GOVERNMENT POLYTECHNIC, PUNE

'120 – NEP' SCHEME

PROGRAMME	DIPLOMAIN CM/IT
PROGRAMME CODE	06/07
COURSE TITLE	BASIC MATHEMATICS
COURSE CODE	SC11206
PREREQUISITE COURSE CODE & TITLE	NA

I. LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Course Type	Learning Scheme					Credits	Assessment Scheme										
			Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory				Based on LL &TSL				Based on SL		Total Marks
														Practical						
			CL	TL	LL					FA-TH	SA-TH	Total		FA-PR		SA-PR		SLA		
										Max	Max	Max	Min	Max	Min	Max	Min	Max	Min	
SC11206	BASIC MATHEMATICS	AEC	4	2	-	2	8	4	3	30	70	100	40	-	-	-	-	25	10	125

Total IKS Hrs for Term: 6 Hrs

Abbreviations: **CL**-Classroom Learning, **TL**-Tutorial Learning, **LL**-Laboratory Learning, **SLH**-Self Learning Hours, **NLH**-Notional Learning Hours, **FA** - Formative Assessment, **SA** -Summative assessment, **IKS** – Indian Knowledge System, **SLA**- Self Learning Assessment

Legends: @-Internal Assessment, # - External Assessment,*# - Online Examination,@$ - Internal Online Examination

Note:

FA-TH represents an average of two class tests of 30 marks each conducted during the semester.

1. If a candidate is not securing minimum passing marks in **FA-PR** (Formative Assessment - Practical) of any course, then the candidate shall be declared as **'Detained'** in that semester.
2. If a candidate does not secure minimum passing marks in SLA (Self Learning Assessment) of any course, then the candidate shall be declared as **'fail'** and will have to repeat and resubmit SLA work.
3. **Notional learning hours** for the semester are **(CL + LL + TL + SL) hrs. * 15 Weeks**
4. **1 credit** is equivalent to **30 Notional hours.**
5. * Self-learning hours shall not be reflected in the Timetable.
6. *Self-learning includes micro-projects/assignments/other activities.

II. RATIONALE:

Basic Mathematics plays a crucial role in diploma Programmes as it fosters the development of critical thinking skills, enhances quantitative literacy, prepares students for higher education, promotes problem-solving abilities, cultivates logical and abstract thinking, and fosters mathematical literacy. By engaging with Mathematics, students acquire logical reasoning, problem-solving techniques, and analytical thinking, which are valuable for lifelong learning and professional growth.

Calculus is a branch of Mathematics that calculates how matter, particles, and heavenly bodies move. Derivatives are useful for finding maxima and minima of the function; velocity and acceleration are also useful for many engineering optimization problems. Statistics can be defined as a type of mathematical analysis which involves the method of collecting and analyzing data and then summing up the data into a numerical form for a given set of factual data or real-world observations. It equips individuals with the ability to interpret numerical information, make informed decisions, and navigate real-world situations. Moreover, Mathematics provides a foundation for further studies in various disciplines and prepares students to tackle complex challenges.

By exploring abstract concepts and logical structures, students develop their ability to reason; make connections, and approach problems with clarity and precision. Furthermore, studying Mathematics helps students appreciate the historical and cultural significance of Mathematics and its applications in diverse fields, thereby fostering mathematical literacy and a deeper understanding of the world. Hence the course provides the insight to analyze engineering problems scientifically using logarithms, matrices, trigonometry, straight line, differential calculus, and statistics.

By incorporating these topics, students comprehend to approach engineering problems from a mathematical perspective, enabling them to devise efficient and effective solutions, and this leads to preparing Diploma graduates well-rounded, adaptable, and capable of making significant contributions to the branch-specific problems.

III. COURSE-LEVEL LEARNING OUTCOMES(CO'S)

Studentswillbeabletoachieve&demonstratethefollowing CO'soncompletionofcourse-basedlearning

CO1 - Apply the concepts of algebra to solve engineering (discipline) related problems.
CO2 - Utilize trigonometry to solve programme-specific engineering problems.
CO3 - Solve programme-specific engineering problems under given conditions of straight lines.
CO4 - Apply differential calculus to solve programme-specific problems.
CO5 - Use techniques and methods of statistics to crack programme-specific problems.

