2015

# PHYSICS

( Major )

Paper : 5.4

**( Electronics )**

*Full Marks* : 60

*Time* : 3 hours

*The figures in the margin indicate full marks for the questions*

**1.** Answer the following questions very briefly : 1×7=7

*(a)* How does the peak inverse voltage (PIV) for a half-wave rectifier change when a capacitor filter is used?

*(b)* Which diode is also called the negative resistance semiconductor diode? Why is it so called?

*(c)* Give the statement of Millman's theorem with its importance.

(d) For a power amplifier using radio-frequency signal, what type of coupling is preferred?

(e) Mention the type of feedback required to obtain undamped oscillations with reasons.

(f) Explain the principle that modern radio receivers employ.

(g) In what respects does the output voltage of a real OP-AMP differ from that of an ideal OP-AMP?

**2.** Answer the following questions : 2×4=8

(a) What is the need of stabilization of *Q*-point of a transistor amplifier?

(b) What changes are to be made to make a positive clamping circuit to a negative clamping circuit?

(c) Draw the circuit diagram of an astable (free running) multivibrator.

(d) A 741 is an OP-AMP with $A = 30000$ and $CMRR_{dB} = 9$ dB. What is the common-mode voltage gain?

**3.** A transistor having $\alpha = 0{\cdot}98$ has a reverse saturation current $I_{CO} = 10\ \mu A$ and is operated in CB configuration. If the base current is 3 mA, calculate the following : 5

*(a)* $\beta$ for transistor

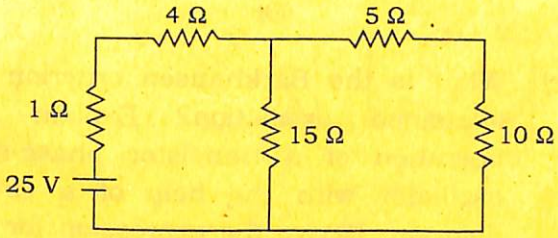
*(b)* Collector current $I_C$

*(c)* Emitter current $I_E$

*Or*

Draw the circuit diagram of a full-wave rectifier feeding an inductor filter and a load resistance. Calculate the ripple factor for such a circuit. 5

**4.** Using Norton's theorem, find the current through resistance 10 Ω of the following circuit. Draw the equivalent circuit : 5




**5.** Draw the circuit diagram of a two-stage *RC*-coupled amplifier and calculate the voltage gain in the mid-frequency range. What is meant by frequency-response curve? 5

6. Answer *either (a)* and *(b)* *or (c)* and *(d)* of the following questions : 5+5=10

(a) What is a regulated power supply? Draw the circuit diagram of a series voltage regulator and explain its principle of operation.

(b) A CE amplifier has a load resistance of 3 kΩ and an emitter load resistance $R_E = 100\ \Omega$. The *h*-parameters are

$$h_{ie} = 4000\ \Omega,\ h_{re} = 7 \times 10^{-4},\ h_{fe} = 135$$

and $h_{oe} = 25\ \mu A/V$

Determine the current gain, the input resistance, the output resistance and the voltage gain.

*Or*

(c) What is the Barkhausen criterion for sustained oscillation? Explain the operation of a transistor phase-shift oscillator with the help of a circuit diagram. Derive the expression for the frequency of oscillation.

(d) Show that negative feedback improves the stability of the gain and reduces the frequency distortion of an amplifier.

**7.** Answer *either (a)* and *(b)* *or (c)* and *(d)* of the following questions : 5+5=10

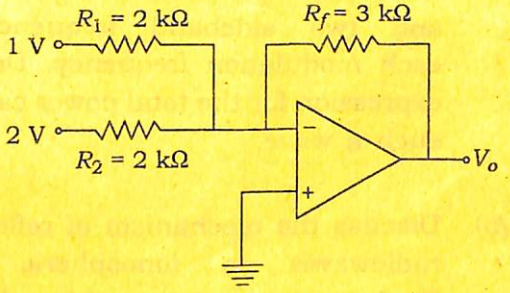
*(a)* *(i)* Convert binary 101·1101 to its decimal equivalent.

*(ii)* Convert decimal 1256·25 to its binary equivalent.

*(iii)* Add 1101+101+10+1.

*(iv)* Subtract 11000·11−101·111 using 2's complement method.

*(b)* Calculate the output of an OP-AMP ($V_o$) of the following circuit :




What is the output when $R_1$ is replaced by a 1 kΩ resistor?

*Or*

*(c)* State De Morgan's theorems. Explain how you can realise NAND and NOR gates using diodes and transistors.

*(d)* Show the working of a master-slave *J-K* flip-flop with the help of a circuit diagram. State how the race-around condition can be avoided by using this flip-flop. How can you convert *J-K* flip-flop to *D* flip-flop?

**8.** Answer *either (a)* and *(b) or (c)* and *(d)* of the following questions : 5+5=10

*(a)* Show that an amplitude-modulated wave can be represented by a carrier and two sideband frequencies for each modulation frequency. Derive an expression for the total power carried by such a wave.

*(b)* Discuss the mechanism of reflection of radiowaves in ionospheric layers. Explain the terms 'skip distance', 'maximum usable frequency (MUF)' and 'fading' in sky wave communications.

*Or*

*(c)* What is SSB transmission? Why is it preferred? Describe with a block diagram a method for generating single-sideband.

*(d)* Draw the block diagram of a general purpose CRO and indicate its basic components. How can the phase difference between two a.c. voltages be measured by a CRO using Lissajous' figure?

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