KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2018

MAR 1 1 2018

Level : B. Sc.
Year : II
Time : 2 hrs. 30 mins.

Course : PHYS 201
Semester : I
F. M. : 55

SECTION "B"
[5Q × 4 = 20 marks]

1. What is a zener diode? Explain how a zener diode regulates the dc output voltage.

2. Define the dc alpha and dc beta of a transistor. Derive the equation $\alpha_{dc} = \frac{\beta_{dc}}{1+\beta_{dc}}$.

OR

Derive an accurate formula for the dc emitter current of a voltage-divider biased circuit.

3. Sketch the structure of an n-channel D-MOSFET and explain its working of depletion mode. Draw a typical set of static drain characteristics.

4. Determine the value of R_f necessary for the circuit in Figure B-1 to operate as an oscillator. Also, determine the frequency of oscillation.

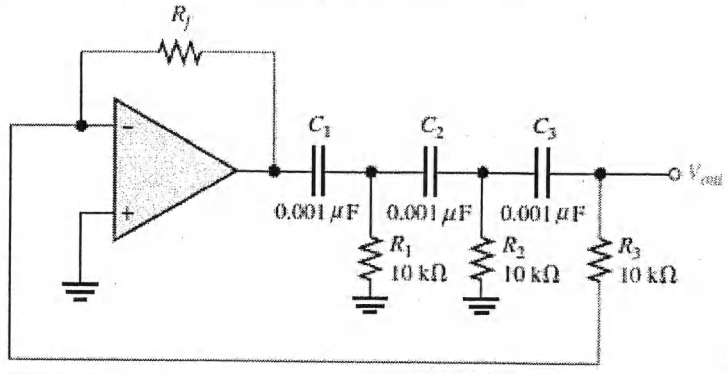

Figure B-1

5. State De Morgan's theorems. Starting with the Boolean expression for a two-input OR gate, apply Boolean laws and theorems to modify it in such a way as to facilitate the implementation of a two-input OR gate by using two-input NAND gates only.

OR

Show the logic circuit for $Y=(\bar{A}+B)(A+B)$. Then, simplify the circuit as much as possible using algebra.

SECTION "C"
[5Q × 7 = 35 marks]

6. Draw a circuit diagram for the CE amplifier as well as its dc and ac equivalent circuits. Derive the expression for the current gain, voltage gain, and power gain. Explain why there is phase inversion between input and output.

OR

Draw a circuit diagram for the RC-Coupled class A amplifier. Show that the maximum possible efficiency for any RC-Coupled class A amplifier is 8.33 percent. Why a transformer-coupled amplifier has better efficiency than an RC-coupled amplifier.

7. A circuit has a Thevenin voltage of 12 V and a Thevenin resistance of 3 kΩ. What is the Norton circuit? Using Superposition Theorem, calculate the current flowing through 60Ω resistor of the circuit shown in Figure C-1.

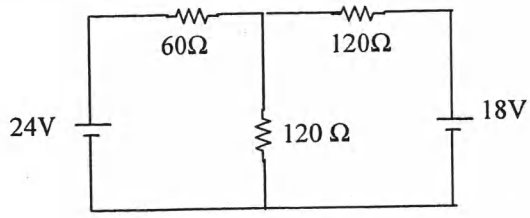

Figure C-1

8. Define closed-loop voltage gain. Using inverting configuration of an op-amp, explain a two- input summing amplifier, an op-amp differentiator.

9. What is the binary equivalent of decimal 363? Add these 8-bit numbers: 0101 0111 and 0011 0101. Show the corresponding hexadecimal and decimal numbers.

10. Consider the circuit in Figure C-2.

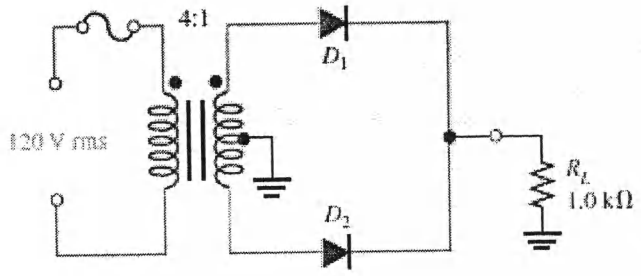

Figure C-2

(a) What type of circuit is this?
(b) What is the total peak secondary voltage?
(c) Find the peak voltage across each half og the secondary?
(d) Sketch the voltage waveform across R_L.
(e) What is the dc diode current?
(f) What is the PIV for each diode?

OR

A crystal diode having internal resistance $r_d = 20\Omega$ is used for half-wave rectification. If the applied voltage $v = 50\sin\omega t$ and load resistance $R_L = 800\Omega$,

Find (i) I_m, I_{dc}, I_{rms}.

(ii) a.c power input and d.c. power output.
(iii) d.c. output voltage .
(iv) efficiency of rectification.

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SECTION "A"
[20 Q. × 1 = 20 marks]

Choose and tick the most appropriate answer. Symbols have their usual meanings unless stated.