IV. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr. No	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	UNIT-I ALGEBRA (CL Hrs-12, Marks-14)			
1.	TLO 1.1 Solve the given simple problem based on laws of logarithm. TLO 1.2 Solve the given system of linear equations using the matrix inversion method. TLO 1.3 Obtain the proper and improper partial fraction for the given simple rational function. TLO 1.4 Solve simultaneous equations by using concepts given in Ancient Indian Mathematics.	1.1 Logarithm: Concept and laws of logarithm. 1.2 Matrices: Matrices, algebra of matrices, transpose, value of determinant of matrix of order 3x3, adjoint and inverse of matrices. 1.3Matrices: Solution of simultaneous equations by matrix inversion method. 1.4 Partial Fractions: Types of partial fractions based on the nature of factors and related Problems. 1.5 Algebra in Indian Knowledge System: Solution of simultaneous equations (Indian Mathematics).	Improved Lecture Tutorial Assignment Demonstration Simulation	CO1

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Sr. No.	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	UNIT-II TRIGONOMETRY (CL Hrs-16, Marks-14)			
2	TLO 2.1: Apply the concept of Compound angle, allied angle, and multiple angles to solve the given simple engineering problem(s). TLO 2.2: Apply the concept of Sub-multiple angle to solve the given simple engineering-related problem(s). TLO 2.3: Apply the concept of factorization and de-factorization formulae to solve the given simple engineering problem(s). TLO 2.4: Investigate given simple problems by utilizing inverse trigonometric ratios. TLO 2.5: Use concepts given in Ancient Indian Mathematics for trigonometry to solve given problems.	2.1 Trigonometric ratios of allied angles, compound angles, multiple angles (2Λ, 3Λ), and submultiples angles (without proof). 2.2 Factorization and De factorization formulae (without proof). 2.3 Inverse Trigonometric Ratios and related problems. 2.4 Principal values and the relation between trigonometric and inverse trigonometric ratios. 2.5 Trigonometry in Indian Knowledge System: The Evolution of Sine Function in India. 2.6 Indian Trigonometry: Basic Indian Trigonometry - Introduction and Terminology (From Ancient Beginnings to Nilakantha). 2.7 Trigonometry in Indian Knowledge System: Pythagorean triples in Sulabasutras.	Improved Lecture Tutorial Assignment Demonstration Simulation	CO2
	UNIT-III STRAIGHT LINE (CL Hrs-06, Marks-08)			
3	TLO 3.1 Calculate the angle between given two straight lines. TLO 3.2 Formulate equation of straight lines related to given engineering problems. TLO 3.3 Identify the perpendicular distance from the given point to the line. TLO 3.4 Calculate theperpendicular distance between the given two parallel lines. TLO 3.5 Use geometry given in Sulabasutras to solve the given problems.	3.1 Straight line and slope of a straight line: The angle between two lines Condition of parallel and perpendicular lines 3.2 Various forms of straight lines: a. General form b. Slope-point form c. Slope-intercept form d. Two-point form e. Double intercept form 3.3 Perpendicular distance from a point on the line 3.4 Perpendicular distance between two parallel lines 3.5 Geometry in Sulabasutras in Indian Knowledge System: a. Construction of square b. Circling the square	Improved Lecture Tutorial Assignment Demonstration Simulation	CO3

Sr. No.	Theory Learning Outcomes (TLO'S) aligned to CO's.	Learning content mapped with TLO's.	Suggested Learning Pedagogies	Relevant COs
	UNIT- IV DIFFERENTIAL CALCULUS (CL Hrs-16, Marks-20)			
4	TLO 4.1: Solve the given simple problems based on functions. TLO 4.2: Solve the given simple problems based on rules of differentiation. TLO 4.3: Obtain the derivatives of composite, implicit, parametric, inverse, logarithmic, and exponential functions. TLO 4.4: Apply the concept of differentiation to find the given equation of tangent and normal. TLO 4.5: Apply the concept of differentiation to calculate maxima, minima, and radius of curvature for a given function. TLO 4.6: Familiar with the concept of calculus given in Indian Mathematics.	4.1 Functions and Limits: Concept of function and simple examples. 4.2 Functions and Limits: Concept of limits without examples. 4.3 Derivatives: Rules of derivatives such as sum, product, and quotient of functions. 4.4 Derivatives: Derivative of composite functions (chain rule), implicit and parametric functions. 4.5 Derivatives: Derivatives of inverse, logarithmic, and exponential functions. 4.6 Applications of derivative: Second-order derivative without examples, equation of tangent and normal, maxima and minima, radius of curvature. 4.7 Calculus in Indian Knowledge System: The Discovery of Calculus by Indian Astronomers.	Improved Lecture Tutorial Assignment Demonstration Simulation	**CO4**
	UNIT –V STATISTICS (CL Hrs-10, Marks-14)			
5	TLO 5.1: Obtain the range and coefficient of range of the given grouped and ungrouped data. TLO 5.2: Calculate the mean and standard deviation of ungrouped and grouped data related to the given simple engineering problem(s). TLO 5.3: Determine the variance and coefficient of variance of given grouped and ungrouped data. TLO 5.4: Justify the consistency of given simple sets of data.	5.1 Range, coefficient of range of discrete and grouped data. 5.2 Mean deviation and standard deviation from the mean of grouped and ungrouped data. 5.3 Variance and coefficient of variance. 5.4 Comparison of two sets of observation.	Improved Lecture Tutorial Assignment Demonstration Simulation	**CO5**

V. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL/TUTORIAL EXPERIENCES.

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
1	LLO 1.1: Solve simple problems of Logarithms based on given applications.	Logarithm and applications.	2	CO1
2	LLO 2.1: Solve elementary problems on Algebra of matrices for branch-specific engineering-related applications.	Algebra of matrices	2	CO1
3	LLO 3.1: Apply the concept of matrix to solve engineering problems.	Simultaneous Equations using the inversion method.	2	CO1
4	LLO 4.1: Apply the concept of matrix to solve engineering problems.	Matrix Inversion method to determine currents.	2	CO1
5	LLO 5.1: Apply the concept of matrix to solve engineering problems.	Inverse of a non-singular matrix.	2	CO1
6	LLO 6.1: Apply the concept of partial fractions to solve engineering problems.	Partial fractions.	2	CO1
7	LLO 7.1: Solve problems on Compound, Allied, multiple and sub-multiple angles for related shapes.	Compound, Allied, multiple, and sub-multiple angles.	2	CO2
8	LLO 8.1: Utilize the concept of trigonometry to solve engineering problems.	Factorization and de-factorization formulae.	2	CO2
9	LLO 9.1: Utilize the concept of trigonometry to solve engineering problems.	Inverse trigonometric ratios.	2	CO2
10	LLO 10.1: Solve branch-specific engineering problems under given conditions of straight lines.	Equation of straight lines using different forms.	2	CO3
11	LLO 11.1: Solve branch-specific engineering problems under given conditions of straight lines.	Perpendicular distance, distance between two parallel lines, and angle between two lines.	2	CO3
12	LLO 12.1: Solve branch-specific engineering problems under given conditions of straight lines.	Use of a straight line to calculate the speed, distance, and time of a moving object.	2	CO3
13	LLO 13.1: Apply the concept of derivative to solve engineering problems.	Derivatives of implicit functions and parametric functions.	2	CO4
14	LLO 14.1 - Apply the concept of derivatives to solve engineering problems.	Derivative of logarithmic and exponential functions.	2	CO4
15	LLO 15.1 - Apply the concept of the equation of tangent and normal to solve engineering problems.	Equation of tangent and normal.	2	CO4

Sr. No	Practical/Tutorial/Laboratory Learning Outcome (LLO)	Laboratory Experiment / Practical Titles /Tutorial Titles	Number of hrs.	Relevant COs
16	LLO 16.1 - Apply the concept of maxima, minima, and radius of curvature to solve engineering problems.	Maxima, minima of function and radius of curvature.	2	CO4
17	LLO 17.1 - Apply the concept of the equation of tangent and normal to solve engineering problems.	Concept of tangent and normal to solve the given problems of Engineering Drawing.	2	CO4
18	LLO 18.1 - Apply the concept of maxima and minima to solve engineering problems.	Maxima and Minima to obtain optimum value.	2	CO4
19	LLO 19.1 - Apply the concept of the radius of curvature to solve engineering problems.	Radius of curvature.	2	CO4
20	LLO 20.1 - Utilize the concept of derivatives to solve engineering problems.	Use of derivative to find the slope of a bending curve.	2	CO4
21	LLO 21.1 - Use the concept of range and mean deviation to crack branch-specific problems.	Range, coefficient of range and mean deviation.	2	CO5
22	LLO 22.1 - Use the concept of standard deviation and coefficient of variance to crack branch-specific problems.	Standard deviation, coefficient of variation and comparison of two sets.	2	CO5
23	LLO 23.1 - Use the concept of standard deviation to crack branch-specific problems.	Standard Deviation for Concrete with the given data.	2	CO5

Note: 1.Take any15 tutorials out of 23 and ensure that all the units are covered.
2.Take the tutorial in a batch size of 20 to 30 students.
3.Give students at least 10 problems to solve in each tutorial.

