Module (Course Syllabus) Catalogue

2023-2024

College/ Institute	**Erbil Technology College**	
Department	**Automation Industrial Technology Engineering (AITE)**	
Module Name	**Engineering Analysis**	
Module Code	**ENA605**	
Degree	**Technical Diploma** [ ] **Bachelor** [/] **High Diploma** [ ] **Master** [ ] **PhD** [ ]	
Semester	**Sixth**	
Qualification	**Automation Industrial Technology Engineering (AITE)**	
Scientific Title	**Assistant Lectuerer**	
ECTS (Credits)	**MSc**	
Module type	**Prerequisite** [/] **Core** [ ] **Assist.** [ ]	
Weekly hours	**3**	
Weekly hours (Theory)	**(2)hr Class**	**(12)Total hrs Workload**
Weekly hours (Totorial)	**(1)hr Class**	**(12)Total hrs Workload**
Number of Weeks	**12**	
Lecturer (Theory)	**Salar Ismael Ahmed**	
E-Mail & Mobile NO.	**0750 4685776**	
Lecturer (Totorial)	**Salar Ismael Ahmed**	
E-Mail & Mobile NO.	Salar.ahmed@epu.edu.iq	
Websites		

Course Book

Course Description	In life there is no certainty about what will happen in the future but decisions still have to be taken. Therefore, decision processes must be able to deal with the problems of uncertainty. Uncertainty creates risk and this risk must be analysed. Then Engineering anlysis for solving many problems in our life has important role in applied scinces. In many situations large amounts of problems is available which requires mathematical Engineering techniques for analysis. There fore angenering anlysis currently plays an important role in the development of so many other sciences such as. Engineering, medicine, Agriculture, commerce, economy, social sciences, practical sciences (mathematics, physics and chemistry). Also, The application of numerical methods is very extensive and is used in all branches of Science and Technology, Industry, Business, Finance, Economics, Sociology, Psychology, Education, Medicine etc. The concept of Engineering anlysis with the common people consists of problems and modulls for describing a phenomenon such as electronic, digital signal prossesing, mathematical and physics problems.
Course objectives	The course objective of this course for the student is to know the subject of Engineering analysis. In addition, they able to understand and get benefit for all of the methods and transformations, also to know the concept and basic of the Engineering anlysis to be able to apply these concepts to solve application problems and examples which they make in apply science like electronic, digital signal prossesing, engineering, network and computer science. Identifying the student with the importance of Engineering analysis, and the stages of it and learning laplace transformation, z transformation, foruerier series, taylor series Macloryan series

Student's obligation	1)Student readiness is very important to learn and get a note about the lesson because you are amenable to the lesson. 2) Be in the Hall or lab before starting time of the lecture 3) Listen to the lecture and write a note 4) If you don't understand please ask? **5) Is not allowed to use a mobile phone in the classroom during the time of lecture until the teacher goes out of the classroom, If you use it, therefore you face legal punishment.**
Required Learning Materials	White board and Data show to view the headlines, definitions and tables.

Evaluation

	Task	Weight (Marks)	Due Week	Relevant Learning Outcome
	Paper Review	0		
Assignments	Homework	2		
Assignments	Class Activity	2		
Assignments	Report	1		
Assignments	Seminar	1		
Assignments	Essay	0		
Assignments	Project	0		
	Quiz	5%		
	Lab.	15%		
	Midterm Exam	20%		
	Final Exam	40%		
	Total	100%		

Specific learning outcome:	1- white bourd. 2- Data show 3- Discussion on subjects.
Course References:	[1] Merle C. Potter.,(2019) Engineering analysis, third edition.

	[2] Tai-Ran Hsu (2018); Applied Engineering Analysis. [3] Kirk D. Hagen (2020) Introdution to Engineering Analysis. Forth Edition. B– Magazines and review (internet): Using internet to get more information about the subjects of Engineering analysis.

