Total No. of Questions – [5]   Total No. of Printed Pages 6

G.R. No.	

Marking Scheme

DECEMBER 2017 / ENDSEM

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**

				Marking scheme	Cognitive	Difficulty	CO
Q1	a)	Explain with the help of neat diagrams construction and working of CO_2 laser.	[6]	Construction diagram – 1M Energy level diagram – 1M Construction – 2M Working – 2M	U	M	5
	b)	Derive an expression for Natural Aperture (NA) of an optical fibre.	[6]	Diagram – 2M NA – 4M	U	M	5
	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]	$\theta = \sin^{-1}$ (8732×10^{-7}mm /1mm)=0.05 $\tan\theta = s/100\times10^3$ mm = 87 mm width = a+2s = 1+ 2×87=175mm	A	M	5
		OR					
Q2	a)	Describe with the help of neat diagrams	[6]	Construction diagram – 1M Band level diagram – 1M	U	M	5

		construction and working of a Single Hetero-junction 5diode laser.					
	b)	Explain with the help of appropriate diagrams, the role of optical cavity in directionality, monochromaticity and coherence of a laser.	[6]	Directionality – 2M Monochromaticity – 2M Cohenrence – 2M	U	M	5
	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 or k = 8.6×10^{-5} eV/K.	[4]	$E_2 - E_1 = \frac{1.24}{9.6\ (\mu m)} = 0.1292\ eV$ $\frac{N_2}{N_1} = e^{-(E_2-E_1)/kT}$ $T = \frac{-(E_2 - E_1)}{k\ ln\left(\frac{N_2}{N_1}\right)}$ T = -3705K	A	H	5
Q3	a)	Draw a neat diagram of a nuclear fission reactor and explain its construction and working.	[6]	Diagram - 2M Construction and working – 4M	U	M	6
	b)	With the help of a potential energy diagram, explain fission on the basis of liquid drop model.	[4]	Labeled diagram – 2M Explanation – 2M	U	M	6
	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 neutron = 1.67 × 10^{-27} kg, h = 6.63 × 10^{-34}Js.	[4]	$E = \frac{n^2h^2}{8mL^2}$ $E = \frac{1^2(6.63 \times 10^{-34})^2}{8 \times 1.67 \times 10^{-27}(10^{-14})^2}$ $= 3.29 \times 10^{-13} J$ $E = \frac{3.29 \times 10^{-13}}{1.6 \times 10^{-19}} = 2.05\ MeV$	A	M	6

OR							
Q4	a)	Derive Schrodinger's time independent equation.	[6]	Definition of potential – 1M Derivation – 5M	U	M	6
	b)	Parameters of three moderator materials are tabulated below: | | σ_s (b | | H_2O | 49.2 | | D_2O | 10.6 | | Graphite | 4.7 | 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.	[4]	In totality - 4M	U	H	6
	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]	Δm = (92 ×1.007276 + 143 × 1.008665) – 235.0439299 = 1.8645571 amu BE = 1.8645571 amu × 931.5 MeV/amu = 1743.36MeV BE/A = 1743.36MeV/235 = 7.4 MeV	A	L	6

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

			Ans	Cog	Dif	CO
a)	Sound waves with frequency > 20kHz is called (i) audible (ii) hypersound (iii) ultrasound (iv) supersound	[1]	iii	K	L	1
b)	Variation of Loudness of sound with its intensity (i) linear (ii) natural logarithm (iii) exponential (iv) logarithm to the base 10	[1]	iv	K	M	1
c)	Ultrasound with high frequency is used in ultrasonic non-destructive testing because smalle wavelength (i) gives better resolution (ii) better collimated be	[1]	iv	K	M	1

	noise (iv) all of the above					
d)	Thickness of a quartz crystal generating ultrasou determines its (i) frequency (ii) speed (iii) intensity (iv) directio	[1]	i	K	M	1
e)	Reverberation time of an auditorium will decrease (i) chairs in the auditorium are made softer (ii) its volume is increased (iii) its surface area is decreased (iv) all of the above	[1]	i	K	M	1
f)	A film is said to be thin if its thickness is smaller than (i) wavelength of light (ii) coherence length of ligh (iii) line width of a spectral line (iv) none of the above	[1]	ii	K	M	2
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 = (i) $\mu_1\mu_2$ (ii) $\frac{\mu_1}{\mu_2}$ (iii) $(\mu_1\mu_2)^{1/2}$ (iv) $\left(\frac{\mu_1}{\mu_2}\right)^{1/2}$	[1]	iii	K	M	2
h)	When monochromatic light with wavelength λ is incident on a slit with width a, maximum diffraction occurs when (i) $a < \lambda$ (ii) $a = \lambda$ (iii) $a > \lambda$ (iv) none of the above	[1]	i	K	M	2
i)	Keeping all other parameters same, if the value o grating element is decreased then grating's (i) resolving power decreases (ii) dispersion increases (iii) angle of first order spectrum decreases (iv) none of the above	[1]	ii	K	M	2
j)	Light from sodium vapour lamp is diffracted usin diffraction grating. Two prominent lines have wavelengths 5890Å and 5896Å. If the angle of diffraction in the first order is $\theta(5890)$ and $\theta(589$ then (i) $\theta(5890) > \theta(5896)$ (ii) $\theta(5890) = \theta(5896)$ (iii)	[1]	iii	U	M	2

k)	In an unbiased p-n junction diode (i) Intrinsic Fermi energy E_{Fi} is higher on the p-si 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-s and the n-side (iv) none of the above	[1]	i	K	H	3
l)	The barrier potential V_{bi} in a p-n junction diode depends on (i) carrier density in both n-side and p-side (ii) ba gap of the semiconductor (iii) temperature of the diode (iv) all of the above	[1]	iv	K	H	3
m)	In an n-type semiconductor, the value of E_F - E_{Fi} increases with (i) increase in doping concentration of trivalent impurity (ii) increase in doping concentration of pentavalent impurity (iii) increase in temperatur (iv) all of the above	[1]	ii	U	M	3
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}, the hole concentration in sample B is (i) 3×10^{12} m^{-3} (ii) 1×10^{12} m^{-3} (iii) 27×10^{12} m^{-3}(iv) 9×10^{12} m^{-3}	[1]	i	A	H	3
o)	In an intrinsic semiconductor, the Fermi energy l at the centre of (i) conduction band (ii) valence band (iii) forbidd band (iv) covalent bond	[1]	iii	K	L	3
p)	Sun light is converted to electrical energy by (i) photovoltaic effect (ii) photo-electric effect (iii) photo-conductance (iv) photo-luminescence	[1]	i	K	L	4
q)	For a solar PV cell current is equal to I_{sc} when th	[1]	iii	K	M	4

	load resistance is (i) infinite (ii) equal to series resistance of solar c resistance (iii) zero (iv) equal to parallel resistanc of solar cell resistance					
r)	A solar PV panel is kept at a latitude such that th sun is overhead at 12 noon. Sun beam will go through air mass AM1.2 at an angle of (i) 30° (ii) 33.6° (iii) 60° (iv) 67.2°	[1]	ii	A	M	4
s)	Texturing of the surface of solar PV cell is done to (i) decrease temperature of solar cell (ii) increase light refracted into solar cell (iii) increase reflectiv of the surface of solar cell (iv) decrease reflectivit of solar cell	[1]	ii	K	M	4
t)	If the band gap of the solar cell material is 1.44 then it will not absorb light of wavelength (i) 4000Å (ii) 6000Å (iii) 8000Å (iv) 9000Å	[1]	iv	A	H	4