Time: 01 hours.

Answer ALL Questions.

---

01. Describe the properties of an ideal operational amplifier.

Draw circuits containing the device which are suitable for the applications listed below, and in each case derive the relation between the input and output signals.

(a) Inverting amplifier

(b) Non inverting amplifier

(c) Differential amplifier

(d) Integrator

Use op-amp summers and integrators to solve the differential equation

$$\frac{d^2x}{dt^2} + 10^3 \frac{dx}{dt} + 10^6 = 0$$

02. (a) State De Morgan's theorem. Hence show that all three basic logic operations can be carried out using combinations of NAND gates only.

(b) Draw the symbols and truth tables for the following logic gates.

i. AND

ii. exclusive OR

(c) Using the Boolean algebra, show that

i. $AB + \overline{AC} + A\overline{B}C(AB + C) = 1$

ii. $\overline{A}C + \overline{A}B + A\overline{B}C + BC = \overline{A}B + C$

iii. $AB + A(B + C) + B(B + C) = B + AC$