Tutorial Letter 101/3/2018

Electronics II (Theory)

ECT2601

Semesters 1 and 2

Department of Electrical and Mining Engineering

This tutorial letter contains important information about your module.

BARCODE

Define tomorrow.

UNISA university of south africa

CONTENTS

Page

Dear Student

1 INTRODUCTION

Dear Student

Welcome to the subject **Electronics II (ECT2601)** at UNISA. This tutorial letter serves as a guideline to this course. It provides you with general administrative information as well as specific information about the subject. Read it carefully and keep it safe for future reference. We trust that you will enjoy this course.

2 PURPOSE AND OUTCOMES

2.1 Purpose

The main objective of this module is to equip the student with the basic knowledge of Transistors their basic structure and how to design Amplifiers using transistors. The emphasis is on understanding rather than the memorizing of concepts with the goal of stimulating creative thinking and enhancing innovative skills amongst students in the field of Electronics Engineering. A problem-driven approach to learning is followed.

The objectives of this module are achieved through self-study and discussion classes. On-line support is also provided. Students are advised to embark on a well-structured and systematic study program, in which the module material is studied in a probing, scientific and innovative manner, rather than by simple and passive memorizing.

2.2 Outcomes

Critical learning outcomes

The following ECSA exit-level outcomes are addressed in this module, i.e. at the conclusion of this module the student will be capable of:

ECSA 2.1: **Engineering problem solving**
At the end of this module the student will be able to do D.C and A.C analysis of transistor circuits.

ECSA 2.2: **Application of scientific and engineering knowledge**
The student will be able to use A.C and D.C analysis of transistors to design simple transistor amplifier circuits.

ECSA 2.4: **Investigations, experiments and data analysis**
The student will be able to simulate amplifier circuits by using multisim and critically analyse, interpret and present the results of such simulations. The student will also be able to prepare a simplified technical report on the findings of such simulations.

3 LECTURER(S) AND CONTACT DETAILS

3.1 Lecturer(s)

You can contact Mr P Umenne for any theoretical questions at the following number:
Mr P Umenne
umennpo@unisa.ac.za
Telephone number: 011-4713482
Contact Times: Monday to Thursday 10h00 – 15h00

3.2 Department

Department of Electrical and Mining Engineering: electrical&mining@unisa.ac.za

3.3 University

If you need to contact the University about matters not related to the content of this module, please consult the publication *My studies @ Unisa* that you received with your study material. This brochure contains information on how to contact the University (e.g. to whom you can write for different queries, important telephone and fax numbers, addresses and details of the times certain facilities are open). Always have your student number at hand when you contact the University.

4 RESOURCES

4.1 Prescribed books

Electronic Devices: Conventional Current Version - Seventh Edition 2005 by FLOYD T.L Pearson Prentice-Hall. ISBN: 0-13-127827-4 (or newest edition)

4.2 Recommended books

Electronic Devices

Conventional Current Version

Thomas L. Floyd

Ninth Edition

4.3 Electronic reserves (e-reserves)

There are no electronic reserves for this module.

4.4 Library services and resources information

For brief information, go to www.unisa.ac.za/brochures/studies

For detailed information, go to http://www.unisa.ac.za/library. For research support and services of personal librarians, click on "Research support".

The library has compiled a number of library guides:

- finding recommended reading in the print collection and e-reserves – http://libguides.unisa.ac.za/request/undergrad
- requesting material – http://libguides.unisa.ac.za/request/request
- postgraduate information services – http://libguides.unisa.ac.za/request/postgrad
- finding, obtaining and using library resources and tools to assist in doing research – http://libguides.unisa.ac.za/Research_Skills
- how to contact the library/finding us on social media/frequently asked questions – http://libguides.unisa.ac.za/ask

5 STUDENT SUPPORT SERVICES

Important information appears in your *my Studies @ Unisa* brochure.

6 STUDY PLAN

Use your *my Studies @ Unisa* brochure for general time management and planning skills.

Topic **UNIT 1**	**SECTION**	**LEARNER ACTIVITY**
APPLICATION 1	3 - 4	• Practical application of optical diodes. [p139] • Do practical 1 tructure. [p170]
BIPOLAR JUNCTION TRANSISTORS	4 - 1	• Describe the basic structure of the bipolar junction transistor (BJT). • Explain the difference in construction of an npn and a pnp transistor. • Identify the symbols for npn and pnp transistors. • Name the three regions of a BJT and their labels. • Do Section Review 4-1.
	4 - 2	• Basic Transistor Operation. [p171] • Explain how a transistor is biased and discuss the transistor currents and their relationships. • Describe forward and reverse bias. • Show how to connect a transistor to the bias voltage source. • Describe the basic internal operation of a transistor. • State the formula relating the collector, emitter and base current in a transistor. • Do Section Review 4-2.
	4 - 3	• Transistor Characteristics and Parameters. [p174] • Discuss transistor parameters and characteristics and use these to analyze a transistor circuit. • Define dc Beta (βDC). • Define dc Alpha (αDC). • Identify all currents and voltages in a transistor circuit. • Analyze a basic transistor dc circuit. • Interpret collector characteristic curves and

BIPOLAR JUNCTION TRANSISTORS		use a dc load line. • Describe how βDC varies with temperature and collector current. • Discuss and apply maximum transistor ratings. • Derate transistor for power dissipation. • Interpret a transistor data sheet. • Do all the Examples. • Do Section Review 4-3.
	4 - 4	• Transistor as an Amplifier. [p187] • Discuss how a transistor is used as a voltage amplifier. • Describe amplification. • Develop the ac equivalent circuit for a basic transistor amplifier. • Determine the voltage gain of a basic transistor amplifier. • Do the Example. • Do Section Review 4-4.
	4 - 5	• Transistor as a Switch. [p190] • Discuss how a transistor is used as an electronic switch. • Analyze a transistor switching circuit for cutoff and saturation. • Describe the conditions that produce cutoff. • Describe the conditions that produce saturation. • Discuss a basic application of a transistor switching circuit. • Do all the Examples. • Do Section Review 4-5.
BIPOLAR JUNCTION TRANSISTORS	4 - 6	• Transistor Packages and Terminal Identification. [p193] • Identify various types of transistor package configurations. • List three broad categories of transistors. • Recognize various types of cases and identify the pin configurations. • Do Section Review 4-6.
	4 - 7	• Troubleshooting. [p196] • Troubleshoot various faults in transistor circuits. • Explain floating point measurement. • Use voltage measurements to identify a fault in a transistor circuit. • Use a DMM to test a transistor. • Explain how a transistor can be viewed in terms of a diode equivalent. • Discuss in circuit and out of circuit testing. • Discuss point of measurement in troubleshooting. • Discuss leakage and gain measurements. • Do Section Review 4-7. • Do all of the Self-Test. • Do the following Basic Problems: 1-31+ 35-41
	5 - 1	• The DC Operating Point. [p224] • Discuss the concept of dc bias in a linear amplifier. • Describe how to generate collector characteristic curves for a biased transistor. • Draw a dc load line for a given biased transistor circuit. • Explain Q-Point. • Explain the conditions for linear operation. • Explain the conditions for saturation and

TRANSISTOR BIAS CIRCUITS		cutoff. • Discuss the reasons for output waveform distortion. • Do the Example. • Do Section Review 5-1.
	5 - 2	• Voltage Divider Bias. [p230] • Analyze a voltage divider bias circuit. • Discuss the effect of the input resistance on the bias circuit. • Discuss the stability of voltage divider bias. • Explain how to minimize or essentially eliminate the effect of βDC and VBE on the stability of the Q-point. • Discuss voltage divider bias for a pnp transistor. • Do the Example. • Do Section Review 5-2.
	5 - 3	• Other Bias Methods. [p239] • Analyze three additional types of bias circuits. • Recognize base bias. • Recognize emitter bias. • Recognize collector feedback bias. • Discuss the stability of each bias circuit and compare with the voltage divider. • Do all the Examples. • Do Section Review 5-3.
TRANSISTOR BIAS CIRCUITS	5 - 4	• Troubleshooting. [p245] • Troubleshoot various faults in transistor bias circuits. • Use voltage measurements to identify a fault in a transistor bias circuit. • Analyze a transistor bias circuit for several common faults. • Do Section Review 5-4. • Do all of the Self Test. • Do the following Basic Problems:1–33 + 38-42
TOPIC UNIT 2	SECTION	Learner Activity
	6 - 1	• Amplifier Operation. [p268] • Understand the amplifier concept. • Interpret labels used for dc and ac voltages and currents. • Discuss the general operation of a small signal amplifier. • Analyze ac load line operation. • Describe phase inversion. • Do the Example. • Do Section Review 6-1.
BJT AMPLIFIERS	6 - 2	• Transistor AC Equivalent Circuits. [p271] • Identify and apply internal resistance parameters. • Define the r parameters. • Represent transistor by an r parameter equivalent circuit.

		• Distinguish between the dc beta and the ac beta. • Define the h parameters. • Do the Example. • Do Section Review 6-2.
	6 - 3	• Common Emitter Amplifier. [p274] • Understand and analyze the operation of common emitter amplifiers. • Represent a CE amplifier by its dc equivalent circuit. • Analyze the dc operating of a CE amplifier. • Represent a CE amplifier by its ac equivalent circuit. • Analyze the ac operation of a CE amplifier. • Determine the input resistance. • Determine the output resistance. • Determine the voltage gain. • Explain the effects of an emitter bypass capacitor. • Describe swamping and discuss its purpose and effects. • Describe the effect of a load resistor on the voltage gain. • Discuss phase inversion in a CE amplifier. • Determine current gain. • Determine power gain. • Do all the Examples. • Do Section Review 6-3.
BJT AMPLIFIERS	6-4	• Common Collector Amplifiers. [p287] • Analyze a common collector amplifier. • Calculate voltage gain. • Calculate input resistance. • Calculate current gain. • Calculate power gain. • Describe the Darlington pair configuration. • Do Section Review 6-4.
	6-5	• Common Base Amplifiers. [p294] • Analyze a common base amplifier. • Calculate voltage gain. • Calculate input resistance. • Calculate current gain. • Calculate power gain. • Compare the three basic amplifier configurations. • Do the Example. • Do Section Review 6-5.
AMPLIFIERS	6-6	• Multi Stage Amplifiers. [p297] • Analyze a multistage amplifier. • Determine the multistage voltage gain. • Convert the voltage gain to decibels. • Determine the effects of loading on the gain of each stage and on the overall gain. • Do the Example. • Do Section Review 6-6. • Do the following Basic Problems: 1 – 33.
AMPLIFIERS	9-1	Class A Operation. [p428]

AMPLIFIERS	9-2	• Explain class A amplifier operation. • Define Q-Point. • Use a load line to analyze class A operation. • Calculate power gain of a CE class A amplifier. • Determine dc quiescent power. • Determine output power. • Determine maximum efficiency of class A amplifiers. • Do the Example. • Do Section Review 9-1.
	9-3	• Class B and AB Operation. [p434] • Analyze class B and AB amplifiers. • Explain class B and AB operation. • Discuss the meaning of push-pull amplifier operation. • Define crossover distortion. • Describe how a class B push-pull amplifier is biased. • Determine the maximum output power. • Determine the efficiency of a class B amplifier. • Do Examples 9-3 to 9-5. • Do Section Review 9-2. • Class C Operation. [p448] • Explain the basic operation of a class C amplifier. • Discuss power in a class C amplifier. • Discuss a tuned amplifier. • Determine maximum output power. • Determine class C efficiency. • Do the Examples. • Do Section Review 9-3. • Do all of the Self Test.
TOPIC UNIT 2	SECTION	Learner Activity

