

# **DEPARTMENT OF BASIC SCIENCES AND RELATED STUDIES**

# Annexure-A

# **BS-Mathematics**

# (Scheme & Courses)

Total Credit hours for four years 129

# Curriculum Structure

Duration	4 Years
Semesters	8
Courses	43
Total Credit Hours	129

First ye	First year				
First Se	mester				
<b>S.</b> #	Course Title	Course Code	Cr. Hr	Marks	
1	Calculus-I	MATH 105	3	100	
2	Set Theory	MATH 110	3	100	
3	Functional English	ENG 101	3	100	
4	Islamic Studies/Ethics	IS 111/ SS 104	2	50	
5	Physics-I	MEBP 101	3	100	
6	Introduction to Computers	CS 130	3	100	
		Total	17	550	

First year				
Second S	Semester			
<b>S.</b> #	Course Title	Course Code	Cr. Hr	Marks
1	Calculus II	MATH 150	3	100
2	Discrete Mathematics & Graph Theory	MATH 155	3	100
3	Statistics & Probability	MATH 160	3	100
4	Communication Skills	ENG 102	3	100
5	Pakistan Studies	PS 106	2	50
6	Physics-II	EL 127	3	100
		Total	17	

#### MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES

Title of Subject:	<u>Calculus-I</u>
Discipline:	Mathematics
Code:	MATH 105
Pre-requisites:	Intermediate
Assessment:	20% Sessional work, 20% Mid Examination, and 60% Final Examination
<b>Credit Hours:</b>	03+00 Marks: 100
<b>Minimum Contact</b>	Hours: 45+00

#### **Course Learning Outcomes (CLOs):**

Upon successful completion of the course, the student will be able to:

CLO	Description	Maximum Taxonomy Level	PLOs
1	Explain the concept of functions, limit, and continuity	C3	1
	including graphical implementation		
2	Find the derivatives and use them for real-life problems	C3	2
3	Explain concept of integration and apply substitution rule	C3	1

#### **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

#### **Course Contents**

**Functions and graphs:** Introduction to mathematical functions. Domain and range of a function with examples. Polynomial, rational, irrational, and absolute functions, and evaluation of such functions. Operations with functions: sum, product, quotient, and composition. Graphs of functions: linear, quadratic and piece-wise functions.

**Limits and continuity:** Functions, limit of a function. Graphical approach. Properties of limits. Theorems of limits. Limits of polynomials, rational and transcendental functions. Limits at infinity, infinite limits, and one-sided limits. Continuity and discontinuity of function.

**Derivatives:** Definition, techniques of differentiation. Derivatives of polynomials rational, exponential, logarithmic, trigonometric, and hyperbolic functions. The chain rule. Implicit differentiation. Rates of Related rates. Linear approximations and differentials. Higher derivatives, Leibnitz's theorem.

**Applications of derivatives:** Increasing and decreasing functions. Relative extrema and optimization. First derivative test for relative extrema. Convexity and point of inflection. The second derivative test for extrema. Asymptotes and radius of curvature. Rolle's and Mean value theorems. Maclaurin and Taylor series. Indeterminate forms and L'Hôpital's rule. Inverse functions and their derivatives.

Res. No. 02, Res. No. 04 Res. No 94.11(a)

**Integration**: Anti derivatives and integrals. Riemann sums and the definite integral. Properties of Integral. The fundamental theorem of calculus. The substitution rule.

#### **Recommended Books (latest edition):**

1. Stewart, J., Clegg, D. K., & Watson, S. (2020). *Calculus: early transcendentals*. Cengage Learning.

2.Zill, D., & Wright, W. S. (2009). *Calculus: early transcendentals*. Jones & Bartlett Learning.

3. Thomas, G. B., Weir, M. D., & Hass, J. (2013). *Thomas' Calculus: Single Variable*. Pearson.

4.Zill, D. G., & Dewar, J. M. (2015). *Precalculus with calculus previews*. Jones & Bartlett Publishers.

