EN642/302 Power Generation and Systems Planning

Assignment # 1

1. For equal annual payments for 10 years, calculate present worth factor, capital recovery factor, compound amount factor and sinking fund factor. Annual discount rate is 5%. What will be these values if payments are made in alternate years?

2. (a)Calculate total present value of 3 payments of Rs. 1000, Rs. 1500 and Rs. 3000 after two years, after 5 years and after 6 years from today, respectively. The discount rate is 6% per year.
   (b) Calculate the annual levelized cost equivalent value for the payments in part (a) for a period of 6 years. can be obtained by multiplying total present value by CRF or just assuming 5 equal payments after each year; calculating their present value and equating to the present value in part (a)).
   (c) The above two parts explain levelizing of unequal payments at different intervals. Use this idea to derive formula for levelized factor where payments increase every year by a factor of$(1 + a)$ due to inflation rate of a. The payments are made at end of each year.

3. (a) Calculate the discount rate for a combination of 50% bonds (interest of 7%/ year), 20% preferred stock (interest rate 8%/ year) and 30 %common stock (rate of return 11%/ year). (It is just weighted average of the three).
   Assuming a plant life of 30 years and discount rate in part (a), calculate,
   (b) Annual levelized depreciation rate DB(equal payments for 30 years adding to 1).
   (c) Calculate annual levelized(income + interest) [for j th year payment is $1 - \sum_{i=1}^{j-1} DB$. This is because interest and income is on the current value which is calculated after reducing depreciation. Annual levelized rate becomes $(1 - DB/discount\ rate + SFF/discount\ rate)$. It can be obtained by the idea given in part (b) of previous problem.]
   (d) Calculate annual levelized income tax rate if income tax rate is 30% . [IT = tax rate* (Net Income +IT) and Net Income is calculated only with return for preferred stock and common stock , not on bonds)
   (e) Ad valorem tax and insurance at the constant rate of 3% per year.
   (f) Calculate fixed charge rate. (It is sum of all four costs)

4. For the following information,
   Heat Rate:9300Btu/kWh
   Fuel Cost:$2/MBtu
   Plant cost $1500/kW
   O&M fixed cost:$ 20/kW/year
   O&M variable cost:$5/MWh
   Present Worth rate (Discount rate) : Use from previous problem

Fixed Charge Rate: Use from previous problem
Plant Life: 30 years
Plant Size : 400 MW
Inflation rate (Escalation Rate) : 3%
Capacity Factor = 70%

(a) Calculate levelized annual cost of the plant. Also, calculate levelized cost of electricity. (Note that for fuel and O & M costs ,levelized factor of the inflation series has to be used)

(b) Repeat part (a) for a plant with plant cost 500$/kW to and fuel cost $5/MBtu. All remaining numbers are same.

5. (a) Draw annual levelized cost per Kw of the plant as function of capacity factor for the two plants in the previous problem on the same plot.
   (b) Using screening curve analysis (approximately) find out how a load of 5000MW is distributed among two plants if load curve is as follows: