DIGITAL SIGNAL PROCESSING (EC 31008) Total marks: 30.

State and Prove the modulation / windowing Thm. (i.e. [5]

If $x[n] \xleftrightarrow{F} X[e^{jw}]$
$w[n] \xleftrightarrow{F} W[e^{jw}]$, then $y[n] = x[n]\,w[n] \xleftrightarrow{F} ?$

a) State & prove the Thm. for Calculate Inverse z-Transform ? [3]

b) Find using the above Thm. the inverse z-transform of $Y(z)$, [4]
where, $Y(z)$ Satisfies the relation, $z\left[\ln Y(z)\right] = K$,
K = constant & $\ln e = 1$ (natural logarithm).

Consider the periodic fn. $f(x) = x$ over $x \in [-\pi, \pi]$. [2+2+1+3]

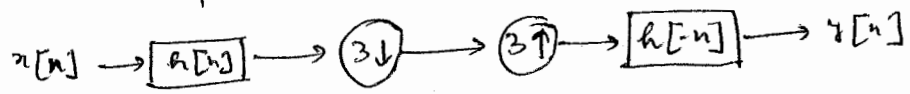
a) Calculate the Fourier Series expansion of $f(x)$.

b) Use Parseval's identity & find out $\sum_{n=1}^{\infty} \frac{1}{n^2}$

c) Can you comment whether $\sum_{n=1}^{\infty} \frac{1}{n^4}$ is divergent / convergent & why?

d) Let, $f_N(x)$ be the truncated version of the Fourier Series expansion upto N- coefficients. Calculate the critical pts. where, $|f(x) - f_N(x)|$ is maximum ? Derive the max^m. error in approximation as $N \to \infty$. [HINT:- the max^n. error points are located at the end-points].

Consider the following system:- [5]



where, $x[n]$, $h[n]$ are real sequences.

a) Find the relation (DTFT) of $Y(e^{jw})$ to $X(e^{jw})$. [Derivation req^d.]

b) What are the conditions that $y[n] = x[n]$.

For a Generalized Least Squares based design of FIR filter, if instead [5]
the error is weighted by a matrix 'W'. Using the same philosophy i.e. the weighted error (ie. $\underline{\underline{W}}\underline{e}$) is minimized, then derive the Normal Eqns. for generalized least squares soln.