5. Anton, H., Bivens, I. C., & Davis, S. (2016). *Calculus: Early Transcendental Single Variable*. John Wiley & Sons.

6. Penney, D. E., & Edwards, C. H. (1994). *Calculus and Analytic Geometry*. Prentice-Hall International.

7. Larson, R., & Edwards, B. H. (2010). *Calculus: Early transcendental functions*. Cengage Learning.

8.Zill, D. G. (2020). Advanced engineering mathematics. Jones & Bartlett Publishers.
9.Greenwell, R. N., Lial, M. L., & Ritchey, N. P. (2017). Calculus with applications.
Pearson Education.

10. Stewart, J., Clegg, D. K., & Watson, S. (2020). *Multivariable calculus*. Cengage Learning.

11. Zill, D. G., & Wright, W. S. (2009). *Multivariable Calculus*. Jones & Bartlett Publishers.

# MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO

DEPA	<u>KIMENI OF BASIC S</u>	CIENCE AND RELATED STUDIES
Title of Subject:	Set Theory	<b>Marks: 100</b>
Discipline:	Mathematics	
Code:	MATH 110	
<b>Pre-requisites:</b>	Intermediate	
Assessment:	20% sessional work,	20% midterm, 60% final examination
<b>Credit Hours:</b>	03	Minimum Contact Hours: 45

Objectives: To give advanced idea of sets

#### **Course Learning Outcomes**

After completion of this course the student should be able to:

CLO	Description	Maximum Taxonomy Level	PLOs
1	Understand basic concepts of sets and their properties	C2	1
2	Describe relations and functions with types	C2	1
3	Extend the concept of sets to ordered sets, cardinality, and ordinal numbers	C2	1

#### **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

# Contents:

**SETS:** Set, set notations: tabular, descriptive and set builder. Equal and equivalent sets, operations on sets: subset, empty set, power set of a set, union, intersection, differences of sets, de Morgan's laws, ordered pairs, Cartesian product of sets, infinite Cartesian products, representation of sets as bit strings, principle of inclusion/exclusion, ordered pair.

**RELATIONS AND FUNCTIONS:** Pictorial representation of relations, composition of relations, types of relations, partial ordering relations, *n*-Ary Relations, composition of functions, types of function.

**CARDINALITY NUMBERS:** Cardinality of sets, equipotent sets, denumerable and countable sets, cardinal numbers and Algebra of (Addition, multiplication and Cartesian products), continuum cardinality and Cantor's theorem.

**ORDERED SETS:** Ordered sets, set construction and order, partially ordered set, minimal and maximal elements, isomorphic ordered sets.

**ORDINALS NUMBERS:** Well-ordered sets, limit elements, similarity between well-ordered and its subsets, ordinals numbers and its arithmetical operations.

### **BOOKS RECOMMENDED:**

- 1. Lipstchiz, S: Set theory and Related topics; Schaum's outline series, McGraw Hill Book Company.
- 2. Discrete Mathematics for Computer Scientists, Gray Haggard, John Schlipf, Sue Whitesides, (Latest Edition)
- 3. Set Theory: A first course, Daniel W. Cunnunngham, Cambridge University Press, (Latest Edition)
- 4. Hand Book of Set Theory; Matthew Foreman, Akihiro Kanamori: Springer Netherlands, 2010
- 5. Herbert Enderton: Elements of Set Theory, Gulf Professional Publishing, (Latest Edition)

