3 (Sem–6/CBCS) PHY HE 1

2022

PHYSICS

(Honours Elective)

Paper : PHY–HE–6016

(Communication Electronics)

Full Marks : 60

Time : Three hours

The figures in the margin indicate full marks for the questions.

1. Answer **any seven** questions : 1×7=7

   (i) Why is modulation needed for communication ?

   (ii) Define noise.

   (iii) What is baseband signal ?

   (iv) What is IMEI number of a mobile phone ?

(v) Write the frequency range for 4G network.

(vi) For amplitude modulation, write the relation between powers of side and carrier frequency if the depth of modulation is 1.

(vii) Define pre-emphasis.

(viii) How many side bands exist in frequency modulation ?

(ix) What are the frequencies the modulated wave has in case of amplitude modulation ?

(x) Write *one* difference between FM and PM.

2. Answer *any four* of the following : 2×4=8

(i) Draw a block diagram for communication system.

(ii) Write the significance of signal-to-noise ratio.

(iii) Explain briefly the importance of modulation index.

(iv) Define ASK and FSK.

(v) How many AM stations can be accommodated in a 100 kHz bandwidth if the highest frequency of the message signal is 5 kHz ?

(vi) A 500 W carrier is to be modulated to 90% level. Determine the total transmitted power.

(vii) Write two differences between GSM and CDMA.

(viii) Define path loss in satellite communication and express it mathematically.

3. Answer *any three* of the following :

5×3=15

(i) What are the advantages of geostationary satellite ? Draw a simplified block diagram of earth station. 2+3=5

(ii) Discuss briefly about cell splitting and cell sectoring.

(iii) If a 1000 *kHz* carrier wave is modulated by an audio signal varying between 10 and 500 *Hz*, Calculate the —

(a) frequency span of sideband;

(b) maximum upper side frequency;

(c) the frequency range of the channel.

(iv) Draw a simplified block diagram of mobile phone handset.

(v) Consider an audio signal $15 \sin 2\pi$ (1500 *t*) that amplitude modulates a carrier $60 \sin 2\pi (100000\ t)$.

(a) Construct all the signals.

(b) Determine the modulation index and percentage modulation.

(c) What are the frequencies of audio signal and the carrier ?

(vi) Discuss the generation of frequency modulation using VCO.

(vii) Write a short note on mobile communication network.

(viii) Explain briefly about the process of uplink in satellite communication.

4. Answer *any three* of the following :

10×3=30

(i) Derive an expression for amplitude modulated wave. The output signal from an AM modulator is
$s(t) = 5\ cos\ (1800\,\pi\,t) + 20\ cos\ (2000\,\pi\,t) + 5\ cos\ (2200\,\pi\,t)$. Calculate —

(a) the modulation index; and

(b) the ratio of the power in the sidebands to the power in the carrier. 5+5=10

Contd.

(ii) Derive the expression of modulated wave in case of frequency modulation. A 100 *MHz* carrier is frequency modulated by 10 *kHz* wave. For a frequency deviation of 50 *kHz*, calculate the modulation index of the FM signal.

6+4=10

(iii) Explain the emitter modulation method to generate AM wave.

(iv) Draw a block diagram of super heterodyne receiver and explain the function of each section.

(v) Define PAM, PWM and PPM. Consider a sinusoidal signal and draw the corresponding modulated wave for each modulation method.   (3+2+2)+3=10

(vi) Explain with diagram the working of ASK, FSK and PSK.   3+3+4=10

(vii) Explain the diode detector method to detect amplitude modulated wave.

(h) Write short notes on :   5+5=10

    (a) Global positioning system

    (b) Electromagnetic communication spectrum

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3 (Sem–6/CBCS) PHY HE 4

2022

PHYSICS

(Honours Elective)

Paper : PHY–HE–6046

(Astronomy and Astrophysics)

Full Marks : 80

Time : Three hours

The figures in the margin indicate full marks for the questions.

1. Answer **any ten** questions from the following : 1×10=10

   (a) Ẁrite *one* point of difference between Astronomy and Astrophysics.

   (b) What is a Celestial Sphere ?

   (c) What is the declination of the north Celestial Pole ?

   (d) What is Parsec ?

(e) Which of the following co-ordinates does not change with time ?

   (i)   Right ascension

   (ii) Hour angle

   (iii) Azimuth

(f) Write the range of value of the Azimuth of celestial objects.

(g) What is f-number of a Telescope ?

(h) Which of the following features does not pertain to a telescope ?

