International Islamic University Chittagong

Department of Electrical and Electronic Engineering

B. Sc. Engineering in EEE

Final Exam, Autumn 2022

Course Code: **EEE 2301** Course Title: **Electronics-I**

Time: 2 hours 30 minutes Full Marks: 50

(i) The figures in the right-hand margin indicate full marks

(ii) Course Outcomes and Bloom's Levels are mentioned in additional Columns

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Course Outcomes (COs) of the Questions	
CO1	Knowledge of basic semiconductor devices such as PN junction and Zener diode, BJT, FET, MOSFET, modelling of diodes, field-effect, and bipolar junction transistors, and different amplifier circuits.
CO2	Problem-solving of different types of electronic circuit consisting of diode, BJT, FET, transistor amplifiers as discrete and integrated devices.
CO3	Design and modelling of BJT, FET, MOSFET, differential and simple amplifier circuits and their small signal, large signal, and frequency response performance.

Bloom's Levels of the Questions						
Letter Symbols	**R**	**U**	**App**	**An**	**E**	**C**
Meaning	Remember	Understand	Apply	Analyze	Evaluate	Create

Part A

[Answer the questions from the followings]

1. a) (i) Write down the advantages of h-parameter analysis. **CO3** **R, An** **5**
(ii) Show the analysis of Emitter Follower using exact h-parameter model, and derive the equations for voltage gain, current gain, input impedance, and output admittance for a BJT. Also, mention why it is known as Emitter Follower.

b) Consider the fixed bias configuration of the network of **"Fig. 1"** where r_o is infinite. Determine a) r_e, b) Z_i, c) Z_o, d) A_v. Considering r_o is 50 Ω, calculate Z_o and A_v , and compare the results. **CO3** **E** **5**

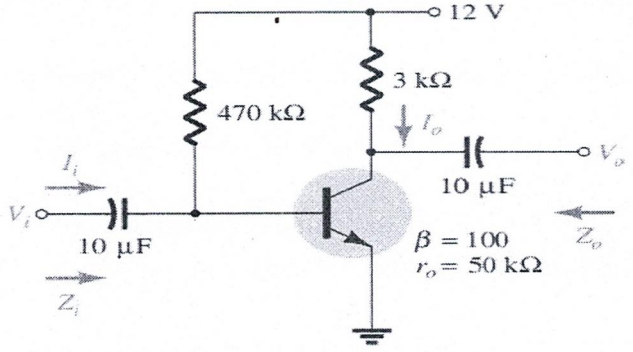

Fig. 1 CE Fixed biased Configuration

OR

1.. a) (i) What is modeling of transistor? Why h-parameter model is important for BJT? **CO3** **R, An** **6**
(ii) Draw the r_e- equivalent model of a CE transistor configuration. Also, derive the expressions for input impedance, output impedance, voltage gain, and current gain.

1.	b)	The hybrid parameters for a transistor used in CE configuration are h_{ie} =5kΩ; h_{fe} = 180; h_{re} = 1.25 × 10^{-4}; h_{oe} = 16 × 10^{-6} ohms. The transistor has a load resistance of 20 KΩ in the collector. Compute the value of input impedance, output impedance, current gain, and voltage gain.	**CO3**	**E**	**4**
2.	a)	(i). Why multi stage transistor is used? Categorize the different coupling schemes used in multistage amplifiers. Also mention the role of capacitor in amplifier.	**CO1**	**U, An**	**6**
		(ii) . With neat diagram explain the working principle of a transformer coupled transistor amplifier. Also, write down the physical significance of CMRR in case of differential amplifier.	**CO3**	**An**	
2.	b)	Consider the basic differential amplifier circuit shown in **Fig. 2.** Determine, (a) the dc voltages and currents, (a) the differential gain, (b) the common-mode gain, (c) the single-ended output voltage V_{o1} (e) the single-ended voltage gain (A_v)	**CO2**	**E**	**4**

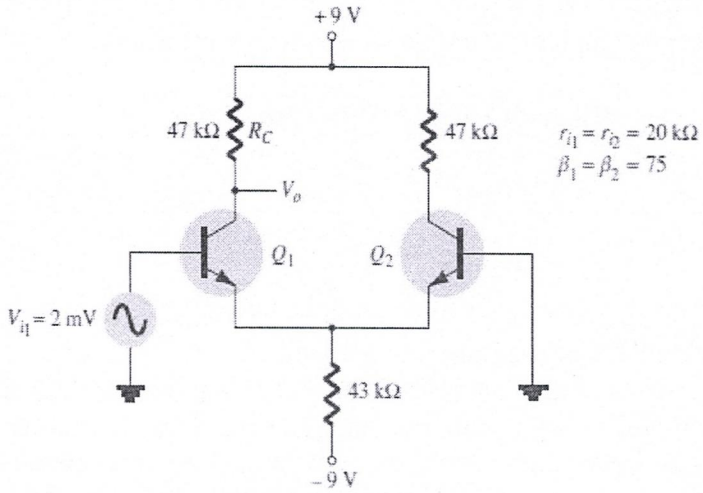

Fig. 2 Differential amplifier

Part B

[Answer the questions from the followings]