THYRISTORS AND OTHER DEVICES	11-1	• The Basic Four-Layer Device. [p534] • Describe the basic structure and operation of a 4 layer diode. • Identify the Shockley diode symbol. • Define forward break-over voltage. • Define holding current. • Define switching current. • Discuss an application. • Do all the Examples. • Do Section Review 11-1.
	11 - 2	• The Silicon Controlled Rectifier (SCR). [p537] • Describe the basic structure and operation of an SCR. • Identify an SCR by the schematic symbol. • Draw the bipolar equivalent circuit of an SCR. • Explain how to turn an SCR on and off. • Explain the characteristic curves of an SCR. • Define forced commutation. • Define various SCR parameters. • Do Section Review 11-2.
	11 - 3	• SCR Applications. [p542] • Discuss several SCR applications. • Explain how an SCR is used to control current. • Describe half wave power control. • Explain a basic phase control circuit. • Discuss the function of an SCR in lighting systems for power interruptions. • Explain an over voltage protection or 'crowbar' circuit. • Do Section Review 11-3.
THYRISTORS AND OTHER DEVICES	11 - 4	• The Diac and Triac. [p547] • Describe the basic structure and operation of diacs and triacs. • Identify the Diac or Triac by the schematic symbol. • Discuss the equivalent circuit and the bias conditions. • Explain the characteristic curve. • Discuss an application. • Do Section Review 11-4.
	11 - 5	• The Silicon Controlled Switch (SCS). [p551] • Describe the basic operation of an SCS. • Identify the SCS by its schematic symbol. • Use a bipolar equivalent circuit to describe SCS operation. • Compare the SCS to the SCR. • Do Section Review 11-5.
	11 - 7	• The Programmable Unijunction Transistor (PUT). [p557] • Describe the structure and operation of a PUT. • Compare PUT structure to that of the SCR. • State how to set the PUT trigger voltage. • Discuss an application. • Build and test an application. • Do Section Review 11-7.
THYRISTORS AND OTHER DEVICES	11 - 8	• The Phototransistor. [p559] • Descibe a phototransistor and its operation. • Explain how the base current is produced. • Discuss how phototransistors are used. • Do Section Review 11-8. • The Light Activated SCR (LASCR). [p563]

	11 - 9	• Describe the LASCR and its operation. • Compare the LASCR to the conventional SCR. • Discuss an application. • Do Section Review 11-9.
	11 - 10	• Optical Couplers. [p564] • Discuss various types of optical couplers. • Define isolation voltage. • Define the current transfer ratio. • Define LED trigger current. • Define transfer gain. • Discuss fiber optics. • Explain refraction and reflection of light. • Do Section Review 11-10. • Do all of the Self Test. • Do the following Basic Problems: 1 – 11 ; 15 - 24
FIELD EFFECT TRANSISTORS AND BIASING	7-1	• The Junction Field Effect Transistor (JFET). [p328] • Describe the basic structure and operation of a JFET. • Identify the standard JFET symbols. • Explain the difference between the N-channel and the P-channel JFET's. • Label the terminals of a JFET. • Do Section Review 7-1.
	7-2	• JFET Characteristics and Parameters. [p330] • Define, discuss and apply important JFET parameters. • Explain ohmic region, constant current region, and breakdown. • Define pinch-off voltage. • Describe how gate to source voltage controls the drain current. • Define cutoff voltage. • Compare pinch-off and cutoff. • Analyze a JFET transfer characteristic curve. • Use the equation for the transfer characteristic to calculate ID. • Use a JFET data sheet. • Define transconductance. • Explain and determine input resistance and capacitance. • Determine drain to source resistance. • Do all the Examples. • Do Section Review 7-2.
	7-3	• JFET Biasing. [p340] • Discuss and analyze JFET bias circuits. • Set the self-biased Q-Point. • Analyze a voltage divider-biased JFET circuit. • Use transfer characteristic curves to analyze JFET bias circuits. • Discuss Q-Point stability. • Do all the Examples. • Do Section Review 7-3.
FIELD EFFECT TRANSISTORS AND BIASING	7-4	• The MOSFET. [p351] • Explain the basic structure and operation of MOSFETs. • Explain the depletion mode. • Explain the enhancement mode. • Identify the symbols for both types of MOSFETs.
	7 - 5	• MOSFET characteristics and parameters. [p356]

		• Describe the proper handling of MOSFETs and discuss why it is necessary.

7 PRACTICAL WORK AND WORK-INTEGRATED LEARNING

The practical part of the subject is covered in ECTPRA2.

8 ASSESSMENT

8.1 Assessment criteria

- Semiconductor materials are described.
- The operation and Characteristics of the diode is analysed.
- The Bipolar Junction transistor as a Linear Amplifier to boost an electrical signal
- The direct current biasing of a BJT transistor and the Q-point values are discussed.
- The Bipolar Junction Transistor (BJT) circuits to function s a small-signal amplifier is designed
- The FET (Field-Effect Transistor) as a unipolar device is illustrated.
- Class A, B, AB and C amplifiers are illustrated
- Different types of thyristors are illustrated

8.2 Assessment plan

You will find your assignments for this subject in this Tutorial Letter. **Assignment 1 and 2 are compulsory and** both assignments will be used in the calculation of your year mark. Please send the completed assignments to UNISA before the closing dates stated in this section.

The mark for Electronics II (ECT2601) is calculated as follows:

- The year mark contributes to 20%.
- The examination mark contributes to 80%

The year mark is based on all the assignment marks obtained and their contribution towards the final year mark are as shown in the table below:

ASSIGNMENT NUMBER	CONTRIBUTION TOWARDS YEAR MARK
1 (Compulsory)	10%
2 (Compulsory)	90%
TOTAL	**= 100 %**

8.3 Assignment numbers

8.3.1 General assignment numbers

Assignments are numbered consecutively per module, starting from 01.

8.3.2 Unique assignment numbers

SEMESTER 1

Assignment 1: (Compulsory)	809441
Assignment 2: (Compulsory)	766205

SEMESTER 2

Assignment 1: (Compulsory)	860087
Assignment 2: (Compulsory)	805901

8.4 Assignment due dates

THE CUT-OFF SUBMISSION DATES FOR THE ASSIGNMENTS ARE :	
Assignment 1: (Compulsory) **Assignment 2: (Compulsory)**	**5 March 2018** **9 April 2018**

SEMESTER 2

THE CUT-OFF SUBMISSION DATES FOR THE ASSIGNMENTS ARE :	
Assignment 1: (Compulsory) **Assignment 2: (Compulsory)**	**29 August 2018** **27 September 2018**

8.5 Submission of assignments

ALL ASSIGNMENTS (submitted) HAVE TO BE ATTEMPTED!!!!!!!

THE SUBMISSION OF AN EMPTY ASSIGNMENT COVER IS UNACCEPTABLE.

IT IS VERY IMPORTANT TO CONSIDER THE FOLLOWING POINTS :

- NO LATE ASSIGNMENT SUBMISSIONS WILL BE ACCEPTED.
- KEEP A CLEAR COPY OF THE ASSIGNMENT FOR YOUR OWN REFERENCE. THIS IS IMPORTANT, AS ASSIGNMENTS DO GET LOST.
- **SUBMISSIONS OF ASSIGNMENTS MUST BE IN ACCORDANCE WITH "MY STUDIES @ UNISA".**

Please note that model answers for the assignments will be dispatched to all students shortly after the closing date of the assignment. This implies that you cannot submit your assignment later than the stipulated submission date.

The model answers will be in tutorial letter 201, under additional Resources on myunisa.

For detailed information and requirements as far as assignments are concerned, see the brochure *my Studies @ Unisa* that you received with your study material.

To submit an assignment **via *myUnisa*:**

- Go to *myUnisa*.
- Log in with your student number and password.
- Select the module.
- Click on assignments in the menu on the left-hand side of the screen.
- Click on the assignment number you wish to submit.
- Follow the instructions.

8.6 The assignments

SEMESTER 1

THE CUT-OFF SUBMISSION DATES FOR THE ASSIGNMENTS ARE :	
Assignment 1: (Compulsory) **Assignment 2: (Compulsory)**	**5 March 2018** **9 April 2018**

Assignment 1

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

ASSIGNMENT 1

1. Which statement best describes a p-type semiconductor?

1) A material where holes are the minority carriers.

2) Silicon with trivalent impurity atoms added.

3) Silicon with pentavalent impurity.

4) Pure intrinsic silicon.

5) None of the above.

2. The atomic number of an atom refers to the

1) number of protons in the nucleus.

2) Net electrical charge of the atom.

3) Number of electrons in a charged atom.

4) Number of neutrons in the nucleus.

5) None of the above.

3. The difference in energy levels that exists between the valence band and the conduction band is called.

1) energy gap

2) covalent gap

3) spark gap

4) semiconductor region

5) None of the above.

4. How much forward diode voltage is there with the ideal-diode approximation?

   1) 1 V

   2) More than 0.7 V

   3) 0 V

   4) 0.7 V

   5) None of the above.

5. If the positive lead of an ohmmeter is placed on the cathode and the negative lead is placed on the anode, which of the following readings would indicate defective diode?

   1) 0 Ω

   2) 400 kΩ

   3) ∞

   4) 1 MΩ

   5) None of the above

6. What is the maximum number of electrons that can exist in the shell closest to closest to the nucleus of an atom?

   1) 1

   2) 2

   3) 4

   4) 8

   5) None of the above

7 A typical value of reverse breakdown voltage in a diode is

   1) 0.7 V

   2) 0.3 V

   3) 0 V

   4) 50 V

   5) None of the above

8. The small current when a diode is reverse-biased is called

1) reverse breakdown current

2) reverse-leakage current

3) Conventional current

4) forward-bias current

5) None of the above

9. As the forward current through a forward-biased diode decreases, the voltage across the diode.

1) immediately drops to 0V

2) increases and then decreases

3) increases

4) is relatively constant.

5) None of the above.

10. A diode is operated in reverse bias. As the reverse voltage is decreased, the depletion region.

1) narrows

2) is not related to reverse voltage

3) has a constant width.

4) widens

5) None of the above.

ASSIGNMENT 2

BIPOLAR JUNCTION TRANSISTORS

QUESTION 1

The transistor in figure 1 has the following maximum ratings: $P_{D(\max)} = 500\ mW, V_{CE(\max)} = 25\ V, and\ I_{C(\max)} = 200\ mA$.

1.1 Determine the maximum value to which V_{CC} can be adjusted without exceeding a rating. (8)

1.2 Which rating would be exceeded first? (6)

[14]

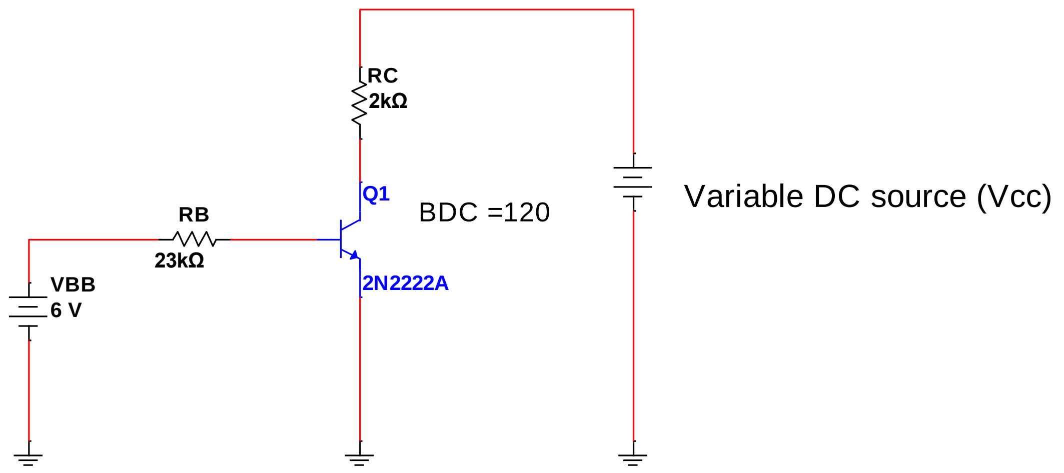


Figure 1

TRANSISTOR BIAS CIRCUITS

QUESTION 2

Find I_C and V_{CE} for the pnp transistor in figure 2. (8)

[8]

