Total No. of Questions – [5] Total No. of Printed Pages : 4

G.R. No.	

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F. Y. B. TECH. (COMMON) (SEMESTER - I)

COURSE NAME: ENGINEERING PHYSICS

COURSE CODE: ES10175A

(2017 PATTERN)

Time: [**2 Hours**] [Max. Marks: **50**]

Instructions to candidates:

1) **Answer Q.1 OR Q.2, Q.3 OR Q.4 and Q.5**
2) **Figures to the right indicate full marks.**
3) **Use of scientific calculator is allowed**
4) **Use suitable data wherever required**

Q1 a) Explain with the help of neat diagrams construction and working of CO_2 laser. [6]

b) Derive an expression for Natural Aperture (NA) of an optical fibre. [6]

c) Laser beam comes out of a diode laser (λ = 8732Å) through a rectangular slit with width 1mm. Calculate the width of the beam at a distance of 100m from the source. [4]

OR

Q2 a) Describe with the help of neat diagrams, construction and working of a Single Hetero-junction diode laser. [6]

b) Explain, with the help of appropriate diagrams, the role of optical cavity in directionality, monochromaticity and coherence of a laser. [6]

c) Population inversion is obtained in a CO_2 laser. The ratio of number of molecules in the higher energy state to that in the lowest energy state $\left(\frac{N_2}{N_1}\right)$ is 1.5. Calculate the equivalent temperature for laser wavelength λ = 9.6 µm. Given, Boltzmann constant k = 1.38×10^{-23} J/K. [4]

Q3 a) Draw a neat diagram of a nuclear fission reactor and explain its construction and working. [6]

b) With the help of a potential energy diagram, explain fission on the basis of liquid drop model. [4]

c) Calculate the energy of the ground state of a neutron trapped in an infinite potential well of width L = 10^{-14} m. Given mass of [4]

neutron = 1.67×10^{-27} kg, h = 6.63×10^{-34}Js.

OR

Q4 a) Derive Schrodinger's time independent equation. [6]

b) Parameters of three moderator materials are tabulated below: [4]

	σ_s (barns)	σ_a (barns)	Cost
H_2O	49.2	0.66	low
D_2O	10.6	0.001	High
Graphite	4.7	0.0045	moderate

Where, σ_s is scattering cross-section and σ_a is absorption cross-section. On the basis of this information, discuss merits and demerits of these moderator materials.

c) Calculate binding energy per nucleon for U_{92}^{235}. Given, mass of U^{235}, proton and neutron as 235.0439299amu, 1.007276 amu and 1.008665 amu, respectively. [4]

Q.5 Attempt following multiple choice questions:[1x20=20 marks]

a) Sound waves with frequency > 20kHz is called [1]

(i)audible (ii) hypersound
(iii) ultrasound (iv) supersound

b) Variation of Loudness of sound with its intensity is [1]

(i)linear (ii) natural logarithm
(iii) exponential (iv) logarithm to the base 10

c) Ultrasound with high frequency is used in ultrasonic non-destructive testing because smaller wavelength [1]

(i)gives better resolution (ii) better collimated beam
(iii)cannot be heard by human ear and hence less noise
(iv) all of the above

d) Thickness of a quartz crystal generating ultrasound determines its [1]

(i) frequency (ii) speed
(iii) intensity (iv) direction

e) Reverberation time of an auditorium will decrease if [1]

(i) chairs in the auditorium are made softer
(ii) volume of the auditorium is increased
(iii) surface area of the auditorium is decreased
(iv) all of the above

f) A film is said to be thin if its thickness is smaller than [1]

(i) wavelength of light (ii) coherence length of light
(iii) line width of a spectral line (iv) none of the above

g) If μ_1, μ, μ_2 are the refractive indices of air, anti-reflection coating (ARC) and glass, respectively, then the ARC has maximum efficiency if μ = [1]

(i) $\mu_1\mu_2$ (ii) $\frac{\mu_1}{\mu_2}$ (iii) $(\mu_1\mu_2)^{1/2}$ (iv) $\left(\frac{\mu_1}{\mu_2}\right)^{1/2}$

h) When monochromatic light with wavelength λ is incident on a slit with width a, maximum diffraction occurs when [1]

(i) $a < \lambda$ (ii) $a = \lambda$ (iii) $a > \lambda$ (iv) none of the above

i) Keeping all other parameters same, if the value of grating element is decreased then grating's [1]

(i) resolving power decreases (ii) dispersion increases
(iii) angle of first order spectrum decreases (iv) none of the above

j) Light from sodium vapour lamp is diffracted using a diffraction grating. Two prominent lines have wavelengths 5890Å and 5896Å. If the angle of diffraction in the first order is θ(5890) and θ(5896) then [1]

(i) θ(5890)> θ(5896) (ii) θ(5890)= θ(5896)
(iii) θ(5890)< θ(5896) (iv) none of the above

k) In an unbiased p-n junction diode [1]

(i) Intrinsic Fermi energy E_{Fi} is higher on the p-side than that on the n-side
(ii) Intrinsic Fermi energy E_{Fi} is lower on the p-side than that on the n-side
(iii) Intrinsic Fermi energy E_{Fi} is equal on the p-side and the n-side
(iv) none of the above

l) The barrier potential V_{bi} in a p-n junction diode depends on [1]

(i) carrier density in both n-side and p-side
(ii) band gap of the semiconductor
(iii) temperature of the diode
(iv) all of the above

m) In an n-type semiconductor, the value of $E_F - E_{Fi}$ increases with [1]

(i) increase in doping concentration of trivalent impurity
(ii) increase in doping concentration of pentavalent impurity
(iii) increase in temperature
(iv) all of the above

n) For two samples A and B of n-type semiconductor, the doping concentration of donor impurities is 1×10^{20} m^{-3} and 3×10^{20} m^{-3}, respectively. If the hole concentration in sample A is 9×10^{12} m^{-3}, then the hole concentration in sample B is [1]

(i) 3×10^{12} m^{-3} (ii) 1×10^{12} m^{-3} (iii) 27×10^{12} m^{-3} (iv) 9×10^{12} m^{-3}

o) In an intrinsic semiconductor, the Fermi energy lies at the centre of [1]

(i) conduction band (ii) valence band
(iii) forbidden band (iv) covalent bond

p) Sun light is converted to electrical energy by [1]

(i) photovoltaic effect (ii) photo-electric effect
(iii) photo-conductance (iv) photo-luminescence

q) For a solar PV cell current is equal to I_{sc} when the load resistance is [1]

(i) infinite (ii) equal to series resistance of solar cell resistance
(iii) zero (iv) equal to parallel resistance of solar cell resistance

r) A solar PV panel is kept at a latitude such that the sun is overhead at 12 noon. Sun beam will go through air mass AM1.2 at an angle of _____ w.r.t. vertical [1]

(i) 30° (ii) 33.6° (iii) 60° (iv) 67.2°

s) Texturing of the surface of solar PV cell is done to [1]

(i) decrease temperature of solar cell
(ii) increase light refracted into solar cell
(iii) increase reflectivity of the surface of solar cell
(iv) decrease reflectivity of solar cell

t) If the band gap of the solar cell material is 1.44 then it will not absorb light of wavelength [1]

(i) 4000Å (ii) 6000Å (iii) 8000Å (iv) 9000Å