Astrophysics of Interacting Binary Stars

Questions for the exam

Exam

The exam will consist of two large questions requiring a detailed answer, a few questions requiring a few sentence answers, plus two problems similar to the home exercises. No help from the books, lecture notes, or any other material is allowed during the exam. A standard non-programmable calculator could be used.
Some questions from the list below can be combined, separated, or rephrased.

Questions:

1. Types of binary stars (a general classification). Using binaries to weigh stars and to determine other system parameters. Why the mass function is a useful quantity?
2. Roche lobe and Roche-Lobe overflow. How does mass transfer occur? Interacting binary stars.
3. Formation of an accretion disk. A distance of the closest approach of the stream, r_{min}. The circularization radius, r_{circ}.
4. Energetics of accretion.
5. Observational evidence for accretion disks.
6. Accretion disk properties (order-of-magnitude estimates): mass flow rates, temperatures, disk masses, the azimuthal and radial velocities.
7. The angular momentum problem. Viscous accretion disks.
8. Accretion disk temperature structure and accretion disk spectrum.
9. Surface density evolution in accretion disks.
10. Vertical structure and thickness of thin accretion disks.
11. Viscosity in an accretion disk. Problem with normal molecular viscosity. Shakura-Sunyaev α-disk prescription. Source of anomalous viscosity? The magneto-rotational instability.
12. General properties of the thin, steady-state α-accretion disk.
13. Accretion disk typical timescales.
14. Structure of the standard α-disk.
15. Accretion disks: tidal limitations, boundary layer, bright spot, stream-disk overflow.
16. Accretion disks in close binary systems.
17. Classification of Cataclysmic Variables.
18. Cataclysmic Variables: distribution of orbital periods.
19. Observational evidence for accretion disks in Cataclysmic Variables.
20. Light curves of eclipsing Cataclysmic Variables.
21. Eclipse Mapping: the basic principle. Important results.
22. Emission lines from accretion disks. Double-peaked profiles and their modeling.
23. Trailed spectra. Principle of Doppler Tomography. Important and unexpected results.
24. Single peaked emission lines. The wind from an accretion disk.
25. Dwarf Nova outbursts.

26. Thermal limit cycle instability.
27. Superoutbursts and Superhumps.
28. Nova-like Variables.
29. Consequences of mass transfer.
30. The Evolution of Cataclysmic Variables.
31. The Physics of CV Secondaries (donor stars).
32. Magnetically-Controlled Accretion. The magnetospheric radius and the corotation radius. Polars and Intermediate Polars.
33. X-ray Binaries. The Eddington Luminosity and Eddington Limit for mass-transfer rate.
34. Bondi-Hoyle wind accretion.
35. What is common and what is different in Algol binaries, Symbiotic binaries, CVs, AM CVn stars, LMXBs, HMXBs, γ-ray binaries, AMXPs.