ELT 431

Instructions: ***Answer any four questions all questions carry equal marks.***

Q1(a) With the aid of a functional block diagram, explain how a 555 timer works as a monostable multivibrator.

(b) It is desired to design an astable multivibrator using a 555 timer. Given the timing capacitor of 1nF, period of 100μS and a duty cycle of 20%,

(i) Sketch the circuit diagram of the astable multivibrator.

(ii) Determine timing resistors. **(17.5 Marks)**

Q2 It is desired to design a high input resistance universal voltmeter to read 100V maximum. If the meter movement used has a full-scale deflection of 10 μA with an internal resistance of 100kΩ,

(a) Sketch the schematic diagram of the voltmeter.

(b) Label the schematic diagram of the voltmeter.

(c) Determine the input resistors for the following ranges

(i) dc reading

(ii) rms reading

(iii) peak reading

(iv) peak to peak reading

(d) Sketch the design of a light column voltmeter using operational amplifiers to measure up to 10V in steps of 1 V. On your sketch, label the component values. Use LEDs for display. **(17.5 Marks)**

Q3 (a) Design an audio mixer with individual and master controls. It should be possible mix four signals independently and have a gain of 1 to 100.

(b) Design a non-inverting ac amplifier with a voltage gain of 20 to operate on a single supply of 15V. **(17.5 Marks)**

Q4 A double-input, single output differential amplifier is made of identical transistors. It has a 10kΩ collector resistor, 20kΩ tail resistor and two 1kΩ base resistors. A dual power supply of +/-15V is used to power the amplifier. If the transistors have a dc beta of 100 000, an emitter to base voltage of 0.7V and an emitter dynamic resistance given by $r'e=50mV/I_E$,

(a) Sketch the amplifier circuit.

(b) Determine the amplifier's emitter current.

(c) Calculate the amplifier's gain.

(d) Calculate the amplifier's output voltage if the input voltages v1 and v_2 are 50mV and 150mV respectively. **(17.5 Marks)**

Q5 Give two fixed three terminal LM 7805 (5V/1A) and LM 7905 (-5V/1A) IC regulators and other components design a power supply that outputs +/-5V to +/-15V @ 10A, operating from 240V/50Hz;

(a) Sketch the schematic circuit diagram of the design.

(b) Calculate the minimum dc voltage needed for the power supply.

(c) Calculate the values of all resistors needed for the +/-15V output. **(17.5 Marks)**

Q6 (a) Sketch a four-input inverting adder whose output can be amplified.

(b) An operational amplifier is used as a sound-activated alarm. Sketch the schematic circuit of the design.

(c) Sketch a circuit of a current booster with a light-emitting diode as the load.

(17.5 Marks)