3.	a)	i). "A field effect transistor (FET) is a voltage-controlled device"- **Justify** the statement. Why the input impedance of FET is very high in comparison with BJT?	**CO1**	**An**	**6.5**
		ii). What are the parameters of JFET? Draw the small signal model of a common-source FET amplifier, and derive the equation for voltage gain.	**CO1**	**Un, E**	
3.	b)	For the network of **"Fig. 3"**, the levels of V_{DQ} and I_{DQ} are specified. Determine the required values of R_D and R_S. What are the closest standard commercial values?	**CO2**	**E**	**3.5**

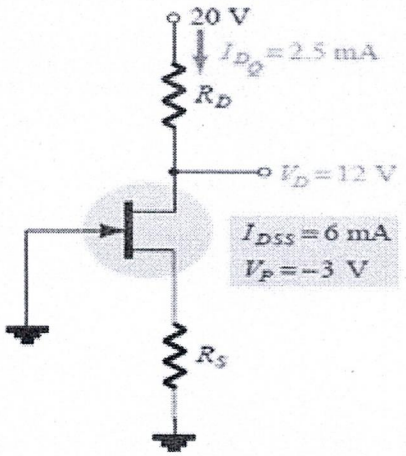

Fig. 3

4.	a)	Why drain current of MOSFET is zero before threshold voltage? With relevant sketches, briefly explain the working mechanisms of depletion-type MOSFET. Also, draw its output characteristics. Examine why Depletion-type MOSFET is commonly known as "Normally-ON" MOSFET?	**CO1**	**An**	**6**
4.	b)	(i) Why MOSFET is advantageous than JFET? What is the basic difference between D-MOSFET and E-MOSFET? (ii) Draw the MOSFET AC equivalent model. Also, sketch the transfer characteristics of an n-channel enhancement-type MOSFET from the drain characteristics.	**CO1**	**An**	**4**
5.	a)	(i) In case of MOSFET, Explain the term "Body effect". Also, write a short note on "VMOS". (ii) Briefly explain the operation of CMOS as an inverter with necessary diagram.	**CO1**	**An**	**5**
5.	b)	The network shown in **"Fig. 4"** is an n-channel D-MOSFET amplifier circuit, resulting in $V_{GSQ} = 0.35$ V and $I_{DQ} = 7.6$ mA. a. Determine g_m and compare to g_{mo}. b. Find r_d. c. Calculate *Zi* and *Av*	**CO2**	**E**	**5**

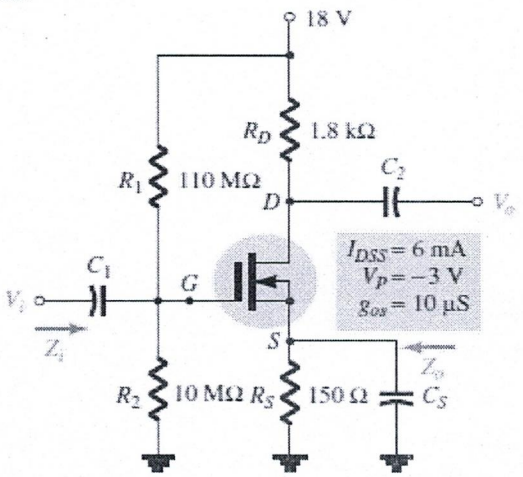

Fig. 4 n-channel D-MOSFET amplifier circuit.

OR

5.	a)	(i) What is UJT? Draw the equivalent circuit of UJT. (ii) Why CMOS is used in logic design? Also, sketch the construction of a CMOS inverter, and explain its working principle.	**CO1**	**U, An**	**6**

5. b) For the n -channel depletion-type MOSFET shown in **Fig. 5**, determine: **CO2** **E** **4**
a. I_{DQ} and V_{GSQ}
b. V_{DS}

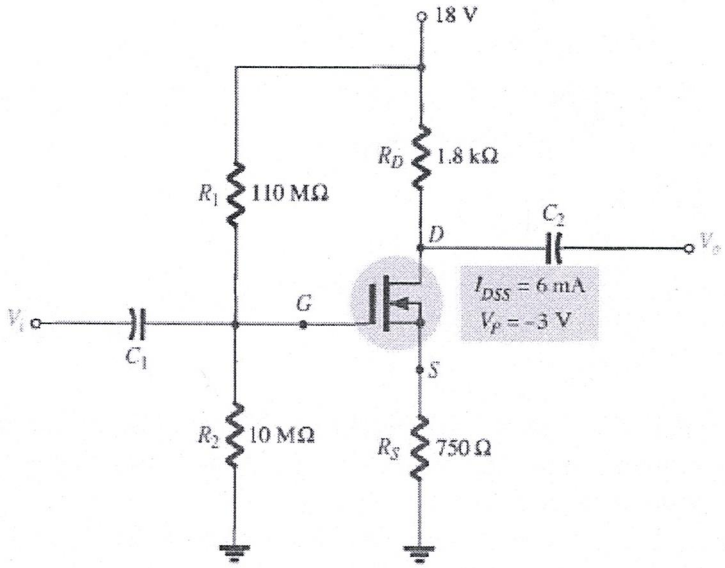

Fig. 5 An n -channel depletion-type MOSFET