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Engineering Mathematics 2 Important Questions PDF

Engineering Mathematics 2 usually covers higher-order differential equations, Laplace transform, sequences and series with Fourier series, and complex variables (differentiation and integration). The most repeated questions are complementary function and particular integral, Laplace solution of an ODE, Fourier series of x or x^2, analytic functions and residue theorem.

Key takeaways

- Differential equations: CF and PI for standard right-hand sides, Cauchy-Euler equations and variation of parameters.
- Laplace transform: standard transforms, inverse by partial fractions, convolution theorem and solving ODEs.
- Series: convergence tests and Fourier series, including half-range series.
- Complex variables: Cauchy-Riemann equations, Milne-Thomson method, Cauchy integral formula and residues.
- These are practice questions based on common syllabus topics, not verified past papers.

About these important questions

These are **practice questions** built from topics that appear in most Indian B.Tech syllabi for Engineering Mathematics 2, including AKTU and universities that follow the AICTE model curriculum. They are **not verified past papers**, and we do not claim that any question will appear in your exam. Unit numbers and topic order differ between universities, so first match each unit below with your own university syllabus. For real previous papers, use your university's official archive. AKTU students can download them from the AKTU old question paper page.

Each unit lists key definitions, derivations or theory questions, numericals with short answer outlines, and long-answer questions. Use the outlines to check your method, then write full solutions yourself.

Unit 1: Ordinary Differential Equations of Higher Order

Key definitions: linear differential equation with constant coefficients, complementary function (CF), particular integral (PI), auxiliary equation, Cauchy-Euler (homogeneous) equation, Wronskian.

Numericals (answer outline):

- Solve $(D^2 - 3D + 2)y = e^{3x}$. Outline: auxiliary equation $m^2 - 3m + 2 = 0$ gives $m = 1, 2$, so CF = $c_1 e^x + c_2 e^{2x}$. PI = $e^{3x}/(9 - 9 + 2) = e^{3x}/2$.
- Solve $(D^2 + 4)y = \sin 2x$. Outline: CF = $c_1 \cos 2x + c_2 \sin 2x$. This is a case of failure, so PI = $-(x \cos 2x)/4$.
- Solve $y'' + y = \sec x$ by variation of parameters. Answer: $y = c_1 \cos x + c_2 \sin x + x \sin x + \cos x \log|\cos x|$.
- Solve a Cauchy-Euler equation $x^2y'' + xy' + y = \log x$ by putting $x = e^z$.
- Simultaneous linear differential equations with dx/dt and dy/dt.

Long-answer questions: Applications to simple harmonic motion or an LCR circuit, where you form the equation and then solve it.

Unit 2: Laplace Transform

Key definitions: Laplace transform, existence conditions, unit step function, Dirac delta function, periodic function, convolution.

Results to remember: $L\{1\} = 1/s$, $L\{e^{at}\} = 1/(s - a)$, $L\{\sin at\} = a/(s^2 + a^2)$, $L\{t \sin at\} = 2as/(s^2 + a^2)^2$, first and second shifting theorems, transform of derivatives and integrals.

Numericals (answer outline):

- Find the inverse Laplace transform of $1/[s(s + 1)]$. Outline: partial fractions $1/s - 1/(s + 1)$, so the answer is $1 - e^{-t}$.
- Use the convolution theorem to find the inverse of $1/[(s^2 + a^2)^2]$ or $s/[(s^2 + a^2)^2]$.
- Solve $y' + y = 1$, $y(0) = 0$. Outline: $(s + 1)Y = 1/s$, so $Y = 1/[s(s + 1)]$ and $y = 1 - e^{-t}$.
- Find the Laplace transform of a periodic square or triangular wave.

Long-answer questions: Solve a second-order ODE with initial conditions by Laplace transform; state and prove the convolution theorem.

Unit 3: Sequences, Series and Fourier Series

Key definitions: convergence of a sequence, comparison test, D'Alembert's ratio test, Cauchy's root test, Raabe's test, Fourier coefficients, Dirichlet conditions, half-range series.

Numericals (answer outline):

- Test the convergence of the p-series and of a series such as $\Sigma\, n/(n^2 + 1)$ by comparison.
- Find the Fourier series of $f(x) = x$ in $(-\pi, \pi)$. Answer: $2\,\Sigma\, (-1)^{n+1} \sin(nx)/n$.
- Find the Fourier series of $f(x) = x^2$ in $(-\pi, \pi)$. Answer: $\pi^2/3 + 4\,\Sigma\, (-1)^n \cos(nx)/n^2$. Putting $x = \pi$ gives $\Sigma\, 1/n^2 = \pi^2/6$.
- Find the half-range sine series of $f(x) = x$ in $(0, \pi)$.

