Maharashtra State Board of Technical Education (MSBTE)

I – Scheme
II – Semester Course Curriculum

Course Title: **Applied Mathematics** (AE, CH, FG, ME, PT)
(Course Code: ....)

Diploma programme in which this course is offered	Semester in which offered
Mechanical engineering, Automobile engineering, Production Technology, Fabrication Technology and Erection Engineering, Chemical Engineering	Second

1.   RATIONALE
Subject of applied mathematics is being introduced in diploma courses to provide mathematical background to the students. This course follows in developing theory and competency needed for a wide range of engineering applications. In particular the technique of calculus, differentiation, integration, differential equations and probability distribution for modeling and analysis in a wide range of applications. This course further develops the skills and understanding of mathematical concepts which underpin the investigative tools used in Mechanical 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 mechanical engineering related 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 concept of integration to find area and volume.
   d. Solve the differential equation of first order and first degree using suitable methods.
   e. Utilize basic concepts of probability distribution to solve elementary engineering problems.

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.
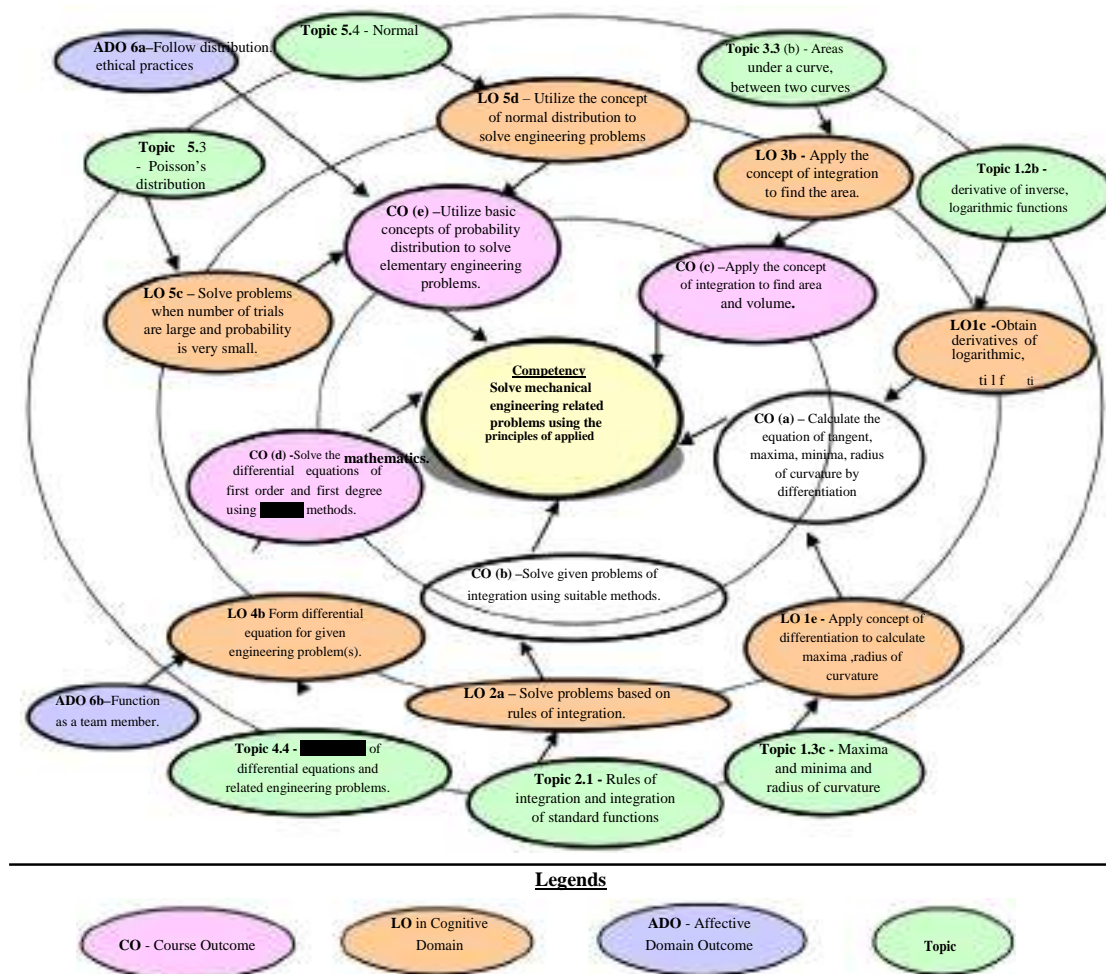

Figure 1 - Course Map

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

S. No.	Tutorials	Unit No.	Approx. Hrs. Required
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 Binomial Distribution related to engineering problems.	V	2
15	Solve problems based on Poisson Distribution related to engineering problems.	V	2
16	Solve problems based on Normal Distribution related to engineering.	V	2
Total			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 :

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
	logarithmic, exponential functions. 1d. Apply the concept of differentiation to find given equation of tangent and normal 1e. Apply the concept of differentiation to calculate maxima and minima and radius of curvature of given problem.	a) Rules of derivatives such as sum, 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 simple problem(s) based on rules of integration. 2b. Obtain the given 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 simple given engineering problem(s). 4c. Solve given differential equations using the method of variable separable. 4d. Solve the given simple problem(s) 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 Probability Distribution	5a. Make use of probability distribution to identify discrete and continuous probability distribution 5b. Solve given problems based on repeated trials using Binomial distribution. 5c. Solve given problems when number of trials are large and probability is very small. 5d. Utilize the concept of normal distribution to solve related engineering problems.	5.1 Probability distribution a. Discrete Probability distribution b. Continuous Probability distribution. 5.2 Binomial distribution. 5.3 Poisson's distribution. 5.4 Normal distribution.

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	Probability distribution.	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 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 and laboratory 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 probability distribution 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.

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 a chart of binomial distribution by collection of suitable manufacturing industry base data.
j. Prepare a chart of normal distribution by collection of suitable manufacturing industry base data
k. Prepare a chart of Poisson distribution by collection of suitable manufacturing industry base data

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	A Text Book of Engineering Mathematics	Dutta, D.	New Age Publications, New Delhi, 2006, ISBN-978-81-224-1689-3
3	Advanced Engineering Mathematics	Krezig, Ervin	Wiley Publications, New Delhi, 2016 ISBN:978-81-265-5423-2,
4	Advanced Engineering Mathematics	Das, H.K.	S. Chand Publications, New Delhi, 2008, ISBN:9788121903455
5	Engineering Mathematics, Volume 1 (4th edition)	Sastry, S.S.	PHI Learning, New Delhi, 2009 ISBN-978-81-203-3616-2,
6	Comprehensive Basic Mathematics, Volume 2	Veena, G.R.	New Age Publications, New Delhi, 2005 ISBN: 978-81-224-1684-8
7	Getting Started with MATLAB-7	Pratap, Rudra	Oxford University Press, New Delhi, 2009, ISBN: 10: 0199731241
8	Engineering Mathematics (3rd 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