## **Question Paper**

Exam Date & Time: 24-Apr-2018 (09:30 AM - 12:30 PM)



## MANIPAL ACADEMY OF HIGHER EDUCATION

## INTERNATIONAL CENTRE FOR APPLIED SCIENCES IV SEMESTER B.S. (ENGG.) END - SEMESTER THEORY EXAMINATIONS APRIL - 2018 DATE: 24 APRIL 2018 TIME: 9:30 AM TO 12:30 PM IC Systems [EC 243A]

Marks: 100

Duration: 180 mins.

## Answer 5 out of 8 questions.

<sup>1)</sup> Draw the circuit of an emitter coupled differential amplifier. <sup>(10)</sup>

<sup>A)</sup> Derive an expression for CMRR. Explain how CMRR can be improved by using current mirror circuit. Find the difference between  $V_2 \& V_1$  assuming identical transistors with large  $\beta$  value for the circuit shown in

Fig. Q1A.





- <sup>B)</sup> Draw the internal block diagram of OP-AMP and explain <sup>(6)</sup> each block.
- <sup>C)</sup> Draw the circuit diagram to measure the input resistance  $^{(4)}$  of an OP-AMP and derive the expression for R<sub>i</sub>.
- Analyze and determine the expression of the output voltage <sup>(10)</sup>
   for the circuit shown in Fig. Q2A(i) & Q2A(ii). State the function of each circuit.



<sup>B)</sup> Draw an inverting amplifier circuit using OP-AMP. Derive (10) the expression for the output voltage assuming ideal conditions. Design the circuit to obtain voltage gain of 10. Draw the output waveform for the input signal (i)  $V_j=0.5$ sin(3140*t*) (ii)  $V_i=3$  sin(3140t) Use supply voltage ±12V.

Assume gain of OP-AMP is 10.

- <sup>3)</sup> Draw the schematic diagram of feedback amplifier and <sup>(10)</sup> derive the expression for Af. What are the advantages of negative feedback? What are the functions of feedback network in the oscillators?
  - <sup>B)</sup> Draw the circuit diagrams of V to I converter with Floating <sup>(10)</sup> and Grounded load using OP-AMP. Derive the expressions for load current.
- <sup>4)</sup> Draw the circuit diagram of second order Butterworth (10) active Low pass filter and derive the expression for AV(s).
  - <sup>B)</sup> Draw the circuit diagram of precision full wave rectifier. <sup>(10)</sup> Explain its working principle with neat waveform and necessary expressions.
- <sup>5)</sup> Draw the circuit diagram of OP-AMP based triangular wave <sup>(10)</sup> generator. Explain its working principle with neat waveform and necessary expressions.
  - <sup>B)</sup> Draw the circuit of an 8-bit successive approximation type <sup>(10)</sup> ADC. Explain the conversion process with an example. List the names of other ADCs.
- <sup>6)</sup> Draw the circuit diagram of Astable Multivibrator for <sup>(10)</sup>
   <sup>A)</sup> variable duty cycle using IC 555 and explain its operation with neat waveform and expression. Modify this circuit to obtain 50% duty cycle output waveform and give the

necessary equations.

| B) | Draw the functional diagram of<br>its operation. Derive the expres<br>oscillation, voltage to frequency  | VCO (IC 566) and explain<br>sions for frequency of<br>conversion factor.   | (10)  |
|----|--|--|---|
| A) | Design a second order Butterworth high pass filter with a cutoff frequency of 1 kHz and pass band gain of 10.<br>Assume R=15.9k $\Omega$ .   |  | (5)   |
| В) | Mention any two important features of a good $(5)$ instrumentation amplifier. Draw the circuit diagram of instrumentation amplifier and derive the expression for V <sub>O</sub> . |  | (5)   |
| C) | Draw the circuit diagram of OP-AMP based series voltage (1<br>regulator and adjustable regulator. Explain its operation<br>and derive the output voltage<br>expression. (5+5)      |  | (10)  |
|    | Explain the following with circui<br>expressions: (5+5+5+<br>A. Log amplifier<br>trigger<br>B. Sample and Hold circuit   | t diagram, waveforms and<br>5)<br>C. Inverting Schmitt<br>D. Analog Divider  | (20)  |
|    | B)<br>A)<br>B)<br>C)   | <ul> <li><sup>B)</sup> Draw the functional diagram of its operation. Derive the express oscillation, voltage to frequency Design a second order Butterwork (Cutoff frequency of 1 kHz and pressume R=15.9kΩ).</li> <li><sup>B)</sup> Mention any two important feat instrumentation amplifier. Draw instrumentation amplifier and derive the circuit diagram of OP-regulator and adjustable regulator and derive the output voltage expression.</li> <li>Explain the following with circuit expressions: (5+5+5+6)</li> <li>A. Log amplifier trigger</li> <li>B. Sample and Hold circuit</li> </ul> | <ul> <li>B) Draw the functional diagram of VCO (IC 566) and explain its operation. Derive the expressions for frequency of oscillation, voltage to frequency conversion factor. Design a second order Butterworth high pass filter with a cutoff frequency of 1 kHz and pass band gain of 10. Assume R=15.9kΩ.</li> <li>B) Mention any two important features of a good instrumentation amplifier. Draw the circuit diagram of instrumentation amplifier and derive the expression for V<sub>O</sub>.</li> <li>C) Draw the circuit diagram of OP-AMP based series voltage regulator and adjustable regulator. Explain its operation and derive the output voltage expression. (5+5)</li> <li>Explain the following with circuit diagram, waveforms and expressions: (5+5+5+5)</li> <li>A. Log amplifier C. Inverting Schmitt trigger</li> <li>B. Sample and Hold circuit D. Analog Divider</li> </ul> |

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