# **MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO**

DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES								
Title of Subject:		of Subject: Functional Englis	Functional EnglishMarks: 100					
	Discip	oline: Mathematics						
	Code:	ENG 101						
	Pre-re	equisites: Intermediate						
	Assess	sment: 20% Sessional wo	ork, 20% midterm, 60% final e	xamination				
	Credit	t Hours: 03	Minimum Co	ontact Hours:	urs: 45			
Aims:		Enable students to u components of gramm	use four skills of language with confi ar	idence and use	different			
	Objecti After o	ives: To comprehend authentic text Composing different types of sub- Listen and comprehend lectures Identify and improve pronuncian of diphthongs, stress patterns and completion of this course the studes	entences s and collect information ation with the help of sounds, Individual a nd intonation nt should be able to:	nd combination				
	CLO	Descr	iption	Maximum Taxonomy Level	PLOs			
1         Write varied consummarize the test		Write varied contents including official summarize the texts using appropriate geven devi	al letters, e-mails, and applications and grammatical mechanisms and cohesive ces.	C2	12			
	2	Apply skimming, scanning and detail understand gist of th	led reading and listening strategies to text/conversation.	C3	2			
	3	Utilize their skills using English langua arguments and deliver a prese	ge to express their point of view, show ntation in a real-life situation.	C3	7			

The course is designed so that students will achieve the following PLOs:

1	Applied and Basic Mathematics Knowledge	7	Communication
2	Problem Analysis	8	The Mathematician and Society
3	Investigation	9	Individual and Teamwork
4	Design/Development of Solutions	10	Project Management
5	Modern Tool Usage	11	Environment and Sustainability
6	Ethics	12	Lifelong Learning

#### Content:

Reading:	Interactive Reading, apply the skills of surveying skimming, scanning and detailed reading and identify topic sentence
Writing:	Audience Related Writing, composition of sentences, Paragraph, short descriptive writing, précis and letter and application, identify contextual clues with the help of cohesive devices.
Listening:	Collect gist and important points from a listening text or any other oral source viz. Lecture, speech or conversation
Speaking:	Taking part in different real-life situations, answer question, argue and explain one's point of view, ask for in format- ion turn taking techniques and presentation skills.

Grammar: Mechanics of English Language, Punctuation, vocabulary, conversion of words, tenses and sentence structure

**Recommended Materials:** Dawn newspaper, Reader Digest, New Scientist and other interesting materials selected by teachers

Books: A. J, Thomson and A. v. Martinet and Practical English Grammar

Sarwar Zakia, (Edt) 1991 English Study Skills A Spelt Publication Karachi.

R.R. Jordon, 1980 Collins Study skills in English. William Collins Sons & Co. Glasgow Great Britain.

Jones Rhodri, 1986, A New English Course (An Approach to GCSE English Language for Individual Study or Class Use)

K. James at al, 1986, Listening Comprehension and Note-Taking Course (Collins Study Skills In English)

Selected Text from Dawn, Readers Digest, New Scientist and other relevant material of teacher's Choice.

Book: 1. Oxford Advanced Learning's Dictionary

2. Oxford Practice grammar By John Eastwood

3. English for Undergraduates by D.H. Howe, T.A. Kirkpatrick and D. L.

4. Essential Grammar in use By Raymond Murphy

5. The concise Guide to writing by Rise B. Axelrod Charles R. Cooper

6. Academic Writing Course by R. R. Jordan

7. Study Skills in English by Michael J.

8. A practical English Grammar by Thomas and Martinet

9. The Ultimate Job search Letter by Martin Yat

10. English for Business by J. Chiver

11. How to Write Better English by Robert allen.

#### MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES

Title of Subject	: ISLAMIC	STUDIES	Code: SS 111
Discipline	: AR/CRP/	TE/MN/MT/IN/ME/CH/PG/	EE/TL
_	: CE/EL/C	S/SW/ES/BM	
Semester	: 1 <sup>st</sup> semeste	r and 2 <sup>nd</sup> semester	
Effective	: 17 Batch o	nwards	
Pre-requisites	: Social Sci	ence	
Assessment	: 20% Sessi	onal, 20% Mid Semester and 60	% End Semester
Marks	: TH: 50	PR: 00	
Credit Hours	: TH: 02	PR: 00	
Min. Contact Hours	: TH: 30	PR: 00	