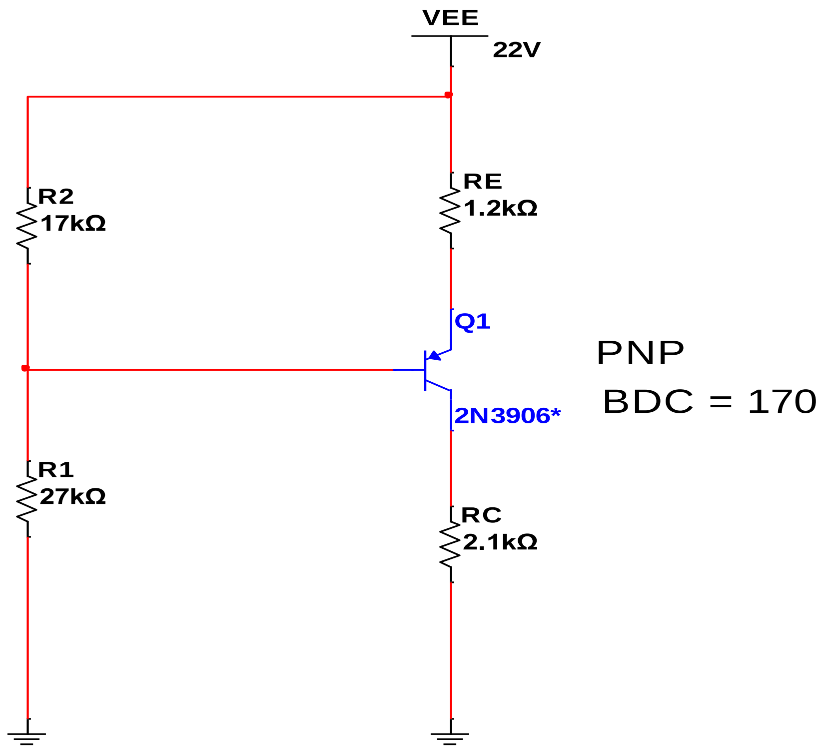


Figure 2

QUESTION 3

Determine I_C and V_{CE} in the pnp emitter bias circuit of figure 3. Assume $B_{DC} = 130$. (8)

[8]

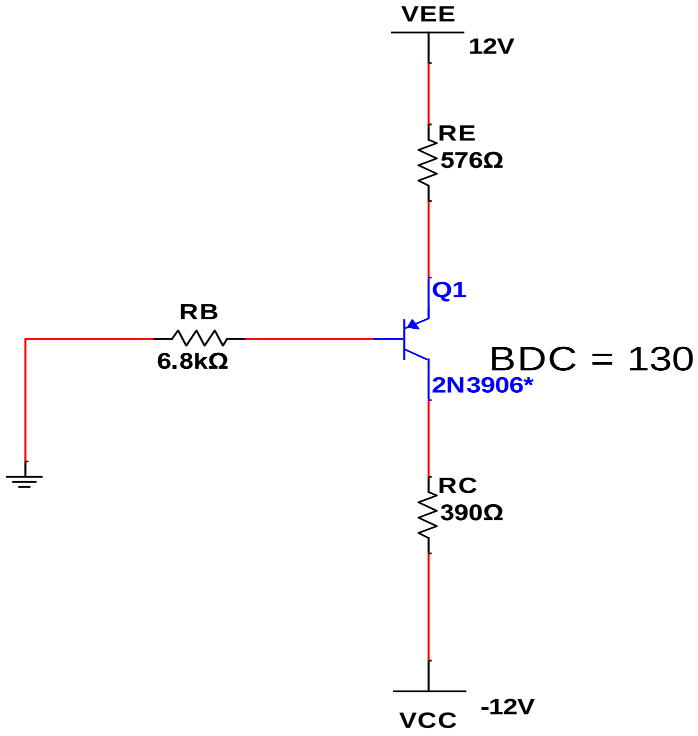


Figure 3

QUESTION 4

Determine the most probable failures, if any in the circuit of figure 4.

4.1 Calculate all the D.C values in the voltage divider circuit. (10)

4.2 Compare these values to the measured values on the multimeters and determine the failure. (2)

(Hint: the calculated D.C values and the measured values do not have to be exactly the same the fact that they are not exactly the same is not a fault.)

[12]

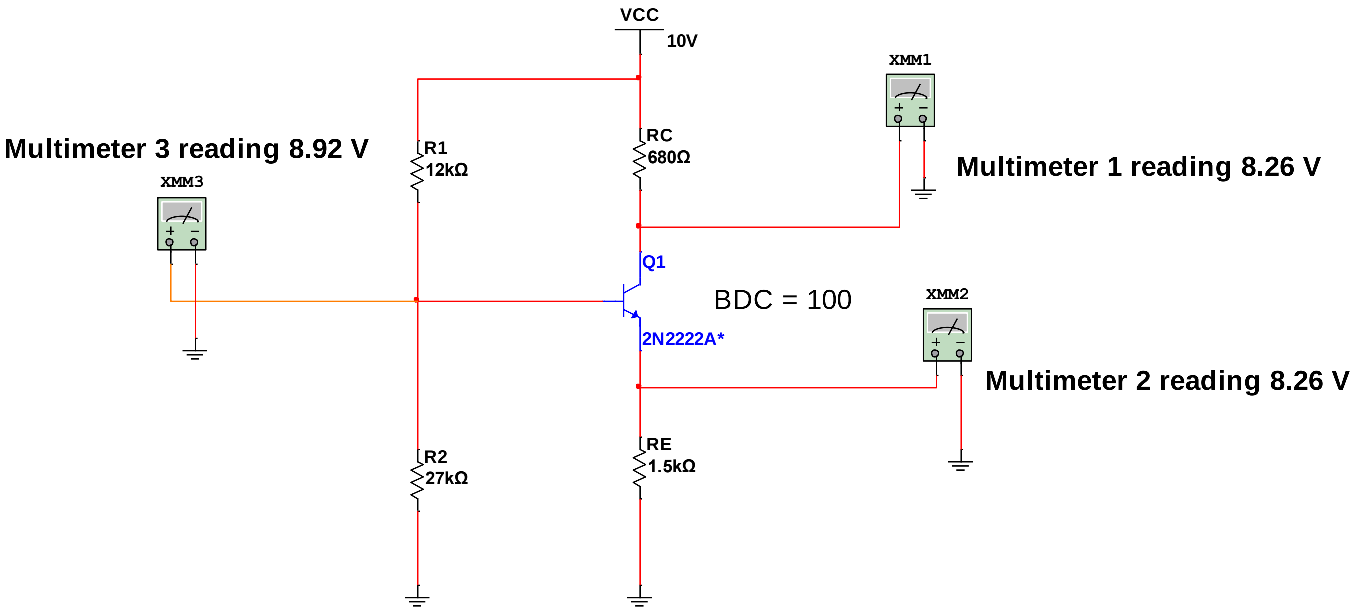


Figure 4

BJT AMPLIFIERS

QUESTION 5

5.1 Determine the following dc values for the common-emitter amplifier in figure 5.

5.1.1 V_{TH} (1)

5.1.2 R_{TH} (1)

5.1.3 I_E (2)

5.1.4 V_B (2)

5.1.4 V_C (2)

5.1.5 V_{CE} (2)

5.2 Determine the following ac values for the common-emitter amplifier in figure 5.

5.2.1 r_e' (2)

5.2.2 $R_{in(base)}$ (2)

5.2.3 $R_{in(tot)}$ (2)

5.2.4 $Attenuation$ (2)

5.2.5 A_v (2)

5.2.6 $Overall\ Gain$ (2)

5.2.7 A_i (8)

5.2.8 A_p (2)

[32]

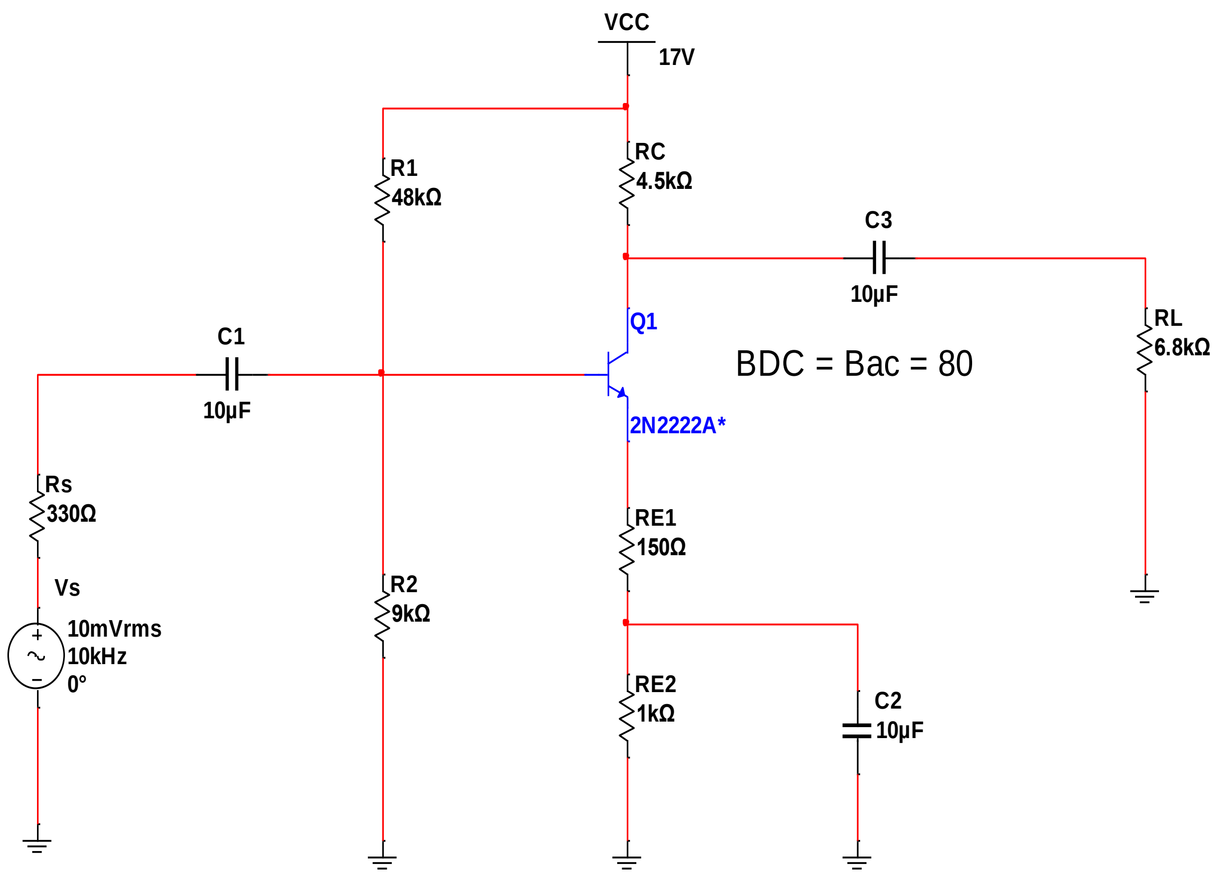


Figure 5

FIELD EFFECT TRANSISTORS

QUESTION 6

For the JFET in figure 6, $V_{GS(off)}$ = - 6V and $I_{DSS} = 11mA$. Determine the minimum value of V_{DD} required to put the device in the constant-current region of operation when $V_{GS} = 0\ V$. (12)

[12]

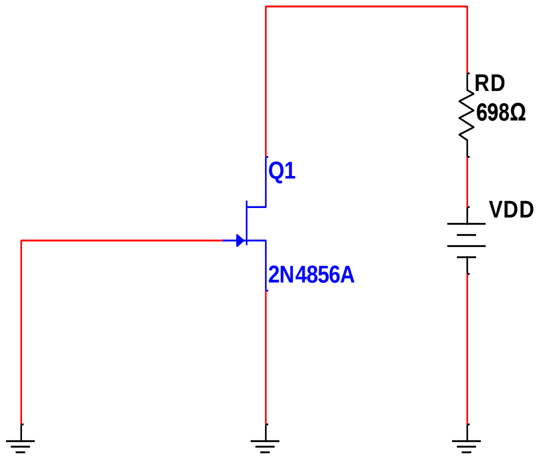


Figure 6

QUESTION 7

Determine I_D and V_{GS} for the JFET with voltage-divider bias in Figure 7, given that for this particular JFET the parameter values are such that $V_D = 4\ V$ (12)

[12]

