Total No. of Questions – [3] Total No. of Printed Pages: [4]

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DECEMBER 2021 (INSEM+ ENDSEM) EXAM

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

COURSE NAME: ENGINEERING PHYSICS

COURSE CODE: ES10204A

(PATTERN 2020)

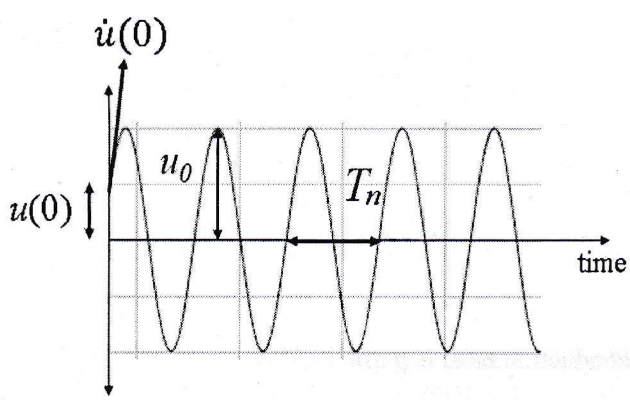
Time: [2Hr] [Max. Marks: 60]

(*) Instructions to candidates:

1) **Figures to the right indicate full marks.**
2) **Use of scientific calculator is allowed**
3) **Use suitable data where ever required**

Q.1 **Solve the following**

i) In the figure given below $\dot{u}(0)$and u_o are [2]



(a)The initial velocity and the initial displacement
(b)The initial velocity and the amplitude
(c)The maximum displacement and the amplitude
(d)The velocity at time and the initial displacement

ii)If the damping ratio is 0.12, find the ratio of the 5th and the 15th amplitude for a viscously damped system. [2]
(a) 1988 (b) 1748 (c) 1784 (d) 1478

iii) In a Harmonic vibration, the angular frequency 'ω_n' is ________ proportional to the time period 'T'. [2]
a) not b) directly c) inversely
d) none of these

iv) In Forced Harmonic Oscillations with viscous damping, when the frequency of the harmonic driving force is very high compared to the natural frequency of the system, the deformation response factor is governed by [2]
(a)The stiffness of the system. (b) The applied force
(c) The mass of the system (d) None of these factors

v) In a critically damped system, which of the following statements is false? [2]
(a) The value of the damping ratio is unity.
(b) There is no oscillation.
(c) The angular frequency is imaginary.
(d) The time period is infinite.

vi) A spring mass system with m=1kg, k=64N/m and ζ=0.19 is driven by an external harmonic force F= (3.2N) sin(ωt). Calculate the static amplitude and the angular frequency at which there will be resonance? [2]
a)0.05m, 8rad/s (b) 0.5m, 8rad/s (c) 0.005m, 8rad/s (d) 0.05m, 0.8rad/s

vii) The displacement of a simple harmonic motion is represented by the equation, u(t)=(2.6 cm) sin(4.52t-0.01). Calculate the acceleration at t=5 secs. [2]
(a) 20 cm/s^2 (b) 25 cm/s^2 (c) 30 cm/s^2 (d) 35 cm/s^2

viii) For a spring mass system, with mass of 7.5kg, oscillating with a damping ratio of 0.012 and a damped frequency of 5Hz, what is the critical damping coefficient? [2]
(a) 741 (b) 417 (c) 147 (d) 471

ix) In an n-type semiconductor, the value of (E_F - E_{Fi}) increases with [2]
(a) increase in doping concentration of trivalent impurity
(b) increase in doping concentration of pentavalent impurity
(c) decrease in doping concentration of pentavalent impurity
(c) none of the options

x) In a semiconductor at room temperature [2]
(a) the valence band is completely filled & the conduction band is completely empty
(b) the valence band is partially empty & conduction band is partially filled
(c) the valence band is completely filled & conduction band is partially filled
(d) the valence band is completely empty and the conduction band is completely filled

xi) For a reverse biased diode, the fermi levels are related as, [2]
(a) $(E_F)_n > (E_F)_p$
(b) $(E_F)_p > (E_F)_n$
(c) $(E_{Fi})_n > (E_{Fi})_p$
(d) $(E_c)_n > (E_c)_p$

xii) Sodium has a non-zero band gap and its valence band is partially filled and conduction band is completely empty at T =0K. Sodium is therefore a [2]
(a) insulator
(b) semiconductor
(c) conductor
(d) none of the options

xiii) For p-type GaAs with a band gap of 1.424eV, if $(E_{Fi} - E_{Fp})$ =0.5eV, then $(E_{Fp} - E_v)$ is equal to [2]

(a) 0.924eV

(b) 0.212eV

(c) 1.012eV

(d) 1.212eV

xiv) The value of gamma integral $\Gamma(1/2)$ is $\sqrt{\pi}$ then the value of $\Gamma(9/2)$ is [2]

(a) $(9\times\sqrt{\pi})/2$

(b) $(945\times\sqrt{\pi})/32$

(c) $(15\times\sqrt{\pi})/8$

(d) $(105\times\sqrt{\pi})/16$

xv) In an intrinsic semiconductor like pure Si, it is true that [2]

(a) the bonds between the Si ions are covalent bonds

(b) the bond strength of each bond is different from that of all others

(c) the energy required to break the weakest bond and set an electron free is equal to the band gap of the material

(d) all of the options

Q2 **Solve any three out of four**

a) Derive the expressions for phase velocity and group velocities for light traveling through a material with refractive index n. What is the difference between them when the light is traveling through vacuum? Why? [5]

b) If the group velocity of light in the core of an optical fibre is $v_g = \frac{c}{\left(n_l - \lambda\frac{dn_l}{d\lambda}\right)}$ then derive the expression for the RMS material dispersion. Analyze if the use of an LED or a diode laser is more appropriate for transmission of data for long distance communication. [5]

c) An optical fibre has refractive indices n_l=1.5 and n_2=1.4982, for the core and the cladding, respectively. A digital signal is generated using a light source with wavelength λ=15000Å and a spectral width of 395Å sent through an 8km long optical fibre which has a dispersion $\left(\lambda^2 \frac{d^2n_l}{d\lambda^2}\right) = 0.025$. Calculate the total RMS dispersion. [5]

d)The detector at the end of a 12km long optical fibre cannot detect an optical power of less than 1μW. If the power of the source is 1mW and the signal has to be sent through an optical fibre which is 10km long, find the corresponding fiber loss parameter. To what extent can the input power be increased to ensure that the signal be detected? Explain with reason. [5]

Q.3 **Solve any three out of four**

i) Draw a labelled diagram of a single hetero-junction diode laser. Indicate the optical cavity and the direction in which the light comes out. Why does a diode laser not require mirrors for the formation of the optical cavity? [5]

ii) Derive an expression for the threshold optical gain in the active medium enclosed in an optical cavity. Which mechanism is used to increase the gain of the active medium above its threshold value? [5]

iii) If a diode laser emits a light beam of wavelength 8500Å through an aperture of diameter 1mm, then what is its diameter at distance of 10m from the output of the laser? Up to what distance is the laser beam assumed to be collimated (i.e. a parallel beam) in an engineering application? [5]

iv) Derive an expression for the coherence length of a beam of light. A He-Ne laser has a full width of the gain curve of $\Delta\nu$ =2.6 GHz at 6328Å. What is its coherence length? [5]