   (i)   Light-gathering

   (ii) Resolution

   (iii) Dispersion

   (iv) Magnification

(i) If the distance of a star is increased by a factor of 2, then write how much the radiation flux received changes.

(j) Write the sequence of classification of stars.

(k) Which class of the stars are found in the disc of the Milky Way ?

(l) Which aspect is not dealt with under cosmology ?

  (i) Origin of the Universe

  (ii) Evolution of Sun

  (iii) Evolution of Universe

  (iv) Ultimate fate of Universe

(m) What is Chandrasekhar Limit ?

(n) Which is the catalytic process for the production of energy in the core of a star ?

  (i) PP-chain

  (ii) CNO cycle

  (iii) Both PP-chain and CNO cycle

  (iv) None of the above

(o) Write the value of mass of a neutron star.

2. Answer *any five* of the following questions :
$$2 \times 5 = 10$$

(a) What are vernal equinox and the right ascension (RA) ?

(b) What is the difference between sidereal time and solar time ?

(c) For what points on the Celestial sphere are both Right ascension and declination equal to zero ? What are the astronomical latitudes and longitudes of these points ?

(d) A particular star has apparent and absolute magnitudes as −0·3 and +4·1. Calculate the distance in A.U.

(e) For stars having more mass than $10M_\odot$, the luminosity is directly proportional to their masses. Show that their life time on the main sequence is independent of their masses.

(f) Calculate the ratio of Radiant fluxes received from two stars whose magnitudes differ by 2·5.

(g) Draw a schematic ray diagram of a Newtonian reflecting telescope.

(h) Write the different parts of Milky Way. Draw its schematic diagram showing the parts.

3. Answer *any four* of the following questions :

$5 \times 4 = 20$

(a) What are white dwarf stars ? Show that, as the mass of the white dwarf increases, its radius decreases.

$1+4=5$

(b) What is light gathering power of a telescope ? Compare the light gathering power of the $8m$ telescope and $0.8m$ telescope.

$2+3=5$

(c) What do you understand by hydrostatic equilibrium in a star ? Derive the equation of hydrostatic equilibrium for a star.

$2+3=5$

(d) Describe the sequence of reactions in the carbon-nitrogen cycle for production of energy of a star.

5

(e) State Hubble's law and explain how Hubble's constant indicates the age of the Universe.

$2+3=5$

(f) Using Stefan-Boltzmann law of radiation, obtain the ratio of radii of two stars interms of their surface temperatures and absolute magnitudes.

5

(g) Explain the formation of neutron stars and its internal structure.   5

(h) What is resolving power of a telescope ? A telescope has a diameter 2·34m and it detected a radiation of wavelength 5500Å. Calculate the resolving power of the telescope.   2+3=5

4. Answer **any four** questions of the following :

   10×4=40

   (a) (i) Describe the trigonometric parallax method of determining stellar distances. Mention the limitation of the method.   6

   (ii) What is solar corona ? Explain why the solar corona is observed only during total solar eclipse.

   1+3=4

   (b) What is meant by Hertzsprung-Russell diagram ? Discuss what pieces of information about the properties of a star may be gathered from its position in this diagram.   2+8=10

   (c) (i) Explain Hubble's classification of galaxies with Hubble's tuning fork diagram.   7

(ii) Define active galaxy. What is the source of its activity ? 1+2=3

(d) Discuss qualitatively the different stages in the evolution of a star. 10

(e) State the cosmological principle. Derive Friedmann equation used for evolution of a homogeneous universe. 2+8=10

(f) What are the different types of optical telescopes used for astronomical observations ? What is the main difference between them ?

What do you mean by magnifying power of a telescope ?

Find the magnifying power of a 6 inch, $f/8$ telescope when an eyepiece of $12\cdot5mm$ focal length is used. How could one increase the magnifying power of this telescope ? 2+3+1+3+1=10

(g) Write short notes on **any two** of the following : 5×2=10

(i) Virial theorem

(ii) Cosmic microwave Background Radiation

(iii) Black holes

(iv) Stellar magnitude scale

(v) Meteorites and Comets

(h) *(i)* What are apparent and absolute magnitudes of a shining object ? Derive a relation between them.

$1+1+4=6$

(ii) The Sun has an apparent magnitude $m = -26.5m$. Calculate its absolute magnitude. 4

(i) Write down the sequence of events leading to the formation of a protostar. When does a protostar become a star ? Describe briefly the occurrence of helium flash. $6+2+2=10$

(j) What is the basis of spectral classification of stars ? Enumerate the special features of Harvard special sequence. $4+6=10$