Manmohan Technical University
Service Commission
Curriculum of Open Competitive Examination
For the Post of Lecturer in **Mathematics**

Description of the post:

Service: Teaching	Group: Mathematics
Post: Lecturer, Mathematics	Level: Lecturer

Framework of the Curriculum:

The examinations are conducted in two phases as mentioned below:

First Phase: Written Exam   Full Marks: 150
Second Phase: (a) Qualification, Publications and Teaching Experience: Full Marks: 50
                        (b) Interview & Presentation: Full Marks: 50

Table No: 1
First Phase: Written Exam   Full Marks: 150

Paper	Subject	Full Marks	Pass Marks	Examination System	Number of Questions	Time
First	Teaching, Research and General Knowledge	50	25	MCQs	20	50 Minutes
	Subject Related Contents			MCQs	30	
Second	Subject, Research and Teaching Related Contents	100	50	Subjective Questions (short & long answer type)	14	3 Hours

Table No: 2
Second Phase: Interview   Full Marks: 100

Subject	Full Marks	Examination System	Remarks
Interview and Presentation	50	Oral and Very Short Presentation	
Evaluation of Documents	50	Observation and Marking	
Total	100		

Note:

1. This curriculum framework is divided into two phases.
2. Open/internal competitive examination will be held as mentioned above.
3. The medium of language in written exam will be Nepali or English or both Nepali+ English only.
4. Examinees are prohibited to take mobile phone, programmable calculator, smart watch or other similar electronics devices in the examination hall.
5. The marks of academic qualification, publications and teaching experiences in the concerned field will be evaluated before the time of interview. All the publications and related documents are to be submitted before the last date of application submission.
6. The marks are allotted for these documents as given below:

S. No	Documents	Full Marks
1	Academic qualification	30
2	Research publication	10
3	Teaching experience	10
	Total	50

7. The final result will be published on the basis of total marks of written exam, interview/ presentation, evaluation of academic qualification, research publications and teaching experiences.
8. In a subjective question, one or more than one questions can be included within the allotted marks area.
9. The full marks and weightage of questions are based on the given curriculum.
10. Research and problem solving types of questions will be selected from the related field.
11. This curriculum will be effective from the date of 2080/05/13

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Subject: Mathematics
Paper: First (Objective)
Objective (Multiple Choice) Questions

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Full Marks: 50
Pass Marks: 25
Time: 50 Minutes

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Part	Subject Matter	Number of Questions	Marks per Question	Total Marks
First Part	Teaching, Research and General Knowledge	20	1	20
Second Part	Subject Related Contents	30	1	30
Total		50		50

(Extention of the Curriculum) पाठ्यक्रमको विस्तृतीकरण

First Part: (Teaching, Research and General Knowledge)　　　　20×1=20

क) शिक्षण सीप, बिधि र विद्यार्थी मुल्याङ्कन (Teaching Skill, Methods and Evaluation):　(5)

विस्तृतिकरण	उच्च शिक्षा शिक्षणका लागि आवश्यक गुण, संचार सीप, शिक्षण बिधि र विद्यार्थी मुल्याङ्कन सम्बन्धी प्रश्नहरु ।
शीर्षक	थप विस्तृतिकरण
उच्च शिक्षा शिक्षणका लागि आवश्यक गुणहरु Required qualities for teaching in higher education:	उच्चशिक्षामा शिक्षणको लागि आवश्यक व्यक्तिगत, सामाजिक तथा पेशागत गुणहरुः (Required qualities for teaching in higher education: Individual, social and occupational/professional)
कक्षामा सञ्चार सीप (Communication Skill in the classroom)	सिकाइमा उत्प्रेरणा जगाउने तरिका र कक्षामा विषयवस्तुको प्रस्तुतिकरण सीपः (Motivational and presentation skills of subject matter in the classroom): भाषाको प्रयोग, विषयवस्तुको क्रमवद्धता, सिकारुमैत्री वातावरण निर्माण ।
शिक्षण बिधि (Teaching methods)	शिक्षण बिधिका अवधारणा र प्रयोगः (Concept and uses of teaching methods): • Demonstration method • Problem solving method • Discovery method • Project method • Practical /Experimental method • Field work method