Course topics (Theory)	Week	Learning Outcome
1- General Basic about Engeneering Analysis.	1	
2- Laplace Method Transform.	2	
3- Laplace Transformation and Numerical examples.	3	
4- Laplace Transformation Rules and Numerical examples.	4	
5- Laplace transformation (Partial Function) and Numerical examples.	5	
6- Invese Laplace transformation and Numerical examples.	6	
7- Laplace Transform Integration and Numerical examples.	7	
8- Fourier Representation.	8	
9- Forier series Transorm and Numerical examples.	9	
10- Gamma Function and Numerical examples.	10	
11- Z-Transform and Numerical examples	11	
12- Euler's Relation in Z-Transform and examples.	12	

Quasion example design

Ministry of Higher Education &

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Erbil Polytechnic University

Examination

Third Semester 2023-2024

Class : Third
Subject : Engineering Analysis
Time : 2 Hours
Date : 8 - 1 - 2024
Code : ENA501

Q1/ Choose True (**T**) or False (**F**) for the following, then correct the falses: 10 Marks

1. The Laplace transformation is not a linear operation and considered as an integral.
2. The Laplace Euler relation for: $\sinh x = \frac{e^{x}+e^{-x}}{2}$.
3. Periodic Function for cosine is the function that repeated itself every (π).
4. Shifting inverse used for functions when (S) with a number all raised with a power: $(S \pm a)^{x}$.
5. In Z-Transform, for Unit Step function: $f(Z) = \frac{Z}{1-Z}$.

Q2/ By using Laplace Theorems (by integration), find $f(s)$ if: $f(t) = \mathrm{e}^{-\mathrm{t}}$ 10 Marks

Q3/ Find the Laplace Transform for the functions: $f(t) = (t+7)^2$ 10 Marks

Q4/ By using derivative, find Laplace for the function: $f(t) = \mathcal{L}\cosh 2\mathrm{t}$ 10 Marks

Q5/ Find the Laplace Transform for the partial function: $f(t) = \frac{s+7}{(s+3)(s+2)}$ 10 Marks

Q6/ For the function: $f(s) = \frac{4.5}{S^2+9}$, find the Inverse Laplace Transform. 10 Marks

Q7/ By using first and second integration, solve the Inverse Laplace function: $\mathcal{L}^{-1}\frac{1}{S^2(S-a)}$ — 10 Marks

Q8/ Find the Fourier Series for the periodic function: $f(x)=\begin{cases} k, & 0 \le x \le \pi \\ -k, & -\pi \le x \le 0 \end{cases}$ — 10 Marks

Q9/ Find the value of: 1. $\Gamma_{-2.5}$, 2. $\Gamma_{\frac{11}{5}}$ — 10 Marks

Q10/ Find Z-Transform for the function: $f(s)=\frac{1}{S(S+1)}$ — 10 Marks

wish you all the success

Salar Ismael Ahmed

Ministry of Higher Education & Scientific Research

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Examination

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Typical answers

Q1/ 1. F: (The Laplace transformation is a linear operation and considered as an integral).

2. F: The Laplace Euler relation for: $\sinh x = \frac{e^{x}-e^{-x}}{2}$.

3. F: Periodic Function for cosine is the function that repeated itself every (2π).

4. T:

5. F: In Z-Transform, for Unit step function: $f(Z) = \frac{Z}{Z-1}$

.....

Q2/

$$f(s) = \mathcal{L}f(t) = \int_0^\infty e^{-t} f(t)\, dt = \int_0^\infty e^{-t}\, e^{at}\, dt = \int_0^\infty e^{-st+at}\, dt$$

$$= \int_0^\infty e^{-t(s+1)} dt \times \left[\frac{-(s+1)}{-(s+1)}\right] = \frac{1}{(s+1)} \int_0^\infty e^{-t(s+1)}\ -(s+1)dt$$

$$= -\frac{1}{(s+1)} e^{-t(s+1)}|_0^\infty = -\frac{1}{(s+1)}(e^\infty - e^0) = -\frac{1}{(s+1)} \times (-1)$$

$$= \frac{1}{(s+1)}$$

.....

