SET 1
CONFIDENTIAL

UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION
JANUARY 2016 SEMESTER

COURSE CODE	:	LED10503
COURSE NAME	:	ANALOGUE ELECTRONICS
PROGRAMME NAME	:	DIPLOMA OF ENGINEERING TECHNOLOGY IN ELECTRICAL AND ELECTRONICS (MARINE)
DATE	:	
TIME	:	
DURATION	:	3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please CAREFULLY read the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper consists of TWO (2) sections; Section A and Section B.
4. Answer ALL questions in Section A. For Section B, answer THREE (3) questions.
5. Please write your answers on the OMR answer script and answer booklet provided.
6. Answer all questions in English language ONLY.

THERE ARE 9 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

SECTION A (Total: 25 marks)

INSTRUCTION: Answer ALL questions.
Please use the objective answer sheet provided.

1. Amplification is the process of
   - A. linearly increasing the amplitude of an electrical signal
   - B. linearly decreasing the amplitude of an electrical signal
   - C. linearly increasing the amplitude of none electrical signal
   - D. None of the above

2. A transistor can act as an amplifier directly using the
   - A. internal resistance
   - B. gain
   - C. biasing
   - D. base current

3. A transistor is in cutoff region when the BE junction is
   - A. forward biased
   - B. NOT biased
   - C. NOT forward biased
   - D. NOT forward

4. Which of the statements below is correct?
   - I. A transistor is in saturation when the BE junction is forward biased.
   - II. A transistor is in saturation when there is enough base current to produce a maximum collector current.
   - III. Minimum value of base current needed.
   - IV. $I_{B(min)} = I_{C(sat)} / \beta_{DC}$
   - A. I and IV only
   - B. II and III only
   - C. I and III only
   - D. I, II, III and IV

5. Which of the statements below is correct?
   - I. Transistors must be properly biased to work as amplifiers.
   - II. DC biasing is used to establish a steady level of transistor current and voltage.
   - III. Amplification is an example of linear applications.
   - IV. Amplifiers are the most common linear devices.
   - A. I and IV only
   - B. II and III only
   - C. I and III only
   - D. I, II, III and IV

6. A dc operating point must be set so that signal variations at the input terminal are
   - A. amplified and accurately reproduced at the output terminal
   - B. amplified and accurately reproduced at the input terminal
   - C. NOT amplified and accurately reproduced at the output terminal
   - D. None of the above

7. Q-point (quiescent point) are
   - A. I_B and I_C
   - B. I_C and V_{CE}
   - C. I_C and I_E
   - D. I_C and V_{BE}

8. Which of the statements below is correct?
   - I. Voltage-divider Bias is the most widely used method for biasing a transistor for linear operation.
   - II. Voltage-divider Bias is not the most widely used method for biasing a transistor for linear operation.
   - III. Voltage-divider Bias uses a single voltage source and a voltage divider circuit.
   - IV. Voltage-divider Bias uses a single voltage source and two voltage divider circuits.
   - A. I and IV only
   - B. II and III only
   - C. I and III only
   - D. I, II, III and IV

9. Which of the Collector-feedback bias statements below is correct?
   - I. The base resistor is connected to the collector rather than to V_{CC}.
   - II. Collector voltage provides the bias for the base-emitter junction.
   - III. The negative feedback creates an offsetting effect that tends to keep the Q-point stable.
   - IV. If I_C increases, it drops more voltage across RC, thus causing VC to decrease.
   - A. I and IV only
   - B. II and III only
   - C. I and III only
   - D. I, II, III and IV

10. Emitter bias generally provides good Q-point stability, but requires
    - A. negative supply voltage.
    - B. positive supply voltage.
    - C. both positive and positive supply voltages.
    - D. both positive and negative supply voltages.

11. Which of the Common-Emitter (CE) Amplifier statements below is correct?
   I. Common-emitter amplifiers exhibit high voltage and current gains.
   II. Output is taken from emitter.
   III. Input is applied to emitter of transistor.
   IV. Input is applied to base of transistor.
   A. I and IV only
   B. II and III only
   C. I and III only
   D. I, II, III and IV

12. Which of the Transistor AC equivalent circuit statements below is correct?
   I. Capacitors are replaced with open circuits.
   II. Capacitors are replaced with short circuits.
   III. DC sources are replaced with ground.
   IV. AC and dc grounds are both assumed to be at the different potential.
   A. I and IV only
   B. II and III only
   C. I and III only
   D. I, II, III and IV

13. Voltage gain of the CE amplifier (A_v) is the ratio between
   A. the ac output voltage (Ve) and input voltage (Vb).
   B. the ac output voltage (Vc) and input voltage (Ve).
   C. the ac output voltage (Vc) and input voltage (Vb).
   D. the ac output voltage (Ve) and input voltage (Vc).