विद्यार्थी मूल्याङ्कन (Student evaluation and assessment)	• सुधारात्मक, निर्णयात्मक तथा निदानात्मक मूल्याङ्कन (Formative, summative and diagnostic evaluation). • मूल्याङ्कनबाट प्राप्त जानकारीको प्रयोग (Using assessment information): निर्णय गर्नका लागि (For Decision making), सुधारका लागि पृष्ठपोषण (Feedback for improvement)।

(ख) Research Aptitude, Publication Ethics and Data Interpretation: (5)

Extention	• Meaning of research and its objectives, types and methods, • Research & publication ethics, • Types of data sources, access to data, availability of data and data presentation • Research based article, • Quality of journal • Dissertation/thesis framework

(ग) उच्च शिक्षा प्रणाली (Higher Education System) (5)

विस्तृतिकरण	नेपालको संविधानमा शिक्षा संबन्धी प्रावधानहरु, नेपालको शिक्षा प्रणाली, नेपालमा उच्च शिक्षाको वर्तमान अवस्था, उच्च शिक्षा नीति ।
नेपालको संविधानमा शिक्षा संबन्धी प्रावधानहरु, नेपालको शिक्षा प्रणाली, नेपालमा उच्च शिक्षाको वर्तमान अवस्था, उच्च शिक्षा नीति ।	● नेपालको संविधानमा शिक्षा संबन्धी प्रावधानहरु: • नेपालको शिक्षा प्रणाली: शिक्षाको संरचना, औपचारिक र अनौपचारिक प्रणाली । • उच्च शिक्षामा प्राविधिक विषयको आवश्यकता • विश्वविद्यालय अनुदान आयोगका प्रमूख कार्यहरु तथा यसबाट विश्व विद्यालयहरुलाई दिइने अनुदानका प्रकार । • उच्च शिक्षा नीति ।

(घ) मनमोहन प्राविधिक विश्वविद्यालय सम्वन्धी जानकारी (Information on Manmohan Technical University) (5)

विस्तृतिकरण	म. प्रा. वि. ऐन, नियम तथा सांगठनिक स्वरुप सम्बन्धी प्रश्नहरु ।
४.१ मनमोहन प्राविधिक विश्वविद्यालय ऐन, २०७६	
४.२ मनमोहन प्राविधिक विश्वविद्यालय शिक्षक तथा कर्मचारीको सेवाका सर्त र सुविधासम्बन्धी नियमावली, २०७८	
४.३ मनमोहन प्राविधिक विश्वविद्यालय शैक्षिक प्रशासन नियमावली, २०७८	
४.४ मनमोहन प्राविधिक विश्वविद्यालय सेवा आयोग सम्वन्धी नियमावली, २०७८	
४.५ मनमोहन प्राविधिक विश्वविद्यालय परीक्षा सम्वन्धी नियमावली, २०७८	

Subject: Mathematics
Paper: First
First Part: Teaching, Research and General Knowledge

Sample Questions (MCQs)   **20×1=20**
(20 MCQs are asked from the contents of the First Part. Each question carries one mark.)

Tick the best answer for the following questions from the given alternatives:

1. In the context of higher education, which of the followings is the most important role of a good teacher?
   A) An evaluator of students in the class
   B) A guide liner, analyzer and synthesizer of related information effectively
   C) Innovator and Creator
   D) **Effective communicator**

2. Which of the following assessment techniques is used to evaluate a student's progress and give feedback?
   a) Summative
   b) **Formative**
   c) Decisive
   d) Diagnostic

3. Which one is not a part of research proposal?
   a) Methodology
   b) Objectives
   c) **Recommendations**
   d) References

4. Which one is not a tool of data collection in engineering education?
   A) Campaigning
   B) Questionnaire
   C) Focus group discussion
   D) Participatory rural appraisal

5. The main mandate of the University Grants Commission (UGC) Nepal includes:
   A) **Disbursing grants to universities and colleges**
   B) Recognizing and monitoring technical institutions
   C) Funding research centers in universities
   D) Managing various scholarship programs