Long-answer questions: Fourier series of a piecewise function, followed by a deduction of a numerical series. Make sure you check whether the function is even or odd first, because that removes half the work.

Unit 4: Complex Variable: Differentiation

Key definitions: analytic function, Cauchy-Riemann equations, harmonic function, harmonic conjugate, conformal mapping, bilinear transformation.

Derivations: Derive the Cauchy-Riemann equations in Cartesian and polar form.

Numericals (answer outline):

- Show that $u = x^2 - y^2$ is harmonic and find its conjugate. Answer: $v = 2xy$, so $f(z) = z^2$.
- Use the Milne-Thomson method to find an analytic function when its real or imaginary part is given.
- Find the bilinear transformation that maps three given points to three given points, and find its fixed points.

Unit 5: Complex Variable: Integration

Key definitions: line integral in the complex plane, Cauchy's integral theorem, Cauchy's integral formula, Taylor and Laurent series, singularity, pole, residue.

Numericals (answer outline):

- Evaluate the integral of $e^z/(z - 1)$ around $|z| = 2$. Outline: $z = 1$ lies inside, so by Cauchy's integral formula the value is $2\pi i\, e$.
- Evaluate the integral of $1/[z(z - 1)]$ around $|z| = 2$. Outline: residues at $z = 0$ and $z = 1$ are -1 and 1, the sum is 0, so the integral is 0.
- Expand $1/[(z - 1)(z - 2)]$ as a Laurent series in $1 < |z| < 2$.
- Evaluate the integral of $d\theta/(2 + \cos\theta)$ from 0 to 2π by contour integration. Answer: $2\pi/\sqrt{3}$.

Long-answer questions: State and prove Cauchy's integral theorem, then evaluate a real definite integral with the residue theorem.

How to score well in Engineering Mathematics 2

- Keep one sheet of PI rules (for e^{ax}, sin ax, x^n, $e^{ax}V$) and Laplace transform pairs. These two sheets cover a large share of the paper.
- In Fourier series, first check even or odd, then write a_0, a_n and b_n separately.
- For contour integrals, always draw the contour and mark which singular points lie inside it.
- Write the final answer in a box. In long numericals examiners look for the method and the final result.

Short-answer (2-mark) questions for Engineering Mathematics 2

Short questions test definitions and one-line results. Practise answering each in two to four lines:

1. Define the order and degree of a differential equation.
2. What is the Wronskian, and what does a non-zero Wronskian tell you?
3. Write the auxiliary equation of $y'' + 4y' + 4y = 0$ and its solution. (Answer: $m = -2$ twice, $y = (c_1 + c_2x)e^{-2x}$.)

4. State the first shifting theorem of Laplace transform.
5. Find $L\{t^2\}$. (Answer: $2/s^3$.)
6. Define the unit step function and write its Laplace transform.
7. State the ratio test for convergence of a series.
8. State Dirichlet's conditions for a Fourier series.
9. Write the Cauchy-Riemann equations in Cartesian form.
10. Is $f(z) = \bar{z}$ (the conjugate of z) analytic? Give a reason. (Answer: no, the C-R equations fail.)
11. Define a pole of order m and a removable singularity.
12. State Cauchy's residue theorem.

A 7-day revision plan for Engineering Mathematics 2

Use this plan in the last week before the exam. Adjust it to the units and weightage in your own syllabus.

- **Day 1 (Unit 1, Ordinary Differential Equations of Higher Order):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 2 (Unit 2, Laplace Transform):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 3 (Unit 3, Sequences, Series and Fourier Series):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 4 (Unit 4, Complex Variable: Differentiation):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 5 (Unit 5, Complex Variable: Integration):** revise the definitions, then solve the numericals and one long answer from this unit without notes.
- **Day 6:** attempt one full three-hour practice paper made from these questions, or an official previous paper from your university archive.
- **Day 7:** go through your formula sheet, the short-answer list and every question you got wrong in the practice paper.

Frequently asked questions

Which topics in Engineering Mathematics 2 are the easiest to score?

Laplace transform and differential equations with constant coefficients are the most formula-based units. Once you know the standard pairs and PI rules, these questions follow a fixed method.

How do I find a PI when the normal formula fails?

When the denominator becomes zero after substitution, multiply by x and differentiate the denominator with respect to D. For $\sin ax$ or $\cos ax$ with $D^2 + a^2$, the PI picks up a factor of x.

What is the quickest way to solve residue theorem questions?

Find all singular points, check which lie inside the contour, calculate the residue at each of those, and multiply the sum by $2\pi i$. Drawing the contour avoids most mistakes.

Are these questions from real past papers?

No. These are practice questions based on topics that are common in B.Tech syllabi. They are not verified past papers, and no question is promised to appear in your exam. Check your own university syllabus and official previous papers; AKTU students can use the AKTU old question paper archive.

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