K L University
Freshman Engineering Department
Semester – I, A.Y. 2012 – 13

COURSE HANDOUT

Course Code **:** 11-BS101

Course Title **: ENGINEERING MATHEMATICS**

Course Structure **:** Credits 3 L – T – P: 3 – 1 - 0

Course Coordinator **:** Dr V Srinivasa Bhagavan

Team of Instructors **:** Dr. R. Raghavendra Rao, Dr. A.S.N.Murthy, N. Vedavathi, T Srinivasa Rao, B S Kumar, K V Chandrasekhar, P Sumathi Kumari, K Gowthami.

Course Context and Overview:

This is the first year of first semester course which is offered common to all branches of Engineering. Many problems arises in engineering are modeled by either ordinary or partial differential equations which depends on the number of independent variables involved in the given system. Some systems are dependent on time domain which are called as dynamical systems. This course is intended to highlight the importance of the first , second and higher order differential equations and their applications to various engineering sciences namely, the Newton's law of cooling in mechanical engineering, the rate of growth and decay problems in both bio technology and chemical engineering applications, atmospheric pressure in astrophysics etc., .To solve the electric network problems of type LR, LCR circuits with an e.m.f and mechanical vibrating string problems in terms of second order differential equations.

The Laplace transform of unit impulse function and dirac delta function are introduced and also use the transform techniques to solve the differential equations. Further, the stability of the system and the bonding structure of chemical compounds are studied with the help of eigen values in matrix theory. The system of differential equations which arises In dynamical systems are solved by matrix theory.

Syllabus:

ORDINARY DIFFERENTIAL EQUATIONS OF FIRST ORDER: Formation, Conversion of some models to Differential Equations (Modeling differential equations), Variable separable method, exact equations, Applications to law of natural growth and decay problems, Newton's law of cooling, Chemical Reactions and Solutions, Orthogonal Trajectories, Linear Equations and Non- Linear Equations, R-L circuits with step unit, R-L Circuits With input. ORDINARY DIFFERENTIAL EQUATIONS OF SECOND & HIGHER ORD :Formation, Conversion of some models to Differential Equations of second and higher order, Homogeneous equations (Complementary Function), Non- Homogenous equations (Particular Integral).APPLICATIONS OF ORDINARY SECOND & HIGHER ORDER DIFFERENTIAL EQUATIONS: Cauchy's linear equation, Legendre's linear equation, Method of variation of parameters, Solving system of simultaneous Ordinary differential equations. L-C-R Circuits with and without e.m.f., Oscillations

of a spring without damping and with damping, Oscillation and deflection of beams. LAPLACE TRANSFORMS:_ Laplace transforms of some standard functions, properties of Laplace transforms - Linearity, First Shifting Property, Change of Scale Property, Transforms of derivatives, Integrals multiplication by t^n, division by t, Inverse Laplace transforms, Convolution theorem, transforms of periodic functions and Unit-Step function. Applications: Solving ODE using Laplace transforms method. **MATRICES**: Rank of a Matrix, Solving system of equations by using rank method, Linear independence and dependence of a set of vectors, Eigen values and eigen vectors, Stability of the system by eigen values, Orthogonality of eigen vectors, Cayley -Hamilton theorem and its applications, Complex matrices, Quadratic forms and canonical forms, Nature of Quadratic forms, Diagonalization. Dynamical systems: State variables, State vector, State space formation of OCF, CCF, Solution of homogeneous and non-homogeneous state equation.

Scope and Objective of the course:

The course is designed for the first year first semester students. The course will provide an overview of the study of differential equations of first order and higher order. Further, the students will understand how the course instructions are useful in mathematical modeling.
It's needless to state that any engineering problem must be suitably mathematically modeled and the solution must be studied in detail for its physical interpretation and viability.

Competencies:

At the end of the course the student should be able to

C 1 Formulate differential equations for given families of curves.

C 2 Solve linear and non-linear differential equations using methods, including variable separable, exact differential, and variation of parameters.