#### **Course Learning Outcomes:**

On completion of this course the students should be able to:

CLO	Description	Maximum	PLOs
		Taxonomy	
		Level	
1	Explain scope and significance of basic <b>beliefs &amp; pillars</b> of Islam, their effects on different aspects of individual life and society	C2	6
2	Enhance understanding of <b>Quran, Hadith and life of Holy Prophet</b> <b>Muhammad (</b> <sup>ag)</sup> as the source of inspiration and guidance.	C2	8

# **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

#### **Course Contents:**

**Quran and Uloomul Quran:** Surah Al-Hujurat., Surah Al-Furqan (These both surahs cover all topics related to ethical values of Islamic society including Taqwa, Taqwa, Simplicity, Lawful earning, Social Justice, Rights of Parents, elders, neighbors, Fear of Allah and Truthfulness), Excellence of Holy Quran (Aijazul Quran), History of collection and compilation of Holy Quran.

**Basic Beliefs of Islam:** Tauheed, its importance, effects on the life of believer, shirk and its types, Existence of Angles, Holy Scriptures, Prophethood, its need and necessities, characteristics and Finality of Prophethood, Concept on life hereafter.

Life history of Holy Prophet Muhammad (ﷺ): Life history at Makkah (Before Prophethood), Life history at Makkah (after Prophethood), Life history at Madina {including Brotherhood, Charter of Madina, Victory of Makkah

and Last Sermon of Holy Prophet Muhammad (ﷺ), Importance of Hadith and Sunnah, Ten selected Ahadiths (Covering topics related to Proper usage of time, Hospitality, quality of shyness, love and affection to humanity,

facilitate to others and tolerance etc). Fundamentals of Islam: Testifying KalimaShahadah, Prayer, its importance, pre-conditions, obligations and effects,

Zakat, its aims & objectives, Requirements, Legal recipients, Nisab and benefits, Fasting, its philosophy, requirements and benefits, Pilgrimage, requirements, types, obligations, procedure and benefits, Jihad and its types.

**Islam and Science:** Quran and Science, Importance of science and technology in Islam, Historical contribution of Islam and Muslims in the development of science, Verses of Holy Quran those cover different fields of science e.g. social, management and natural science.

#### Text books :

Approved: Board of Studies, BSRS: 01/2019 Board of Faculty (FOST&H) 01/2019 Academic Council

Res. No. 02, Res. No. 04 Res. No 94.11(a)

A.A. Umrani, Islam: The universal Religion, Naseem book depo, latest edition.

A.Q. Natiq, Sirat-e-Mustageem, Urdu bazzar Karachi, latest edition.

**Reference books:** 

S.M. Saeed, Islam aurHamariZindagi, Naseem book depo, latest edition.

M. Shabudden, Quran Science and Muslims, Al Maktabah Al Ashrafiya, Lahore, latest edition.

Res. No. 02, Res. No. 04 Res. No 94.11(a)

#### <u>MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO</u> <u>DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES</u>

Title of Subject Discipline	: Ethics (op : AR/CRP/ CE/EL/CS	otional for only TE/MN/MT/II /SW/ES/BM/N	Code: SS 104	
Semester	: 1 <sup>st</sup> semest	er and 2 <sup>nd</sup> sem	ester	
Effective	: 17 Batch	onwards		
Pre-requisites	: Social So	cience		
Assessment	: 20% sess	ional work	Mid-sem. Exam: 20%	End-Sem Exam: 60%
Marks	: TH: 50	PR: 00		
Credit Hours	: TH: 02	PR: 00		
Min. Contact Hours	: TH: 30	PR: 00		

#### **Course Learning Outcomes:**

After com	After completing this course student should be able to:					
CLO No.	Description	Taxonomy	PLOs			
		Level				
1	Create stable and healthy civilized society.	C2	6			
2	Develop uniformity of moral beliefs and behavior.	C2	8			

#### **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

#### **Course Contents:**

Ethics: Definition of Ethics, Position of ethics in different religions.

