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

G.R. No.	

Paper Code - U127-105A (ESB)

May 2018 / END SEM

F. Y. B. TECH. (COMMON) (SEMESTER - II)

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	Marks	Distribution	DL	BT	CO
Q1	a)	With the help of energy level diagrams, explain the pumping mechanisms for a) CO_2 laser and b) Single hetero-junction diode laser.	[6]	a) 3M – 1M-diagram, 2M explanation b) 3M – 1M-diagram, 2M explanation	M	K, C	5
	b)	Explain any three advantages of laser based surgery as against conventional surgery.	[6]	2M each	M	K, C	5
	c)	If light is incident through water (n_0 = 1.33) onto an optical fibre which has refractive indices of n_1 = 1.55 and n_2 = 1.5 for the core and the cladding, respectively. Calculate the maximum acceptance angle.	[4]	$\theta_0 = sin^{-1}\left(\frac{\sqrt{n_1^2 - n_2^2}}{n_0}\right)$ = 17.07 degrees	M	A	5
				OR			
Q2	a)	Derive an expression for numerical aperture	[6]	Diagram - 1 M Derivation – 5M	M	K, C	5

		of an optical fibre in terms of n_0, n_1 and n_2, the refractive indices of medium of incident light, core and cladding, respectively. Draw appropriate diagram.					
	b)	Why is a laser monochromatic, coherent and intense. Explain in detail with the help of appropriate diagram(s).	[6]	2M each	H	K, C	5
	c)	Calculate the coherence length for Kr orange line with wavelength λ = 6058 Å and a line width of $\Delta\lambda$ = 0.00550 Å in a medium with refractive index 1.5.	[4]	$l_{coh} = \frac{\lambda^2}{\mu\Delta\lambda} = \frac{6058^2 \times 10^{-10}}{1.5 \times 0.0055} = 0.445m$	M	A	5
Q3	a)	Derive Schrodinger's time independent equation.	[6]	6 M in totality	M	K, C	6
	b)	Explain the role of moderator and control rods in a Nuclear reactor.	[4]	2M each	M	K, C	6
	c)	Calculate the ground state energy and momentum of a proton confined to a rigid box of dimensions L = 4.5 × 10^{-14} m. Given, h = 6.63 × 10^{-34} Js and m_p = 1.67 × 10^{-27} kg.	[4]	$E = \frac{n^2h^2}{8mL^2}$ $= \frac{1 \times (6.63 \times 10^{-34})^2}{8 \times 1.67 \times 10^{-27}(4.5 \times 10^{-14})^2}$ $=0.163\times10^{-13}$J $=0.102\times10^{6}$ eV = 0.102 MeV $P = \sqrt{2mE} = 7.37 \times 10^{-21}$ kgm/s	L	K, C	6
				OR			
Q4	a)	Discuss fission of a nucleus on the basis of liquid drop model with the help of a diagram.	[6]	Diagram – 1M Discussion – 5M	M	K, C	6
	b)	Write the expression for the energy of a particle in a rigid box. Discuss any three quantum mechanical characteristics of this	[4]	Expression – 1M Three points – 1M each	M	K, C	6

		equation in comparison with classical Mechanics.					
	c)	If energy released per fission of U^{235} nucleus is 200MeV, calculate the mass of U^{235} required, to generate 7000MWh electric energy. Assume reactor efficiency of 35%.	[4]	$\eta = \frac{Electrical\ energy\ (\frac{O}{P})}{Nuclear\ energy\ (\frac{I}{P}}$ Nuclear energy = 7000/0.35 = 20000MWh Energy released /fission = 200MeV No. of U235 nuclei required $= \frac{20000\times10^6\times3600}{200\times10^6\times1.6\times10^{-19}} = 2.25\times10^{24}$ Mass of U = $\frac{2.25\times10^{24}\times235}{6.023\times10^{23}}$ = 877.89 gm	H	K, C	6

