Semester: *III*

Course name & Code: *Section 1: Waves and Oscillations; & PYC 103*
Section 2: Electronics

Total marks: *80* **Date:** *24/11/2022* **Duration:** *2 Hours* **Total No of pages:** *02*

Instructions:

1) *Answer Section-1 and Section-2 on separate answer book.*
2) *All questions are compulsory, however internal choice is available.*
3) *Figures to the right indicate maximum marks to the question.*
4) *Symbols have their usual meanings unless otherwise stated.*
5) *Draw neat diagram wherever necessary.*
6) *Use of non-programmable calculator is permitted.*

Section -1

Q1. Answer **any FOUR** of the following questions. *(4 x 4 = 16)*

(A) A mass-spring system undergoes simple harmonic motion with angular frequency ω and amplitude A. Find its speed at the point where the kinetic and potential energies are equal.

(B) Obtain an expression for the resultant of two simple harmonic motions, moving in same direction and having same frequency but different phase angles. Also obtain the expression for the resultant amplitude.

(C) Deduce the general differential equation for wave motion.

(D) A Helmholtz resonator has a volume of 1 liter. The radius of the neck is 1 cm and the length of the neck is 0.2 cm. Calculate the frequency at resonance. (Velocity of sound at room temperature is 350 m/s^2).

(E) Discuss the phenomenon of sharpness of resonance and show with the help of a plot how it depends upon damping factor.

(F) Show that at velocity resonance the maximum velocity is inversely proportional to damping.

Q2.(A)

(p) One pendulum consists of a solid rod of mass m and length L, and another consists of a compact ball of the same mass m on the end of a massless string of the same length L. Which has the greater period? Why? *(3)*

(q) A simple harmonic motion is given by $x = A\cos(\omega t + \delta)$. Draw a scaled plot comparing displacement, velocity and acceleration v/s time respectively. *(3)*

OR

Q2.(A)

(x) Write a short note on bifilar pendulum. *(3)*

(y) Ultrasound used in a medical imager has frequency 4.8 MHz and wavelength 0.31 mm. Find (a) the angular frequency, (b) the wave number, and (c) the wave speed *(3)*

Q2.(B)

Derive the period of a simple pendulum by considering the horizontal displacement s and the force acting on the bob, rather than the angular displacement and torque. *(6)*

Q3.(A)

(p) What are Lissajous figures? State any two applications. *(3)*

(q) Opera singers have been known to break glasses with their voices. How? *(3)*

OR

Q3.(A)

(x) Is it possible to have damped oscillations when a system is at resonance? Explain. *(3)*

(y) A pendulum of length 1.50 m is set swinging with an initial amplitude of 10°. After 12 min, friction has reduced the amplitude to 4°. What is the value of Q for this pendulum? *(3)*

Q3.(B)

Derive the equation of motion for a forced underdamped oscillator for a system of a suspended rod. *(6)*

Section -2

Q4. Answer **any FOUR** of the following questions. *(4 x 4 = 16)*

(A) Explain with a neat circuit diagram the working of a Zener diode as a voltage regulator.

(B) With neat diagram explain input and output characteristics of CB configuration?

(C) Using the graphical method, determine the dc load line for a class 'A' amplifier in CE mode.

(D) What is meant by thermal stability? Explain how stable collector current in CE configuration is if temperature rises from 25°C to 100°C.

(E) State Barkhausen criterion for oscillation. Draw a neat labelled circuit diagram for Phase shift oscillator.

(F) Define the terms differential gain and common mode gain in case of operational amplifier.

Q5.(A)

(p) What is amplitude and frequency distortions in amplifier circuit? *(3)*

(q) For a fixed bias circuit, if $V_{CC} = 15$ V, $\beta = 100$, $I_B = 0.3$ mA, $R_C = 250\ \Omega$, find R_B and S. *(3)*

OR

Q5.(A)

(x) Explain how thermistor is used for the bias compensation. *(3)*

(y) A single stage amplifier uses 6 V battery having current drain of 10 mA as a dc source. The output voltage is 2 volts and the load current is 5 mA, calculate the conversion efficiency of the amplifier. *(3)*

Q5.(B)

Draw a neat circuit diagram of a half wave rectifier and obtain an expression for the rectification efficiency. *(6)*

Q6.(A)

(p) What is an amplifier? Explain the terms voltage gain, power gain, conversion efficiency and bandwidth of amplifier. Give mathematical expression for each term above. *(6)*

OR

Q6.(A)

(x) Draw a neat circuit diagram of an inverting operational amplifier. Derive the expression for its voltage gain. *(6)*

Q6.(B) What is feedback? Obtain an expression for gain of the amplifier with feedback. Comment on the gain when feedback is positive and negative. *(6)*