C 3 Model as differential equations phenomena including Newton's law of cooling, Growth and decay, Chemical reactions, L-R, C-R and LCR circuits, and mechanical vibrating string

C 4 Determine the Laplace transform of a given functions

C 5 Solve linear differential equations using Laplace transforms

C 6 Perform elementary operations on matrices including determination of rank, and inverse.

C 7 Solve a system of linear homogeneous and non-homogeneous equations using rank of a matrix

C 8 Importance of Cay-ley Hamilton Theorem and its applications

Text Books:

T.1 Advanced Engineering Mathematics by Michael D. Greenberg, Pearson Education 4e,2008.

T.2 Higher Engineering Mathematics by B.S.Grewal, Khanna Publishers. 40th edition, New Delhi.

Reference Books:

R.1 Control Systems theory and application by Smarajit Ghosh, Pearson education, 2009.(Chapter17, pp:498-522).

R.2 Advanced Engineering Mathematics by Ervin kreyszig

R.3 Advance Engineering Mathematics by Wyli and Barret.

R.4 Higher Engineering Mathematics by B.V. Ramana, Mc.Grew Hill Co, 2010.

R.5 Engineering Mathematics, by Anthony Croft, Robert Davison, Martin Hargreaves, Pearson education, 3 ed., 2009.

Course Plan:

The course plan is only a guide line. There may be changes in the order.

L.No.	C.Level	Learning Objective	Topics to be covered	Reference
1	C 1.1	Introduction	Formation of ordinary differential equations of first order, conversion of some models to differential equations	$T_{2:}$ 11.1 -11.3
2			Formation of ordinary differential equations of first order, conversion of some models to differential equations	$T_{2:}$ 11.1 -11.3
3	C 2.1	Solutions of First order ODE	Variables seperable method, exact equations, Applications to law of natural growth and decay problems	T1:1.3 (32-38)
4			Variables seperable method, exact equations, Applications to law of natural growth and decay problems	T1:1.3 (32-38)
5			Variables seperable method, exact equations, Applications to law of natural growth and decay problems	T1:1.3 (32-38)
6			Variables seperable method, exact equations, Applications to law of natural growth and decay problems	T1:1.3 (32-38)
7	C 3.1	Applications of first order ODE	Newton's law of cooling, chemical reactions and solutions, orthogonal trajectories	T_2:12.6, 12.9, 12.3

8			Newton's law of cooling, chemical reactions and solutions, orthogonal trajectories	T_2:12.6, 12.9, 12.3
9			Newton's law of cooling, chemical reactions and solutions, orthogonal trajectories	T_2:12.6, 12.9, 12.3
10	C 2.2	Linear and Non-linear equations	Linear equations and Non-linear equations	T_2:11.9-11.13
11			Linear equations and Non-linear equations	T_2:11.9-11.13
12	C 1.2	Introduction	Formation, conversion of some models to ODE of second and higher order	T_2:11.1-11.3
13			Formation, conversion of some models to ODE of second and higher order	T_2:11.1-11.3
14	C 2.2	Homogeneous equations	Finding complementary functions for second and higher order homogeneous equations	T_2:13.4
15			Finding complementary functions for second and higher order homogeneous equations	T_2:13.4
16	C 2.3	Non-Homogeneous equations	Finding particular integrals for non-homogeneous equations of second and higher order equations	T_2:13.5
17			Finding particular integrals for non-homogeneous equations of second and higher order equations	T_2:13.5
18	C 2.4	Equations reducible to linear equations	Cauchy's and Legendre's linear equations	T_2:13.9
19			Cauchy's and Legendre's linear equations	T_2:13.9
20	C 2.5	Variation of parameters method and solution of simultaneous equations	Method of variation of parameters for second order and solving system of simultaneous ODE's	T_2:13.8,13.11
21	C 2.5	Variation of parameters method and solution of simultaneous equations	Method of variation of parameters for second order and solving system of simultaneous ODE's	T_2:13.8,13.11
22	C 3.2	Applications to linear Differential equations	L.C.R circuits with and without E.M.F	T_2:14.5
23	C 3.2	Applications to linear Differential equations	L.C.R circu its with and without E.M.F	T_2:14.5
		Applications of Linear	Oscillation of spring with and	