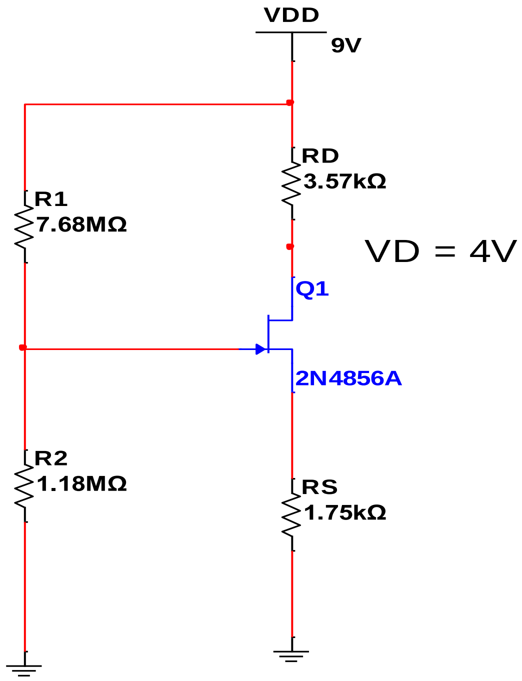


Figure 7

QUESTION 8

A given JFET has the following characteristics: $I_{DSS} = 12\ mA$, $V_{GS(off)} = -5\ V$, and $g_{m0} = g_{fs} = 3000\mu S$. Find g_m and I_D when $V_{GS} = -2\ V$ (2)

[2]

Total Marks [100]

ASSINGMENT 3

SELF ASSESSMENT NO NEED TO SUBMIT

Question 1

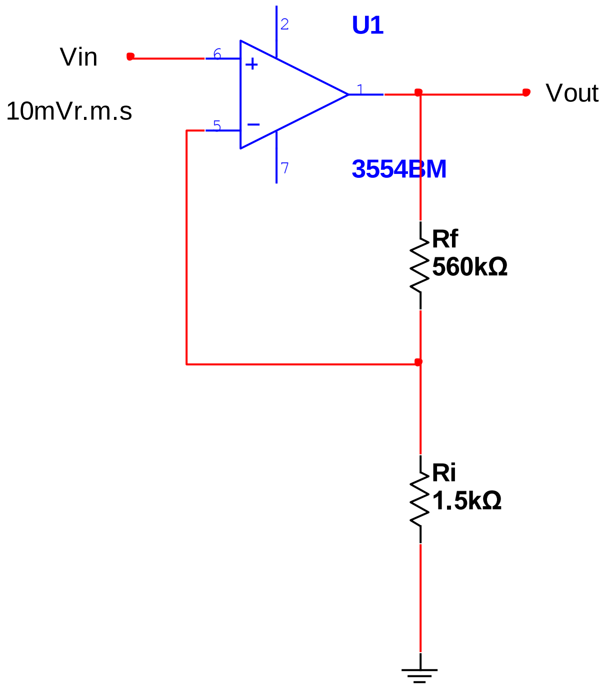


Figure 1

For the amplifier in figure 1determine the

1.1 $A_{cl(NI)}$ [6]

Question 2:

Figure 2 shows a direct-coupled two-stage amplifier. Determine all the dc voltages for both stages as well as the overall voltage gain. (14)

Do your calculations here:

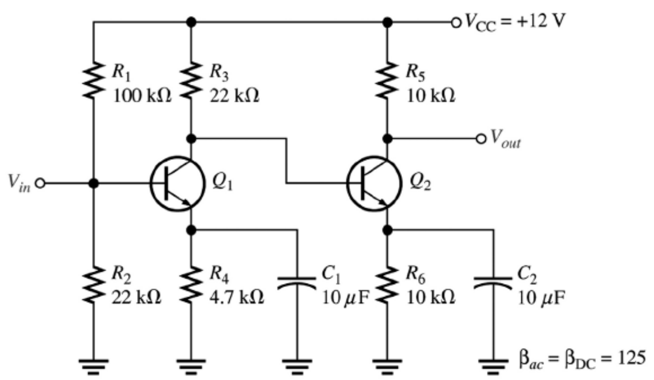


Figure 2:

V_{B1} =

V_{E1} =

V_{C1} =

V_{B2} =

V_{E2} =

V_{C2} =

A'_v =

[14]

Question 3:

Calculate A_{v1} for the circuit in Figure 3. (5)

Do your calculations here:____

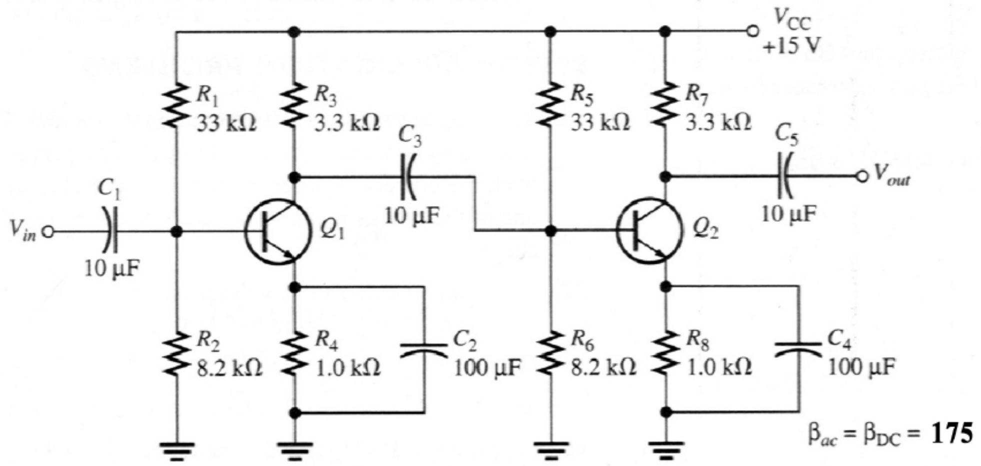


Figure 3:

[5]

Question 4:

(a) What type of amplifier circuit is shown in Figure 4? (2)

Answer =

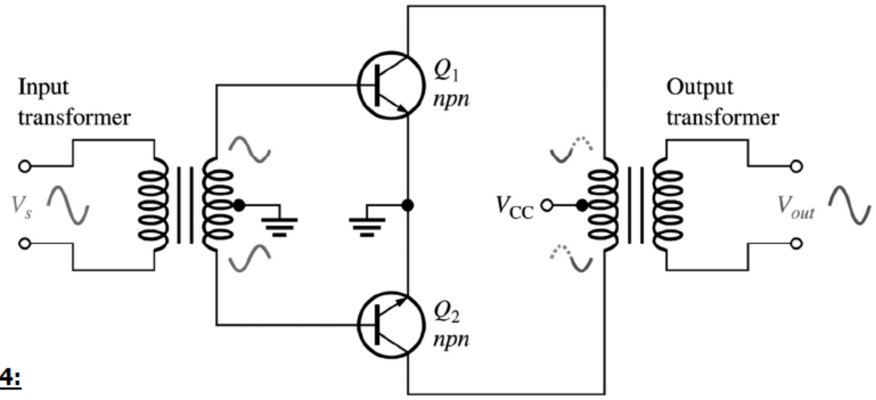


Figure 4:

(b) What type of amplifier circuit is shown in Figure 5? (2)

Answer =

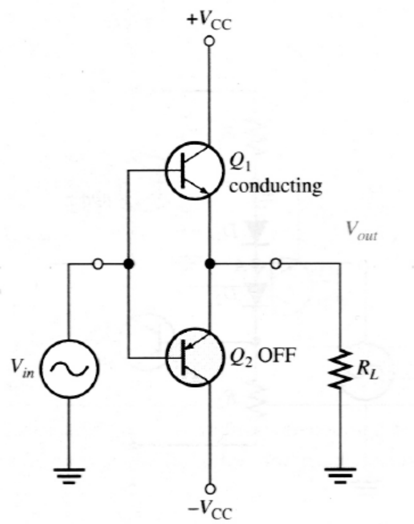


Figure 5:

(c) Explain, by means of sketching input and output waveforms in the space below, what is meant by "crossover distortion" in class B push-pull amplifiers. (6)

(d) Sketch, in the space provided below, how to bias the push-pull amplifier current-mirror diode bias to eliminate crossover distortion. (6)

[16]

Question 5:

Draw a fully labeled family of drain characteristic curves of an n-channel JFET. Indicate five values for V_{GS}, as well as where V pinch-off and I_{DSS} will be. (7)

____**[7]**

Question 6:

Set up a midpoint bias for a JFET with I_{DSS} = 16 mA and $V_{GSS(off)}$ = -12 V. Use a 24 V dc source as the supply voltage. Draw the circuit and label with all the calculated values. Select R_G = 1,0 MΩ. Convert calculated resistor values to the neatest available value in the E12 standard. (6)

[6]

Question 7:

(a) Determine the value of R_S required to self-bias an n-channel JFET that has the transfer characteristic curve shown in Figure 6 at V_{GS} = -5,5 V. Show on the curve how the necessary value was obtained. (5)

Do your calculations here:_______________

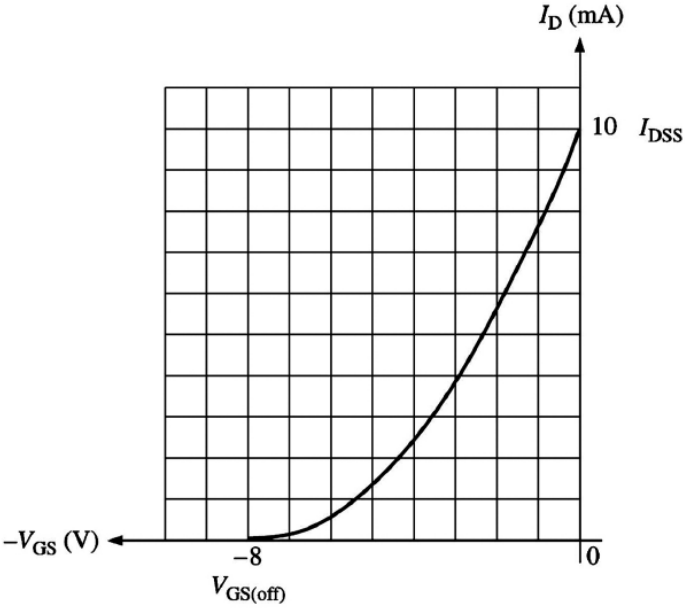


Figure 6:

R_s =

(b) Find the Q-point for the JFET circuit in Figure 7. Show on the transfer characteristic curve given in Figure 8 how this was accomplished by showing broken lines and labeling with values. (7)

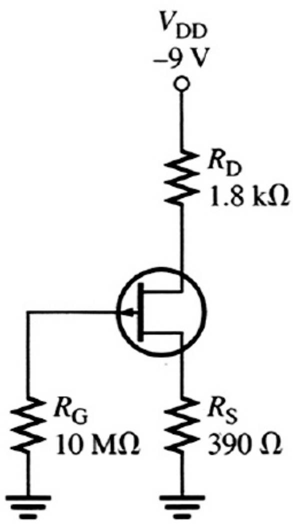


Figure 7:

Do your calculations here:____

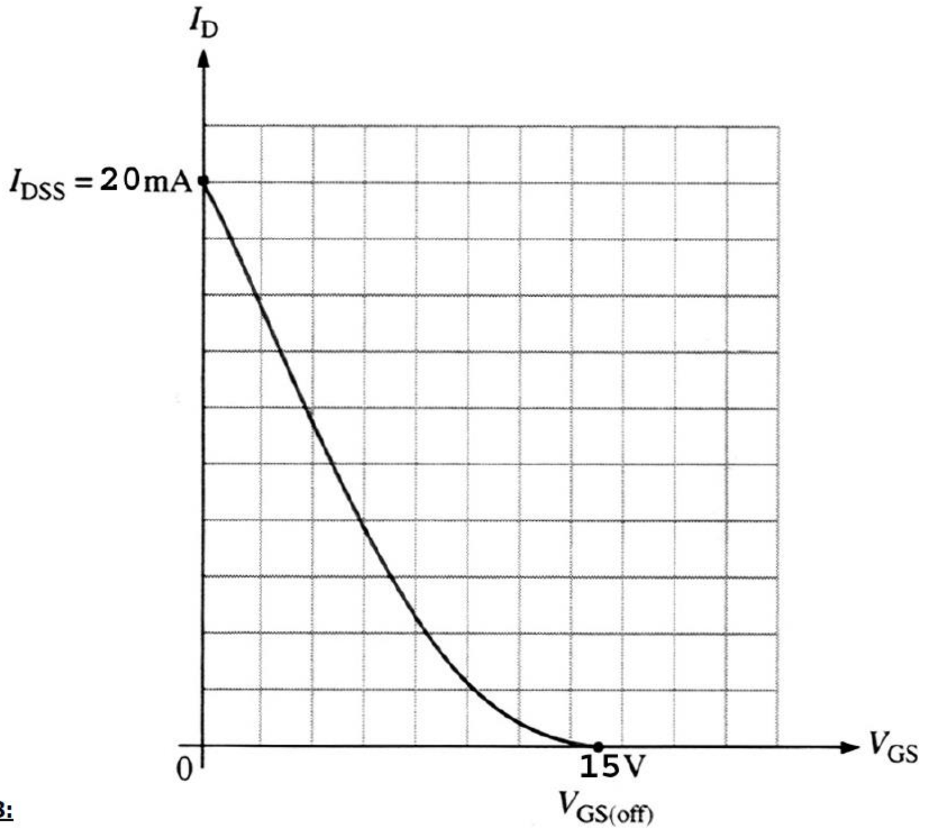


Figure 8:

