P1) Prove the Gutman-Godsil theorem: If $\chi_s(x) = \det(xI - A_s)$ where $A_s$ is the signed adjacency matrix of $G$, then

$$E_{s \in \{\pm 1\}^E}[\chi_s(x)] = \sum_{\text{matching } M} (-1)^{|M|} x^{n-2|M|}.$$  

P2) Prove that if $f$ and $g$ have a common interlacing, then $h_t(x) = tf(x) + (1-t)g(x)$ is real-rooted (even in the case where $f, g$ have some multiple roots).
P1) Compute the eigenvalues of the following graph. Is it Ramanujan?

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P2) Compute the matching polynomials for $K_2, K_3, K_4$ and find the recursive formula for $K_n$. These are also known as Hermite polynomials.

P3) Compute the matching polynomials for $K_{1,1}, K_{2,2}, K_{3,3}$ and find the recursive formula for $K_{n,n}$. These are also known as Laguerre polynomials.