Indian Institute of Technology Bombay
IDP in Educational Technology
Instructor Resources

Resource – *Peer Instruction Activity constructor*	Version 1.0, Feb 2014
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Constructing Peer-Instruction questions of various types for different purposes
Peer-Instruction questions can have a variety of goals, and can be formed using different pedagogical strategies. Questions below contain different possible goals and instructor can have. The questions also contain brief 'how-tos' for writing Peer-Instruction questions for each goal.

Part 1 – Plan your PI activity

1. Choose a subject and topic that you will be taking in the next/current semester.

Subject: Signal Conditioning and circuit design
Topic: Operational Amplifier

Part 2 – Type of PI Instruction

For each goal given below, write a Peer-Instruction question in your chosen topic. Each question must contain the question 'stem' along with 3-5 choices.

A. Goal: Conceptual reasoning "one right answer" questions.
How to write the PI question: Write conceptual questions which can be answered using verbal arguments, logical reasoning, proportional relationships, and so on. Avoid questions that need numerical calculations.
Examples (note that these are merely ideas – you have to write the full question and choices):
Describe a scenario such as a process or a phenomenon. Ask what would happen to the objects in the scenario or the variables in the process if a certain stimulus were applied.

- Does it increase / decrease / stay same?
- Move left / right?
- Compare A & B –which is greater /less same?

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Time stamp: 0.25
A circuit whose output is proportional to the difference
between the input signals is considered to be which type of
amplifier?

      1. operational

      2. common-mode

      3. differential

      4. darlington
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B. Goal: Discussion "no one right answer" questions

How to write the PI question: Write questions which genuinely admit multiple possible answers, say while making design choices, modeling systems.

Examples (note that these are merely ideas – you have to write the full question and choices):

- If you could choose only one X, which would it be?
- What do you think is the reason for Y?
- If you had to make a decision for Z, what would it be?

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 Time stamp: 0.30
Which of the following could be the valid CMRR value of
Practical Op-amp
   1. 1000
   2. 10000
   3. 2000
   4. Infinity
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C. Goal: Predict an outcome (e.g., of an experiment, or a program)

How to write the PI question: Describe the experiment. You can partially show it (not the result) using a demo, video, simulation. Ask students to predict what would happen if something were changed. Choices should indicate specific possible outcomes.

Examples: If P were changed, what would happen to Q? (You can ask along following parameters) *(note that these are merely ideas – you have to write the full question and choices):*

i) …becomes bigger/ smaller

ii) … changes brightness – increase / decrease / stay same

iii) … changes shape to A / B / C
iv) … moves along path A/ B/ C …
After voting, during discussion phase, ask students to give reasons along with their choices. These are excellent questions to elicit students' wrong reasoning patterns.

Time stamp: 6.54

If the gain of a closed-loop inverting amplifier is 3.9, with an input resistor value of 1.6 kilohms, what value of feedback resistor is necessary?

1. 410 ohms
2. 6240 ohms
3. 2.4 kilohms
4. 0.62 kilohms

D. Goal: Embed reasoning in answers

How to write the PI question: The question describes a phenomenon or a situation. Choices include not just what happens but also possible reasons including plausible but wrong reasons. Different choices can correspond to multiple reasons for the same outcome.

Examples (note that these are merely ideas – you have to write the full question and choices):

· …slower since gravity is acting against it;
· … slower since there is friction

Time stamp:16.04

What will be the output voltage of an Op-amp inverting adder for the input voltages V1 = -10V, V2 = +10V, V3 = +5V and resistances R1 = 600K Ω, R2 = 3000K Ω & R3 = 2M Ω if the feedback resistance is considered to be 2M Ω?

