B.Tech/ECE/3rd Sem/ECEN 2101/2015

2015

ANALOG ELECTRONICS CIRCUIT

(ECEN 2101)

Time Alloted : 3 Hours *Full Marks : 70*

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

Candidates are required to give answer in their own words as far as practicable

GROUP - A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for the following : **[10×1=10]**

   i) The input/output impedence of a transconductance amplifier, with negative feedback,

   (a) increases/decreases (b) increases/increases

   (c) decreases/ increases (d) decreases/decreases

   ii) The voltage gain of differential-input-balanced-output amplifier is m times that of differential-input-unbalanced-output amplifier. Here m is

   (a) 2 (b) 0.5

   (c) 1 (d) undefined

   iii) In which type of amplifier's operation is cross-over distortion observed?

   (a) Class A (b) Class B

   (c) Class C (d) Class AB

   iv) The oscillating frequency of Colpitts oscillator can be found as

   (a) $f = \frac{1}{2\pi}\sqrt{\frac{1}{LC_1}\left(1+\frac{C_1}{C_2}\right)}^{\frac{1}{2}}$

   (b) $f = \frac{1}{2\pi}\sqrt{\frac{1}{LC_1}}(1+C_1C_2)^{\frac{1}{2}}$

   (c) $f = \frac{1}{2\pi}\sqrt{\frac{1}{LC_1}}(1+C_1+C_2)^{\frac{1}{2}}$

   (d) $f = \frac{1}{2\pi}\sqrt{\frac{1}{LC_1C_2}\left(1+\frac{C_1}{C_2}\right)}^{\frac{1}{2}}$

   v) With respect to the feedback topologies a common emitter and common collector amplifier fall under the category of

   (a) Voltage-Series/Current-Series

   (b) Current-Series/Voltage-Series

   (c) Current-Shunt/Voltage-Series

   (d) Current-Series/Voltage-Shunt

   vi) Placing a bypass capacitor, in common-emitter configuration, is necessary to

   (a) prevent the fall of mid-band voltage gain

   (b) achieve a stable Q point

   (c) prevent thermal runway

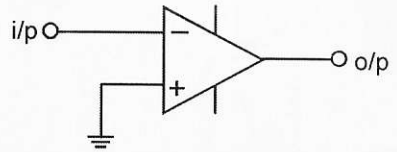
   (d) none of these

vii) A circuit that removes positive or negative parts of waveform is called

(a) clamper (b) clipper

(c) diode clamp (d) limiter

viii) If the input to the circuit of figure is a sine wave the output will be



(a) A half wave rectified sine wave

(b) A full wave rectified sine wave

(c) A triangular wave

(d) A square wave

ix) An ideal op-amp is an ideal

(a) voltage controlled current source

(b) voltage controlled voltage source

(c) current controlled current source

(d) current controlled voltage source

x) In a bipolar junction transistor the base region is made very thin so that

(a) recombination in base region is minimum

(b) electric field gradient in base is high

(c) base can be easily fabricated

(d) base can be easily biased

GROUP - B

2. (a) Draw the circuit of a transistor in CE configuration.

(b) What is a load line? Explain the concept of Q-point.

(c) For CE configuration prove that $I_C = \beta I_B + (1+\beta)I_{CO}$.

(d) In a collector to base bias circuit indicated in Fig.1., a transistor with $\beta = 50$ is used. Supply voltage $V_{CC} = 10V$, $V_{BE} = 0.7V$, collector resistor $R_C = 2k\Omega$. The bias is obtained by connecting $100k\Omega$ resistor from collector ro base. Find the Q-point and stability factor.

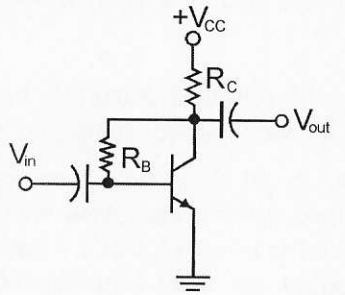


Fig.1

2+3+2+5 = 12

3. (a) The emitter resistance is inevitable to make a common emitter circuit stable. How this resistance affects the mid-band voltage gain? How can we handle this consequence?