(c) Find the Q-point values for the JFET circuit in Figure 9(a). Show on the transfer characteristic curve on Figure 9(b) how it was determined using broken lines. Show your calculations in the space provided. (7)

Do your calculations here:____

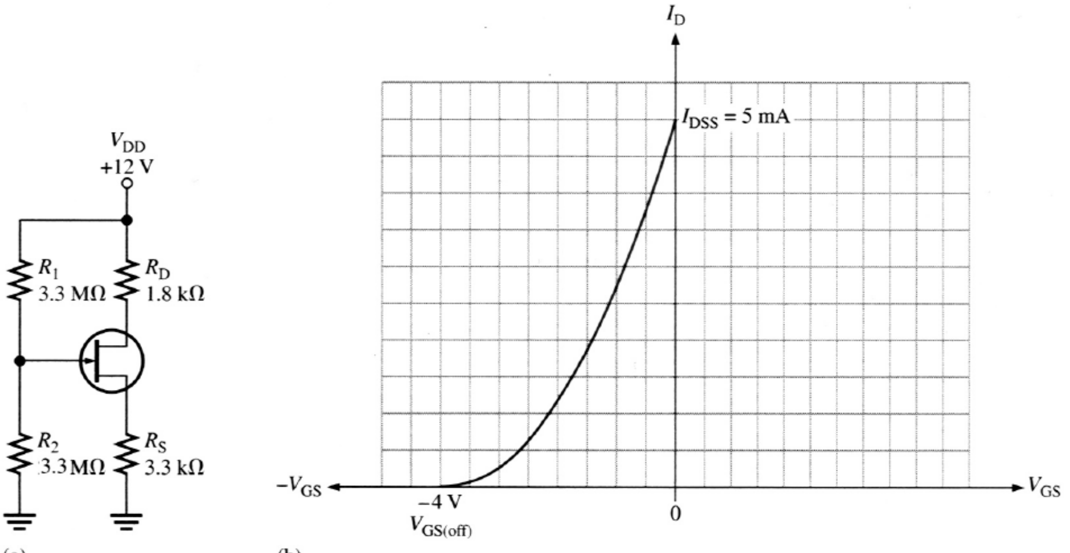


Figure 9:

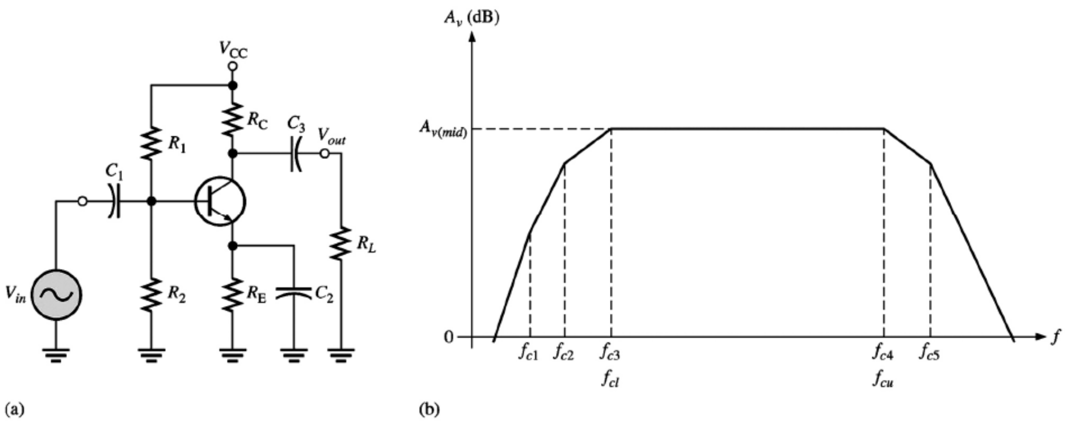
[19]

Question 8:

(a) How does the coupling, bypass capacitors and the internal capacitances of the transistor influence the frequency response of an amplifier? (2)

(b) What is meant by "roll-off" with reference to frequency response of amplifiers? (2)

(c) Indicate on the figure below where the bandwidth would be determined. (2)



[6]

Question 9:

(a) Draw, in the space provided, two simple methods to turn an SCR off by using the current interruption method.(4)

(b) Draw a fully labeled characteristic curve for the triac in the space provided below. (6)

[10]

Question 10:

(a) Draw a simple on-off SCR control circuit in the space provided. (3)

Answer =

(b) To what value must the variable resistor be adjusted in Figure 10 in order to turn the SCR off? (2)
Assume I_H = 10 mA and V_{AK} = 0,7 V.

Do your calculations here:____

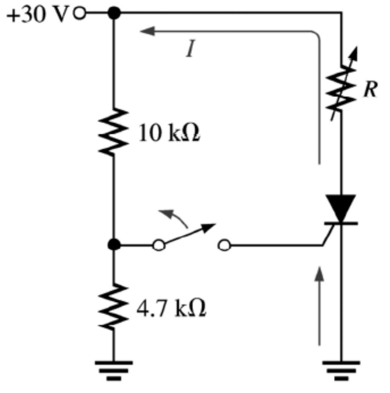


Figure 10:

$\mathbf{R}_{max}$ =

(c) Sketch the V_R waveform, in the space provided, for the circuit in Figure 11, given the indicated relationship of the input waveforms. (3)

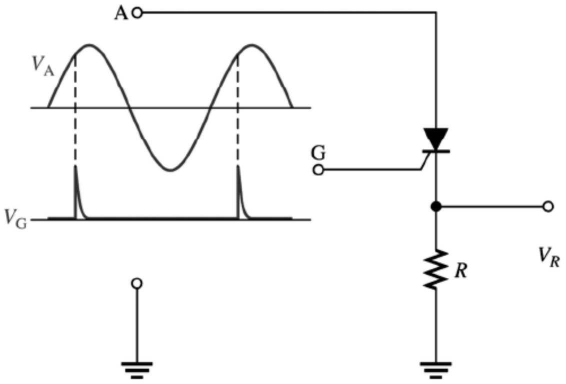
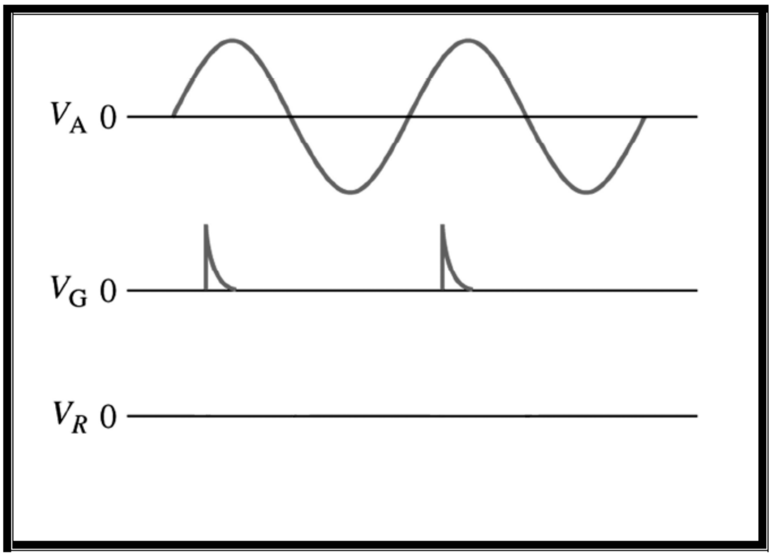
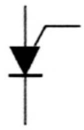


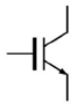
Figure 11:

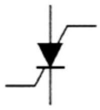
Answer =



(d) Identify the following symbols: (3)

(i)  =

(ii)  =

(iii)  =

[11]

TOTAL MARKS = 100

FULL MARKS = 100 = 100%

SEMESTER 2

THE CUT-OFF SUBMISSION DATES FOR THE ASSIGNMENTS ARE :	
Assignment 1: (Compulsory)	**29 August 2018**
Assignment 2: (Compulsory)	**27 September 2018**

TO BE COMPLETED ON MARK READING SHEET

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

ASSIGNMENT 1

1) Valence electrons have --------------------energy level of all the electrons in orbit around the nucleus of a given atom.

1) the same
2) the lowest
3) the highest
4) None of the above
5) All of the above

2) A DMM measures 0.13Ω in both directions when testing a diode. The diode is

1) operating normally
2) shorted
3) open
4) constructed of Si and is good
5) None of the above

3) Germanium has limited use in modern electronics due to

1) Higher forward voltage drop when compared to Si
2) Filament warm-up time.
3) High temperature instability
4) Shortages of raw materials.
5) None of the above.

4) The resistance of a forward-biased diode is

1) Minimal below the knee of the curve.

2) Minimal above the knee of the curve.

3) Infinite

4) Perfectly linear

5) None of the above.

5) A reverse-biased diode has the ____________connected to the positive side of the source, and the _____________connected towards the negative side of the source.

1) Cathode, base

2) Cathode, anode

3) Base, anode

4) Anode, cathode

5) None of the above

6) The knee voltage of a diode is approximately equal to the

1) Breakdown voltage

2) Reverse voltage

3) Applied voltage

4) Barrier potential

5) None of the above

7) A silicon diode is connected in series with a 10 kΩ resistor and a 12 V battery. If the cathode of the diode is connected to the positive terminal of the battery, the voltage from the anode to the negative terminal of the battery is.

1) 12 V

2) 11.3 V

3) 0 V

4) 0.7 V

5) None of the above

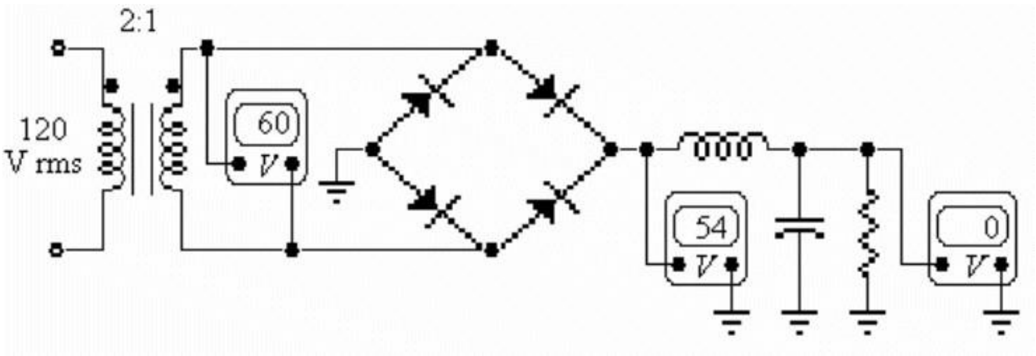


Figure 1

8) Refer to the figure 1 above. In servicing this power supply, you notice that the ripple voltage is higher than normal and that the ripple frequency has changed to 60 Hz. The probable trouble is that

1) a diode has shorted

2) the filter capacitor has opened

3) a diode has opened

4) the inductor has opened

5) None of the above.

9) Refer to figure 1 above. If the voltmeter across the transformer secondary reads 0 V, the probable trouble is that.

1) The filter capacitor is open

2) one of the diodes is open

3) The inductor is open

4) The transformer secondary is open

5) No trouble exists; everything is normal

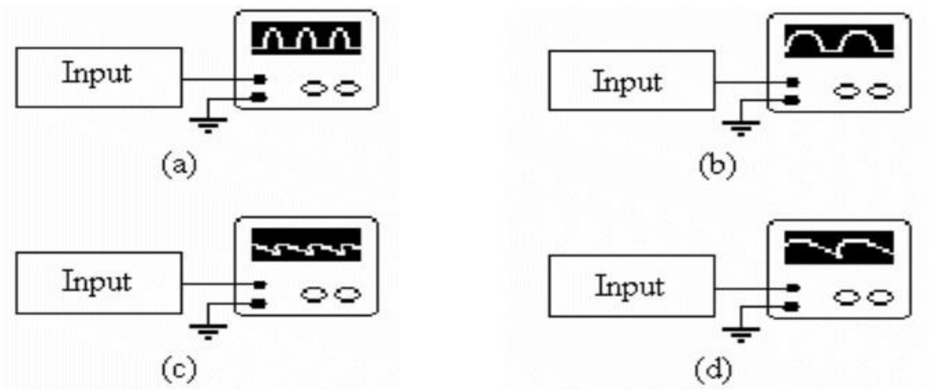


Figure 2

10) Refer to figure 2 (a) above. This oscilloscope trace indicates the output from.

