Maharashtra State Board of Technical Education (MSBTE)

I – Scheme
II – Semester Course Curriculum

CourseTitle: **Applied Mathematics** (DE, EE, EJ, IE, IS, MU)

(Course Code: ....   )

Diploma programme in which this course is offered	Semester in which offered
Industrial Electronics, Digital Electronics, Medical Electronics, Instrumentation, Electrical, Electronics and Telecommunication Engineering	Second

1.   RATIONALE

The core technological studies can be understood with the help of potential of applied mathematics. This course is an extension of Basic Mathematics of first semester which is designed for its applications in engineering and technology using the techniques of calculus, differentiation, integration, differential equations and in particular complex numbers and Laplace transform. Derivatives are useful to find slope of the curve, maxima and minima of the function, radius of curvature. Integral calculus helps in finding the area. In analog to digital converter and modulation system integration is important. Differential equation is used in finding the curve and its related applications for various engineering models like LCR circuits. This course further develops the skills and understanding of mathematical concepts which underpin the investigative tools used in engineering.

2.   COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Solve electrical and electronics engineering related broad-based problems using the principles of applied mathematics**.

3.   COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following *industry oriented* COs associated with the above mentioned competency:

a. Calculate the equation of tangent, maxima, minima, radius of curvature by differentiation.
b. Solve the given problem(s) of integration using suitable methods.
c. Apply the concepts of integration to find the area and volume.
d. Solve the differential equation of first order and first degree using suitable methods.
e. Use Laplace transform to solve first order first degree differential equations.

4.   TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
4	2	-	6	70	30*	-	-	100

(*): *Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.*

Legends: *L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P -Practical; C – Credit, ESE -End Semester Examination; PA - Progressive Assessment*

5. COURSE MAP (with sample COs, Learning Outcomes i.e. LOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The tutorials in this section are LOs (i.e.sub-components of the COs) to be developed and assessed in the student to lead to the attainment of the competency.

S. No.	Tutorials	Unit No.	Approx. Hrs. Required
1	Solve problems based on finding value of the function at different points.	I	2
2	Solve problems to find derivatives of implicit function and parametric function	I	2
3	Solve problems to find derivative of logarithmic and exponential functions.	I	2
4	Solve problems based on finding equation of tangent and normal.	I	2
5	Solveproblems based on finding maxima, minima of function and radius of curvature at a given point.	I	2
6	Solve the problems based on standard formulae of integration.	II	2
7	Solve problems based on methods of integration, substitution, partial fractions.	II	2
8	Solve problems based on integration by parts.	II	2
9	Solve practice problems based on properties of definite integration.	III	2
10	Solve practice problems based on finding area under curve, area between two curves and volume of revolutions.	III	2
11	Solve the problems based on formation, order and degree of differential equations.	IV	2
12	Develop a model using variable separable method to related engineering problem.	IV	2
13	Develop a model using the concept of linear differential equation to related engineering problem.	IV	2
14	Solve problems based on algebra of complex numbers.	V	2
15	FindLaplace transform and inverse Laplace transformusing related properties.	V	2
16	Make use of concept of Laplace transform to solve first order first degree differential equation..	V	2
			32

Note: The above tutorial sessions are for guideline only. The remaining tutorial hours are for revision and practice.

7.   MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED
- Not applicable -

8.   UNDERPINNING THEORY COMPONENTS
The following topics/subtopics should be taught and assessed in order to develop LOs in cognitive domain for achieving the COs to attain the identified competency.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit – I Differential Calculus	1a. Solve the given simple problems based on functions. 1b. Solve the given simple problems based on rules of differentiation. 1c. Obtain the derivatives of	1.1 Functions and Limits : a) Concept of function and simple examples b) Concept of limits without examples. 1.2 Derivatives : a) Rules of derivatives such as sum,

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	logarithmic,exponential functions. 1d. Apply the concept of differentiation to find equation of tangent and normal. 1e. Apply the concept of differentiation to calculate maxima and minima and radius of curvature of given problem.	product, quotient of functions. b) Derivative of composite functions (chain Rule), implicit and parametric functions. c) Derivatives of inverse, logarithmic and exponential functions. 1.3 Applications of derivative : a) Second order derivative without examples. b) Equation of tangent and normal c) Maxima and minima d) Radius of curvature
Unit– II Integral Calculus	2a. Solve the given problem(s) based on rules of integration. 2b. Obtain the given simple integral(s) using substitution method. 2c. Integrate given simple functions using the integration by parts. 2d. Evaluate the given simple integral by partial fractions.	2.1 Simple Integration: Rules of integration and integration of standard functions. 2.2 Methods of Integration: a) Integration by substitution. b) Integration by parts c) Integration by partial fractions.
Unit– III Applications of Definite Integration	3a. Solve given simple problems based on properties of definite integration. 3b. Apply the concept of definite integration to find the area under the given curve(s). 3c. Utilize the concept of definite integration to find area between given two curves. 3d. Invoke the concept of definite integration to find the volume of revolution of given surface.	3.1 Definite Integration: a) Simple examples b) Properties of definite integral (without proof) and simple examples. 3.2 Applications of integration : a) Area under the curve. b) Area between two curves. c) Volume of revolution.
Unit-IV First Order First Degree Differential Equations	4a. Find the order and degree of given differential equations. 4b. Form simple differential equations for given engineering problem(s). 4c. Solve the given differential equations using the method of variable separable. 4d. Solve the given problems based on linear differential equations.	4.1 Concept of differential equation 4.2 Order, degree and formation of differential equation. 4.3 Solution of differential equation a. Variable separable form. b. Linear differential equation. 4.4 Application of differential equations and related engineering problems.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit –V Complex Numbers and Laplace transform.	5a. Solve given problems based on algebra of complex numbers. 5b. Solvethe given problems based on properties of Laplace transform 5c. Solve the given problems based on properties of inverse Laplace transform. 5d. Invoke the concept of Laplace transform to solve first order first degree differential equations.	5.1 Complex numbers: a. Cartesian, polar and exponential form of a complex number. b. Algebra of complex numbers. 5.2 Laplace transform: a. Laplace transform of standard functions (without proof). b. Properties of Laplace transform such as linearity, first and second shifting properties (without proof). c. Inverse Laplace transform using partial fraction method, linearity and first shifting property. d. Laplace transform of derivatives and solution of first order first degree differential equations.