(b) Find the input and output impedence for the common-emitter circuit, shown in Fig.2, operated at mid frequency, with

V_{CC} = +12V, R_1 = 2 KΩ, R_2 = 4 KΩ, R_S = 50 Ω, $R_C = R_L$ = 10 KΩ, R_E = 10 KΩ, and h_{ie} = 1 KΩ, h_{fe} = 150.

Assume $\frac{1}{h_{oe}} \rightarrow \infty$,

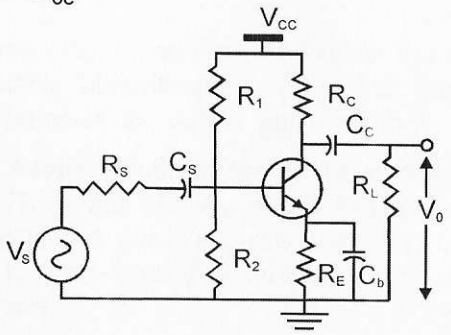


Fig.2

6+6 = 12

GROUP - C

4. (a) State Barkhausen criterion and explain the conditions that must be satisfied for a feedback amplifier to produce steady oscillations.

   (b) Sketch the circuit of a phase-shift oscillator and explain its operation. Find an expression for the frequency of oscillations and the condition for sustained oscillation.

5+7 = 12

5. (a) List the merits and demerits of negative feedback.

   (b) The open-loop gain Ao = 99990, of a high-gain amplifier, varies by 20%. Design a feedback path with feedback factor K such that the closed-loop gain varies only by 0.02%.

(c) Derive an expression of output impedence for voltage-series type feedback amplifier.

(d) Draw the hybrid π model of BJT. **2+3+4+3 = 12**

Group - D

6. (a) Discuss the advantages of differential amplifiers. Find the expression of differential voltage gain for a differential input balanced output type amplifier.

   (b) Write the properties of instrumentation amplifier. Draw the circuit of an instrumentation amplifier.

   (c) Draw a precision rectifier circuit with response curve.

4+5+3 = 12

7. (a) Describe the different building blocks of Op-Amp. Mention the properties of an ideal op amp.

   (b) The circuit shown in the Fig.3, R_1 = 100Ω, R_2 = 56 kΩ, v_{in} = 1V pp sine wave, and the op-amp is type 741 with supply voltages = ±15V. Determine the upper and lower threshold voltages and draw the output waveform.

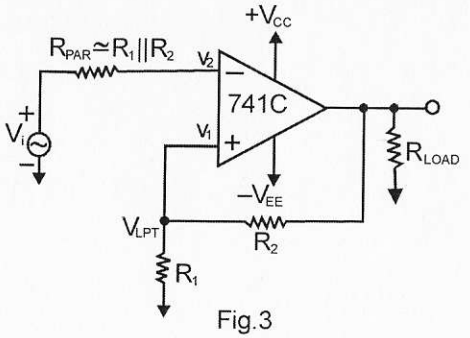


Fig.3

(3+3)+6 = 12

GROUP - E

8. (a) Derive the efficiency of transformer coupled class A power amplifier.

   (b) Explain the operation of a push pull amplifier circuit.

   (c) Write a short note on cross over distortion. How can it be overcomed? **5+4+3 = 12**

9. (a) Draw the circuit diagram and explain the operation of a Monostable Multivibrator using a 555 timer IC. Derive the expression for output pulse width.

   (b) In the Astable Multivibrator of the circuit shown in the Fig.4, R_1 = 2.2 kΩ, R_2 = 3.9 kΩ, and C = 0.1 μF. Determine the positive pulse width T1, negative pulse width T_2, free-running frequency f_0 and percentage of duty cycle.

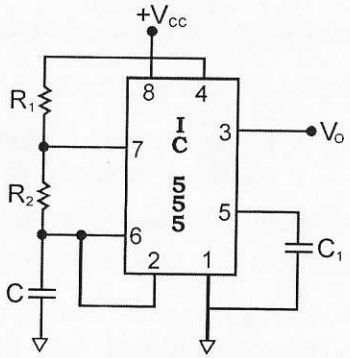


Fig.4

6+6 = 12