1) a half-wave filtered rectifier

2) a full-wave filtered rectifier

3) a full-wave rectifier with no filter and an open diode.

4) a full-wave filtered rectifier with an open diode.

5 None of the above.

ASSIGNMENT 2

BIPOLAR JUNCTION TRANSISTORS

QUESTION 1

Determine whether or not the transistor in figure 1 is in saturation. Assume $V_{CE(SAT)} = 0.3V$ (8)

[8]

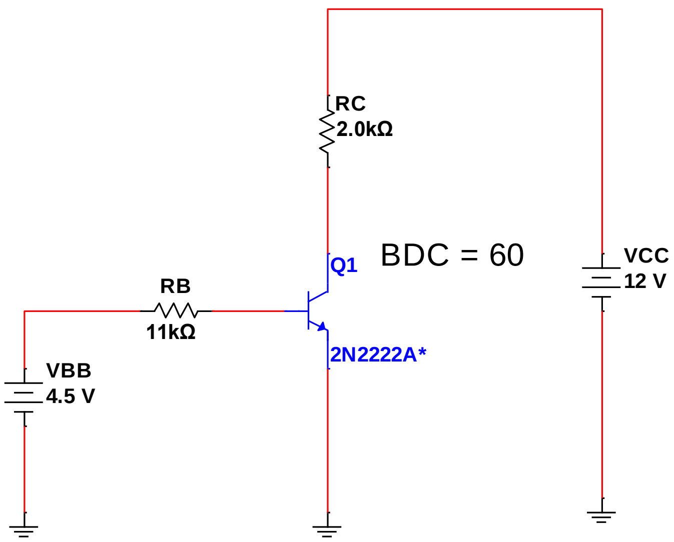


Figure 1

QUESTION 2

For the PNP transistor in figure 2. Calculate,

2.1	V_{TH}	(2)
2.2	R_{TH}	(2)
2.3	I_E	(2)
2.4	V_{CE}	(2)
2.5	V_B	(2)
2.6	I_B	(2)
2.7	I_1	(2)
2.8	I_2	(2)
		[16]

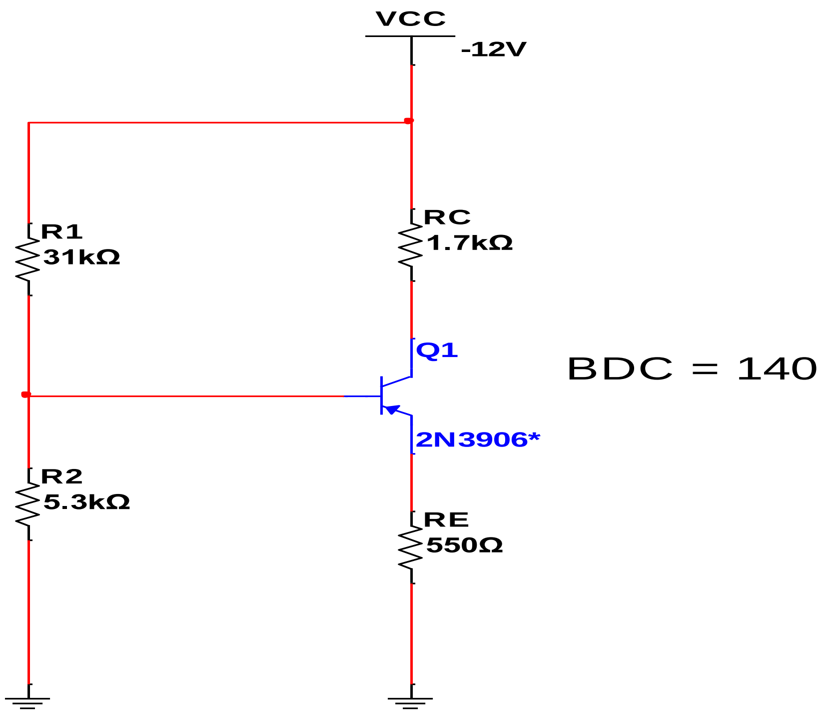


Figure 2

QUESTION 3

Determine the value of I_C and V_{CE} for the collector-feedback Bias circuit of figure 3. (8)

[8]

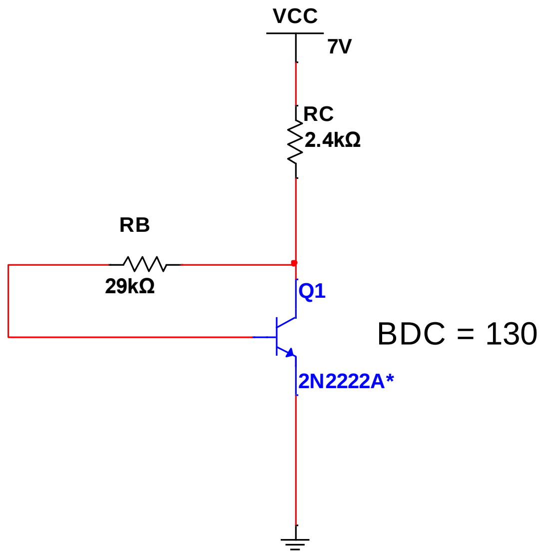


Figure 3.

QUESTION 4

Determine the most probable failures, if any in the circuit of figure 4.

4.1 Calculate all the D.C values in the voltage divider circuit. (8)

4.2 Compare these values to the measured values on the multimeters and determine the failure. (2)

[10]

(Hint: the calculated D.C values and the measured values do not have to be exactly the same. The fact that they are not exactly the same is not a fault.)

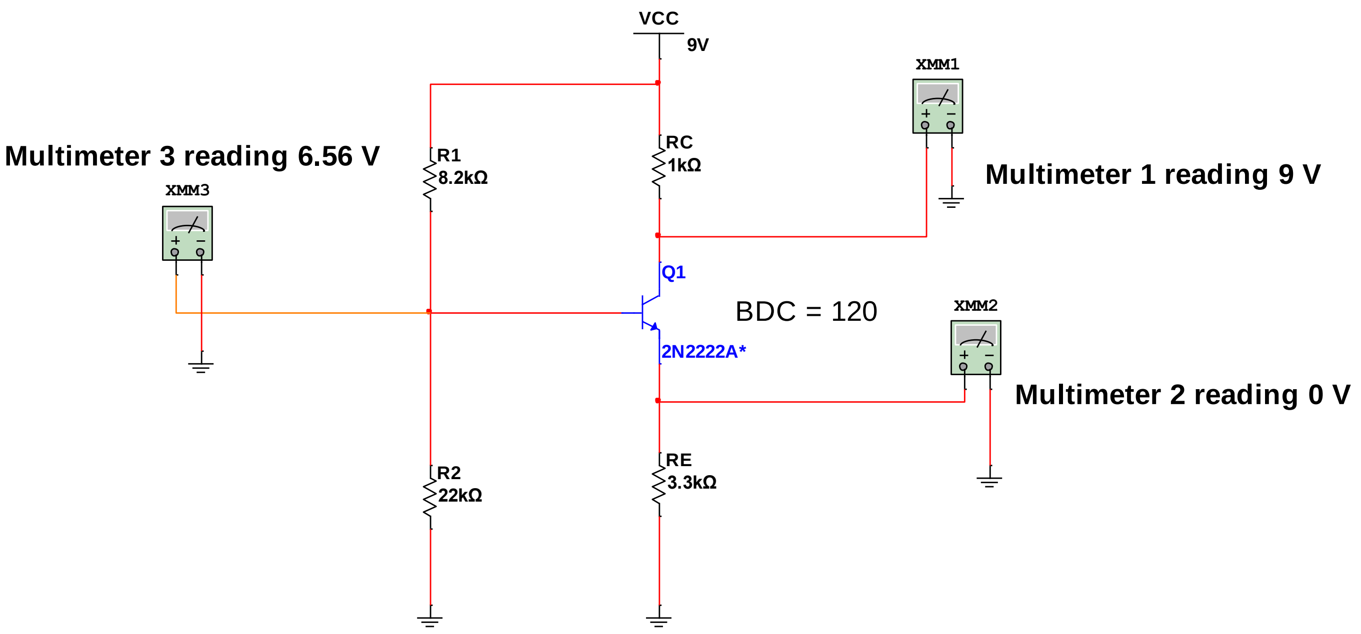


Figure 4

BJT AMPLIFIERS

QUESTION 5

5.1 Determine the following dc values for the common-base amplifier in figure 5.

5.1.1 V_{TH} (2)

5.1.2 R_{TH} (2)

5.1.3 I_E (2)

5.1.4 V_{CE} (2)

5.2 Determine the following ac values for the common-base amplifier in figure 5.

5.2.1 r_e' (2)

5.2.2 A_v (2)

5.2.3 V_{out} *Output collector voltage* (2)

5.2.4 A_i (2)

5.2.5 A_p (2)

[18]

BDC = Bac = 170

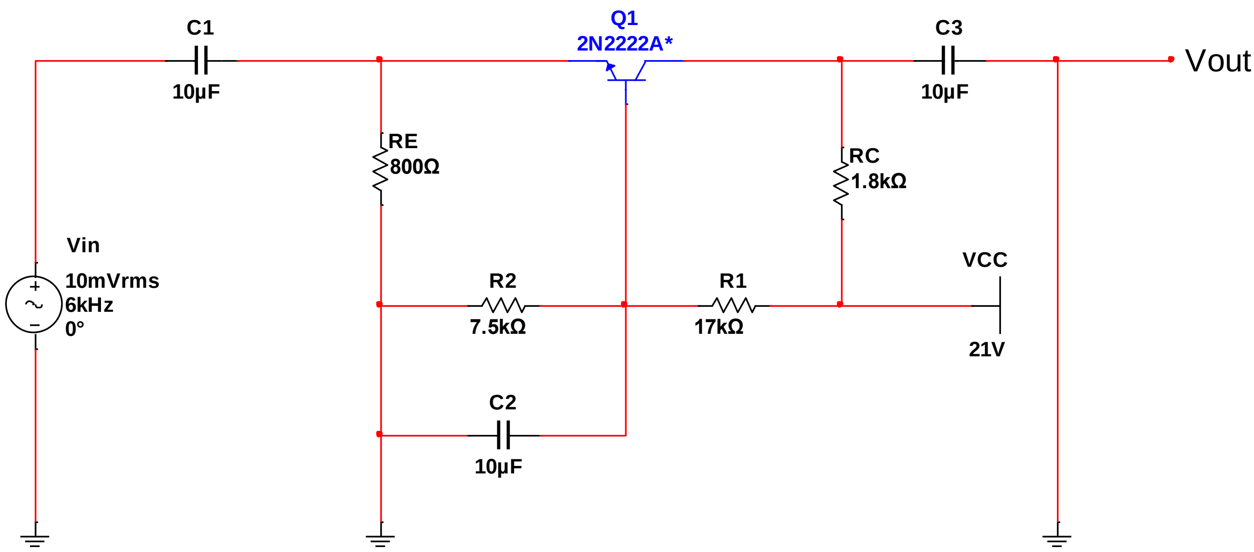


Figure 5

QUESTION 6

For the circuit in figure 6, determine the following:

6.1	Q_1 and Q_2 dc terminal voltages	(5)
6.2	$Overall\ B_{ac}$	(1)
6.3	r_e' for each transistor	(4)
6.4	$total\ input\ impedance$	(6)
		[16]

