1 question 1

The equation of the fundamental matrix is $x_r^T F x_l = 0$. Now consider an epipolar line $l^{'} = Fx_l$. The right epipolar line e_r lies on this line, so $e_r^T l^{'} = 0$ or $e_r^T F x_l = 0$ for all x_l.
This implies that $e_r^T F = 0$. in similar way we can show that $Fe_l = 0$. Hence F has a null space which is not just the zero vector (we found that e_l is in the null space of F), means that F is not full rank

2 Part 2 question 1

Assume we have a pixel P = (x,y) in one image, and we want to find the matching pixel P' = (x', y) in the other image. Let's call the first image the source image (e.g. L) and the latter one the target image (e.g. R). When window size is too small we may miss the matching pixel. Why? If we would have looked only in a single pixel resolution (a window of size one), we would have obviously found many candidate matching pixels. In order to screen those false pixels (in the target image), and to be able to distinguish the true matching pixel P' from the false ones, we need to to look at the neighbours around both P and P'. In other words, two pixels match each other if they have similar neighbors. Now, if we look at too few neighbours, namely, a small window, that might not be enough to find the matching pixel P'. We could find several windows in the target image, which are similar to the window in the source image. Thus misidentified P'. Now, why not using a large window? If we take a too large window, we may not be capturing the minimal region which distinguishes one pixel from another. In other words, the effect of the pixel and its unique surrounding neighbors on the similarity metric may not be significant enough. We may thus receive several windows on the target image where each perhaps include the matching pixel and its surrounding but with more or less the same similarity, thus misidentifying P'. About the disparity range - if the maximum disparity range is too small, we could obviously miss the matching pixel P' (when shift between two images is larger than disparity range). If, on the other hand, disparity range is too high, we may have several matching candidates, thus misidentifying P'. Secondly, contrary to our first observation, using a high value of disparity range could be beneficial since we may identify matching pixels that have been largely shifted. This is typical to foreground objects which are sensitive to the camera moves. In fact we have seen that the color intensity is darker when disparity range is higher. This is reasonable, since it means that we could find matching pixels which are far from each other. In this case maximum of the disparity map increases, and consequently intensity decreases (recall, intensity is computed by dividing the distances by the maximum distance).

3 Part 2 question 2

The generated disparity maps are hardly resemble to the gt disparity maps. Objects of the image are hardly can be discerned. This is reasonable since SSD is not robust to scaling or to additive and multiplicative . Given two windows, SSD computes the sum of Euclidean distances between the two windows intensities. Scaling or multiplying by a small amount noise the intensities of one of the images therefore, changes the Euclidean distances, thus the SSD measure. Contrary to SSD, NCC is invariant to scaling and multiplicative noise. Since NCC is equal to the dot product of two window vectors normalized by the multiplication of their sizes. Scaling one of the vectors by a fixed factor doesn't change the normalized dot product. More over even scaling each dimension a little bit differently doesn't change radically the normalized dot product.