VI. SUGGESTED MICROPROJECT/ASSIGNMENT/ACTIVITIES FOR SPECIFIC LEARNING/SKILLS DEVELOPMENT (SELF-LEARNING).

Micro-project

- **Matrix Inversion Function:** Create a function that takes a matrix as input and returns its inverse matrix if it exists. You can implement this using various programming languages like Python, and libraries like NumPy can be helpful.
- **Variance and Coefficient of Variance Calculation**: Collect data on marks obtained by your class in a mid-term test. Compute the variance and coefficient of variance of the data. Interpret the results using free open-source software like Orange, which is a data visualization and analysis tool.
- **Cryptography Using Matrices**: Prepare models using matrices to solve simple problems based on cryptography. You can explore techniques like matrix multiplication for encryption and decryption.
- **Data Analysis Models**: Collect data on quality control analysis, energy efficiency assessment, environmental monitoring, and process optimization. Analyze the data, calculate variance and standard deviation, and create a presentation, including short videos, to present your findings.
- **Geometric Models**: Prepare models using the concept of tangent and normal bending of roads in case of sliding of a vehicle. Express these geometric models using any open-source software suitable for geometry visualization.
- **Radius of Curvature in Railway Tracks**: Create models using the concept of the radius of curvature in

railway track design. Express these models geometrically through any open-source software suitable for geometry visualization.

- **Maxima and Minima Model**: Design a model for a window in the form of a rectangle surmounted by a semicircular opening. Optimize the total perimeter of the window to admit maximum light through the whole opening using the concept of maxima and minima. Verify the result mathematically.
- **Trigonometric Waveform Visualization**: Visualize trigonometric waveforms and create animations using sine or cosine functions. Use software or programming languages like Python with libraries such as Matplotlib to create these visualizations.
- **Trigonometric Function Calculator**: Develop a program for a trigonometric function calculator that computes sine, cosine, and tangent values. This can be implemented as a simple command-line tool or a graphical calculator application.
- **Applications of Radius of Curvature**: Collect and present applications of the radius of curvature in various fields such as lens design, optics, mirror properties, road design, structural analysis, roller coaster track design, and composite material manufacturing in a 5-minute video presentation.
- **Engineering Problems with Trigonometry**: Prepare models using trigonometry based on at least 10 engineering problems. Apply trigonometric principles to calculate angles, distances, forces, and dimensions relevant to the chosen area and create a poster presentation.
- **Determinant-Based Area Calculation**: Create charts and use determinants to find the area of regular shapes. You can use software like MATLAB, Python, or even manual calculations.
- **Matrix-Based Math Game**: Design a puzzle and create a math game based on matrix operations. Develop a grid of numbers and operations for players to solve using matrix manipulation rules.
- **Musical Composition with Matrices**: Use matrices as a tool for music composition. Assign different musical elements (notes, chords, rhythms) to matrix elements and experiment with combining and transforming matrices to create unique musical compositions. You can use music notation software or traditional instruments to bring your compositions to life.

Assignment

- Collect examples based on real-world applications of logarithms and prepare a PDF file.
- Solve the simultaneous system of equations in two variables by Matrix Inversion Method. Write down a mathematical program using any open-source software to verify the result.
- Collect examples of coding theory using applications of matrices and prepare a PDF file.
- Represent the Graph of the Trigonometric function and logarithmic function on Geogebra and interpret the nature of the graph. Make a PDF file.
- Measure the height of trees in surrounding locations using trigonometry and prepare a presentation.
- Find the derivative of y = x^sinx and visualize the graph of the function and its derivative using any open-source software geometrically.
- Find the height of the room or distance between two pillars by using the concept of a straight line.
- Collect at least 10 examples based on real-world applications of standard deviation/variance.
- Collect at least 10 examples based on real-world uses of applications of derivatives.

VII. LABORATORY EQUIPMENT/INSTRUMENTS/TOOLS/SOFTWARE REQUIRED

Sr. No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Open-source software like SageMaths, MATHS3D, GeoGebra, Graph, DPLOT, and Graphing Calculator (GraphEq2.13),ORANGE can be used for Algebra, Calculus, Trigonometry and Statistics respectively.	All

VIII.SUGGESTED FOR WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Algebra	CO1	12	2	6	6	14
2	II	Trigonometry	CO2	16	2	6	6	14
3	III	StraightLine	CO3	6	2	2	4	8
4	IV	Differential Calculus	CO4	16	2	8	10	20
5	V	Statistics	CO5	10	2	6	6	14
Grand Total				**60**	**10**	**28**	**32**	**70**