**Islam:** Introduction, Role of Beliefs and Arakans in character building, Rights of Non-Muslim, Ill effects of corruption and respect of law.

**Hinduism:** Introduction, Role of doctrines in character building, Religious books, Concept of Re-Birth and its influence in social life, Celebration days and their social effects, Comparative study of cast systems in the contemporary atmosphere.

**Buddhism:** Introduction, Doctrines, Eight Nobel Paths of Buddha and its benefits, Critical study on concept of Renunciation of material & worldly life.

Christianity: Introduction, Doctrines, Religious books, Celebration days.

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Judaism: Introduction, Doctrines, Religious books, Ten Commandments of Moses and its importance in social life.

**Moral values of different religions:** Patience, Modesty, Moderation, Tawakal, Taqwa, Lawful earning, Sincerity, Positivity, Forgiveness and Softening.

Bad morals: lying, pride, selfishness, Fame, Greed, Extravagantness, Bribe, Social injustice,

Religious biasness and Discrimination on the basis of race, color and faith

#### **Text Books:**

- 1. Dr. A Rasheed, Comparative Study of Religions Tahir sons Karachi, latest edition.
- 2. AadilFaraz, IkhlaqiyatMazahib-e-Aalamkinazar main, ApnaIdara Lahore latest edition.

#### **Reference Books:**

- 1. Jeoge D. Chryssides, the study of religions an introduction to key ideas and methods, London, latest edition.
- 2. GhulamRasool Cheema MazahibAalamkaMutalia, Ilm o Irfan publishers Lahore latest edition.

# MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO

DEPAR	DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES					
Title of Subject:	Physics-I	Marks: 100				
Discipline:	Mathematics					
Code:	<b>MEBP 101</b>					
<b>Pre-requisites:</b>	Intermediate					
Assessment:	20% Sessional work,	20% midterm, 60% final examination				
Credit Hours:	03	Minimum Contact Hours: 45				

Objective: Introduce the idea of motion and energy

	Applied and Basic Mathematics		
1	Knowledge	7	Communication
2	Problem Analysis	8	The Mathematician and Society
3	Investigation	9	Individual and Teamwork
4	Design/Development of Solutions	10	Project Management
5	Modern Tool Usage	11	Environment and Sustainability
6	Ethics	12	Lifelong Learning

#### **Contents:**

**Introduction:** standards of length, mass and time, the building block of matter, dimensional analysis, uncertainty in measurement and significant figures, conversion of units, estimates and order of magnitude calculations, coordinate system, trigonometry, problem solving strategy,

**Vector:** introduction to vectors, geometrical representation of vector, laws of vectors, triple scalar and vector product, vector algebra and calculus,

**Vectors and Two-three dimensional Motion:** Vectors and their Properties, Components of vectors, displacement, Velocity, and Acceleration in two dimensions, Motion in two dimensions, Relative velocity, projectile motion, freely fall objects projectile motion analyzed, Momentum: Linear momentum, the linear momentum of a system of particles, conversation of linear momentum, angular momentum.

Laws of Motion: Forces, Newton's Laws, Application of Newton's laws, forces of friction Work and Energy: work, work done by gravitational force, work done by spring force, work done by a general variable force, power. Kinetic energy and work-energy theorem, gravitational, spring potential energy, systems and energy conversation, power, work done by varying force. Motion in Space: Gravity, Circular motion, Centripetal force, Centrifugal Force, Newton gravitational Law, Kepler's Law.

