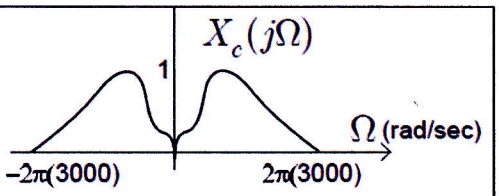
**Q [3]:** Final-291

The frequency spectrum $X_c(j\Omega)$ of a continuous-time audio signal $x_c(t)$ is shown. It is sampled at a sampling frequency of $f_s = 9000$ samples/sec.

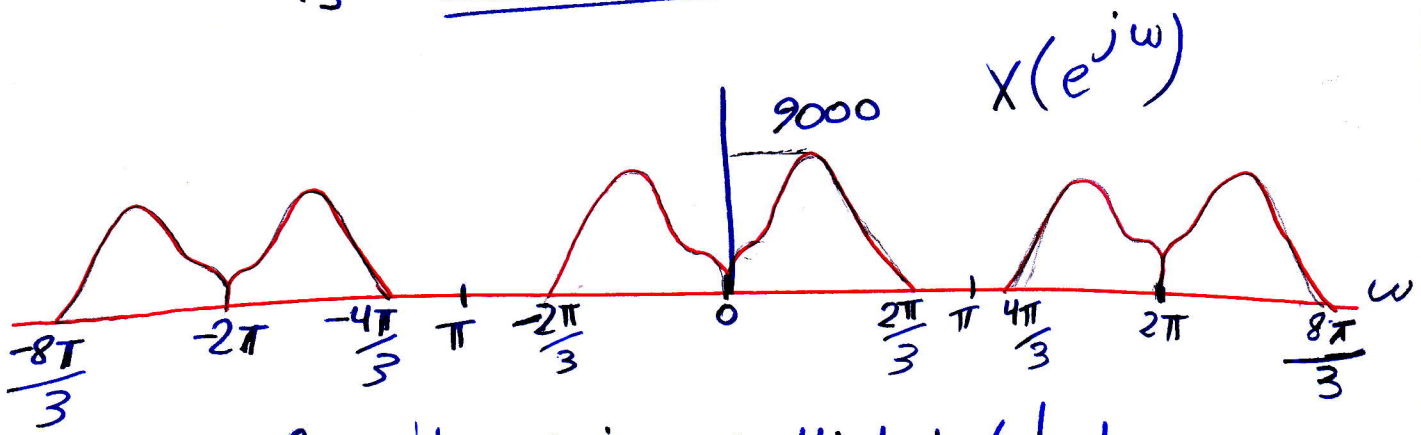



a) Sketch the spectrum $X(e^{j\omega})$ of the sampled signal for $-3\pi < \omega < 3\pi$

b) To recover the original signal: **(i)** what type of filter should be used **(ii)** what is its cutoff frequency?

c) What is the minimum sampling rate $f_s$ (in samples/sec) so that no aliasing occurs?

(a) $T = \frac{1}{f_s} = \left(\frac{1}{9000}\right) s$




* for the gain → multiply by $\left(\frac{1}{T}\right)$

* $\omega = \Omega(T)$ rad/s.

(b) LPF, $\Omega_m < \Omega_c < (\Omega_T - \Omega_m)$

→ $2\pi(3000) < \Omega_c < 2\pi(6000)$

(c) $\Omega_s = 2\Omega_m = 2\pi(6000)$

→ $\Omega_s = 2\pi f_s$

→ $f_s = \frac{\Omega_s}{2\pi} = \frac{2\pi(6000)}{2\pi} = 6000\ Hz$