Q3/

$\mathcal{L}\{(t+7)^2\}$

$(t+7)^2 = t^2 + 14t + 49$

$= \mathcal{L}\{t^2 + 14t + 49\}$

$= \mathcal{L}\{t^2\} + 14\mathcal{L}\{t\} + \mathcal{L}\{49\}$

$L\{t^2\}: \frac{2}{s^3} \quad \mathcal{L}\{t\}: \frac{1}{s^2} \quad \mathcal{L}\{49\}: \frac{49}{s}$

$= \frac{2}{s^3} + 14 \cdot \frac{1}{s^2} + \frac{49}{s}$

.....

Q4/

$f(t) = \text{Cosh } 2t \qquad f(0) = 1$

$f^{-}(t) = 2 \sinh 2t \qquad f^{-}(0) = (0)$

$f^{=}(t) = 4 \cosh 2t \qquad f^{=}(0) = -4$

$$\mathcal{L}f^{=}(t) = S^2\mathcal{L}f(t) - Sf(0) - f^{-}(0)$$

$$\mathcal{L}\,4\cosh 2t = S^2\mathcal{L}\cosh 2t - S(1) - 0$$

$$S = S^2\mathcal{L}\cosh 2t - 4\mathcal{L}\cosh 2t$$

$$= \mathcal{L}\cosh 2t\,[S^2 - 4]$$

$$\mathcal{L}\cosh(2t) = \frac{s}{s^2 - 2^2}$$

$$= \frac{s}{s^2 - 4}$$

.....

Q5/

$$\frac{s+7}{(s+3)(s+2)} = \frac{A}{(s+3)} + \frac{B}{(s+2)}$$

$$A = \frac{s+7}{(s+3)(s+2)} \times (s+3)|_{(s+3)=0} = \frac{s+7}{s+2}|_{s=-3} = \frac{-3+7}{-3+2} = \frac{4}{-1} = -4$$

$$B = \frac{s+7}{(s+3)(s+2)} \times (s+2)|_{(s+2)=0} = \frac{s+7}{s+3}|_{s=-2} = \frac{-2+7}{-2+3} = \frac{5}{1} = 5$$

$$\therefore \frac{s+4}{(s+3)(s+2)} = \frac{A}{(s+3)} + \frac{B}{(s+2)} = \frac{-4}{(s+3)} + \frac{5}{(s+2)}$$

.....

Q6/

$$\mathcal{L}^{-1}\frac{4.5}{S^2+9} = 4.5\mathcal{L}^{-1}\frac{1}{S^2+9} = 4.5\mathcal{L}^{-1}\frac{1}{S^2+3^2}$$

$$= 4.5\mathcal{L}^{-1}\frac{1}{S^2+3^2}\times\frac{3}{3}$$

$$= \frac{4.5}{3}\mathcal{L}^{-1}\frac{3}{S^2+3^2} = \frac{4.5}{3}\sin 3t = 1.5\sin 3t$$

.....

Q7/

$$\mathcal{L}^{-1}\frac{1}{S^2(S-a)} = \mathcal{L}^{-1}\frac{1}{S^2(S-a)} = \frac{1}{S}\frac{1}{S}\frac{1}{S-a}$$

First Integration: $\int_0^t e^{at}\,dt \times \frac{a}{a} = \frac{1}{a}\int_0^t e^{at}\,a\,dt = \frac{1}{a}e^{at}|_0^t$

$$= \frac{1}{a}(e^{at}-e^0) = \frac{1}{a}(e^{at}-1)$$

Second Integration: $\int_0^t \frac{1}{a}(e^{at}-1)\,dt = \frac{1}{a}\int_0^t e^{at}\,dt - \frac{1}{a}\int_0^t dt$

$$= \frac{1}{a^2}e^{at}|_0^t - \frac{1}{a}t\,|_0^t$$

$$= \frac{1}{a^2}e^{at} - 1 - \frac{1}{a}t$$

.....