IX. ASSESSMENT METHODOLOGIES/TOOLS

Formative assessment (Assessment for Learning)	Summative Assessment (Assessment of Learning)
1. Tests 2. Rubrics for COs 3. Assignment 4. Self-Learning	1. End Term Exam 2. Micro-project

X. SUGGESTED COS- POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes*(PSOs)		
	PO-1 Basic and Discipline-Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	1	-	1	-	1	1			
CO2	3	1	-	-	1	1	1			
CO3	3	-	-	-	-	-	-			
CO4	3	1	1	1	-	1	-			
CO5	3	2	1	1	1	1	1			

Legends:-High:03, **Medium**:02, **Low**:01, **No Mapping:** -
*PSOs are to be formulated at the institute level

XI. SUGGESTED LEARNING MATERIALS/BOOKS

Sr. No	Author	Title	Publisher
1	Grewal B.S.	Higher Engineering Mathematics	Khanna publication New Delhi, 2013 ISBN: 8174091955

Sr. No	Author	Title	Publisher
2	Dutta D.	A textbook of Engineering Mathematics	New Age publication New Delhi,2006 ISBN: 978-81-224-1689-3
3	Kreysizg, Ervin	Advance Engineering Mathematics	Wiley publication New Delhi 2016 ISBN:978-81-265-5423-2
4	Das H. K.	Advance Engineering Mathematics	S Chand publication New Delhi 2008 ISBN: 9788121903455
5	Marvin L. Bittinger David J. Ellenbogen Scott A. Surgent	Calculus and Its Applications	Addison-Wesley 10th Edition ISBN-13:978-0-321-69433-1
6	C. S. Seshadri	Studies in the History of Indian Mathematics	Hindustan Book Agency, New Delhi110016. ISBN978-93-80250-06-9
7	George Gheverghese Joseph	Indian Mathematics Engaging with the World from Ancientto ModernTimes	World Scientific Publishing Europe Ltd. 57 ISBN 978-17-86340-61-0
8	Deepak Singh	Mathematics-I	Khanna Book Publishing Co.(P) Ltd. ISBN: 978-93-91505-42-4
9	Garima Singh	Mathematics-II	Khanna Book Publishing Co.(P) Ltd. ISBN: 978-93-91505-52-3
10	Gareth James, Daniela Witten, Trevor Hastie Robert and Tibshirani	An Introduction to Statistical Learning with Applications in R	Springer New York Heidelberg Dordrecht London ISBN 978-1-4614-7137-0 ISBN978-1-4614-7138-7 (eBook)
11	Gunakar Muley	Sansar Ke Mahan Ganitagya	First Edition,Rajkamal Prakashan, ISBN-10. 8126703571, ISBN-13.978-8126703579
12	T. S. Bhanumurthy	A Modern Introduction to Ancient Indian Mathematics	New Age International Private Limited, 1 January 2008 ISBN-10.812242600X, ISBN-13.978-8122426007
13	M. P.Trivedi and P.Y.Trivedi	Consider Dimension and Replace Pi	Notion Press;1stedition (2018), ISBN-978-1644291795

XIII. LEARNING WEBSITES & PORTALS

Sr. No	Link/Portal	Description
1.	http://nptel.ac.in/courses/106102064/1	Online Learning Initiatives by IITs and IISc
2.	www.scilab.org/-SCILab	Signal processing, statistical analysis and image enhancement.
3.	www.mathworks.com/product/matlab/-MATLAB	Applications of concepts of Mathematics to coding.
4.	SpreadsheetApplications	Use of Microsoft Excel, Apple Numbers and Google Sheets.

Sr. No	Link/Portal	Description
5.	https://ocw.mit.edu/	MIT Courseware
6.	https://www.khanacademy.org/math?gclid=CNqIIuabCys4CFdOJaddHoPig	Concept of Mathematics through video lectures and notes
7.	http://ocw.abu.edu.ng/courses/mathematics/	List of Mathematical Courses.
8.	https://libguides.furman.edu/oer/subject/mathematics	Open Education Resources (OER) in Mathematics.
9.	https://phet.colorado.edu/en/simulations/filter?subjects=math&type=html,prototype	Phet Simulation for Mathematics.
10.	https://libguides.cmich.edu/OER/mathematics	Mathematics with OER.

Name & Signature:

Shri. Vitthal B. Shinde
Lecturer in Mathematics

Shri. Sachin B. Yede
Lecturer in Mathematics

(Course Experts)

Name & Signature:	Name & Signature:
Dr. D. N. Rewadkar (Programme Head)	**Shri. S. B. Kulkarni** (CDC In-charge)