Plan for 8.821, String Theory

as of 11.29.07. with relevant reading material.

1. overview. (Joe 1.1, 3.1, try GSW ch 1, Uranga's overview lectures)

2. classical bosonic strings (mostly GSW 2.1, Joe 1.2)

3. why and how do we impose virasoro constraints? (some of GSW 2.2)
   solve them using lightcone gauge quantization.
   find the spectrum of the open string. (Joe 1.3-4, GSW 2.3)
   use zeta-function regularization to find the critical dimension at which the light cone quantization gives a lorentz-invariant spectrum

4. closed-string spectrum in LCG
   high-energy density of states (GSW p. 117 et seq., Joe vI p. 320-321.)
   there is more to life than 26-d flat space: torus compactification (the non-CFT parts of Joe 8.1-8.3, Uranga's lecture 3)
   the spectrum of the bosonic string on a circle
   enhanced gauge symmetry at $R = \sqrt{\alpha'}$
   T-duality

5. how do the spacetime EoM arise from 2d perspective and why?
   strings in background fields (effect of dilaton, strings are charged under $B_{\mu\nu}$, beta functions) [GSW 3.1, 3.4, Joe ch 3.2, 3.3, 3.7]

6. gauge fixing of polyakov path integral (to discover another example of a 2d CFT) [Joe §3.3, GSW §3.1]
   systematic discussion of euclidean 2d CFT, part 1 [Peskin's lectures linked on webpage (§2, 3.1, 4.3), Joe Ch. 2]

7. CFT, part 2
   Ginsparg CFT notes §1,2,3,6. Try §4. Joe, Chapter 2, again. GSW, Chapter 3 (note that the CFT is hidden in §3.2, entitled 'BRST Quantization').

8. In what sense is $c \neq 26$ a conformal anomaly? [Joe §3.4, Peskin TASI lectures p. 19 et seq.]
   the bc ghost system as a CFT. [Joe 2.5, 2.7]

9. BRST quantization [Joe 4.2-4, GSW 3.2, Peskin §4-5]
   Ghost zeromodes and the measure for moduli [Peskin §4-5, Joe ch 5],

10. where to put the ghosts [JP §5.3]
    closed-string tree level amplitudes [JP §6.1,2,3,6]

11. one loop amplitudes, modular invariance [Peskin §8.1,2, JP ch 7, Uranga lecture 5]

12. open strings, D-branes, worldvolume gauge theory [JP ch 6.2,4,5, 8.6-8.7, JP, 'TASI lectures on D-branes,' hep-th/9611050 §1,2.]

13. factorization of the annulus, D-brane tension. [JP 7.4, 8.7, hep-th/9611050 §2.]

14. superstring worldsheet technology [JP ch 10, Peskin §3.2, 7.1, Uranga lecture 7, GSW ch 4.]

15. superstring spectrum [Lust and Theisen ch 7, 8.]

16. spin structures and GSO [JP ch 10.5-7, Lust and Theisen ch 9.]; heterosis [JP ch 11.]

17. bosonization, Ramond vertex operators. [JP 10.2,3]

18. the superconformal ghosts save the day, superstring scattering. [JP 10.4, 12.3-5]

19. D-branes of the superstring. [JP chapter 13, 14.4; hep-th/9611050 §3,4, see also 5.]

20. orientifolds and type I. [JP v. I pp. 189-192, 226-229, §8.8, v. II pp. 29-31, §10.8, §13.2; Uranga, chapter 10.]

21. tadpole cancellation and anomalies. [JP §10.8, Uranga chapter 10, JP §12.1,2.]

22. Calabi-Yau compactification. [GSW chapter 15.]

23. supersymmetric sigma models and the de rham complex [Witten, NP**B202**(1982) 253, §10] heterotic on CY, unification. [GSW chapter 14, 16, 15.6]

24. the conifold and topology change.

25. AdS/CFT

26. flux vacua, throats, the potential for moduli

---

27. orbifolds

28. GLSM

29. black hole microstates.

30. noncritical strings.