2020

PHYSICS — HONOURS

Paper : CC-7

Syllabus : 2018-2019

(Digital Systems and Application)

Full Marks : 50

The figures in the margin indicate full marks.

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

Answer ***question no.* 1** and ***any four*** questions from the rest.

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

(a) How will you use a 3-input AND gate as a 2-input AND gate?

(b) Subtract $(1011)_2$ from $(11100)_2$ using 2's complement method of subtraction.

(c) Draw circuit diagram of AND gate using n-p-n transistors and resistances.

(d) Differentiate between analog and digital signals.

(e) What is negative logic? Explain with the help of truth table of negative logic OR gate.

(f) Convert $(10011010011)_2$ into a hexadecimal number.

(g) Explain the use of PRESET in a sequential circuit.

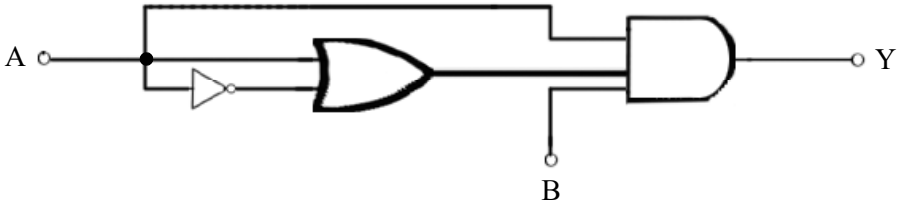
2. (a) State and verify De Morgan's theorem.

(b) Give the sum of
$(4)_{16} + (C)_{16} = (?)_{16}$

(c) Explain how XOR gate can be used as an inverter.

(d) Cite difference between astable and monostable multivibrator. (2+2)+2+2+2

3. (a) Obtain the Boolean expression for the output Y in the following logic circuit.



(b) Simplify the expression and show that the circuit is equivalent to an AND gate with inputs A and B.

(c) Simplify the function $Y = \bar{A}BC + A\bar{B}C + AB\bar{C} + ABC$ by using a Karnaugh map and draw the simplified logic circuit. 2+(2+1)+(3+2)

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4. (a) Implement the following Boolean expression using 4 : 1 Multiplexer $Y = A\bar{B} + \bar{A}B$.

(b) Draw a circuit diagram of a 4 to 10 line decoder using basic gates.

(c) If the output line of a demultiplexer is 12, how many selection lines are required? Give reason.

(d) Draw a block diagram of a 8 : 1 multiplexer. Explain its operation using truth table.

2+2+2+(2+2)

5. (a) What is meant by race around condition in a flip-flop?

(b) Give the truth table of S-R and J-K flip-flop.

(c) Draw the circuit diagram of a Master Slave J-K flip-flop with PRESET and CLEAR inputs.

2+(2+2)+4

6. (a) Cascade two half adders to construct a full adder.

(b) Draw the block diagram for a 4 bit serial in parallel out shift register using D flip-flops.

(c) Draw the output waveform as a function of input pulses for the above circuit.

(d) Mention two basic differences between RAM and ROM. 3+3+2+2

7. (a) A synchronous counter is faster than an asynchronous counter. — Justify the statement.

(b) Explain with proper circuit diagram the function of a Ripple Counter.

(c) Explain the astable modes of a 555 IC timer. 2+4+4

Syllabus : 2019-2020

(Modern Physics)

Full Marks : 50

Answer ***question no.*** **1** and ***any four*** questions from the rest.

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

(a) Explain population inversion in LASERs.

(b) What is the origin of unmodified wavelength in Compton effect?

(c) Find the eigenfunctions of the operator $\hat{p}_x = i\hbar\frac{\partial}{\partial x}$.

(d) If $u = e^{-iAt}$ is a unitary operator, what kind of operator is A?

(e) Justify that an electron cannot be present in the nucleus.

(f) From the binding energy curve, explain the abandance of iron in nature.

(g) Show that $[y, p_y] = i\hbar$.

Answer ***any four*** questions.

2. (a) Derive the Compton equation, $\lambda' = \lambda + (h/m_0c)(1-\cos\theta)$.

(b) Show that a free electron at rest cannot absorb a photon.

(c) When light of wavelength 3000 A° falls on a surface, the kinetic energies of emitted photoelectrons remain in the range from zero to $4{\cdot}0\times10^{19}$ J. Calculate the stopping potential for this emission. 5+3+2

3. (a) In a particle of mass *m* in an infinitely deep one dimensional rectangular patential well, of width L, correspond to a quantum level marked by quantum number *n* calculate the normalized wave function and the energy value of that state.

(b) The wave function of a quantum state is given by $\psi(x) = Bxe^{-\alpha x^2}$. Calculate the expectation value of the momentum operator for that state. 6+4

4. (a) Show that the following matrix can represent an operator correspond to an observable in quantum mechanics and calculate the eigen values.

$$\begin{pmatrix} 0 & -i \\ i & 0 \end{pmatrix}$$

(b) An electron of energy 200 eV is passed through a circular hole of radius 10^{-4} cm. What is the uncertainty introduced in the angle of emergence?

(c) If there exists a function $f(x)$ which is an eigen fucntion of both the operators A and B, what can you conclude about [A, B]? (2+2)+4+2

5. (a) Establish the relation between Einstein's A and B coefficients.

(b) Explain the energy level diagram of the He-Ne laser.

(c) What are the differences between spontaneous and stimulated emission? 4+4+2

6. (a) Calculate the binding energy in MeV of ^{4}He from the following data : Mass of ^{4}He = 4.003875 amu; mass of ^{1}H = 1.008145 amu and mass of a neutron = 1.008986 amu.

(b) Is the nuclear force between two protons different from that between a proton and a neutron? Discuss.

(c) Why in stable heavier nuclei, all the numbers of neutrons are excess of protons? 4+3+3

7. (a) Give an account of the β-ray spectrum.

(b) Explain the role of neutrino hypothesis in understanding the spectrum.

(c) Use the semiempirical mass formula, find out an expression for the energy release in an exactly symmetric fission. Neglect the pairing term. Assume the numbers of neutrons emitted to be zero. 2+4+4

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