Total No. of Questions – [10] Total No. of Printed Pages: 2

G.R. No.	

U118-104CB(ESE)

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

COURSE NAME: Engineering Physics (CB)

COURSE CODE: ES10184A-CB

(PATTERN 2018)

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

Instructions to candidates:

1) **Attempt Q.1, Q.2, Q.3, Q.4 OR Q.5, Q.6 OR Q.7, Q.8 OR Q.9 and Q.10**
2) **Figures to the right indicate full marks.**
3) **Use of scientific calculator is allowed.**
4) **Use suitable data where ever required.**

Q1(a) With the help of a neat diagram, explain the working of anti-reflection coating (ARC) on the basis of interference from a thin film. Derive (a) the minimum thickness and (b) refractive index of the ARC for normal incidence of light. **[4]**

OR

Q1(b) Starting from the expression for resultant amplitude of a grating, obtain conditions for principal maxima and minima. If sodium light is used as a source, will the 5890Å and 5896Å lines, present in the source, be better resolved in 1st or 2nd order? **[4]**

Q2(a) Draw the energy level diagram for an unbiased p-n junction diode at equilibrium. Explain the formation of built in potential on the basis of charge re-distribution in both regions. Derive the expression for built in potential (V_{bi}) for a p-n junction diode. **[4]**

OR

Q2(b) Calculate the built in potential V_{bi} for a diode with a doping of 3.1×10^{14} /cm^3 on the n-side and 7.2×10^{16} /cm^3 on the p-side. The intrinsic charge carrier density at room temperature (T = 300K) for Silicon is 2.1×10^{10} /cm^3. Given, $k = 1.38 \times 10^{-23}$ J/K and $e = 1.6 \times 10^{-19}$ C. **[4]**

Q3(a) What are direct and indirect band gap materials? Illustrate with the help of E-K diagram. Explain how recombinations are facilitated by iso-electronic trap levels **[6]**

OR

Q3(b) With the help of a neatly labeled energy diagram and the physical picture of a photo diode, explain its action. **[6]**

Q4(a) Writing down the expressions for rates of absorption, spontaneous and stimulated emissions, define Einstein coefficients. Hence obtain the condition for light amplification and explain the same. **[6]**

Q4(b) Explain how the property of unidirectionality is achieved for a laser using an optical cavity. **[4]**

OR

Q5(a) With the help of a neatly labelled diagram, explain principle, construction and working of a single heterogeneous laser. **[6]**

Q5(b) In the case of a He-Ne laser, the output beam spot diameters are 3 mm and 5 mm at distances of 1.5 m and 3.5 m respectively. Calculate the laser beam divergence. **[4]**

Q6(a) Obtain an expression for the acceptance angle for an optical fiber. **[6]**

Q6(b)	If the spectral width $\Delta\lambda$=340 Å at λ = 5500Å for a green LED and for the optical fibre, the material dispersion $\left(\lambda^2 \frac{d^2 n_1}{d\lambda^2}\right) = 0.015$. Calculate the material pulse broadening (Δt_m) for an optical fibre of length L = 5 km. What is its value if a laser with the same wavelength but $\Delta\lambda$ = 50 Å is used. Calculate B_{max} for both.	[4]

OR

Q7(a)	Explain, in detail, the various causes for attenuation of a signal in fiber optic communication.	[6]
Q7(b)	If the mean optical power launched into a 100 km long optical fibre is 570 μW and that at the output is 12 μW, then calculate the decibel attenuation and the loss parameter.	[4]
Q8(a)	List the various types of noise associated with a resistor. Explain any two of them in detail.	[6]
Q8(b)	If the resistance of a Pt resistor with R_0 = 100Ω at 0°C, what is its resistance at 250°C and -250°C? Given A = 3.9083×10^{-3} /°C and B = -5.775×10^{-7} /°C.	[4]

OR

Q9(a)	Derive the expression of $\frac{\Delta C}{C}$ for a capacitance sensor for a change in the gap of a parallel plate capacitor. Give two examples of where it could be used.	[6]
Q9(b)	Give the principle of a Hall sensor and explain how it can be used in two applications.	[4]

Q10(a) The Numerical Aperture (NA) of an optical fiber depends on [1]
(i)The refractive index of the cladding alone
(ii) The refractive index of the core alone
(iii) the refractive indices of the core and the cladding
(iv) The refractive index of neither the core nor the cladding

Q10(b) When a pulse of light is launched into an optical fiber, as it travels .... is observed. [1]
(i)the pulse becomes narrower and the height of the pulse becomes larger
(ii)the pulse broadens and the height of the pulse remains constant
(iii) the pulse broadens and the height of the pulse becomes smaller
(iv)the pulse width and height remain constant

Q10(c) For a single mode step index fiber, the intermodal dispersion is remedied by [1]
(i)By changing the refractive continuously from the core to the cladding
(ii) by reducing the radius of the core
(iii) by having a step change in refractive index of core and cladding
(iv) by reducing length of the fiber

Q10(d) For a current of 2μA measured with electronics with a band width of 10kHz, shot noise will be .... [1]
(i)$1.265 \times 10^{-4}\mu A$ (ii)$1.265 \times 10^{-3}\mu A$ (iii)$1.625 \times 10^{-4}\mu A$ $(iv)1.625 \times 10^{-3}\mu A$

Q10(e) Johnson noise can be reduced by decreasing the ....of the measuring instrument. [1]
(i)Voltage (ii) Power (iii) Bandwidth (iv) Frequency

Q10(f) If the separation between the plates of a capacitance sensor is reduced to one fourth of its earlier value the capacitance is ....the previous value. [1]
(i)Double (ii) 4 times (iii) Half (iv) One fourth