This exam has two parts: **I. Multiple Choice 1**: 60 questions worth 1 point each, answer all, for a total of 60 points (60% of the exam); and **II. Multiple Choice 2**: 20 questions worth 2 point each, answer all, for a total of 40 points (40% of the exam). **The exam will be available on Canvas on Tuesday, Dec. 6, 2022 for 3 hours between 6pm-9pm while you are required to finish it within 1 hour and 50 minutes.** You can only have one attempt and will be able to see their scores immediately after the exam.

LECTURE 1: Course introduction

1. What are the elements of the official definition of severe weather?
2. Scales of atmosphere motion: the dimensions (horizontal lengths & time lengths) of synoptic scale, meso α- and meso β- scale motions

LECTURE 2: Properties of atmosphere (CH1)

3. Tropopause height as a function of latitudes.
4. Water phase changes & latent heating. **Part II Question!**
5. What are the clouds composed of?
6. Moisture variables: definitions of vapor pressure, saturation vapor pressure, relative humidity, and dew points
7. Calculating relative humidity using the figure on slide #20, which will be given in the test. **Part II Question!**

LECTURE 3: Meteorological measurements (No questions)

LECTURE 4: Radar and satellite (CH2)

8. Satellite orbits: geostationary vs. polar orbits
9. Interpreting visible, IR, and water vapor satellite images. Table 2.2 on slide #45.

LECTURE 5: Weather maps (CH3)

10. The altitude of 850, 500, and 300 mb pressure levels.

LECTURE 6: Atmospheric Stability and Stability Indies (CH6)

11. What is lapse rate, dry/moist adiabatic lapse rate? What is adiabatic process?
12. Stability criteria: Slides #9-13, especially slide #13.

LECTURE 7: Forces and balanced motions (CH7)

13. Forces in Geostrophic balance & Hydrostatic balance.

LECTURE 8: Pressure system development (CH8)

14. What is Dines' compensation?
15. Understand the curvature effect: slide # 10 (need to understand slides #7-9 too). **Part II Question!**
16. The four quadrant jetstreak model and associated wind & pressure gradient force pattern: slides #11-13. **Part I & II Questions!**

LECTURE 9: Air masses and fronts (CH9)

17. What is the definition of air mass, dry line, warm front cold front, stationary front, and upper-level front.

LECTURE 10: Lee cyclones (CH10)

18. How does a lee cyclone form?

LECTURE 11: East Coast & Gulf Coast Cyclones (CH11)

19. What is cold air damming? In which regions does this occur?
20. What is the cold/warm air boundary prior to the formation of an East Coast cyclone?
21. Deepening of Gulf Coast cyclone with an East Coast storm track: explain contributing factors.

LECTURE 12: Freezing precipitation and ice storms (CH12)

22. Aircraft icing: how does it happen?

LECTURE 13: Lake effect snowstorms (CH13)

23. Physical basis of lake effect snow: vertical cross section in slide #6. **Part II questions.**
24. Topography effect on enhancing lake-effect snow (slide #14)

LECTURE 14: Cold waves (CH14)

25. Weather pattern associated cold waves: center pressure, location of cold ridge, the role of East Coast cyclones in the development of cold waves): slides #4-11

LECTURE 15: Blizzards (CH15)

26. Two types of cyclones that can cause blizzard (slide 7-10, &14-16)
27. Weather pattern for blizzards associated with a Colorado Cyclone (slides #8-10) **Part II questions!**

LECTURE 16: Mountain snowstorms (CH16)

28. The order of mountain ranges from the west coast over which air passes as it moves eastward.
29. What is upslope storm?

LECTURE 17: Mountain windstorms (CH17)

30. How does a shooting flow occur?
31. Factors that determine the temperature of air in downslope windstorms.

LECTURE 18-21: Air-mass thunderstorms, Seabreeze thunderstorms &MCS, frontal squall lines, and supercells (CH18)

32. Under what conditions does airmass thunderstorm form? Under what conditions does severe thunderstorm form?
33. Cloud droplets, warm rain, snow, graupel and hailstones are formed by which microphysical process, respectively
34. Conditions to prevent widespread afternoon seabreeze thunderstorms in south FL.
35. Definition of MCS.
36. Why the elevated mixed layer is important for supercell development?
37. Key ingredients to form supercells.

LECTURE 22-25: Tornadoes (CH19)

38. Horizontal plan view of a tornadic supercell thunderstorm: where would a tornado develop within a supercell?
39. Tornadoes' life time, size & the percentage of all tornadoes that occur in the US.
40. Definitions of gustnado, dust devil, landspout, waterspout, & cold air funnel.
41. How to locate a tornado using radar fields: debris ball, hook echo, and mesocyclone signature.

LECTURE 26: Hailstorms (CH20)

42. Hail embryo formation & How graupel grows to hailstone. Slide #8-13, especially the two figures on slides #10 & 11.
43. Two modes of hail growth: dry & wet growth regimes.

44. Usage of dual-polarization radar in hail detection. slide 24-27.

LECTURE 27: Lightning (CH21)

45. Which state has the highest flash density? How about lightning-related fatalities?
46. Earth's fair weather electric field.
47. What is the distribution of charge in a thunderstorm and on the ground prior to a lightning stroke? What are the two mechanisms causing this distribution? Explain these two mechanisms. Slides 14-16 (**many Part I & II questions!**).
48. Stages of a lightning stroke (A through D): slides #17-21

LECTURE 28: Downbursts (CH22)

49. Difference between downbursts and typical downdrafts in showers and thunderstorms?
50. Structure of downbursts: curl, vortex ring, stagnation cone, runaway vortex roll.
51. Two mechanisms for downburst formation. Slide 5-6.
52. Explain four environmental conditions associated with microburst development. slide 7 (**Part II questions**).
53. What will happen when an airplane encounters downbursts: slides: #16-17.

LECTURE 29: Floods (CH25)

54. What is the meaning of "100-yr flood"? Slide #8
55. The definitions of flash flood, widespread flood, and coastal flood. slides #12-16
56. What is a common feature of many weather systems responsible for floods in North America: slide #17.
57. Typical weather patterns for flooding in North America: slide #17.
58. Weather pattern for flooding associated with frontal squall lines: slide #23.
59. Weather pattern for flooding from frontal overrunning: slide #26.
60. Weather pattern for west coast flooding; definition of Pineapple Express: slide #33-36.