a. -38.3V
b. 38.3V

c. 40V
d. -40V

ANSWER: -38.3V

Given data:
V1 = -10V, R1 = 600k
V2 = 10V, R2 = 300K
V3 = 5V, R3 = Rf = 2M

The output voltage of an inverting adder or summer circuit is evaluated by,

$V_o = -(K_1V_1 + K_2V_2 + K_3V_3)$

where, 'K' represents the constant gain factor.
$K_1 = R_f / R_1 = 2M/ 600K = 2000K/ 600K = 3.33$
$K_2 = Rf / R2 = 2M/300K = 2000K/ 300K = 6.66$
$K_3 = R_f / R_3 = 2M/ 2M = 1$

Therefore, $V_o = -(K_1V_1 + K_2V_2 + K_3V_3)$
$= -[3.33 \times (-10) + 6.66 \times (10) + 1 \times 5]$
$= -[-33.3 + 66.6+ 5]$
$= -38.3$ V

Hence, the final output value of voltage of an inverting amplifier is nothing but summation of all input voltages estimated to be in terms of negative voltage of about -38.3 V.

E. Goal: Reason using representations

How to write the PI question: Give one representation of a scenario or a process. Ask students which of the choices best describes it in a different representation. The question as well as the choices could contain different representations such as diagrams, graphs, equations, words.

Examples (note that these are merely ideas – you have to write the full question and choices):

- Which graph best represents the equation ….?
- For the given configuration, what is the pattern of variable X?
- What is happening to variable Y at this point in the graph?

Time stamp: 14.05

Q.How many Op-amp ment this equation? $V_o = -\left(\frac{R_f}{R_1}V_1 + \frac{R_f}{R_2}V_2 + \frac{R_f}{R_3}V_3\right)$

1. 2
2. 3
3. 4
4. 1

F. Goal: As a stepping stone to problem-solving

How to write the PI question: The goal of this PI question is to help students through the steps of a complex problem without solving it for them yourself. Break up the analytical problem into steps. Convert one or more step into a PI question. This step can involve choice of principles needed to solve the problem, drawing graphs / diagrams needed to solve the problem, setting up of the mathematical equations, etc.

Triangular wave Generator using Op-amp

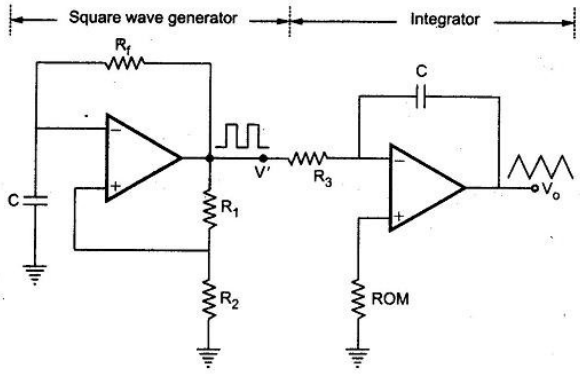

Fig. 2.85 Triangular wave generator

a Triangular Wave Generator Using Op amp can be formed by simply connecting an integrator to the square wave generator

Question:

The ramp voltage at the output of an op-amp integrator

1. increases or decreases exponentially

2. increases or decreases at a linear rate

3. is always increasing and never decreasing

4. is constant

G. Goal: Recall point from previous lecture

How to write the question. These are easier questions than some of the above. The goal is to recap ideas from the previous lecture which are needed in today's class. Give as opening activity of a class. Can replace traditional "Summary of last class" slide. Helpful in getting students to settle down. In the question, ask students to identify definition or give straightforward application of concepts.

The Op-amp can amplify

1.a.c. signals only

2.d.c. signals only

3.both a.c. and d.c. signals

4.neither d.c. nor a.c. signals

Answer : 3

H. Goal: Survey questions / personal opinion

How to write such PI questions: Use such questions as -

a) a means to get group information about the class (*Examples:* how many know programming to level X, level Y …)

b) feedback for instructor on own teaching practice (*Examples:* pace too fast/ slow, exam difficult/ easy, last lecture understood / not)

c) get an opinion of what students think about an open-ended issue (*Examples:* energy, climate change, policy …)

How much you have understood about the topic
1. less than 10%
2 50%
3 Less than 50 %
4. more than 80%

End of Resource: *Peer Instruction constructor*