

2020

PHYSICS (Honours)

Paper Code : IV - A & B

[New Syllabus]

Important Instructions for Multiple Choice Question (MCQ)

- Write Subject Name and Code, Registration number, Session and Roll number in the space provided on the Answer Script.

Example : Such as for Paper III-A (MCQ) and III-B (Descriptive).

Subject Code :

III	A	&	B
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Subject Name :

- Candidates are required to attempt all questions (MCQ). Below each question, four alternatives are given [i.e. (A), (B), (C), (D)]. Only one of these alternatives is 'CORRECT' answer. The candidate has to write the Correct Alternative [i.e. (A)/(B)/(C)/(D)] against each Question No. in the Answer Script.

Example — If alternative A of 1 is correct, then write :

1. — A

- There is no negative marking for wrong answer.

মাল্টিপল চয়েস প্রশ্নের (MCQ) জন্য জরুরী নির্দেশাবলী

- উত্তরপত্রে নির্দেশিত স্থানে বিষয়ের (Subject) নাম এবং কোড, রেজিস্ট্রেশন নম্বর, সেশন এবং রোল নম্বর লিখতে হবে।

উদাহরণ — যেমন Paper III-A (MCQ) এবং III-B (Descriptive)।

Subject Code :

III	A	&	B
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Subject Name :

- পরীক্ষার্থীদের সবগুলি প্রশ্নের (MCQ) উত্তর দিতে হবে। প্রতিটি প্রশ্নে চারটি করে সম্ভাব্য উত্তর, যথাক্রমে (A), (B), (C) এবং (D) করে দেওয়া আছে। পরীক্ষার্থীকে তার উত্তরের স্বপক্ষে (A)/(B)/(C)/(D) সঠিক বিকল্পটিকে প্রশ্ন নম্বর উল্লেখসহ উত্তরপত্রে লিখতে হবে।

উদাহরণ — যদি 1 নম্বর প্রশ্নের সঠিক উত্তর A হয় তবে লিখতে হবে :

1. – A

- ভুল উত্তরের জন্য কোন নেগেটিভ মার্কিং নেই।

Paper Code : IV - A

Full Marks : 15

Time : Thirty Minutes

Answer *all* the Questions.

Choose the Correct Answer.

Each Question Carries 1.5 Marks.

- The electric fields of two light sources with nearby frequencies ω_1 and ω_2 , and wave vectors k_1 and k_2 , are expressed as $\vec{E}_1 = E_{10}\hat{i}e^{i(k_1z - \omega_1t)}$ and $\vec{E}_2 = E_{20}\hat{i}e^{i(k_2z - \omega_2t)}$ respectively. The interference pattern on the sources is photographed at $t = t_0$; denote $(k_1 - k_2)z - (\omega_1 - \omega_2)t_0$ by θ . For this pattern
 - A bright fringe will be obtained for $\cos\theta = -1$
 - A bright fringe intensity is given by $(E_{10})^2 + (E_{20})^2$
 - A dark fringe will be obtained for $\cos\theta = 1$
 - A dark fringe intensity is given by $(E_{10} - E_{20})^2$
- A diffraction grating 3 cm wide produces a deviation of 33 degrees in the second order with light of wavelength 600 nm. What is the total number of lines on the grating?
 - 13, 616
 - 14, 616
 - 15, 216
 - 12, 614

3. The band gap in germanium is $\Delta E = 0.68 eV$. Assuming that the number of hole electron pair is proportional to $e^{-\Delta E/2kT}$. The percentage increase in the number of charge carriers in pure germanium as the temperature is increased from 300k to 320k is —

