Indian Statistical Institute

Semester Examination : 2013 – 2014

Master of Technology in Computer Science, Semester III

Functional Brain Signal Processing: EEG & fMRI

Date: 30 November 2013 Maximum Marks: 100 Duration: 3 hours

Attempt all the questions. Credit will be given for precise and brief answers.

1. Describe T_1, T_2 and T_2^* weighted magnetic resonance imaging. Underlying MR physics will have to be described (illustration with diagrams might be helpful). Reason in favor of the relation $T_2^* \leq T_2 << T_1$. 7 + 7 + 3 + 3 = 20

2. Describe precise spatial localization in MR imaging in terms of *slice localization*, *frequency encoding* and *phase encoding* (diagrams might be helpful). 8 + 6 + 6 = 20

3. Describe any four fMRI artifacts. Give a brief outline about how to remove each of them. Feel free to propose your own ideas. Mathematical equations, formulations are not essential. 4 x 5 = 20

4. Describe general linear model (GLM) for processing of fMRI signals for a single subject (a two-regressor model will be good enough). Mathematical equations and their solutions in general form are required. Feel free to put forward geometric justifications wherever appropriate, perhaps with illustrative diagrams. 20

5. (a) Write a short (but content rich) note on multi-voxel pattern analysis (MVPA). 10

   (b) Mention two most predominating artifacts on EEG signals typical in an environment of simultaneous EEG-fMRI recording (none appears during EEG acquisition far outside of an fMRI scanner), with a brief explanation for each of them. Propose one scheme for removing each of the artifacts. 2 + 2 + 3 + 3 = 10