Total No. of Questions – [ 5 ]                    Total No. of Printed Pages - 5

Marking Scheme

G.R. No. [            ]

Paper Code:- U117-105A (RE-FF&F)

DECEMBER 2017 / ~~ENDSEM~~ RE-EXAM

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

| Q. No. | | Question | M | Marks distribution | Difficulty | Cognitive | C |
|---|---|---|---|---|---|---|---|
| Q.1) | a) | Explain the construction and working of carbon dioxide laser with the help of energy level diagram. | [6] | Construction: 2M, Working with energy level diagram: 4M | M | Compre-hension | 5 |
| | b) | Explain : i) Stimulated emission  ii) Pumping  ii) Optical cavity | [6] | 2M each | M | Compre-hension | 5 |
| | c) | Find the relative population of the two states in a He-Ne laser that produces light of wavelength 6328 Å at 300 K and 600 K. Comment on answer obtained at two different temperatures. | [4] | At T = 300 K and 600 K: 1.5M each. $\frac{N_2}{N_1} = e^{\frac{-(E_2-E_1)}{KT}}$ At T= 300K, Ans- $1.04\times10^{-33}$ and T=600K, $3.17\times10^{-17}$ Comment: 1M | M | Appli-cation | 5 |
| | | **OR** | | | | | |
| Q.2) | a) | Enumerate the applications of laser biomedical field and explain any one in detail. | [6] | Enumerate: 2M  Any one in detail: 4M | M | Compre-hension | 5 |
| | b) | Explain the construction and working of single hetero junction diode laser with suitable energy band diagram. | [6] | Construction: 2M Working with energy level diagram: 4M | M | Compre-hension | 5 |
| | c) | The refractive index of core and cladding of an optical fibre are 1.64 and 1.58, respectively. Calculate its numerical aperture and maximum acceptance angle. | [4] | $NA = \sqrt{n_1^2 - n_2^2}$ $= \sqrt{1.64^2 - 1.58^2}$ $= 0.4396$ | M | Appli-cation | 5 |

1

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | $\sin \theta_0 = NA = 0.4396$ <br> $\therefore \theta_0 = \sin^{-1}(0.4396) = 26.7 \, \text{de}$ | | | |
| Q.3) | a) | Derive Schrodinger's time independent equation for a matter wave. | [6] | Define MW: 1M <br> Derivation: 5M | M | Compre-hension | 6 |
| | b) | What is reactor poisoning? How is nuclear fission reaction rate maintained in spite of reactor poisoning? | [4] | Reactor poisoning: 3M <br> Remedies: 1M | H | Compre-hension | 6 |
| | c) | When a slow neutron is captured by $U^{235}$ nucleus, fission results in the release of 200 MeV energy. If the output power of a nuclear reactor is 1.6 MW, calculate the number of nuclei undergoing fission per second. | [4] | $E = 200$ MeV $= 3.2 \times 10^{-11}$ J <br> Power of rector = 1.6 MW= $1.6 \times 10^6$ J/sec <br> No. of nuclei = $(1.6 \times 10^6)/(3.2 \times 10^{-11}) = 5 \times 10^{16}$ | M | Appli-cation | 6 |
| | | **OR** | | | | | |
| Q.4) | a) | Explain the building blocks of Nuclear reactor with the help of a diagram. | [6] | Diagram: 2M <br> Explanation : 4M | M | Compre-hension | 6 |
| | b) | Discuss with the help of liquid drop model, why nuclear fission takes place in $U^{235}$, but not in $U^{238}$? Also draw an appropriate diagram. | [4] | Diagram: 1M <br> Explanation: 3M | H | Compre-hension | 6 |
| | c) | An infinite potential well has a width of 1 Å. What is the fractional change in the lowest two permissible energies of an electron in this well if the width is increased to 2 Å? (Given: h =6.63 × 10$^{-34}$ J-sec, m = 9.1 × 10$^{-31}$ kg) | [4] | $E = (n^2 h^2)/(8mL^2)$ <br> For L = 1 Å, $E_1 = 37.7$ eV, $E_2 = 150.8$ eV <br> For L = 2 Å, $E_1 = 9.43$ eV, $E_2 = 37.7$ eV <br> $\Delta E_1 = 28.27$ eV, <br> $\Delta E_2 = 113.1$ eV, 2M each | M | Appli-cation | 6 |
| | | | | | | | |
| Q.5) | | Attempt following multiple choice questions: [1x20=20 marks] | | | | | |
| | a) | As the audience increases in a concert hall, the reverberation time _____ <br> i.    remains constant <br> ii.   decreases <br> iii.  increases <br> iv.  initially increases and then decreases | [1] | ii | M | Compre-hension | 1 |
| | b) | Intensity level corresponding to threshold intensity on dB scale is _____ <br> i.    1       ii.  -12 <br> iii.  0       iv.  12 | [1] | iii | M | Appli-cation | 1 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| c) | The sound waves that propagate in a metal bar may be _____<br>i.   Longitudinal<br>ii.   transverse<br>iii.   both longitudinal and transverse<br>iv.   none of the above | [1] | | iii | M | Compre-hension | 1 |
| d) | A sound wave of wavelength 5 cm traveling with a speed of 340 m/s has a time period of _____<br>i.   0.14 Ms    ii.  0.14 s<br><br>iii.  0.14 μs      iv.  0.14 ms | [1] | | iv | M | Appli-cation | 1 |
| e) | Principle of ultrasound echo sounding is used in _____<br>i.   depth sounding   ii. cleaning<br><br>iii. welding          iv. drilling | [1] | | i | M | Appli-cation | 1 |
| f) | For a thin uniform film, the interference pattern by reflection consists of _____.<br>i.   Uniform intensity throughout the film<br>ii.   Straight parallel bands of equal width<br>iii.   Straight parallel bands of unequal width<br>iv.   Curved bands | [1] | | i | M | Compre-hension | 2 |
| g) | The first minimum for a Fraunhofer diffraction from a single slit (width a) occurs at an angle $\theta$ with respect to the incident beam (wavelength $\lambda$) such that $\theta$ = _____<br><br>i. $\sin^{-1}(\lambda/a)$    ii. $\sin^{-1}(a/\lambda)$<br>iii. $\pi$             iv. $\pi/2$ | [1] | | i | L | Compre-hension | 2 |
| h) | For a diffraction grating with a grating element $1.67 \times 10^{-4}$ cm illuminated by light of wavelength $\lambda$ = 6328 Å, the maximum order observed is _____.<br>i.   4    ii. 1    iii. 2<br>iv.   2.6 | [1] | | iii | M | Appli-cation | 2 |
| i) | A wedge shaped film is formed by keeping a separator of thickness t between two glass plates. If a separator is moved away from the angle of wedge, fringes will _____<br>i.   come close to one another<br>ii.   move away from one another<br>iii.   remains as it is<br>iv.   first comes close and then moves | [1] | | ii | M | Compre-hension | 2 |

