1. (15 %) Describe the following terminologies:
   (a) Schmitt trigger;
   (b) Voltage-controlled oscillator (VCO);
   (c) Amplitude modulation (AM);
   (d) Mixed-mode integrated circuit;
   (e) Bode gain plot.

2. (15 %) (a) Please describe the components and working principles of a phase-locked loop (PLL).
   (b) Give brief description for an application example of PLLs.

3. (20 %) (a) Please define the class-A, class-B, class-AB amplifiers and class-C tuned amplifier. You may plot the input-output signals and their working curves.
   (b) Please give your design philosophy for maximizing the efficiency and reducing the distortion for each type of amplifiers in (a). Compare their power conversion efficiency and signal distortion.

4. (15%) For wireless communications in biomedical research, we need an oscillator operating at radio frequency of 2.5 MHz.
   (a) Can you design the circuit by using one of the L-C based oscillators (such as Colpitts Oscillator, Hartley Oscillator, or Wien Bridge Oscillator, etc.) ?
   (b) Please calculate the values of the L and C and determine the resonant frequency.

5. (15 %) (a) Please give example circuits using ideal Op-Amps for (i) full-wave rectifier; (ii) peak detector; (iii)pulse modulator.
   (b) Please sketch their input-output response curves and explain their design principles.

6. (20 %) To design a bio-amplifier for measuring the electrocardiography (ECG) and heart rate of patients in NCKU hospital, we need a differential amplifier in cascade with a bandpass filter with the following specifications:
   (a) a total gain of 800;
   (b) differential inputs with voltage follower as input stage;
   (c) DC coupled stages;
   (d) bandpass filtering with passband of 4-40 Hz.

   Please give your design by using the ideal Op-Amps (e.g. instrumentation amplifier with 4 Op-Amps). Calculate the values of the necessary resistors and capacitors used in your design to achieve the above specifications.