

EIT Review - Spring 2008

Sample Questions

Scott Strong

March 4, 2008

Notes

- Morning Session

- 120 Questions
- Four Hours Maximum
- Mathematics/Statistics Comprise 24%
- Average Two Minutes Per-Question

- Afternoon Session

- 60 Questions
- Four Hours Maximum
- Mathematics/Statistics Comprise 19%
- Average Four Minutes Per-Question

Outline

- Questions 1-40 Multiple Choice \approx Two-Minute
- Questions 41-47 Not Multiple Choice \approx Four-Minute

In reviewing for the mathematics portion of the exam I found that there were quite a few problems that were straightforward and simple. However, there were problems that were:

- More intensive
- Difficult

I recommend that you make two passes through the material. The first pass should be used to knock off the straightforward or easy problems and mark problems, which will require more intensive calculations. These problems can then be dealt with in the second pass. If there is any time then the difficult problems can be addressed.

1. Find one root to the following equation

$$y^4 + y^2 - 12 = 0.$$

(a) 3

(b) i

(c) $-2i$

(d) 3^2

2. Express $\frac{4}{x^2(x^2 - 4x + 4)}$ as the sum of fractions.

(a) $\frac{1}{x} - \frac{1}{x-2} + \frac{1}{(x-2)^2}$

(b) $\frac{1}{x} + \frac{1}{x^2} - \frac{1}{x-2} + \frac{1}{(x-2)^2}$

(c) $\frac{1}{x^2} + \frac{1}{(x-2)^2}$

(d) $\frac{1}{x} + \frac{1}{x^2} + \frac{1}{x-2} + \frac{1}{(x-2)^2}$

3. If $\log_5 x = -1.8$, find x .

(a) 0.00483

(b) 0.0169

(c) 0.0552

(d) 0.0783

4. $(1 - 2i)^{-1}$ can be written as:

(a) $\frac{1}{5} - \frac{2}{5}i$

(b) $\frac{1}{5} + \frac{2}{5}i$

(c) $-\frac{1}{3} - \frac{2}{3}i$

(d) $-\frac{1}{3} + \frac{2}{3}i$

5. Calculate $(1 + i)^4$.

(a) 4

(b) $-4i$

(c) -4

(d) $4i$

6. Determine the adjoint of $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$.

(a) $\begin{bmatrix} 1 & \frac{1}{2} \\ \frac{1}{3} & \frac{1}{4} \end{bmatrix}$

(b) $\begin{bmatrix} -1 & 3 \\ 2 & -4 \end{bmatrix}$

(c) $\begin{bmatrix} -4 & 3 \\ 2 & -1 \end{bmatrix}$

(d) $\begin{bmatrix} 4 & -2 \\ -3 & 1 \end{bmatrix}$

7. The first few terms of the series expansion of $\sin(2x)$.

(a) $1 - \frac{x^2}{2} + \frac{x^4}{24} + \dots$

(b) $1 - 2x^2 + \frac{2x^4}{3} + \dots$

(c) $2x - \frac{4x^3}{3} + \frac{4x^5}{15} + \dots$

(d) $2x - 4x^3 + \frac{x^5}{5} + \dots$

The first few terms of the series expansion of $\sin(2x)$.

(a) $1 - \frac{x^2}{2} + \frac{x^4}{24} + \dots$

(b) $1 - 2x^2 + \frac{2x^4}{3} + \dots$

(c) $2x - \frac{4x^3}{3} + \frac{2x^5}{5} + \dots$

(d) $2x - 4x^3 + \frac{x^5}{5} + \dots$

8. Calculate $\int x \sin(x) dx$.

(a) $x \sin(x) + \cos(x) + C$

(b) $x \sin(x) - \cos(x) + C$

(c) $\sin(x) + x \cos(x) + C$

(d) $\sin(x) - x \cos(x) + C$

9. The solution to the following differential equation $y'' - 2y' + 1y = e^{2t}$ is

(a) $C_1e^t + C_2te^t + te^{2t}$

(b) $C_1e^t + C_2te^t + e^{2t}$

(c) $C_1e^t + C_2e^{-t} + e^{2t}$

(d) $C_1e^t + e^{2t}$

10. Find the scalar projection of \mathbf{y} in the direction of \mathbf{x} if $\mathbf{y} = 14\hat{i} - 7\hat{j}$ and $\mathbf{x} = 6\hat{i} + 3\hat{j} - 2\hat{k}$.

