N.B.: (1) Question No. 1 is Compulsory.
(2) Attempt any three questions out of remaining five.
(3) Figures to the right indicate full marks.

1. Solve any five:

(i) Draw switching characteristics of a diode and explain reverse recovery time.
(ii) Draw energy bond diagram of MUS capacitor in accumulation, depletion and
inversion region for P-substrate.
(iii)

\[ \begin{align*}
\text{Draw the dc load line for above circuit.}
\end{align*} \]
(iv) Compare CE, CB and CC configuration.
(v)

\[ \begin{align*}
V_\text{GS} = 3 \text{V} \\
V_\text{TH} = 1 \text{V} \\
K_n = 0.8 \text{mA/V}^2 \\
\lambda = 0.018 \text{ V}^{-1}
\end{align*} \]

Obtain gm, ro and Av for the amplifier circuit shown in figure. In which region
the device is operating? Justify.
(vi) State and explain Barkhausen's Criteria for oscillation.

2. (a) Obtain \( I_{DQ} \), \( V_{DSQ} \), \( V_{GSQ} \) graphically.

\[ \begin{align*}
I_{DSS} = 10 \text{mA} \\
V_{P} = -3.5 \text{V}
\end{align*} \]
(b) Derive the expression for frequency of oscillation for a transistorized (BJT) RC phase shift oscillator.

(c) Obtain output for the clipper circuit shown in fig. If a sine wave of 15 sin (t) is applied as an input. Assume practical diode with suitable cut in voltage.

3. (a) Determine $V_{GSQ}$ and $V_{DSQ}$.
    Also calculate voltage gain, input and output resistance.

(b) Determine $R_i$, $R_o$, $A_v$ and $g_m$ for amplifier circuit shown in figure.

4. (a) Derive the expression for Threshold Voltage for Enhancement type N-channel MOSFET.
Determin \( I_B, I_C, V_{CE}, V_E \) and \( V_B \) and also \( S_{ICO} \) for the biasing circuit shown in figure.

5. (a) Explain graphical method to obtain to parameters of CE configuration.
(b) 

Calculate \( I_{DQ}, V_{GSQ} \) and \( V_{DSQ} \)

(c) 

Determine hybrid - \( \Pi \) parameters.

6. Write short note (any four):
   (i) Small signal model of a diode
   (ii) Hybrid \( \pi \) model of BJT
   (iii) Regions of operation of FET
   (iv) Crystal oscillator
   (v) Construction and operation of schottkey diode.