6. The main present structure of education in Nepal is:
   i   Primary, secondary and higher level
   ii Pre-primary, Primary, basic, secondary, Higher and Research level
   iii Primary, Secondary, Higher and Research level
   iv **Basic, secondary and Higher level**

7. Which of the following statements is the most appropriate in terms of online education?
   a. It supplements formal education
   b. It reduces the cost of education
   c. It replaces the formal education
   d. **It enhances access to education in low cost and short time.**
8. Which of the following officials is not a member of the academic council of MTU?
   a. Representative of the industrial institute
   b. Teacher representative of MTU
   c. **Member of the service commission of MTU**
   d. Representative from the subject specialist
9. In which of the following case salary is discontinued to a teacher if he/she should be punished?
   a. If he/she frequently denied the code of conduct of teacher
   b. If he/she disclosed the secrecy of the university
   c. If he/she has not got clearance of his/her advance amount taken from the MTU
   d. **If he/she frequently denied and neglected the appeals of stakeholders**
10. Which one of the following statements is true?
    a. Curriculum and syllabus are equivalent components.
    b. Syllabus has a wide scope than curriculum.
    c. **Curriculum is a broad term and syllabus is a part of curriculum.**
    d. Syllabus includes many activities as compare to the curriculum

Sample Questions
(30 MCQs are asked from the Contents of Group A of the Second Paper)

Tick the best answer for the following questions from the given alternatives:

1. The value of $\int_0^\infty e^{-x^2} dx$ is equal to

    b. $\sqrt{\pi}$ b. $\frac{1}{2}\sqrt{\pi}$

    c. $\frac{\pi}{2}$ d.π

1. The coordinates of the center of the conic

    $8x^2 + 4xy + y^2 - 24(x + y) = 0$ is

    a.$(1,2)$ b. $(3,2)$

    c.$(4,5)$ **d.**$(2,3)$

2. If $A = \begin{bmatrix} 0 & -1 & 2 \\ 1 & 0 & 3 \\ -2 & -3 & 0 \end{bmatrix}$ then A+2 A^T equals to

    a.   **A^T**   b. -A^T

    c. A   d.2A^2

4. The value $\oint \frac{dz}{z^3(z+4)}$ along anticlockwise around the circle $|z| = 2$ is

    a.$\frac{\pi i}{16}$ b.$\frac{\pi i}{32}$ c.0   d.$\frac{\pi i}{4}$

5. The Laplace transform of $(\frac{sint}{t})$i.e.$\mathcal{L}(\frac{sint}{t})$ is equal to

    a.$\tan^{-1}(\frac{1}{s})$ b.$\sin^{-1}(\frac{1}{s})$ c. $\cos^{-1}(\frac{1}{s})$ d.$\frac{1}{1+s^2}$

6. The value of $\lim_{n\to\infty} (\frac{1}{n} + \frac{n^2}{(n+1)^{(3)}} + \frac{n^2}{(n+2)^3} ... + \frac{1}{8n})$ is   equal to

    a.$\frac{3}{4}$ b.$\frac{5}{8}$ c.0   d.$\frac{3}{8}$

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Subject: Mathematics
Paper: Second (Subjective)

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| Full Marks: 100 |
| Pass Marks: 50 |
| Time: 3 Hours |

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Group: A
Knowledge of the Subject Matter and its Analysis: 60

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Questions on this part are included from the types as given below:

Question Types	Number of Questions	Per Question Marks	Total Marks
Long Questions	3	10	30
Short Questions	6	5	30
Total	9	-	60

Unit 1: Differential and Integral Calculus with Applications: (10)

1.1 Higher Order Derivatives; Leibnitz's Theorem and its Application

1.2 Mean Value Theorems and Power Series Expansions: Rolle's Theorem, Lagrange's Mean Value Theorem, Cauchy's Mean Value Theorem; Power Series Expansion of Single Valued Function; Methods of Expansion ;Taylor's Series and Maclaurin's Series