(A) 117%

(B) 107%

(C) 97%

(D) 127%

4. Consider the following truth table

A	B	C	F
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

The logic for F is

(A) $AB + BC + CA$

(B) $\bar{A}B + A\bar{C} + \bar{B}C$

(C) $\bar{C}\bar{A}\bar{B} + A\bar{B}$

(D) $\bar{C}(A + \bar{B}) + A\bar{B}$

5. The spherical surface of a plano-convex lens of radius of curvature $R = 1\text{m}$ is placed on a flat plate. The space between them is filled with a transparent liquid. The refractive indices of the lens and the liquid are 1.5 and 1.6 respectively. The radius of the 16th dark Newton's ring in the reflected light is found to be $\sqrt{5}$ mm. The wavelength of the incident light is —
- (A) 4000 Å
 - (B) 5000 Å
 - (C) 3000 Å
 - (D) 3500 Å
6. A Zener diode acts as a perfect voltage regulator when the percentage of regulation has values —
- (A) 100%
 - (B) Not less than 50%
 - (C) Above 90%
 - (D) 0%
7. Huygen's wave theory of light could not explain —
- (A) Photo-electric effect
 - (B) Interference
 - (C) Diffraction
 - (D) Polarization

8. On reflection from a denser medium the path difference is —
- (A) Zero
 - (B) $\lambda/2$
 - (C) λ
 - (D) 2λ
9. A wedge-shaped air film, having an angle of 40 seconds is illuminated by monochromatic light and fringes are observed vertically through a microscope. The distance measured between the consecutive bright fringes is $0.12 \times 10^{-2} \text{m}$. What is the wavelength of light used?
- (A) 4656 Å
 - (B) 4556 Å
 - (C) 4565 Å
 - (D) 4655 Å
10. When operated between cut-off and saturation, a transistor behave like a---
- (A) Linear amplifier
 - (B) Variable resistor
 - (C) Variable capacitor
 - (D) Switch
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2020

PHYSICS (Honours)

Paper Code : IV - B

[New Syllabus]

Full Marks : 55

Time : Three Hours Thirty Minutes

The figures in the margin indicate full marks.

Answer *five* questions taking at least *one* from each group.

Group - A

[Geometrical Optics]

1. (a) By using matrix method, locate the positions of the cardinal points of a Ramsden's eye-piece placed in air. 7
- (b) Show that for refraction at a concave spherical surface (separating glass-air medium), the distance of the object should be greater than three times the radius of curvature of the refracting surface for the image to be real.
 $\mu_{glass} = 1.50$. 4
2. (a) Obtain an expression for the magnifying power of a magnifying glass for normal vision. 7
- (b) State Fermat's principle in optics. Using the principle, show that all the rays passing through one focus of an elliptic reflector pass through the other focus after reflection. 1+3

Group - B

[Physical Optics]

3. (a) Prove that the diameters of dark Newton rings are proportional to the square root of natural numbers. Are the fringes localized or non-localized? 6+1
- (b) Compare the Lloyd mirror and the bi-prism fringes. 4

4. (a) A plane wave front of monochromatic light undergoes diffraction in a double slit. Analyze the diffraction pattern observed. 7
- (b) Separations between the two headlights of a car is 1.22m. Calculate the greatest distance from which a normal human eye can distinguish the two headlights. The diameter of the eye-pupil is 5.0 mm and the wavelength of light is 500nm. 4
5. (a) Discuss the working principle of a Michelson's interferometer. Under what condition are circular and straight fringes produced by it? 5+2
- (b) Compare the actions of Zone plate and a convex lens. 4
6. (a) What do you mean by antireflection coating? Discuss the theory behind it. 2+4
- (b) Why is grating spectrum called a normal spectrum?
- A grating which has 4000 lines/cm is used at normal incidence. Calculate the dispersive power of the grating in the third order spectrum in the wavelength region of 500nm. 1+4

Group - C

[Electronics-I]

7. (a) How the depletion region formed in a p-n junction diode? Explain the variation of its width with biasing. The barrier potential across p-n junction diode cannot be measured simply by placing a voltmeter across diode terminals. Why? 3+2+1
- (b) Draw the hybrid equivalent circuit of a CE amplifier and find out the input and output impedances. 5
8. (a) What do you mean by Q-point of a transistor? The common-base current gain is an n-p-n transistor is 0.98, $I_{CBO} = 12.5 \mu A$. Determine the base current and collector current for an emitter current of 2.0 mA. 2+5
- (b) Prove the Boolean identity :

$$(A + B)(\bar{A} + C) = AC + AB \quad 4$$