1. The current I in any branch of a network due to a single voltage source E anywhere else in the network will be equal to the current through the branch in which the source was originally located if the source is placed in the branch in which the current I was originally measured. This is the statement of
   [a] superposition theorem. [b] Norton's theorem.
   [c] Reciprocity theorem. [d] Maximum power transfer theorem.

2. For abstracting maximum power from any two given terminals of a circuit, the load resistance across the terminals should be
   [a] four times the internal resistance of the network.
   [b] equal to the circuit resistance when viewed back from the two terminals.
   [c] less than the circuit resistance.
   [d] greater than the circuit resistance.

3. In a p-type semiconductor, the majority current carriers are
   [a] free electrons. [b] valence electrons.
   [c] protons. [d] holes.

4. Using ideal Zener diode approximation, the current through the diode of Figure A-1 will be equal to

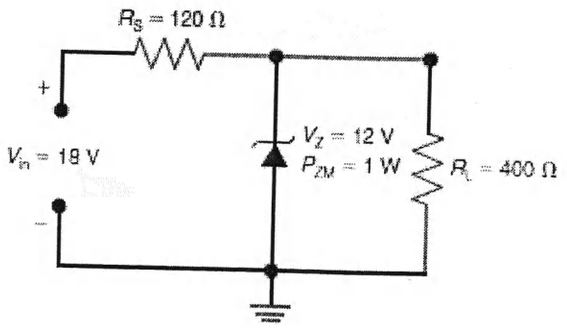

Figure A-1

   [a] 20 mA [b] 30 mA [c] 50 mA [d] 80 mA

5. A varactor diode exhibits
   [a] a variable capacitance that depends on reverse voltage.
   [b] a variable resistance that depends on reverse voltage.
   [c] a variable capacitance that depends on forward current.
   [d] a constant capacitance over a range of reverse voltages.

6. The output from an unfiltered half-wave or full-wave rectifier is a
[a] smooth dc voltage. [b] steady dc voltage.
[c] pulsating dc voltage. [d] horizontal dc voltage.

7. A transistor has $\alpha_{dc} = 0.995$. Its β_{dc} must be equal to
[a] 199. [b] 0.499.
[c] 499. [d] This is impossible to determine.

8. The silicon transistor in the base bias circuit shown in FigureA-2 has a β of 100. The equation of the load line is

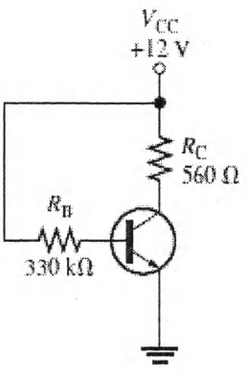

Figure A-2

[a] $I_C = -\frac{1}{100}V_{CE} + \frac{12}{100}$ [b] $I_C = \frac{1}{560}V_{CE} + \frac{12}{560}$
[c] $I_C = -\frac{1}{560}V_{CE} + \frac{12}{560}$ [d] $I_C = -\frac{1}{330}V_{CE} + \frac{12}{330}$

9. The transistor for class C amplifier conducts for
[a] more than 180^0 of the input cycle.
[b] one-half of the input cycle.
[c] a very small percentage of the input cycle.
[d] all of the input cycle.

10. An n-channel JEFT has a pinch-off voltage –4.5 V and $I_{DSS} = 9$ mA. At what value of V_{GS} in the pinch-off region will I_D equal to 3 mA?
[a] 3V [b] 2.6 V [c] –1.9 V [d] –2.9 V

11. A certain op-amp has an open-loop voltage gain of 100,000 and a common-mode gain of 0.2. The CMMR is
[a] 500,000 dB [b] 114 dB
[c] 6 dB [d] 262 dB

12. The Wien-bridge oscillator's positive feedback circuit is
[a] an LR circuit. [b] an LC circuit.
[c] a voltage divider. [d] a lead-lag circuit.

13. The Hartley oscillator uses
[a] negative feedback. [b] two inductors.
[c] a tungsten lamp. [d] a tickler coil.

14. The binary equivalent of octal 553 is
[a]101 011 101. [b]101 101 011. [c] 011 110 011. [d] 011 101 101.

15. Which of the following truth table is TRUE for a circuit shown in Figure A-3?

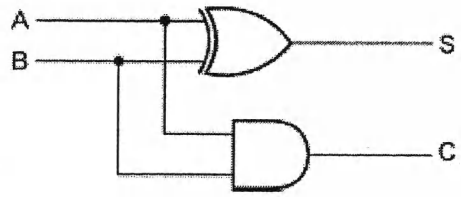

Figure A-3

[a]

A	B	C	S
0	0	0	0
0	1	1	1
1	0	1	1
1	1	0	0

[b]

A	B	C	S
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

[c]

A	B	C	S
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

[d]

A	B	C	S
0	0	0	0
0	1	1	1
1	0	1	1
1	1	0	0

Fill in the blanks.

16. In all-important universal rule for biasing transistor for normal operation: The emitter-base junction must be ....., and the collector-base junction must be .....

17. The schematic symbol for n-channel JFET is .....

18. In an integrator, the feedback element is a .....

19. In a certain oscillator, amplifier gain, $A_v = 50$. The attenuation, B, of the feedback circuit must be .....

20. The 2's complement representation of 1101 0110 is .....