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Your Roll No.

1400

B.Sc. (Hons.) / II A

ELECTRONIC SCIENCE – Paper 2.2 (IX)

(Operational Amplifier and Analog Computation)

Time : 3 Hours

Maximum Marks : 38

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt **five** questions in all, including
Question No. 1, which is compulsory.
Use of Scientific Calculator is allowed.

1. (a) Draw the circuit diagram of a dual input balanced output differential amplifier. Give the significance of the term 'balanced output'. 2
- (b) Explain why an open-loop operational amplifier configuration is not used in linear applications. 2

- (c) What is the concept of Virtual Ground in Operational Amplifier ? Explain with the circuit diagram. 2
- (d) What is zero-level detector ? Compare it with Schmitt Trigger. 2
- (e) What is the importance of Amplitude Scaling in Analog Computation ? Explain giving an example. 2
2. (a) Give the a.c. analysis (voltage gain, input resistance and output resistance) of a single input balanced output differential amplifier. 5
- (b) Explain the advantage of constant current bias over emitter bias in differential amplifier circuits. 2
3. (a) Deduce the expressions for voltage gain, input resistance, output resistance and total output offset voltage for a voltage series feedback amplifiers. 5
- (b) Give the circuit of current-to-voltage converter and specify the conditions under which it will act as an inverter. 2

4. (a) Design a scaling amplifier circuit that will amplify the first input by a factor of 2 and the second by a factor 3. Use inverting configuration for the scaling amplifier. 4
- (b) Design a differentiator using operational amplifier to differentiate an input signal that varies in frequency from 10 Hz to about 1 KHz. 3
5. (a) Give the circuit for a first order high pass Butterworth Filter. Obtain the expressions for gain, magnitude and phase angle equations. Also draw its frequency response. 4
- (b) Design and give the circuit of a second order low pass Butterworth filter at a cut-off frequency of 1 KHz with a passband gain of 2. Also plot its frequency response. 3
6. (a) Give the circuit of a triangular wave generator using operational amplifiers and explain its operation. 4
- (b) What is Voltage-Controlled-Oscillator (VCO) ? Give two applications of VCO. 3

7. (a) What are Multipliers ? Implement division using multipliers. 4

(b) Using Equal Coefficient Rule, amplitude scale the following equation : 3

$$\frac{d^4x}{dt^4} + 15 \frac{d^3x}{dt^3} + 10 \frac{d^2x}{dt^2} + 20 \frac{dx}{dt} + 100x = 0$$

$$\text{with } \frac{d^3x}{dt^3}(0) = 5 \quad \frac{d^2x}{dt^2}(0) = 12 \quad \frac{dx(0)}{dt} = 0$$

$$\text{and } x(0) = 0.5$$