(a) $12\hat{i} - 3\hat{j}$

(b) 9

(c) 0

(d) 15

11. Find the inverse of $\begin{bmatrix} 1 & 2 \\ 1 & 3 \end{bmatrix}$.

(a) $\begin{bmatrix} -1 & 2 \\ 1 & -3 \end{bmatrix}$

(b) $\begin{bmatrix} -1 & 1 \\ 2 & -3 \end{bmatrix}$

(c) $\begin{bmatrix} 3 & 1 \\ 2 & 1 \end{bmatrix}$

(d) $\begin{bmatrix} 3 & -2 \\ -1 & 1 \end{bmatrix}$

12. Find an eigenvector of $\begin{bmatrix} 0 & 2 \\ 2 & 0 \end{bmatrix}$.

(a) $\begin{bmatrix} \sqrt{2} \\ 1 \end{bmatrix}$

(b) $\begin{bmatrix} -1 \\ \sqrt{2} \end{bmatrix}$

(c) $\begin{bmatrix} -1 \\ 1 \end{bmatrix}$

(d) $\begin{bmatrix} 2 \\ .5 \end{bmatrix}$

13. Find an eigenvalue of $\begin{bmatrix} 4 & -13 \\ 1 & 0 \end{bmatrix}$.

(a) $\lambda = 4 + 6i$

(b) $\lambda = 2 + 3i$

(c) $\lambda = 4 - 6i$

(d) $\lambda = 3i$

14. Calculate $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} \begin{bmatrix} 5 & 6 \\ 7 & 8 \end{bmatrix}$.

(a) $\begin{bmatrix} 19 & 43 \\ 22 & 50 \end{bmatrix}$

(b) $\begin{bmatrix} 19 & 22 \\ 43 & 50 \end{bmatrix}$

(c) $\begin{bmatrix} 19 \\ 43 \end{bmatrix}$

(d) $\begin{bmatrix} 22 \\ 50 \end{bmatrix}$

15. Given

$$x - y + z = 2 \quad (1)$$

$$x - z = 0 \quad (2)$$

$$x + y = -3 \quad (3)$$

Solve for y .

(a) $\frac{2}{3}$

(b) 8

(c) $-\frac{4}{3}$

(d) $-\frac{8}{3}$

16. Using the alphabet how many possible four letter 'words' can be made?

(a) 112358

(b) 14950

(c) 358800

(d) 456976

17. Using the alphabet how many possible four letter 'words' can be made assuming letters cannot be reused?

(a) 112358

(b) 14950

(c) 358800

(d) 456976

18. Given 120 cyclists, how many different ways can three of them be given certificates of participation?

(a) 1728000

(b) 1685040

(c) 280840

(d) 8214570

19. Given 120 cyclists, how many different ways can the first, second and third place be arranged?

(a) 1728000

(b) 1685040

(c) 280840

(d) 8214570

20. Express $\cos^2(x) - \sin^2(x)$ as a function of $\cos(2x)$.

(a) 1

(b) $2 \cos(2x)$

(c) $\cos(2)$

(d) $\cos(2x)$

21. Estimate the area of the parallelogram with sides defined by $\mathbf{y} = 2\hat{i} - \hat{j} + \hat{k}$ and $\mathbf{x} = \hat{i} + \hat{j}$.

(a) $\sqrt{3}$

(b) $\sqrt{11}$

(c) $\sqrt{7}$

(d) $\sqrt{5}$

22. The divergence of $\mathbf{u} = x\hat{i} + y^2\hat{j} + z^3\hat{k}$ at $(1, 1, 1)$ is

(a) $\hat{i} + \hat{j} + \hat{k}$

(b) 0

(c) $\hat{i} + 2\hat{j} + 3\hat{k}$

(d) 6

23. The curl of $\mathbf{u} = x\hat{i} + y^2\hat{j} + z^3\hat{k}$ at $(1, 1, 1)$ is

(a) $\hat{i} + \hat{j} + \hat{k}$

(b) $\mathbf{0}$

(c) $\hat{i} + 2\hat{j} + 3\hat{k}$

(d) 6

24. Given the following frequency data associated with course grades

<i>frequency</i>	2	5	1	3	4	1
<i>score</i>	53	65	70	73	80	98

What is the mode?

(a) 53

(b) 70

(c) 98

(d) 65

25. Given the following frequency data associated with course grades

<i>frequency</i>	2	5	1	3	4	1
<i>score</i>	53	65	70	73	80	98

Roughly, what is the arithmetic mean?

- (a) 70.1
- (b) 71.1
- (c) 72.3
- (d) 69.8

26. Given the following frequency data associated with course grades

<i>frequency</i>	2	5	1	3	4	1
<i>score</i>	53	65	70	73	80	98

Roughly, what is the standard deviation?

(a) 5522.3

(b) 75.9

(c) 2.2

(d) 11.2

27. The vector function $\mathbf{u} = y\hat{i} + z\hat{j} + x\hat{k}$ is

(a) conservative only

(b) solenoidal only

(c) neither conservative nor solenoidal

(d) conservative and solenoidal

28. Find the unit vector normal to the surface $x^2 + y^2 + z^2 = 3$ at $(1, 1, 1)$.

(a) $2\hat{i} + 2\hat{j} + 2\hat{k}$

(b) $\hat{i} + \hat{j} + \hat{k}$

(c) $\frac{\hat{i} + \hat{j} + \hat{k}}{\sqrt{3}}$

(d) $\frac{2\hat{i} + 2\hat{j} + 2\hat{k}}{\sqrt{3}}$

What function $y(t)$ has the Laplace transform $\frac{s - 3}{s^2 - 4s + 13}$.