# **Recommended Books**

- 1) University Physics with Modern Physics by Young, Freedman & Lewis Ford
- 2) Physics for Scientists and Engineers with Modern Physics by Douglas C. Giancoli
- 3) Fundamentals of Physics by David Halliday, Robert Resnick and Jearl Walker
- 4) Physics for Scientists and Engineers: A Strategic Approach by Randall D. Knight

Res. No. 02, Res. No. 04 Res. No 94.11(a)

#### MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO DEPARTMENT OF BASIC SCIENCES AND RELATED STUDIES

Title of Subject:	Introduction to Computer	Marks: (100+50)
Discipline:	Mathematics	
Code:	CS 130	
Pre-requisites:		
Assessment:	20% sessional work, 20%	midterm, 60% final examination
Credit Hours:	03	Minimum Contact Hours: 45+30

Objectives: To give idea of computers, Microsoft windows and office.

	Applied and Basic Mathematics		
1	Knowledge	7	Communication
2	Problem Analysis	8	The Mathematician and Society
3	Investigation	9	Individual and Teamwork
4	Design/Development of Solutions	10	Project Management
5	Modern Tool Usage	11	Environment and Sustainability
6	Ethics	12	Lifelong Learning

# **Contents:**

**Introduction to Computer:** Importance of computer, Computers for individual users: desktop computers, workstations, notebook computers, tablet PCs, handhold PCs, smart phones, Computers for organizations: Network services, mainframe computers, minicomputers, super computers, Parts of computer: hardware, software, data, Memory devices: Random access memory (RAM), Read-only memory (ROM), Input and output devices, both input-output devices.

**Microsoft windows:** Operating system: History and development of Microsoft and windows, Windows versions through the year: 1985 windows 1.0, 1987 windows 2.0 & 2.11, 1990 windows 3.0, 1993 windows NT, 1995 windows 95, 1998 windows 98, 2000 windows ME, 2001 windows XP, 2006 windows vista, 2009 windows 7, 2012 windows 8, 2015 windows 2010, Other operating system: UNIX, Mac OS X, Novell NetWare, Linux/FreeBSD differences in windows operating system,

**Microsoft office:** Getting familiar: (Word, Excel, Power Point, Outlook), documents navigation tips, manipulating texts, formatting characters, formatting paragraph, themes and templates, quick parts, preparing documents for printing, organizing contents, tabs, column, charts, links, headers, footers, references, mail merge, visual contents, reviewing documents, protecting, and sharing documents,

Spread Sheets (Microsoft Excel) and other related software Packages (at least two).

# Internet access and different data bases available on the internet

# **BOOKS RECOMMENDED:**

- 1. Introduction to Computer; Revised addition Peter Norton; Tata McGraw-Hill
- Brief introduction to Computers; Thomas J. Cashman, Gray B. Shelly; Course Technology, 1997

- **3.** Introduction to Computers; Gray B. Shelly, Steven M. Freund, Misty E.Vermaat; Cengage Learning, 2010.
- **4.** Computing fundamentals Introduction to computers; FaitheWempon, RoiseHatterley; Jhon Wiley& Sons, Inc.10475.
- 5. Introduction to Computer and Communications; D Ravichandran; Tata McGraw-Hill Publishing Company Limited, New Delhi.

# MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO

DEPA	DEPARIMENT OF BASIC SCIENCE AND KELATED STUDIES					
Title of Subject:	Calculus-II	<b>Marks: 100</b>				
Discipline:	Mathematics					
Code:	MATH 150					
Pre-requisites:	Calculus I					
Assessment:	20% sessional work,	20% midterm, 60% final examination				
<b>Credit Hours:</b>	03	Minimum Contact Hours: 45				

**Objective:** To introducing the students to infinite series, parametric curves and polar coordinates, it focuses on techniques of integration and applications of integrals.