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

a)	Principle of echo is used in (i) SONAR (ii) measurement of position of fault in a solid (iii) Ranging (iv) all of the above	[1]	(iv)	M	K	1
b)	Intensity level of sound I_L is given by (i) $10\ln(I/I_0)$ (ii) $1/10\ln(I/I_0)$ (iii) $10\log_{10}(I/I_0)$ (iv) $1/10\log_{10}(I/I_0)$	[1]	(iii)	M	K	1
c)	Pitch of sound depends on its (i) intensity (ii) intensity level (iii) power (iv) frequen	[1]	(iv)	M	K	1
d)	Reverberation time decreases with (i) increase in intensity of sound (ii) increase in absorption of sound (iii) decrease in the pitch of sound (iv) decrease in the frequency of sound	[1]	(ii)	M	K	1
e)	Sound with frequency more than 20,000 Hz is called (i) Ultrasound (ii) Infrasound (iii) hypersound (iv) supersound	[1]	(i)	M	K	1
f)	In the fringe pattern from a thin wedge shaped film, the path difference between two consecutive dark fringes is (i) $\lambda/2$ (ii) 2λ (iii) λ (iv) $\lambda/4$	[1]	(iii)	M	K	2
g)	Anti-reflection coating works on the principle of (i) constructive interference in reflection (ii) destructive interference in reflection	[1]	(ii)	M	K	2

	(iii) destructive interference in transmission (iv) none of the above					
h)	For 0^{th} principal maximum in Fraunhofer diffraction from a diffraction grating (i) angle of occurrence θ is zero (ii) dispersion is zero (iii) resolution is zero (iv) all of the above	[1]	(iv)	M	K	2
i)	For Fresnel diffraction (i) source is at infinite distance (ii) convex lenses are required (iii) diffracted beam has a plane wave front (iv) none of the above	[1]	(iv)	M	K	2
j)	A soup bubble looks coloured when viewed in white light because of (i) diffraction (ii) interference (iii) absorption (iv) refraction	[1]	(ii)	M	K	2
k)	Built in potential in a p-n junction diode depends on (i) temperature (ii) impurity concentration on the p-s (iii) impurity concentration on the n-side (iv) all of the above	[1]	(iv)	M	K	3
l)	The discrete energy levels due to pentavalent impurities are in (i) conduction band (ii) valence band (iii) forbidden gap (iv) none of the above	[1]	(iii)	M	K	3
m)	In an extrinsic semiconductor, where n_i, n and p is intrinsic charge carrier density, electron density and hole density, respectively: (i) $n_i^2 = n/p$ (ii) $n_i^2 = np$ (iii) $n_i^2 = np/2$ (iv) $n_i^2 = \sqrt{(np)}$	[1]	(ii)	M	K	3
n)	Fermi energy of an intrinsic semiconductor is at the centre of (i) conduction band (ii) valence band (iii) forbidden band (iv) none of the above	[1]	(iii)	M	K	3
o)	Effective mass of a charge carrier in a solid is proportional to (i) $\frac{\partial^2 E}{\partial k^2}$ (ii) $1/\frac{\partial^2 E}{\partial k^2}$ (iii) $\frac{\partial E}{\partial k}$ (iv) $1/\frac{\partial E}{\partial k}$	[1]	(ii)	M	K	3

p)	Conversion of light into electric energy by a solar cell is because of (i) photo-electric effect (ii) photovoltaic effect (iii) photo-conduction (iv) photo-synthesis	[1]	(ii)	M	K	4
q)	Air mass of sun light incident at an angle θ with resp normal is defined as (i) cosθ (ii) sinθ (iii) 1/cosθ (iv) 1/sinθ	[1]	(iii)	M	K	4
r)	The absorption length or absorption depth for Si is largest for (i) UV light (ii) visible light (iii) Infrared light (iv) X-ra	[1]	(iii)	M	K	4
s)	Fill factor for a solar cell is less than one because of (i) series resistance R_s (ii) parallel resistance R_p (iii) both R_s and R_p (iv) none of the above	[1]	(iii)	M	K	4
t)	Solar energy is not completely green because of (i) high energy required for manufacturing solar pane (ii) low efficiency (iii) necessity to use batteries for storage of electric power (iv) all of the above	[1]	(iv)	M	K	4