1.3 Indeterminate Forms: L'Hospital's Rule

1.4 Asymptotes to Cartesian and Polar Curves

1.5 Pedal Equations and Curvature: Pedal Equations to Cartesian and Polar Curves, Curvature and Radius of Curvature, Chord of Curvature

1.6 Properties of Definite Integrals

1.7 Improper Integrals: Types of Improper Integrals, Cauchy's Principal Value

1.8 Differentiation under Integral Sign:

1.9 Reduction Formulas and Beta-Gamma Functions

1.10 Application of Definite Integrals: To find Areas and Arc Lengths, Surface and Volume of Solid of Revolution for Cartesian and Polar Curves

1.11 Ordinary Differential Equations and their Applications:

    1.11.1 First Order and First-Degree Differential Equations: Variable Separation Method and Change of Variable; Homogeneous Differential Equations, Linear Differential Equations; Integrating Factors; Equations Reducible to Linear Differential Equations (Bernoulli's Equation)

    1.11.2 First Order and Higher Degree Differential Equation: Differential Equation of the Form f(x,y,p)=0. where $p = \frac{dy}{dx}$. Solvable for p, y and x; Clairaut's Equation

1.11.3 Second Order and First Degree Linear Differential Equations: Linear Differential Equations with Constant Coefficients, Linear Differential Equations with Variable Coefficients; Cauchy's Equations

1.11.4 Applications of Differential Equations in Related Engineering Fields

Unit 2: Calculus of Two or more Variables and Multiple Integrals: (5)

2.1 Introduction: Limit, Continuity and Derivatives

2.2 Partial Differentiation: Functions of two and three variables; Partial derivatives of second and higher orders, Homogeneous functions; Euler's Theorems on homogeneous functions of two and three variables; Total derivatives; Implicit function.

2.3 Extrema of functions of two and three variables: Maximum and minimum values; Necessary and sufficient conditions for extreme values for function of two variables.

2.4 Criteria for extreme values of function of three variables: Lagrange's multiplier method

2.5 Multiple Integrals:

2.5.1 Introduction: Review of formula and methods of integration; Curve sketching

2.5.2 Double Integrals with applications: Evaluation of double integrals in Cartesian and Polar form; Change of order of integration; Change of variables

2.5.3 Triple Integrals with applications: Triple integrals in Cartesian, Cylindrical and Spherical coordinates; Dirichlet's integral.

Unit 3: Infinite Series, Differential Equations in Series, Solution and Special Functions: (10)

3.1 Introduction of Infinite sequence; Convergent and divergent sequences, Series with Positives terms; Alternating series

3.2 Test of Convergence: Harmonic series or p-series; Limit comparison test, D'Alembert's ratio test, Root test and Integral test; Absolute convergence; Radius and Interval of Convergence

3.3 Solution of Differential Equation: Power series method; Ordinary and singular points; Frobenious method

3.4 Legendre's Equation: Legendre polynomial function, Properties and applications; Generating function for $P_n(x)$; Recurrence relations for Legendre's functions

3.5 Bessel's Equation: Bessel's function of first and second kind, Properties and applications, Linear dependence of Bessel's function $j_n(x)$ and $j_{-n}(x)$;Recurrence relation for Bessel's function

3.6 Simultaneous Differential Equations: Differential equations with an independent variable and two dependent variables; Simultaneous equations of the type $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$

Unit 4: Vector Algebra and Calculus, Vector Integral Calculus, Integral Theorems: **(5)**

   4.1 Introduction: Two- and Three-dimensional vectors, Product of two vectors
   4.2 Product of Three and more Vectors, Reciprocal System of Vectors : Scalar triple product, Geometrical meaning and properties of scalar triple product; Vector triple product, Geometrical meaning and expression of vector triple product; Scalar product and vector product of four vectors, Properties of Reciprocal System of vectors
   4.3 Vector Calculus: Scalar and vector fields, Derivative of vector functions, Higher order derivatives, Techniques of differentiation of vector functions, Velocity and acceleration, Partial derivatives of vector functions, Integration of vector functions;Techniques of integration of vector functions
   4.4 Gradient, Divergence and Curl: Point functions, Vector differential operator Gradient, Directional derivatives; Divergence and its physical interpretation; Curl and its physical interpretation; Vector differential operator applied to products of point functions; Second order differential operator
   4.5 Vector Integral Calculus, Integral Theorems: Line integral and evaluation of line integral; Line integrals independent of path; Green's theorem in the plane; Surface integral; Triple integral; Divergence theorem of Gauss (without proof), Stoke's theorem (without proof)