Note: To attain the COs and competency, above listed Learning Outcomes (LOs) need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.

9.   SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Differential calculus	20	04	08	12	24
II	Integral calculus	14	02	06	08	16
III	Applications of Definite Integration	10	02	02	04	08
IV	First Order First Degree Differential Equations	08	02	02	04	08
V	Complex numbers and Laplace transform	12	02	05	07	14
	Total	**64**	**12**	**23**	**35**	**70**

Legends: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)
Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.

10.   SUGGESTED STUDENT ACTIVITIES
Other than the classroom learning, following are the suggested student-related *co-curricular* activities which can be undertaken to accelerate the attainment of the various outcomes in this course:
   a.   Identify engineering problems based on real world problems and solve with the use of free tutorials available on the internet.
   b.   Use graphical software's: EXCEL, DPLOT, and GRAPH for related topics.
   c.   Use Mathcad as Mathematical Tools and solve the problems of Calculus.

    d. Identify problems based on applications of differential equations and solve these problems.
    e. Prepare models to explain different concepts of applied mathematics.
    f. Prepare a seminar on any relevant topic based on applications of integration.
    g. Prepare a seminar on any relevant topic based on applications of Laplace transform to related engineering problems.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:
    a. Massive open online courses (*MOOCs*) may be used to teach various topics/sub topics.
    b. *'L' in item No. 4* does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
    c. About *15-20% of the topics/sub-topics* which is relatively simpler or descriptive in nature is to be given to the students for *self-directed learning* and assess the development of the LOs/COs through classroom presentations (see implementation guideline for details).
    d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for *co-curricular activities*.
    e. Guide student(s) in undertaking micro-projects.
    f. Apply the mathematical concepts learnt in this course to branch specific problems.
    g. Use different instructional strategies in classroom teaching.
    h. Use video programs available on the internet to teach abstract topics.

12. SUGGESTED MICRO-PROJECTS

Only *one micro-project* is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of practicals, cognitive domain and affective domain LOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than *16 (sixteen) student engagement hours* during the course.

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:
    a. Prepare models using the concept of tangent and normal to bending of roads in case of sliding of a vehicle.
    b. Prepare models using the concept of radius of curvature to bending of railway track.
    c. Prepare charts displaying the area of irregular shapes using the concept of integration.
    d. Prepare charts displaying volume of irregular shapes using concept of integration.
    e. Prepare models using the concept of differential equations for mixing problem.
    f. Prepare models using the concept of differential equations for radio carbon decay.
    g. Prepare models using the concept of differential equations for population growth.
    h. Prepare models using the concept of differential equations for thermal cooling.

i. Prepare models using the concept of Laplace transform to solve linear differential equations.
j. Prepare models using the concept of Laplace transform to solve initial value problem of first order and first degree.
k. Prepare charts displaying various algebraic operations of complex numbers in complex plane.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Higher Engineering Mathematics	Grewal, B.S.	Khanna publications, New Delhi , 2013 ISBN- 8174091955
2	Advanced Engineering Mathematics	Krezig, Ervin	Wiley Publications, New Delhi, 2016 ISBN:978-81-265-5423-2,
3	Advanced Engineering Mathematics	Das, H.K.	S. Chand Publications, New Delhi, 2008, ISBN-9788121903455
4	Engineering Mathematics, Volume 1 (4th edition)	Sastry, S.S.	PHI Learning, New Delhi, 2009 ISBN-978-81-203-3616-2,
5	Getting Started with MATLAB-7	Pratap, Rudra	Oxford University Press, New Delhi,2009 ISBN- 0199731241
6	Engineering Mathematics (third edition).	Croft, Anthony.	Pearson Education, New Delhi,2010 ISBN 978-81-317-2605-1

14. SOFTWARE/LEARNING WEBSITES
a. www.scilab.org/ - SCI Lab
b. www.mathworks.com/products/matlab/ - MATLAB
c. Spreadsheet applications
d. www.dplot.com/ - DPlot
e. www.allmathcad.com/ - MathCAD
f. www.wolfram.com/mathematica/ - Mathematica
g. http://fossee.in/
h. https://www.khanacademy.org/math?gclid=CNqHuabCys4CFdOJaAoddHoPig
i. www.easycalculation.com
j. www.math-magic.com