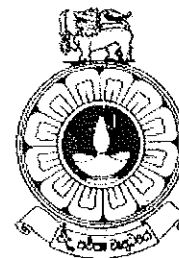


The Open University of Sri Lanka
Faculty of Natural Sciences
B.Sc/ B. Ed Degree Programme



Department	: Physics
Level	: 05
Name of the Examination	: Final Examination
Course Title and - Code	: Practical Physics – PIU5301
Academic Year	: 2020/2021
Date	: 23.03.2022
Time	: 9.30 a.m. – 11.30 a.m.
Duration	: 02 hours

General Instructions

1. Read all instructions carefully before answering the questions.
 2. This question paper consists of (06) questions in (04) pages.
 3. Answer any Four (04) questions only. All questions carry equal marks.
 4. Answer for each question should commence from a new page.
 5. Draw fully labelled diagrams where necessary
 6. Involvement in any activity that is considered as an exam offense will lead to punishment.
 7. Use blue or black ink to answer the questions.
 8. Clearly state your index number in your answer script
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The Open University of Sri Lanka
B.Sc. Degree Programme- Level 05
Final Examination 2020/2021
PHU5301 - Practical Physics



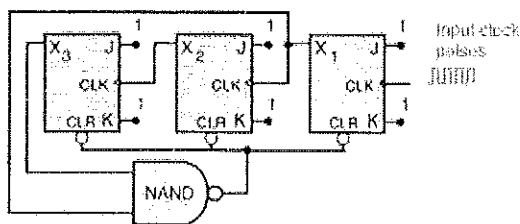
Duration: Two (02) hours

Date: 23.03.2022

Time: 9.30 a.m. – 11.30 a.m.

Answer any Four (04) Questions Only.

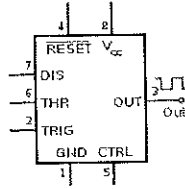
1. (a) Name three components in a microcontroller which use flip-flops as the building blocks.
- (b) Classify different types of flip-flops and write a short description on each type.
- (c) Briefly discuss the advantage of having CLK (Clock), SET (Pre-Set) and CLR (Clear) facilities in a flip-flop when constructing the components that you mentioned in (a).
- (d) If you are provided with three input NAND gates, how would you construct a J-k flip-flop with SET, CLR and CLK inputs? Explain your answer by drawing the necessary circuit diagram.
- (e) Fill the outputs (X_1 , X_2 , X_3) of each flip-flop in the following circuit that change with the clock pulses in the given table by copying it into your answer sheet. Initially all the outputs of the J-k flip-flops will be cleared and flip-flops are triggered by the clock signal at the falling edge.



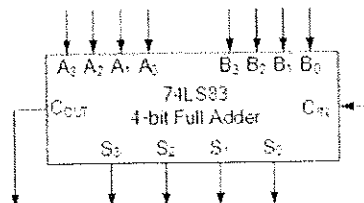
No of clock pulses	X_1	X_2	X_3
0	0	0	0
1			
2			
3			
4			
5			
6			

2. (a) What do you mean by an oscillator? Describe how an oscillator operates in bistable, monostable and astable modes.
- (b) State one application for each mode of operation.
- (c) If you are provided with 555 timer ICs and other necessary circuit elements, how do you construct the three types of oscillators mentioned in (a)? You may draw the circuits

relevant to each mode of operation. Pin diagram of the 555 timer IC is given in the following figure.



- (d) State two ways to determine the period of the output signal practically after constructing the oscillator circuit.
- (e) If you have constructed the oscillator circuit that operates in astable mode using $0.1 \mu\text{F}$ capacitor with $10 \text{ k}\Omega$ and $100 \text{ k}\Omega$ resistors, what are the possible frequencies that can be generated?
3. (a) Construct a half adder circuit with NAND gate and EX-OR gate by drawing its truth table.
- (b) Draw the truth table for a full adder circuit and derive the logical expression for the outputs by using Karnaugh maps.
- (c) What is the difference between the full adder and full subtractor circuits with respect to their inputs and outputs?
- (d) Show that the subtraction can be done as an addition by converting the subtrahend into its Two's complement with the help of an example.
- (e) How do you construct a circuit to function simultaneously as a full adder and a full subtractor if you are provided with 74LS83 IC and four, two input EX-OR gates? The pin diagram of 74LS83 IC is given below.



4. (a) Compare and contrast a microcontroller with a microprocessor with respect to their architecture and operation.
- (b) You are provided with 10 K Ω Resistor, dip switch, 4 MHz Crystal, 22 pF capacitors. How do you construct a Reset circuit and a crystal oscillator for the PIC16F84A microcontroller?
- (c) Draw typical input clock signal pattern of a microcontroller at the OSC1 pin and four clocks generated in the microcontroller for one instruction cycle by dividing the clock signal internally.
- (d) Briefly explain, calling and execution of instructions in a microcontroller according to the sequence of the clock cycles.
- (e) Following programme is written in the programme memory of a microcontroller. Discuss the execution of this programme at different clock cycles in an instruction pipeline flow.
1. MOVLW 55h
 2. MOVWF PORTB
 3. CALL SUB_1
 4. BSF PORTA, BIT3
5. (a) Briefly discuss the memory organization in a PIC16F84A microcontroller.
- (b) Describe the role of the following special function registers in the PIC16F84A microcontroller.
- (i) FSR and INDF
 - (ii) EEDATA and EEADR
 - (iii) PCL and PCLATH
 - (iv) INTCON
- (c) What is the Bank select bit in the Status register? Briefly explain how you address Bank 0 and Bank 1 of the data memory. The designations of eight bits of the STATUS register are given below.

IRP	BPI	RPO	\overline{TO}	\overline{PD}	Z	DC	C
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- (d) Briefly explain how you configure a Port in a microcontroller as inputs or outputs.
- (e) Write a programme in Assembly language to configure all the pins in port B as outputs.
6. (a) An Arduino-Uno board has a 10-bit Analogue to Digital converter (ADC). How many different voltage levels can this ADC detect?
- (b) If we applied a 2.12V to the ADC input, what will be its ADC reading?
- (c) Write a small Arduino script to read and print the voltage at the A0 pin in every second to the serial port.
- (d) A student is designing an automatic flower pot watering system. A sensor detects the moisture content in the soil and output an analogue voltage. If this voltage is below 1V, the pot has to be watered. When the voltage level is above 3V, the watering should be stopped. A water pump is switched on with a 5V signal. It is stopped with 0V signal. Write an Arduino script for the flower pot watering system.
- (e) Clearly indicate which pins are connected to the sensor and to the pump in the comment line.