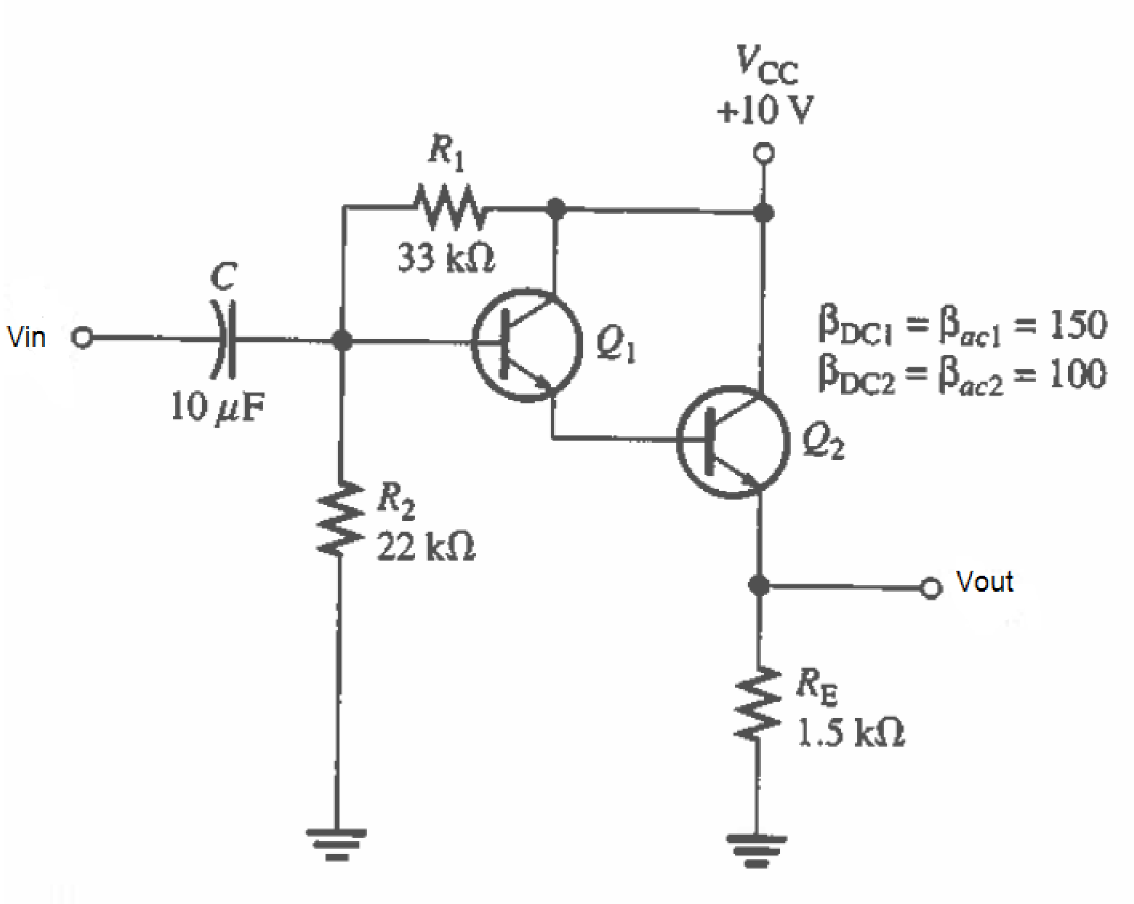


Figure 8

FIELD - EFFECT TRANSISTORS

QUESTION 7

For the JFET in figure 7, $V_{GS(off)}$ = - 7V and $I_{DSS} = 13mA$. Determine the minimum value of V_{DD} required to put the device in the constant-current region of operation when $V_{GS} = -2\ V$. (12)

[12]

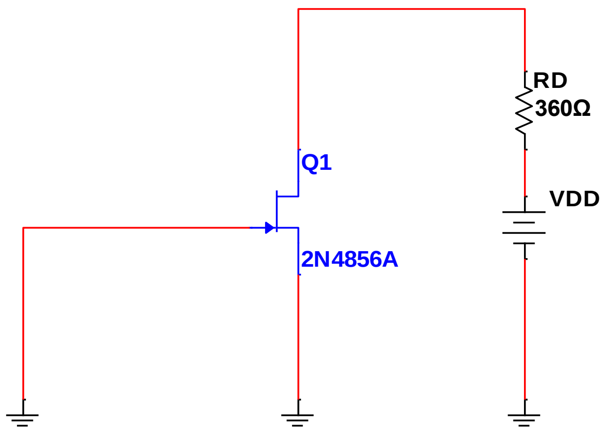


Figure 7

QUESTION 8

Determine I_D and V_{GS} for the JFET with voltage-divider bias in figure 8, given that for this particular JFET the parameter values are such that $V_D = 7.5\ V$ (12)

[12]

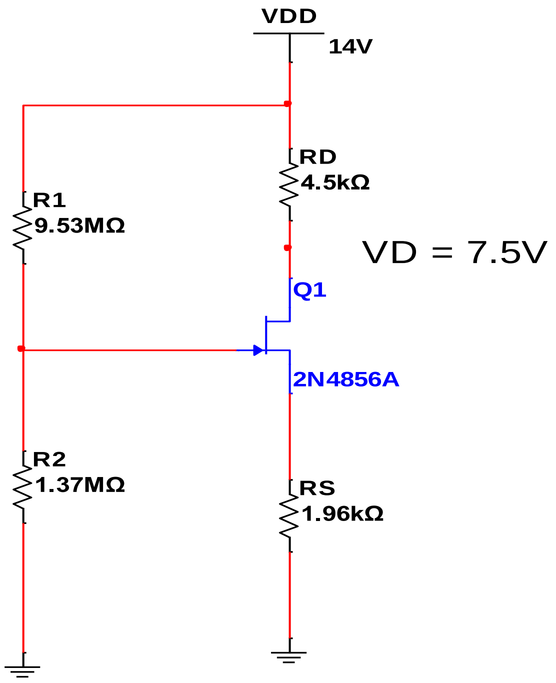


Figure 8

Total Marks [100]

ASSINGMENT 3

SELF ASSESSMENT NO NEED TO SUBMIT

Question 1

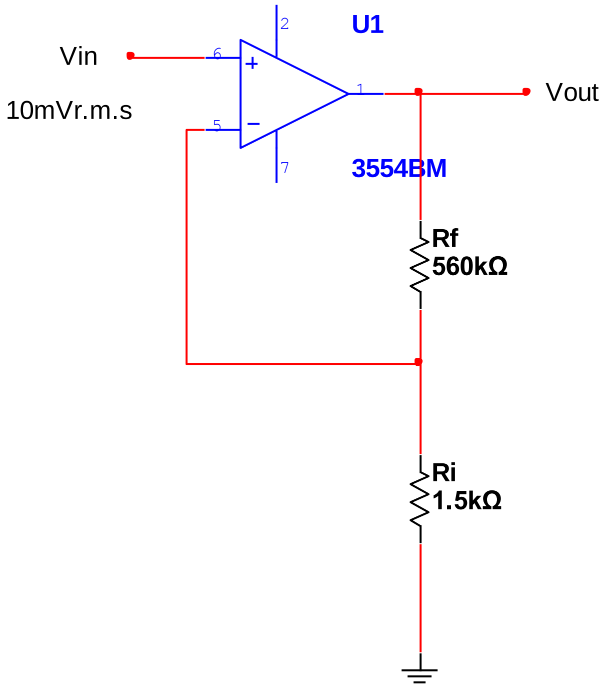


Figure 1

For the amplifier in figure 1determine the

1.2 $A_{cl(NI)}$ [6]

Question 2:

Figure 2 shows a direct-coupled two-stage amplifier. Determine all the dc voltages for both stages as well as the overall voltage gain. (14)

Do your calculations here:____

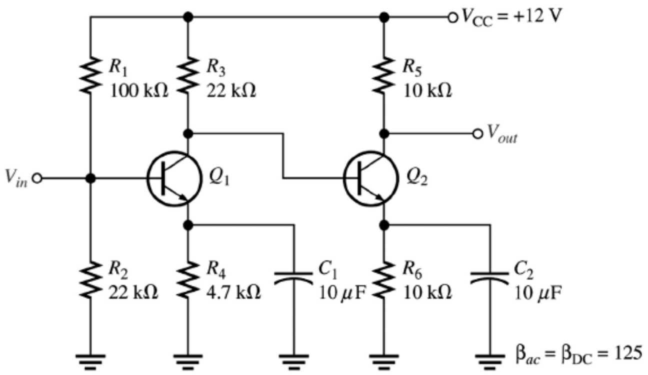


Figure 2:

V_{B1} =

V_{E1} =

V_{C1} =

V_{B2} =

V_{E2} =

V_{C2} =

A'_v =

[14]

Question 3:

Calculate A_{v1} for the circuit in Figure 3. (5)

Do your calculations here:____

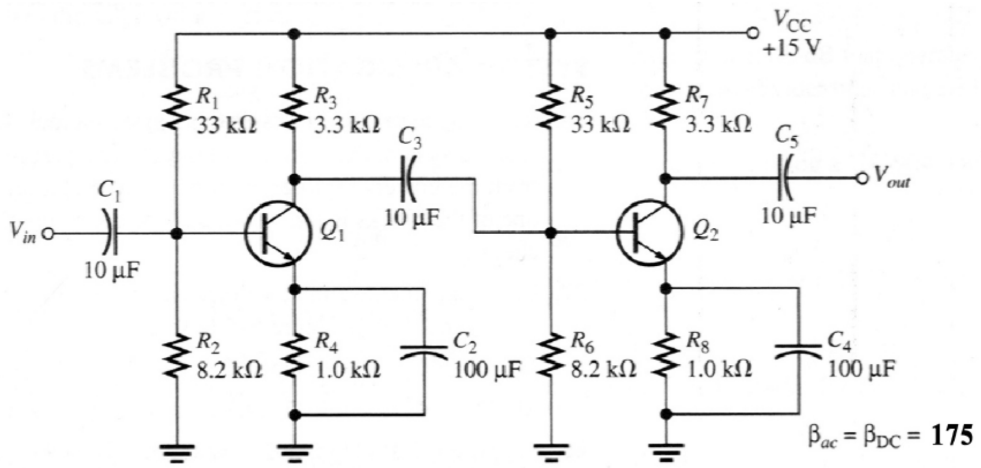


Figure 3:

[5]

Question 4:

(a) What type of amplifier circuit is shown in Figure 4? (2)

Answer =

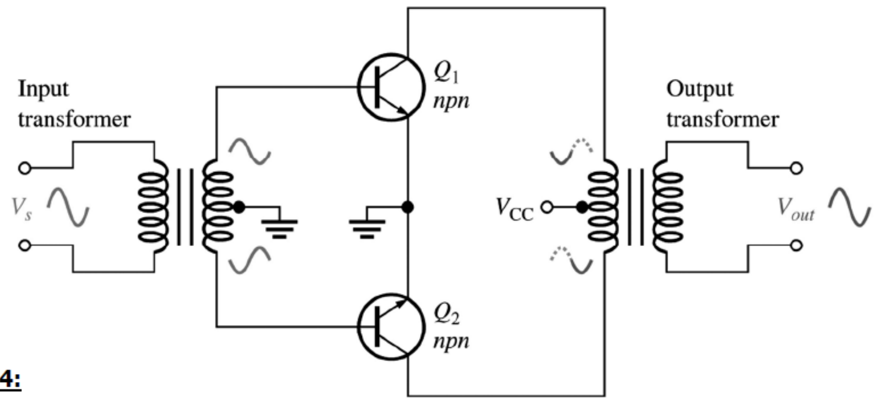
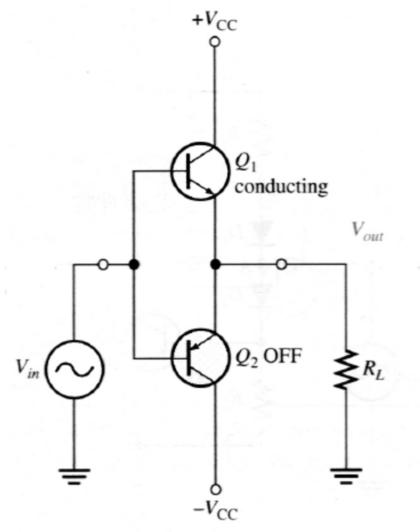


Figure 4:

(b) What type of amplifier circuit is shown in Figure 5? (2)

Answer =



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[7]

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Do your calculations here:_______________