Unit 5: Plane Analytic and Three-Dimensional Solid Geometry: **(5)**

   5.1 Transformation of Coordinates: Translation and Rotation
   5.2 Ellipse and Hyperbola; Standard Forms, Tangent and Normal
   5.3 General Equation of Conics in Cartesian and Polar Forms
   5.4 The Straight Line: Symmetric and General form of straight line, Coplanar lines, Angle between a line and a plane, Plane containing the line, Shortest distance
   5.5 The Sphere: Equation of sphere in central form and general form, Plane Section of a sphere by planes, Tangent Planes and lines to the spheres
   5.6 Cone and Cylinder: Generation of cone and cylinder, Right circular cone, Right circular cylinder

Unit 6: Determinants and Matrices: **(5)**

   6.1 Properties of determinants
   6.2 Some special matrices and complex matrices

6.3 Rank of matrix

6.4 System of linear equations

6.5 Vector spaces, Linear dependence and independence of vectors, linear transformations, orthogonal transformations.

6.6 Characteristics equations, Eigen values, and Eigen Vectors

6.7 Cayley-Hamilton Theorem

6.8 Diagonalization of matrices

Unit 7: Laplace Transform and Fourier Series: (5)

7.1 Laplace Transform: Laplace transform and its properties; Laplace transforms of some elementary functions; First shifting theorem; Unit step function; Second shifting theorem; Dirac's Delta function; Inverse Laplace Transform; Laplace transform of Derivatives and Integrals; Convolution theorem; Application of Laplace transform to differential equation

7.2 Fourier Series: Periodic functions; Fourier series of odd function; Euler's formula to determine the Fourier coefficient; Fourier series for Arbitrary range (-L,L); Half range Fourier series

Unit 8: Linear Programming: (5)

8.1 Introduction and The standard form of linear programming problem

8.2 Mathematical formulation of the linear programming problem

8.3 Simplex method and Artificial variables (Big M-method, Two phase method)

8.4 Concept of duality and Formulation of dual linear programming problem

Unit 9: Complex Variable: (10)

9.1 Introduction: Conjugates of complex numbers, Algebraic properties with geometrical interpretation, Roots of complex numbers

9.2 Analytic Functions: Limits and derivatives of functions of complex numbers; Analytic functions, Cauchy Riemann equations, and its polar form; Harmonic functions and its conjugates

9.3 Conformal mapping: Some standard transformations; conformal mapping and linear fractional transformations, Constructing transformal mappings between given domain (Schwarz-christoffel mapping)

9.4 Integral in complex plane: Line integral and its problems; Cauchy's integral theorem and cauchy's integral formula, Cauchy's and Liouville's inequalities

9.5 Complex power series: Function represented by power series; Taylor series of elementary functions, Laurent series; Analyticity at infinity; Zeros, singularities; Cauchy residue theorem

Group: B
Subject Related Research and Problem Solving: 20

Questions on this part are included from the types as given below:

Question Types	Number of Questions	Per Question Marks	Total Marks
Long Questions	2	10	20
Total	2		20

1. **Research Aptitude, Publication Ethics and Data Interpretation:** **(10)**
   Meaning of research and its objectives, types and methods, Research publication ethics, Process of data collection, availability of data and it's presentation, Research based articles, Process of preparation and publication of qualitative journal and its framework, Dissertation/ thesis framework, Analyze the existing problems and suggest solutions

2. **Problems and Their Solutions in Related Field:** **(10)**
   Identify problems, issues and challenges in related field, Latest trends, issues and challenges in the field of related Subject and suggest appropriate means and ways of solutions to overcome these issues