14. Which of the Common-Collector (CC) Amplifier statements below is correct?
   I. Also called emitter-follower amplifier (EF).
   II. Input is applied to base through a coupling capacitor.
   III. Output is at the emitter.
   IV. Voltage gain is approximately 1.
   A. I and IV only
   B. II and III only
   C. I and III only
   D. I, II, III and IV

15. Which of the Darlington Pair and input resistance of an amplifier statements below is correct?
   I. β_{ac} is a major factor determining the input resistance of an amplifier.
   II. β_{ac} of a transistor limits the maximum achievable input resistance you can get from an EF circuit.
   III. One way to boost the input resistance is to use a Darlington pair.

IV. In a Darlington pair, the collectors are connected, and the emitter of the first, drives the base of the second.

A. I and IV only
B. II and III only
C. I and III only
D. I, II, III and IV

16. Which of the Common-Base (CB) Amplifier statements below is correct?

I. Provides high voltage gain with a maximum current gain of 1.
II. Not good for high frequency applications.
III. The base is the common terminal and is at ac supply.
IV. Low input resistance.

A. I and IV only
B. II and III only
C. I and III only
D. I, II, III and IV

17. A power amplifier is a large signal amplifier that produces

A. a replica of the output signal on its output.
B. a replica of the input signal on its output.
C. a replica of the input signal on its input.
D. a replica of the output signal on its input.

18. Which of the class A power amplifier statements below is correct?

I. A class A power amplifier is a large signal amplifier that operates in the linear region.
II. A class A power amplifier is a small signal amplifier that operates in the linear region.
III. Ideally, a class A amplifier is designed to operate in the center of the ac load line.
IV. Ideally, a class A amplifier is designed to operate in the center of the dc load line.

A. I and IV only
B. II and III only
C. I and III only
D. I, II, III and IV

19. Which of the Push-pull amplifiers statements below is correct?

I. Push-pull amplifiers use two transistors working together.
II. One transistor conducts on the positive half cycle.
III. One transistor conducts on the negative half cycle.
IV. It is class B operation.

A. I and IV only
B. II and III only
C. I and III only
D. I, II, III and IV

20. A class AB amplifier is designed to operate in the linear region

A. for slightly less than ½ of the input cycle.
B. for exactly ½ of the input cycle.
C. all of the time.
D. for slightly more than ½ of the input cycle.

21. The ideal op-amp has

A. infinite input impedance and zero output impedance.
B. zero input impedance and infinite output impedance.
C. zero input impedance and zero output impedance.
D. infinite input impedance and infinite output impedance.

22. CMRR can be expressed in

A. Ohm
B. No unit
C. Volt
D. Amp

23. The difference in the two dc currents required to bias the differential amplifier in an op-amp is called the

A. differential bias current.
B. input bias current.
C. input offset current.
D. none of the above.

24. The input impedance of a noninverting amplifier is

A. nearly 0 ohms.
B. approximately equal to R_i.
C. approximately equal to R_f.
D. extremely large.

25. Given a noninverting amplifier with a gain of 10 and a gain-bandwidth product of 1.0 MHz, the expected high critical frequency is

A. 100 Hz
B. 1 kHz
C. 10 kHz
D. 100 kHz

SECTION B (Total: 75 marks)

INSTRUCTION: Answer THREE (3) questions ONLY.
Please use the answer booklet provided.

Question 1

Transistors are commonly used in digital circuits as electronic switches which can be either in an "ON" or "OF" state, both for high-power marine control system applications such as switched-mode power supplies and for bw-power applications such as logic gates. Figure 1 shows a switched-mode power control for a LED that requires 30 mA to emit a sufficient level of light. Therefore the collector current should be approximately 30 mA.

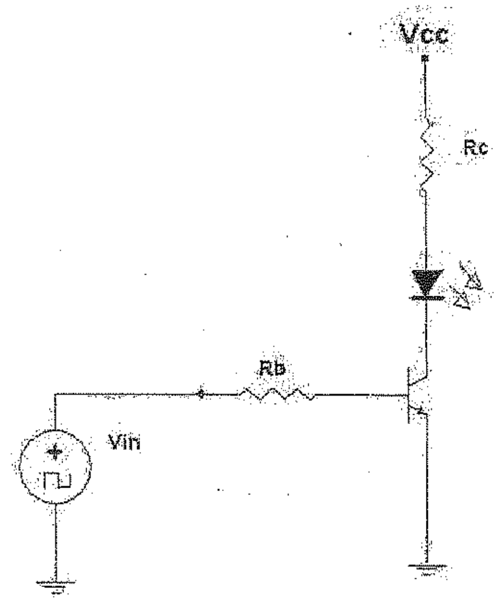

Figure 1

(a) Analyze and explain the operation of the circuit.

(10 marks)

(b) Determine the amplitude of the square wave input voltage necessary to make sure that the transistor saturates. Use double the minimum value of base current as a safety margin to ensure saturation. V_{CC} = 9 V, $V_{CE(sat)}$ = 0.3 V, R_C = 270 Ω, RB =3.3 kΩ, and β_{DC} = 50.

