

**Indian Institute of Science Education and Research Kolkata, Mohanpur 741246, WB**  
**Principles of Physical Chemistry (CH5104)**  
**Mid-semester Examination**

**Full marks – 20**

**Time – 60 minutes**

**17 September 2018**

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Important notes:

- Answer ALL the questions in the question paper.
  - Read the questions carefully and write all parts of one question together.
  - Use your own calculator (if needed).
  - Do not adapt unfair means as the offender will be penalized.
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- (1) In cyclic voltammogram (CV), state (a) when the relation: peak current  $\propto$  (scan rate)<sup>0.5</sup> is valid and (b) in that condition what is the voltage separation between anodic and cathodic peaks. (1+1)
- (2) If an electrode step  $O + e \leftrightarrow R$  is followed by a fast chemical step  $R \rightarrow S$  which is again followed by another electrode step  $T + e \leftrightarrow S$ , show and explain the CV plot. (2)
- (3) How one can calculate electrochemically active surface area (ECSA) for H-adsorption on (i) Pt, assuming full monolayer of adsorbed H, and (ii) carbon by a general method? (1+2)
- (4) What is the difference between resistance and impedance? (1)
- (5) With the help of Lissajous figure, show the phase difference between voltage and current signals in an electrolysis cell. (1)
- (6) Draw a typical Nyquist plot and label important features. (1)
- (7) How many types of spectral broadening mechanisms are there? Name them and give examples. (2+2)
- (8) Provide the principle of action of Cavity Ring-down Laser Absorption Spectroscopy (CRDLAS). (3)
- (9) Describe the action of a four-level laser scheme with diagram. (2+1)

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