B.Sc. Part-III (Honours) Examination, 2020

Subject: Physics

Paper: VIII

(Old Syllabus)

Time: 2 Hours **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.

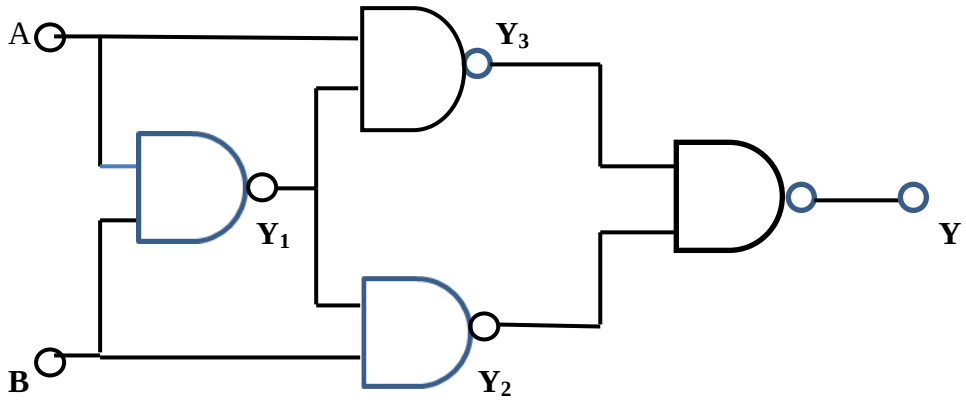
Group-A

Answer *any three* questions from the following 10x3=30

1. (i) With proper schematic diagram describe the principle of construction and working of Michelson's interferometer. (ii) How one can determine the wavelength of a monochromatic wave using this interferometer. 10

2. (i) A uniform string of length L, fixed at both ends, is beaded with N identical particles of mass m with a constant spacing a between two neighbouring particles. Derive the equation of motion of the pth particle. (ii) How do you determine the velocity of sound in vapour by Kundt's tube? (iii) How one can predict the molecular structure of the vapour from this experiment? 10

3. (i) Explain the operation of a full adder using the necessary truth table and Boolean expression. (ii) Hence realise a full adder using two half adders and an OR gate. (iii) Verify that the circuit given below is an EX-OR. 10



4. (i) Using suitable diagrams, discuss classification of amplifiers depending on the operating conditions. (ii) Find out an expression for the voltage gain and bandwidth of a single tuned transistor amplifier in terms of the transistor and the tuned circuit parameters. 10

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5. (i) Physically explain why ground wave is vertically polarised. (ii) Obtain an expression of refractive index of the ionosphere. (iii) What is skip distance? 10

Group-B

Answer *any four* questions from the following 5×4=20

1. (i) Construct a four variable Karnaugh map from the following table:

A	B	C	D	Y
0	0	0	0	0
0	0	0	1	1
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	1
1	1	1	1	0

(ii) From the Karnaugh map shown below, get the Boolean equation for the map:

	$\bar{C}\,\bar{D}$	$\bar{C}\,D$	CD	$C\bar{D}$
$\bar{A}\,\bar{B}$	0	1	1	1
$\bar{A}\,B$	0	0	0	1
AB	1	1	0	1
$A\bar{B}$	1	1	0	1

5

2. The wave equation for a plane monochromatic wave in a conducting medium is given by,

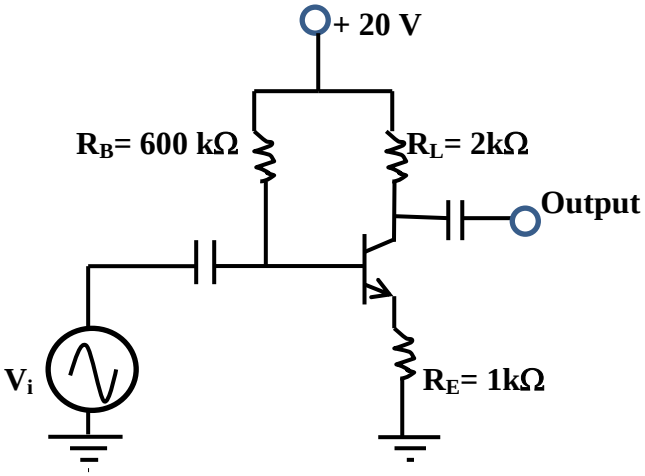
$$\nabla^2 \vec{E} - \varepsilon\mu\frac{\partial^2 \vec{E}}{\partial t^2} - \sigma_c\mu\frac{\partial \vec{E}}{\partial t} = 0$$

Using it show that the refractive index of the medium can be expressed as,

$$n = \sqrt{\frac{k}{2}}\left[1 + \sqrt{1 + \left(\frac{\sigma_c}{\omega\epsilon}\right)^2}\right]^{1/2}$$

(Symbols have their usual significance) 5

3. Draw the h-parameter equivalent circuit for the transistor amplifier shown below. If h_{fe}= 100, h_{ie}= 560Ω, h_{re}= h_{oe}= 0, calculate the input impedance of the amplifier. (Symbols have their usual significance) 5



4. Briefly outline the theory of scattering of electromagnetic radiation by a bound electron and hence derive the condition for Rayleigh scattering. 5

5. (i) Derive an expression for the intensity maxima for the transmitted beam from a Fabry Perot interferometer. (ii) Hence show that the visibility of fringes (V) is given by, $V=2r^2/(1+r^4)$, where r is the reflection coefficient. 5

6. Give physical explanation of generation and detection of ultrasonic sound using piezo electric crystal. 5