| G.R./PRN No. | | PAPER CODE | U113-2041A (BE) |
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## MAY 2023 (INSEM+ ENDSEM) EXAM
## F.Y. B. TECH. (SEMESTER - II)
## 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

| Question No. | Question Description | Marks | CO mapped | Blooms Taxonomy Level |
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| Q.1 | i) Under forced oscillations if the applied frequency is very very less than natural frequency, then <br><br> a) dynamic response factor is infinite <br><br> b) maximum amplitude of system becomes zero <br><br> c) amplitude is independent of applied force <br><br> d) amplitude is nearly equal to static amplitude | [2] | [1] | Understand |
| | ii) If displacement is given as $u(t)=u_0\sin(\omega_n t - \phi_0)$, what is its acceleration if in complex representation. <br><br> a)$Im\{e^{\omega_n t - \phi_0}\}$     b) $Im\{u_o e^{\omega_n t - \phi_0}\}$     c) $Re\{u_o \omega_n e^{\omega_n t - \phi_0}\}$ <br> d) $-Im\{u_o \omega_n^2 e^{\omega_n t - \phi_0}\}$ | [2] | [1] | Understand |
| | iii) Initially only one person was riding a mono suspension bike, after a certain distance another person joins the ride, if the mass of the second person is 1.6 times the first person, natural frequency of bike will change by factor of <br><br> a). 0.62 <br> b) 4 <br> c) 1.264 <br> d) no change | [2] | [1] | Analysis |

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| iv) Harmonic oscillations are:<br><br>a) type of periodic oscillations.<br>b) They can be represented in the form of sinusoidal functions.<br>c) both (a) and (a)<br>d) none of the above | [2] | [1] | Understand |
| v) A system freely oscillating under critically damped conditions, time period becomes........<br><br>a) zero b) finite c) infinite d) depends on mass | [2] | [1] | Understand |
| vi) Ratio of natural angular frequency to damped angular frequency is 1.091, what is the value of its damping ratio<br><br>a) 0.3998 b) 0.1598 c) 0.091 d) 0.99585 | [2] | [1] | Analysis |
| vii) Resonance frequency for a forced system with damping ratio of 0.1 and natural angular frequency of 10 rad/s is.... Hz<br><br>a) 1.59154 b) 9.8994 c) 1.5755 d) 10 | [2] | [1] | Analysis |
| viii) After how much time does the amplitude of the system become $1/e$ times its initial maximum amplitude if damping ratio is 0.02 for a free damped system with natural angular frequency of 5 rad/s.<br><br>a) 10 sec b) 0.1 sec c) 11 sec d) 0.3678 sec | [2] | [1] | Analysis |
| ix) Which parameter is the intrinsic charge carrier independent of?<br>a) Temperature b) built-in potential<br>c) Energy band gap d) Boltzmann constant | [2] | [2] | Understand |
| x) The ratio of current of a forward biased diode at 0.45 V and that at 0.1 300 K is_____. (use $k = 8.6 \times 10^{-5}$ eV/K)<br><br>a) $7.79 \times 10^5$ b) $1.27 \times 10^{-6}$ c) $5.58 \times 10^5$ d) $1.79 \times 10^{-6}$ | [2] | [2] | Analysis |
| xi) Which of the following statements is correct of the fermi energy level in different materials.<br><br>a) Probability of finding an electron at fermi energy is always less than half.<br>b) The fermi level on the p-side is slightly below the fermi level on the n-side for an unbiased diode.<br>c) The fermi level on the p-side is slightly above the fermi level on the n-side for an unbiased diode.<br>d) The fermi level on the p-side is at the same level as that of the fermi level on the n-side for an unbiased diode. | [2] | [2] | Understand |
| xii) If the probability of finding electron in an energy level $\Delta E$ below the fermi level is 0.91, then what is the probability of finding a hole at the same level.<br><br>a) 0.09 b) 0.91 c) 1 d) 0.82 | [2] | [2] | Analysis |
| xiii) A p-type of semiconductor is prepared by doping N atoms/cm$^3$ of acceptor atoms in pure Ge which gives $E_C - E_F$ as 0.47 eV, then what is the difference between $E_F - E_v$ if the band gap is 0.74 eV.<br><br>a) 0.47 eV b) 0.37 eV c) 0.27 eV d) 0.74 eV | [2] | [2] | Analysis |

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| | xiv) If the amount of intrinsic charge carrier is $5 \times 10^{12}$ /cm$^3$, if it is doped with $12 \times 10^{16}$/cm$^3$ donor atoms, what are the minority charge carriers and its concentration respectively<br><br>a) holes, $4.166 \times 10^5$ /cm$^3$<br>b) holes, $2.083 \times 10^8$ /cm$^3$<br>c) electrons, $2.083 \times 10^8$ /cm$^3$<br>d) electrons, $4.166 \times 10^5$ /cm$^3$ | [2] | [2] | Analysis |
| | xv) Within the depletion region of a pn junction diode ........<br><br>a) potential is constant<br>b) electric field is constant<br>c) electric field is positive<br>d) electric field is negative | [2] | [2] | Understand |
| Q2 | **Solve any three out of four** | **[15]** | | |
| | a) Explain quantitatively why Laser diode is more suitable than LED as a source of light in optical fibre communication, if both have same wavelength but the spectral width of Laser diode is 100 times less than that of LED. | [5] | [3] | Analysis |
| | b) Explain steps involved in optical fibre communication. What are the pros and cons of optical fibre communication over radio or wired communication? | [5] | [3] | Understand |
| | c) Derivation an expression for RMS intermodal dispersion. What is $B_{max}$ and how is it related to dispersion. | [5] | [3] | Understand |
| | d) What is Numerical aperture? If the refractive index of the core of an optical fibre is 1.5, with fractional refractive index of 1%, by what factor the maximum angle of acceptance will change when light is coupled to core from epoxy with refractive index 1.6 instead of air. | [5] | [3] | Analysis |
| Q.3 | **Solve any three out of four** | **[15]** | | |
| | a) Is it possible to have population inversion at room temperature without any external energy? If yes, then justify your answer, if no then which process has to be done. | [5] | [4] | Understand |
| | b) With a neat labeled diagram explaining the principle, construction and working of optical fibre laser. | [5] | [4] | Understand |
| | c) Lens with focal length of 20 cm is used to focus a beam of CO2 Laser with wavelength 10.6 $\mu$m. If the diameter of the incident beam is 2cm, what is the beam waist at the focal point? Compare the intensity of the beam at the focal point and before the lens. | [5] | [4] | Analysis |
| | d) Find the divergence of a laser beam whose peak wavelength is 514 nm coming through an aperture of 0.5 mm. what will be the diameter of the beam after 2 m. | [5] | [4] | Analysis |