(15 marks)

Question 2

BJTs are used as small-signal amplifiers for marine electronics equipment such as radar, communication module, eco sounder, sonar, digital display and weapon system. Small-signal refers to signals that are relatively small, in intensity, with respect to the amplifier's operational range. Figure 2 shows a Common-Emitter (CE) Amplifier circuit which exhibit high voltage and current gains. Assume a 10 mV, 300 Ω signal source. I_E was already found to be 3.80 mA.

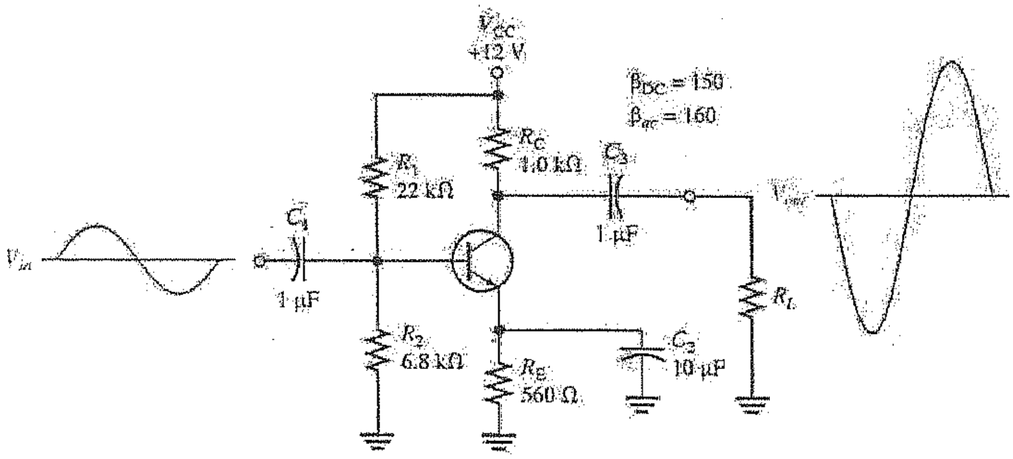

Figure 2

(a) Determine the ac emitter resistance and total input resistance viewed from the source (10 marks)

(b) Evaluate the signal voltage at the base of the transistor in the circuit. (15 marks)

Question 3

(a) Design and explain two circuits of single-ended input modes for an Op-Amp

(5 marks)

(b) An operational amplifier (op-amp) has a well-balanced difference input and a very high gain. This characteristics can be substituted in applications with low-performance requirements such as for marine electronics control system. Referring to the differential amplifier circuit shown in Figure 3, calculate the main output voltage (V_o) if:

i. V1 = 5mV and V2 = 0V.

(5 marks)

ii. V1 = 0V and V2 = 5mV.

(5 marks)

iii. V1 = 50mV and V2 = 25mV.

(5 marks)

iv. V1 = 25mV and V2 = 50mV.

(5 marks)

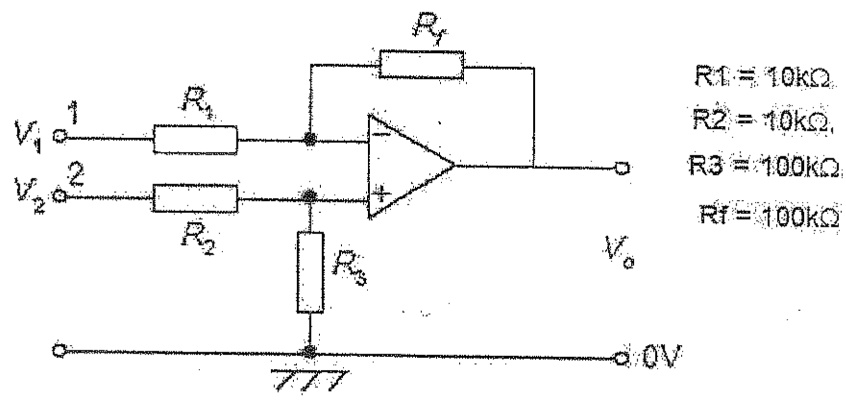

Figure 3

Question 4

A comparator is an electronic component that compares two input voltages. Comparators are closely related to operational amplifiers, but a comparator is designed to operate with positive feedback and with its output saturated at one power rail or the other. An op-amp can be pressed into service as a poorly performing comparator if necessary, but its slew rate will be impaired.

(a) Draw and explain the comparator with hysteresis.

(10 marks)

(b) A comparator with hysteresis is also called a Schmitt trigger. The trigger points are found by applying the voltage-divider rule. Referring to Figure 4, evaluate the trigger points for the circuit if the maximum output is ±13 V.

(15 marks)

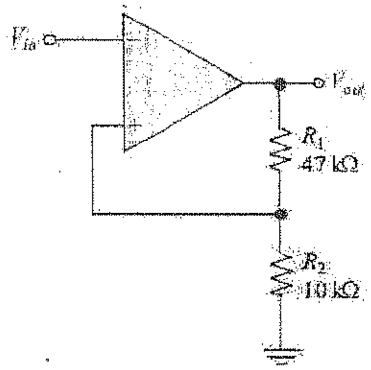

Figure 4

END OF EXAMINATION PAPER