**Specific Objectives of course:** This is second course of Calculus. In continuation of Calculus I, the course also aims at:

#### **Course Learning Outcomes**

After completion of this course the student should be able to:

		Maximum	PLOs
CLO	Description	Taxonomy	
		Level	
1	Apply the partial derivatives with applications in optimization.	C3	2
2	Use techniques of integration in physical and real-life situations.	C3	2
3	Examine the curves with parametrization and polar coordinates and apply these concepts for areas and arc length.	C3	2

# **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

# **Course Outline:**

**Partial derivatives:** Euler's Theorem, Maxima, and Minima of function of two variables and their applications.

**Techniques of integration**: Integrals of elementary, hyperbolic, Trigonometric, logarithmic, and exponential functions. Integration by Parts, substitution and partial fractions. Reduction formula Approximate integration. Improper integrals. Beta and Gamma functions.

**Applications of integrals:** Area between curves. Average value. Volume. Arc length. Area of a surface of revolution. Applications to Economics, Physics, Engineering and Biology.

# Conic section, parameterized curves, and polar coordinates:

Curves defined by parametric equations. Calculus with parametric curves: tangents, areas, arc length. Polar coordinates. Polar curves, tangents to polar curves. Areas and arc length in polar coordinates.

#### **Recommended Books (latest edition):**

1. Stewart, J., Clegg, D. K., & Watson, S. (2020). *Multivariable calculus*. Cengage Learning.

2.Zill, D., & Wright, W. S. (2009). *Calculus: early transcendentals*. Jones & Bartlett Learning.

3. Thomas, G. B., Weir, M. D., & Hass, J. (2013). *Thomas' Calculus: Single Variable*. Pearson.

4.Zill, D. G., & Dewar, J. M. (2015). *Precalculus with calculus previews*. Jones & Bartlett Publishers.

5. Anton, H., Bivens, I. C., & Davis, S. (2016). *Calculus: Early Transcendental Single Variable*. John Wiley & Sons.

6. Penney, D. E., & Edwards, C. H. (1994). *Calculus and Analytic Geometry*. Prentice-Hall International.

7. Larson, R., & Edwards, B. H. (2010). *Calculus: Early transcendental functions*. Cengage Learning.

8. Zill, D. G. (2020). Advanced engineering mathematics. Jones & Bartlett Publishers.

9. Greenwell, R. N., Lial, M. L., & Ritchey, N. P. (2017). *Calculus with applications*. Pearson Education.

10. Stewart, J., Clegg, D. K., & Watson, S. (2020). *Multivariable calculus*. Cengage Learning.

11. Zill, D. G., & Wright, W. S. (2009). *Multivariable Calculus*. Jones & Bartlett Publishers.

#### MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO DEPARTMENT OF BASIC SCIENCES AND RELATED STUDIES

Title of Subject:	Discrete Mathematics and Graph Theory Marks: 100		
Discipline:	Mathematics (2 <sup>nd</sup> Semester)		
Code:	MATH 155		
Pre-requisites:	Intermediate		
Assessment:	20% Sessional work,	20% midterm, 60% final ex	amination
<b>Credit Hours:</b>	03	Minimum Con	tact Hours: 45

**Objectives:** To equip students with skills necessary for decision making in non-continuous situations.

#### **Course Learning Outcomes**

After completion of this course the student should be able to:

CLO	Description	Maximum	PLOs
		Taxonomy	
		Level	
1	Extend basic concepts of sets and induction to solve problems on	C3	1
	formal logic and Boolean algebra		
2	Understand basic counting methods and solve recurrence relations	C3	2
	with principles and applications		
3	Understand and apply concepts of graphs and trees with relevant	C3	4
	algorithms		

# **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

#### **Contents:**

**Sets and Induction:** Basic Definitions, Sets, Operations on Sets, Principle of Inclusion-Exclusion, Mathematical Induction, Program Correctness

**Formal Logic and Boolean Algebra:** Propositional logic, Truth and logical truth, Predicates and quantification, Boolean algebra, Boolean variable, Boolean expression, DeMorgan's Theorem,

**Counting methods:** Basic methods: product, inclusion-exclusion formulae. Permutations and combinations. Recurrence relations and their solutions. Generating functions. Double counting. Applications. Pigeonhole principle, applications.

