC + A\bar{B}C + AB\bar{C} + A\bar{B}\bar{C}.$$

2½

(F) What are the three basic logic gates ? Give their circuit symbols and truth tables. 2½

5. Solve any **TEN** :

(i) Define Common Mode Rejection Ratio (CMRR).

(ii) For an Op-Amp used to amplify an input signal to peak value of output voltage is 100 mV. What is the maximum operating frequency if the slew rate of Op-Amp is 0.5 V/μs ?

(iii) State the difference between an oscillator and an amplifier.

(iv) What is meant by modes in optical fibers ?

(v) What is total internal reflection ?

(vi) An optical signal has lost 85% of its power after traversing 500 m of fiber. What is loss in dB/km of this optical fiber ?

EITHER

2. (A) What is an Optical Fiber ? Explain step index optical fiber and graded index optical fiber. 5

(B) (i) Show that numerical aperture of an optical fiber is given by :

$$N_A = \sqrt{n_f^2 - n_c^2}$$

where n_f and n_c represent refractive index of core and cladding respectively. 3

(ii) Calculate the maximum acceptance angle of a step index fiber when the core refractive index is 1.5 and the cladding refractive index is 1.48. 2

(C) Explain the various types of losses associated with optical fiber. 2½

(D) Explain how dispersion affects the width of a signal pulse while propagating through an optical fiber. 2½

(E) For a silica optical fiber the refractive index of core layer is 1.56 and that of cladding is 1.35. Determine the numerical aperture of the fiber. 2½

(F) Explain how light propagates along an optical fiber. 2½

EITHER

3. (A) What is amplitude modulation ? Obtain an expression for an AM wave with sinusoidal modulation. Show that the rate of change in carrier wave amplitude is proportional to both frequency and amplitude of the modulating signal. 5

(B) (i) Derive an expression for the power in amplitude modulated wave. Show that the power in the side band frequencies in an amplitude modulated wave increases as the square of the modulation index. 3

(ii) An AM wave consists of carrier, lower side frequency and upper side frequency component of peak values 10V, 4V, and 4V respectively. If the AM wave drives a 5 KΩ resistor. Find the power delivered to the resistor by the carrier and each side frequency components. What will be the total power delivered ? 2

OR

(C) State the advantages of frequency modulation as compared to amplitude modulation. 2½

(D) An amplitude modulated wave is represented by the expression :

$e_m = 10 (1 + 0.6 \cos 6280 t) \sin 211 \times 10^4 t$ volt.

Calculate :

(i) the minimum and maximum amplitude of the AM wave.

(ii) The amplitudes of the components contained in the modulated wave. 2½

(E) Define the term modulation index. Draw the wave form of an amplitude modulated wave having modulation index of 0.5. 2½

(F) Define frequency modulation. Obtain an expression for a frequency modulated carrier with sinusoidal modulation. 2½

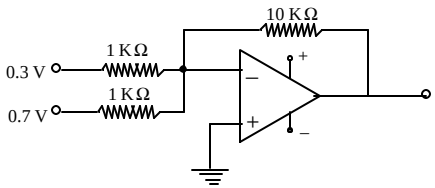
EITHER

4. (A) What are binary numbers ? State the rules for binary subtraction. Explain 1's complement and 2's complement method with suitable examples. 5

(B) (i) What is an exclusive OR (XOR) gate ? Explain it with truth table. 3

(ii) Convert binary number into its decimal equivalent number : $(10111.011)_2$. 2

(ii) Determine the output voltage for the summing amplifier shown in the following figure.



2

OR

(C) What is a multistage amplifier ? Derive the equation for the overall voltage gain of multistage amplifier in terms of individual stage gain. 2½

(D) Show that the voltage gain in a non-inverting amplifier is $1 + \frac{R_f}{R_1}$. 2½

(E) State and explain the Barkhausen's criterion for sustained oscillations in an oscillator. 2½

(F) In a negative feedback amplifier A = 100, $\beta = 0.04$ and v_i = 50 mV. Find :

(i) gain with feedback and

(ii) feedback factor

(iii) output voltage. 2½

(vii) What is meant by over modulation ?

(viii) State two demerits of frequency modulation.

(ix) How much is the bandwidth of amplitude modulation in terms of frequency of modulating signal ?

(x) Draw the circuit symbol of Exclusive NOR gate and write its Boolean equation.

(xi) What is a full adder ?

(xii) What is a nibble ? 1×10=10