(a) $e^{3t} \cos(2t) - e^{3t} \sin(2t)$

(b) $e^{2t} \cos(3t) - 3^{-1} e^{2t} \sin(3t)$

(c) $e^{2t} \cos(3t) - e^{2t} \sin(3t)$

(d) $e^{2t} \cos(3t) + e^{2t} \sin(3t)$

29. The differential equation

$$y'' + \sin(x)y' + y^2 = 2 \text{ is}$$

- (a) Linear, Homogenous, Constant Coefficient
- (b) Nonlinear, Homogeneous, Constant Coefficient
- (c) Nonlinear, Variable Coefficient
- (d) Linear, Nonhomogenous, Variable Coefficient

30. The harmonic oscillator $\ddot{G} + 4G = 0$ is

- (a) Damped
- (b) Critically Damped
- (c) Undamped
- (d) Overdamped

31. What is the particular solution to the harmonic oscillator $\ddot{G} + 4G = 5e^t$?

(a) $\frac{1}{5}e^t$

(b) $\frac{1}{5}e^{2t}$

(c) e^{2t}

(d) e^t

32. Given the forced harmonic oscillator $\ddot{G} + 4G = f(t)$. Which function $f(t)$ would not lead to resonance.

(a) $f(t) = 5 \cos(2t)$

(b) $f(t) = \sin(2t)$

(c) $f(t) = 3e^{2it}$

(d) $f(t) = \pi e^{2t}$

33. The cross product of $\mathbf{y} = \hat{i} + \hat{j}$ with \mathbf{x} is zero.
The dot product $\mathbf{y} \cdot \mathbf{x} = 1$ find \mathbf{x} .

(a) $\mathbf{x} = \frac{-\hat{i} - \hat{j}}{2}$

(b) $\mathbf{x} = \frac{\hat{i} + \hat{j}}{2}$

(c) $\mathbf{x} = \frac{\hat{i} - \hat{j}}{2}$

(d) $\mathbf{x} = \frac{-\hat{i} + \hat{j}}{2}$

34. Calculate the following limit $\lim_{x \rightarrow 0} \frac{2 \sin(x)}{x}$.

(a) ∞

(b) 0

(c) 1

(d) 2

35. Determine the first inflection point for

$$f(x) = e^x \cos(x) \text{ for } x > 0.$$

(a) $\frac{\pi}{2}$

(b) π

(c) $\frac{\pi}{4}$

(d) $\frac{3\pi}{2}$

36. Find the area between the y -axis and $y = x^3$ from $y = 1$ to $y = 8$.

(a) $\frac{12}{3}$

(b) $\frac{45}{4}$

(c) $\frac{60}{3}$

(d) $\frac{28}{3}$

37. The equation $8x^2 + 10xy + 3y^2 - 7x - 58 = 0$ corresponds to which conic?

- (a) Circle
- (b) Hyperbola
- (c) Ellipse
- (d) Parabola

38. Expand the following binomial $(x + 3)^6$.

39. Determine the first few terms of the Taylor's series expansion of $f(x) = e^x \cos x$.

40. Determine the solution to the following linear system of equations:

$$x - y + z = 2 \quad (4)$$

$$x - z = 0 \quad (5)$$

$$x + y = -3 \quad (6)$$

41. Solve the following ODE via Laplace Transforms

$$y'' + 3y' + 2y = 0, \quad y(0) = 1, \quad y'(0) = -1 \quad (7)$$

42. Determine the region in the first quadrant bounded by $f(x) = x$ and $g(x) = x^2$.

43. Given that $\mathbf{F} = (x^2 - y)\hat{i} + 4z\hat{j} + x^2\hat{k}$ and $\mathbf{G} = xye^{xyz}$ calculate:

(a) Divergence of \mathbf{F}

(b) Gradient of \mathbf{G}

(c) Curl of \mathbf{F}

44. Find the volume of the solid generated by revolving the region bounded by $y = \sqrt{x}$ and the lines $y = 1$, $x = 4$ about the line $y = 1$.

45. A box of bolts contains 8 thick bolts, 5 medium bolts, and 3 thin bolts. A box of nuts contains 6 that fit the thick bolts, 4 that fit the medium bolts and 2 that fit the thin bolts. One bolt and one nut are chosen at random. What is the probability that the nut fits the bolt?

46. An urn contains three red balls and one blue ball. Two balls are selected without replacement. What is the probability that they are both red?

47. How many people must you ask in order to have a fifty-fifty chance of finding someone who shares your birthday?

Good luck!