|  |
| --- |
| Course Number SectionElectronics I ELEC 311/1 BB |
| Examination Date Time # of pagesFinal August 21, 2013 3 hours 7 |
| Instructor(s)Dr.R. Raut |
| Students are allowed to use **ONLY** ENCS faculty approved calculatorsSpecial Instructions:You are required to *answer* **SIX** questionsYou MUST attempt **Q.1** (*soft skill* component) : **5 marks**From **Q.2-Q.8**, answer any **FIVE** questions.: **9 marks** (each)*Before submitting* your answer book, **fill in the Table below** indicating the answers you want to be graded.(If you **do not** *fill in the Table*, the instructor will mark your answers *as they appear one after another in the answer book)*Show all steps clearly in neat and legible handwriting.Students are required *to return the question paper* together with exam booklet(s). |
|  |

**(STUDENT) NAME: ID #**

**Table**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Answers to be graded | **Q.1 (compulsory)** |  |  |  |  |  |
| Marks |  |  |  |  |  |  |

(**Some important formulae**)

|  |  |  |
| --- | --- | --- |
| ,  | , ,  | , ,  |
| (linear region) | (saturation region, excluding Early effect) |  |

**Section I (Compulsory):** Soft skill component**-** *The student* ***MUST answer*** *this question*

**Q. 1**: For the MOS circuit shown in **Fig.1**, find V1, and V2. For the NMOS transistors VTH=1V, K =1mA/V2, W/L=8.



 (**5 marks**).

**Figure 1:**

**Section II (**From **Q.2-8,** answer ONLY **FIVE** questions**)**

**Q.2**: A given shunt regulator system is driven by a raw DC voltage source of 10 V (nominal) with a variation of ±1 V. The diode is a 6.8 V Zener at an operationg current of 5 mA, with *rZ* =20 Ω, and *IZK(Min)* =0.2 mA. The line resistance used is 500 Ω. Calculate the following, with supporting circuit analysis. A circuit model for the diode is shown in **Fig.2.**

1. Draw the equivalent circuit for the whole system.
2. Calculate the line regulation and the amount of fluctuation of the output voltage when the input fluctuates by ±1 V.
3. Find the output voltage if a 500 Ω resistance is connected as the load to the system.



**Figure 2:**

**(9 marks)**

**Q.3**(a) : Figure 3(a) shows a half-wave rectifier circuit. The diode D can be considered ideal.



**Figure 3(a):**

Given: vs (t)= 60 Cos[(120πt)] Volts and RL = 100 kilo ohms.

1. Obtain the DC component of vo(t)
2. What is the peak inverse voltage across the diode?

**Q.3(b):** In the system shown in **Fig.3(a),** a capacitor of value 10 μF is connected across RL, as shown in **Fig.3(b).**



**Figure 3(b):**

1. Sketch the waveform of vo (t) and label the various values. Find the *ripple* voltage.
2. Determine the DC component of vo(t).
3. What should be the new value of C, if the *ripple* found in (i) is to be reduced to half the value?

(**9 marks**)

**Q.4:** Calculate the small signal gain *vo/vs* for the BJT amplifier circuit in **Fig. 4**. Assume transistor parameters of β = 99, VBE (on) = 0.7 V, VA = 50V.



**Figure 4**

**(9 marks)**

**Q.5:** For the circuit shown in figure 5 assume that the source *vs* provides a small signal vsig and that the BJT has=49. Find:

(a) the input resistance Rin .

 (b) What will be the maximum *vs* value for which the small signal approximation will remain valid for the operation of the BJT?



**Figure 5:**

 (**9 marks**)

**Q.6:** A common emitter amplifier uses a BJT device with β=100, *Early* voltage =50 V, and is biased by a current source at *I* =5 mA. The amplifier operates between a voltage source with Rsig =10,000 ohms, and a resistance RC of 1000 ohms at the collector. Figure 6 shows the schematic diagram.

(a) Draw the *ac* equivalent circuit and find the voltage gain of the system.

(b) What is the *small signal* current gain of the system?



**Figure 6**

**(9 marks)**

Q.7: Consider figure 7 as the conceptual model of a MOSFET circuit operating as a common source amplifier. Given that *VTH* =0.5V, *K*=5 mA/V2, *W/L =*2, *VGS* =0.7V, *VDD* =2V, *RD* =5000 ohms, and *VA* (*Early* voltage) =50V;



**Figure 7**

Calculate:

1. The *ac* transconductance of the MOS device
2. The small signal voltage gain of the system.

**(9 marks)**

**Q.8:** Figure 8 presents a common gate MOS amplifier as an integrated circuit. The transistor M0 provides a bias current of 0.5 mA. The body transconductance *gmb* is approximately 0.2*gm* of the transistor M1, which is the *driver* transistor. M2 serves as an active load. Find the voltage gain *vo*/*vin* for the amplifier in terms of the *ac* equivalent circuit parameters.



**Figure 8**

**(9 marks)**