24	C 3.3	equations to oscillations of spring	without damping	T_2:14.4
25	C 3.3	Applications of Linear equations to oscillations of spring	Oscillation of spring with and without damping	T_2:14.4
26	C 3.4	Application of linear equations	Oscillation and deflection of beams	T_2:14.7
27	C 3.4	Application of linear equations	Oscillation and deflection of beams	T_2:14.7
28	C 4.1	Laplace transforms	Laplace transforms of some standard functions, properties of Laplace transforms, first shifting property, change of scale property	T_2:21.1-21.4
29	C 4.1	Laplace transforms	Laplace transforms of some standard functions, properties of Laplace transforms, first shifting property, change of scale property	T_2:21.1-21.4
30-31	C 4.2	Properties of laplace transforms	Transforms of derivatives, integrals, multiplication by t^n, division by t.	T_2:21.7-21.10
32-33	C 4.3	Inverse laplace transforms	Inverse laplace transforms	T_2:21.12-21.13
34-35	C 4.4	Laplace Transforms of special functions, convolution theorem	Convolution theorem, transforms of periodic and unit step functions	T_2:21.14-21.18.
36	C 5.1	Application to solve ODE's	Solving ODE's through laplace transforms	T_2:21.15
37-38	C 6.1	Rank	Finding rank of a matrix by using normal form, Solving system of equations by using rank method	T_2:2.8, 2.11.
39	C 6.2	Dependence and independence	Linear dependence and independence of a set of vectors	T_2:2.13
40-41	C 7.1	Eigen values and eigen vectors	Eigen values and eigen vectors of matrices, stability of the system by eigen values, Orthogonality of eigen vectors.	T_2:2.14,2.15
42	C 7.2	Quadratic forms	Quadratic forms and Canonical forms, Nature of canonical forms, Diagonalization.	T_2:2.18,2.19
43	C 8.1	Cayley-Hamilton theorem, Complex matrices	Cayley-Hamilton theorem and it's applications, Complex matrices	T_2:2.16 T2 :2.16
44	C 7.3	Dynamical system and their Solutions.	State variables, vectors, space and formation of O.C.F, C.C.F, Solution of homogeneous and non-homogeneous state equations.	R_1:498-522

45			State variables, vectors, space and formation of O.C.F, C.C.F, Solution of homogeneous and non-homogeneous state equations.	R_1:498-522

Self learning material:

S.No.	Name of the topic	Source
II	Linear equations.	T.1 Higher Engineering Mathematics by B.S.Grewal
II	Rules for finding complementary functions	
III	Basic concepts of Kirchoff's laws in terms of LCR circuits.	
IV	Laplace Transforms & inverse transforms of some trigonometric functions.	
VII	Fundamental concepts of matrices and their ranks.	

Evaluation Scheme:

EC No.	COMPONENT	DURATION (mts)	MARKS	% Weightage	Date
THEORY					
1	Test – I	90	10	15/5	22.8.11
2	Assignment & Quiz	45	10	5	8.10.11
3	Test – II	90	10	15/5	2.11.11
4	Home Assignment	-	5	5	------
5	Attendance(Theory)	Continuous	5	5	------
6	Comprehensive Examination (Theory)	180	60	60	17.11.11
Total			-	100	
7	Internal practical examination a.Mid term lab exam b.continuous viva-voce	90 Continuous	20 15	20 15	------
8	Attendance(Lab)	Continuous	5	5	------
9	Semester-end lab exam (External evaluation)	180	60	60	------
		Total	**-**	100	

Chamber Consulting Hours: To be informed in the class by the respective instructors.

Notices: All notices / circulars regarding course matters will be displayed in the FED notice boards / e-learning site.

Home Assignments: Tutorials exercise material will be supplied from time to time to the students as the class work progresses. Tutorials will be conducted by the respective section instructors along with the teaching assistants. You must attend your registered section for the tutorials in the respective class room. The tutorials are intended to supplement the material taught in the lectures, solve practical problems and clear the doubts. Students must actively participate in the tutorial and come prepared for it.

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