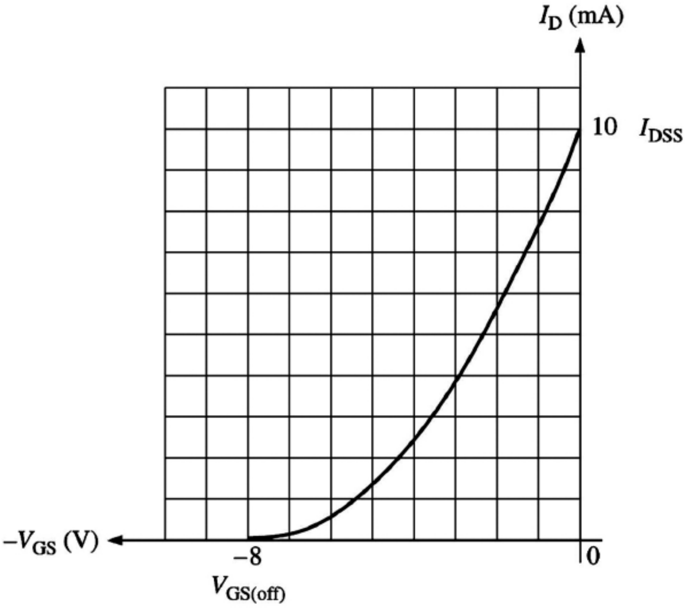

Figure 6:

R_s = _______________

(b) Find the Q-point for the JFET circuit in Figure 7. Show on the transfer characteristic curve given in Figure 8 how this was accomplished by showing broken lines and labeling with values. (7)

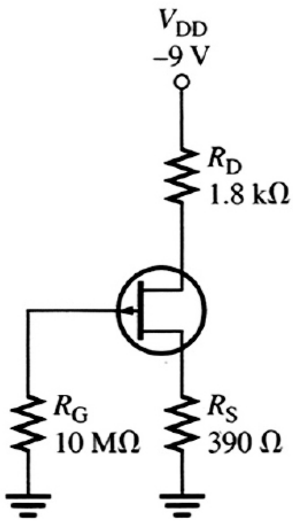

Figure 7:

Do your calculations here:____

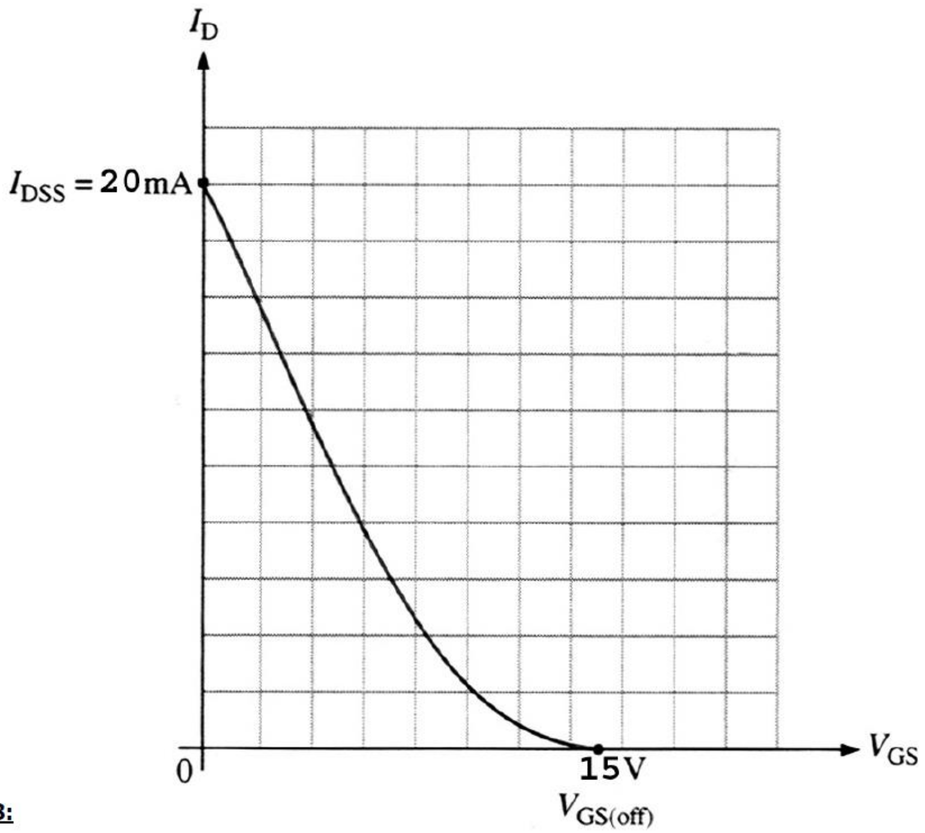

Figure 8:

(c) Find the Q-point values for the JFET circuit in Figure 9(a). Show on the transfer characteristic curve on Figure 9(b) how it was determined using broken lines. Show your calculations in the space provided. (7)

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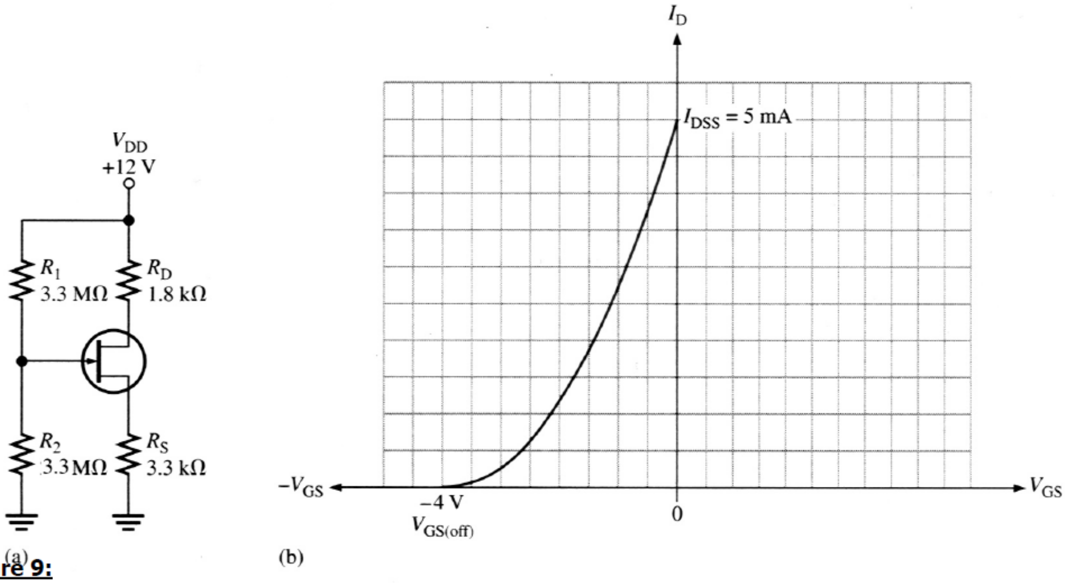

Figure 9:

[19]

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(a) How does the coupling, bypass capacitors and the internal capacitances of the transistor influence the frequency response of an amplifier? (2)

____

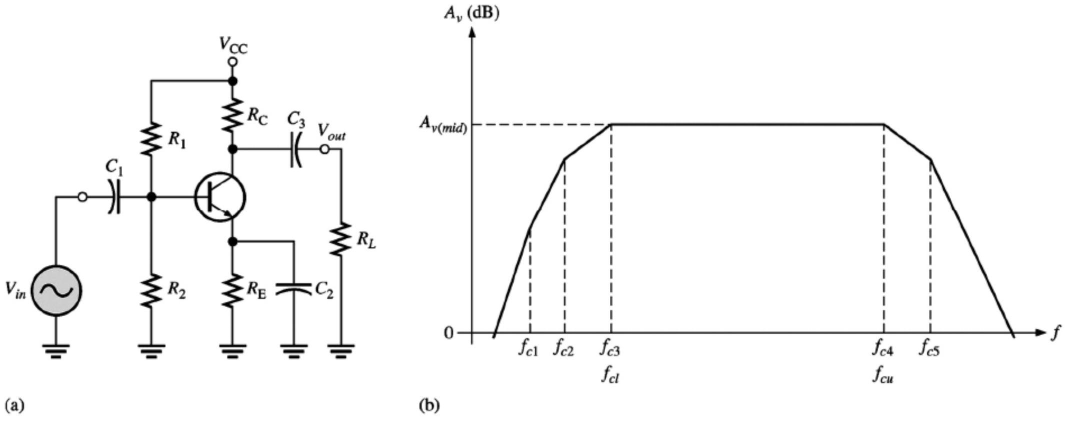
____

(b) What is meant by "roll-off" with reference to frequency response of amplifiers? (2)

____

____

(c) Indicate on the figure below where the bandwidth would be determined. (2)



[6]

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(b) Draw a fully labeled characteristic curve for the triac in the space provided below. (6)

[10]

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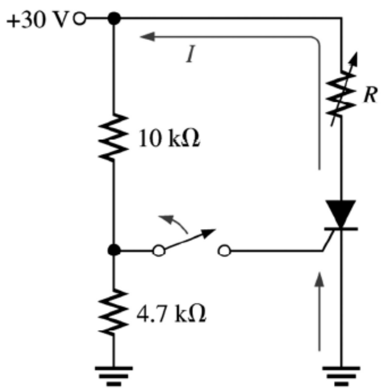
(a) Draw a simple on-off SCR control circuit in the space provided. (3)

Answer =

(b) To what value must the variable resistor be adjusted in Figure 10 in order to turn the SCR off? (2)
Assume I_H = 10 mA and V_{AK} = 0,7 V.

Do your calculations here:

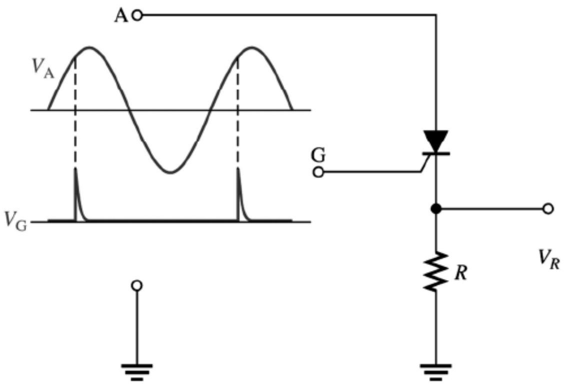


R_{max} =

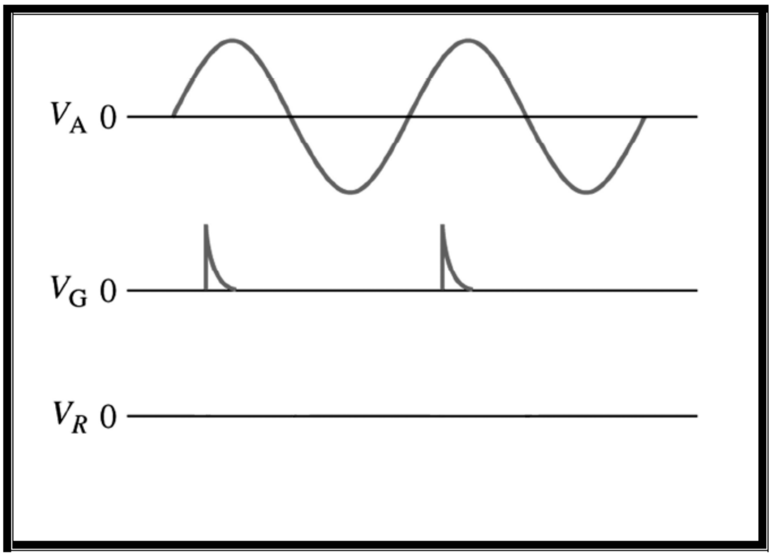
Figure 10:

(c) Sketch the V_R waveform, in the space provided, for the circuit in Figure 11, given the indicated relationship of the input waveforms. (3)

Figure 11:



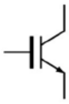
Answer =

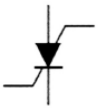


(d) Identify the following symbols: (3)

(i)

=

(ii)  = ______________________________

(iii)  = ______________________________

[11]

TOTAL MARKS = 100

FULL MARKS = 100 = 100%

8.7 Other assessment methods

None

8.8 The examination

Use your *my Studies @ Unisa* brochure for general examination guidelines and examination preparation guidelines.

9 FREQUENTLY ASKED QUESTIONS

The my Studies @ Unisa brochure contains an A-Z guide of the most relevant study information.

10 SOURCES CONSULTED

None

11 CONCLUSION

Please ensure that you have all the tutorial letters and prescribed book available before starting with your studies.

12 ADDENDUM

None