Group: C
Teaching Related Contents: 20

Questions on this part are included from the types as given below:

Question Types	Number of Questions	Per Question Marks	Total Marks
Long Questions	1	10	10
Short Questions	2	5	10
Total	3		20

1. **Curriculum and Teaching Plans:** **(10)**
   General information on curriculum, Analysis, suggestions and Preparation of Bachelor level curriculum of MTU in related subject and its frame work, General information, importance, preparation and implementation of instructional plan, unit plan and daily lesson plan

2. **Teaching Skill, Methods and Evaluation:** **(10)**
   Required qualities for teaching in higher level: Individual, social and occupational/ professional, Communication Skill: motivation and presentation of subject matter in the classroom, Teaching methods: Demonstration method, Problem solving method, Discovery method, Project method, Practical/Experimental method, Field work method, Student Evaluation and Assessment: Formative, summative and diagnostic evaluation, Using assessment information for decision making and feedback for improvement

Subject: Mathematics
Paper: Second
Sample Questions: (long and short answer types)

Full Marks: 100
Pass Marks: 50
Time: 3 Hours

Attempt all questions
Group: A (30+30=60)

Long answer type questions: **3×10=30**

1. Define singularity of a function f(z) and write types of singularity with their examples. Classify the singularity of the function. f(z) $= \frac{SinZ}{cos(z^3)-1}$ at z = 0 and calculate the residue at the point.   (1+3+1+5)
2. Solve the following differential equations: (5+5)
    (i) $(D^2 - 4D + 4) = 8(e^{2X} + sin2x)$
    (ii) $2x(x+1)y^{II} + 3(x+1)y^I - y = 0$ (by Frobenius method)
3. Solve the problem: (3+3+2+2)
    A tank initially holds 50 Litres of water with 5 kg of salt dissolved in   it . A salt solution with concentration of 0.2kg/L flows into the tank at a rate 3L/min. The mixture is stirred uniformly and flows out at a rate of 3L/min. Let x be   the amount   of salt in tank after t minutes.
    a. Write the differential equation that describes scenario.
    b. Solve the differential equation to find x in terms of t.
    c. Calculate the amount of salt in the tank after 3 minutes.
    d. Sketch the graph of x against t.

Short answer type Questions   **6×5=30**

4. Find the equation of the cone formed by rotating the line   (5)
    $2x + 3y = 6, z = 0$ about y axis
5. Solve the following differential equation by using Laplace method   (5)
    $y^{III} + y^{II} = e^t + t + 1$, $y(0) = y^I(0) = y^{II}(0) = 0$
6. Show that $curl(\psi\nabla\emptyset) = \nabla\psi \times \nabla\emptyset$ (5)
7. Evaluate: $\iiint z^2 dx\, dy\, dz$ taken over the region common to the surface $x^2 + y^2 + z^2 = a^2$ and $x^2 + y^2 = ax$.   (5)
8. Find the maximum and minimum values of the function $f(x,y,z) = x^2 + y^2 + z^2$ under the condition: $\frac{x^2}{4} + \frac{y^2}{5} + \frac{z^2}{25} = 1$ and $z = x + y$.   (5)
9. Find the eigen values and associated eigen vectors of the matrix   (5)
    $$A = \begin{bmatrix} 7 & 0 & -3 \\ -9 & -2 & 3 \\ 18 & 0 & -8 \end{bmatrix}$$

Group: B (2×10=20)

10. What is research proposal? What are its components? Write a brief research proposal in any topic of mathematics on the area of your interest. (2+2+6)
11. One problem solving type of question from the related field . (10)

Group: C (10+5+5) =20

12. Find the strong and weak points of Bachelor Level curriculum of Mathematics that has been introduced in MTU and give your opinions to update it. (5+5)
13. Write any five suitable methods for teaching in Mathematics? Which one of them is the best in Bachelor level? Justify with appropriate reasons. (5)
14. Prepare one period's lesson plan for the students of Bachelor Level studying in MTU on a topic of Mathematics. (5)