- **Instructions**
  - **Answer all questions (Question no. 1 to 3).** **Answers must be brief and to the point.**
  - **Avoid writing answers of the various parts of a single question at different locations in your answer-script. For every Question No., start your answer from a new page. Symbols/notations used in the Question paper represent their conventional meanings.**
  - **The final answers (numerical values with unit) should be underlined or enclosed** **box** **within with unit.**
  - **Show the necessary steps in your answers with high clarity and supported explanation.**
  - **All waveform sketches / diagrams must be neatly drawn and clearly labelled.**
  - **For any value related to any device parameter or circuit parameter, which you may find not given with a problem, assume suitable value for such parameter and clearly write your assumptions.**

1. In the bridge-rectifier circuit with filter capacitor as shown in Fig. 1, V_γ of each diode is 0.7 V and the load resistance (R) is 100 Ω. The transformer secondary is delivering a sinusoidal signal of 60 Hz of magnitude 12 V (RMS). (a) Find the value of capacitance (C) such that the peak-to-peak ripple voltage becomes 1 V. (b) In this case, what is the DC value of V_{out}? (c) Estimate the maximum current through 'R'. (d) What is PIV of each diode? (e) For a complete sine wave (one time-period) of input, calculate the time duration (in Sec) when a diode conducts.

[2+2+2+2+2 = 10]

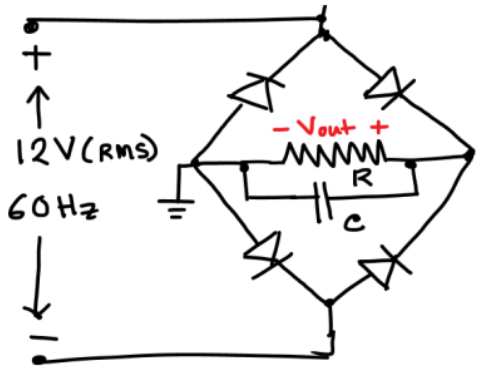

Figure 1

2. Consider the following amplifier circuit (Fig. 2) using a npn BJT. Given that β = 150, V_{BE_ON} = 0.7 V and Early voltage is very high for this transistor. Magnitude of other circuit parameters are indicated in the figure. (a) Estimate the value of emitter current (I_E) and voltage V_C. (b) Neatly draw the complete small signal equivalent circuit and find the magnitude r_π and g_m. (c) Find the small signal voltage gain (A_v) of the amplifier. (d) What will happen to the A_v if you reduce the magnitude of C_2 from 100 μF to 10 nF. (your comment + justification) (e) If V_s = 10 $\sin(\omega t)$ mV, then neatly draw the waveform of output voltage (V_{out}) along with the waveform of signal source (Vs) in a single plot. Clearly indicate the voltage level in the Y-axis. (f) Find V_x (total voltage at this node).

[(1+1)+(1+1+1)+2+1+1+1 = 10]

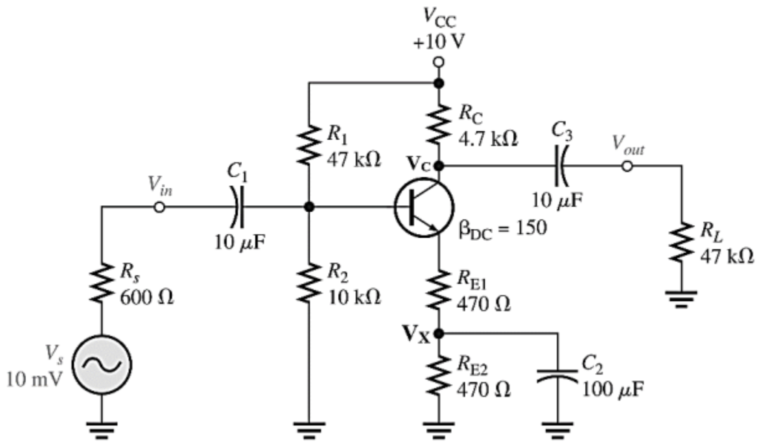

Figure 2

3. In the following circuit (Figure 3) given that $V_{Thn} = 1$ V, $V_{GS} = 2$ V, $k'_n = 2$ mA/V^2. (a) Find the value of node voltage V_D and (W/L) ratio of the MOSFET. (b) Draw the small signal AC equivalent circuit and calculate the voltage gain. For this part, consider $\lambda = 0.01$ V^{-1}. (c) Estimate the small-signal voltage gain if the capacitor C_s is removed from the circuit. Consider $\lambda = 0$ for this part and use suitable approximation for estimating the gain. (d) In the circuit shown in Fig. 3, if the magnitude of C_1 is reduced drastically, then comment on the small-signal voltage gain of the amplifier (compare the gain with that of part (b)). **[(2+2)+ (1+2)+ 2+1) = 10]**

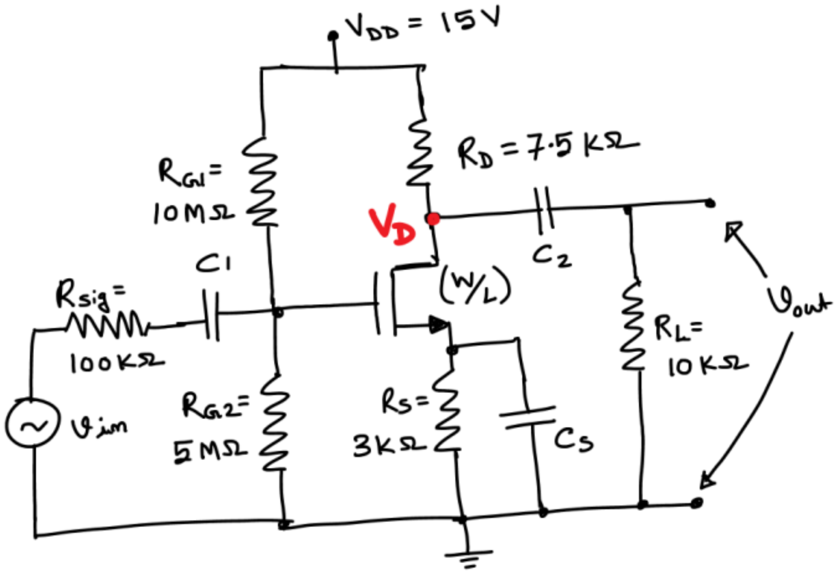

Figure 3

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