3

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | away | | | | | |
| j) | | What should be the thickness of non-reflecting coating on glass if $\mu_{glass} = 1.5$ and $\mu_{film} = 1.25$ and $\lambda = 6000\text{Å}$?<br>  i.  0.2 µm    ii. 0.3 µm<br><br>  iii. 1 µm    iv. 0.12 µm | [1] | iv | M | Application | 2 |
| k) | | Fermi level for n-type semiconductor lies _____ at T= 0K.<br>  i.  close to valence band<br>  ii. close to conduction band<br>  iii. at the center of band gap<br>  iv. within valence band | [1] | ii | M | Comprehension | 3 |
| l) | | Fermi-Dirac function value at room temperature for $E < E_F$ _____<br>  i.   f (E) <1<br>  ii.  f (E) > 1<br>  iii. f (E) = 1<br>  iv.  f (E) = 0 | [1] | i | M | Comprehension | 3 |
| m) | | Resistance of semiconductor _____ with temperature.<br>  i.   Increases<br>  ii.  remains unaffected<br>  iii. decreases<br>  iv.  none of these | [1] | iii | L | Comprehension | 3 |
| n) | | Current in a p-n junction diode _____ for forward biasing.<br>  i.   decreases exponentially<br>  ii.  is linear<br>  iii. is unaffected by biasing<br>  iv.  increases exponentially | [1] | iv | M | Comprehension | 3 |
| o) | | For a n-type semiconductor if the doping concentration of donor impurity is $1.8 \times 10^{15}$ /cm$^3$ and intrinsic charge carriers concentration is $10^{10}$ /cm$^3$ at 300K. Then what is the concentration of minority charge carriers?<br>  a) $0.55 \times 10^{-5}$/cm$^3$<br>  b) $0.55 \times 10^{-5}$/m$^3$<br>  c) $0.56 \times 10^{5}$/cm$^3$<br>  d) $0.56 \times 10^{5}$/m$^3$ | [1] | c | M | Application | 3 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| p) | When the two solar cell are connected in parallel _____ .<br>   i.    current increases<br>   ii.   voltage decreases<br>   iii.  current decreases<br>   iv.  voltage increases | [1] | **i** | L | Compre-hension | 4 |
| q) | In a solar cell, due to internal resistance $R_s$ which is in series with load resistance _____ .<br>   i.    current drops<br>   ii.   voltage drops<br>   iii.  efficiency increases<br>   iv.  fill factor increases | [1] | **ii** | M | Compre-hension | 4 |
| r) | For a solar cell with short circuit current 3.3 A, open circuit voltage 0.614 and fill factor 75%, what is the maximum power generated?<br>   i.   1.52 W     ii. 0.152 W<br>   iii.   15.2 W   iv. 0.0152 W | [1] | **i** | M | Appli-cation | 4 |
| s) | To avoid hot spotting in solar panel _____ .<br>   i)  blocking diode is connected in series to each cell<br><br>   ii) bypass diode is connected in series to each cell<br><br>   iii) blocking diode is connected in parallel to each cell<br><br>   iv) bypass diode is connected in parallel to each cell | [1] | **iv** | M | Compre-hension | 4 |
| t) | Find out the maximum wavelength above which silicon is transparent?<br>(Given: Band gap of Silicon = 1.1 eV,<br>h= $6.63 \times 10^{-34}$ J-sec, c = $3 \times 10^8$ m/s)<br>   i) 1125 Å     ii) 11250 Å<br>   iii) 112.5 Å  iv) 112500 Å | [1] | **ii** | M | Appli-cation | 4 |