Q8/

$$a_0 = \frac{1}{2\pi}\int_{-\pi}^{\pi} f(x)\,dx = \frac{1}{2\pi}\left[\int_{-\pi}^{0} -k\,dx + \int_0^{\pi} k\,dx\right]$$

$$= \frac{1}{2\pi}[(-kx|_{-\pi}^0 + (kx|_0^{\pi}] = \frac{1}{2\pi}[k(-\pi)+k(\pi)] = 0$$

$$a_n = \frac{1}{\pi}\left[\int_{-\pi}^{0} -k\cos nx\,dx + \int_0^{\pi} k\cos nx\,dx\right]$$

$$= \frac{1}{\pi}\left[(-\frac{k}{n}\sin nx|_{-\pi}^0 + (\frac{k}{n}\sin nx|_0^{\pi}\right] = 0$$

$$b_n = \frac{1}{\pi}\left[\int_{-\pi}^{0} -k\sin nx\,dx + \int_0^{\pi} k\sin nx\,dx\right]$$

$$= \frac{2k}{n\pi}[1 - \cos nx] = \frac{4k}{\pi}[\sin x + \frac{1}{3}\sin 3x + \frac{1}{5}\sin 5x + \cdots]$$

.....

Q9/

1. $\Gamma_{-2.5} = \Gamma_{\frac{-5}{2}} = \frac{\Gamma_{\frac{-5}{2}+1}}{\frac{-5}{2}} = \frac{\Gamma_{\frac{-3}{2}}}{\frac{-5}{2}} = \frac{\Gamma_{\frac{-1}{2}+1}}{\frac{-5}{2}\times\frac{-3}{2}} = \frac{\Gamma_{\frac{1}{2}}}{\frac{-5}{2}\times\frac{-3}{2}\times\frac{-1}{2}} = \frac{\Gamma_{\frac{1}{2}}}{\frac{-15}{8}} = \frac{-8}{15}\Gamma_{\frac{1}{2}} = \frac{-8}{15}\sqrt{\pi} = -9.45$

2. $\Gamma_{\frac{11}{5}} = \Gamma_{\frac{6}{5}+1} = \frac{6}{5}\Gamma_{\frac{1}{5}+1} = \frac{6}{5}\times\frac{1}{5}\Gamma_{\frac{1}{5}} = \frac{6}{25}\Gamma_{\frac{1}{5}} = 1.100540$

Q10/

$$f(s) = \frac{1}{S(S+1)} = \frac{A}{S} + \frac{B}{S+1}$$

$$\Rightarrow A = 1$$

$$B = -1$$

$$\Rightarrow f(s) = \frac{1}{S(S+1)} = \frac{1}{S} - \frac{1}{S+1}$$

$$\Rightarrow f(t) = \mathcal{L}^{-1}f(s) = \mathcal{L}^{-1}\frac{1}{S} - \mathcal{L}^{-1}\frac{1}{S+1} = 1 - e^{-t}$$

$$f(Z) = ZF(kt) = Z[1 - e^{-kt}] = \mathrm{Z}1 - \mathrm{Z}e^{-kt}$$

$$=$$

Q1-Define engenerring analysis and what are main techniques for solving problems ?
Q2/ Define the Laplace transformation. Write the properites of laplace transformation.

Q3/ prove that $L\{\sin ax\} = \frac{a}{p^2+a^2}$

Q4. Define the Z transformation . write and solve the examples on the the rules of Z transform.

20. Extra notes:

I have no notification about my subject Engineering analysis.

External Evaluation

1- **The course book of Engineering Analysis is completely related to syllabus of subjects, the preactical syllabus satisfy the goal of Engineering analysis subjects.**

The pratical course is completely defined the theoretical and practical lectures. Dr. Basim Mohammed Fadhil Lecturer of automobile Engenerring department.