**Recurrence Relations:** solving first order recurrence relations, solution of homogeneous and non-homogeneous difference equations.

Res. No. 02, Res. No. 04 Res. No 94.11(a) Dated: 07-02-2019 Dated: 07-03-2019 Dated: 27-03-2019  **Graphs:** Graph terminology. Representation of graphs. Graphs isomorphism. Algebraic methods: the incidence matrix. Connectivity, Eulerian and Hamiltonian paths. Shortest path problem. Trees and spanning trees. Complete graphs and bipartite graphs.

### **Recommended Books:**

- 1. K.H. Rosen, *Discrete Mathematics and its Application*, McGraw-Hill, (Latest Edition)
- 2. K.R. Parthasarathy, Basic Graph Theory, McGraw-Hill, (Latest Edition)
- 3. D.P Acharjya, Sreekumar, Fundamental Approach to Discrete Mathematics, (Latest Edition)
- 4. Gary Haggard, John Schlipf, Sue Whitesides, Discrete *Mathematics for Computer Science*, (Latest Edition)
- **5.** Joe L. Mott, Abraham Kandel, Theodore P Baker , *Discrete Mathematics for Computer Scientists and Mathematicians*, (Latest Edition)

# MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO

DEPA	<u>ARTMENT OF BASIC SCIENCE .</u>	AND RELATED STUDIES
Title of Subject	: Statistics and Probability	<b>Marks: 100</b>
Discipline	: Mathematics	
Code	: MATH 160	
Pre-requisites	: Intermediate	
Assessment	: 20% sessional work, 20% mic	lterm, 60% final examination
Credit Hours	: 03	Minimum Contact Hours: 45

Objective: Introduce the concept of descriptive statistics and basics of Probability

#### Course Learning Outcomes: After completion of this course the students should be able to

CLO	Description	Maximum Taxonomy	PLOs
		Level	
1	Understand basic concepts with statistical techniques for the measure of central values of a data and their interpretation	C2	2
2	Discuss basic concepts of probability theory with several types of probabilities and their applications	C2	4
3	Describe the least squares method for fitting of different curves, simple regression, and correlation	C2	3

#### **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

#### **Contents:**

**Introduction to statistics:** Nature and importance of statistics, descriptive and inferential statistics; population and samples.

**Data organization:** Frequency distribution and its graphical representation. **Descriptive measures:** Measures of central tendency and dispersions.

**Probability:** Introduction to probability, counting techniques, additive and multiplicative rules, conditional probability; Bayes' theorem.

**Probability Distribution:** Concept of random variable, discrete probability distribution. Case study. Continuous probability distribution, Probability destiny function, joint probability distribution. Mean and variance of a random variable. Binomial distribution. Mean and variance of binomial distribution. Poisson distribution, Mean and variance of Poison distribution. Normal

distribution. Standard normal distribution, inverse use of table for area under the normal curve; applications.

**Curve fitting by least squares method:** Goodness of fit, fitting a straight, parabola and higher degree curves.

**Simple regression and correlation:** Regression analysis by least squares method, testing the significance of the slope, simple correlation analysis, coefficient of correlation and coefficient of determination, testing the significance of r; Rank correlation.

# **Books Recommended:**

- M. Anwar Solangi; Statistical Methods and Estimations
- Ronald Walpole, Introductory Statistics
- Sher Muhammad Choudhry, Introduction to Statistics vol. I & II
- Iqbal Bhatti, Elements of Statistics
- Douglas C. Montgomery, Applied Statistics and Probability for Engineering.

#### MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES

DEL	ANTMENT OF DASIC SC	LIENCE AND RELATED STUDIES
Title of Subject	: Communication Skills	Marks: 100
Discipline	: Mathematics	
Code	: ENG 102	
Pre-requisites	: Intermediate	
Assessment	: 20% Sessional work,	20% midterm, 60% final examination
<b>Credit Hours:</b>	03	<b>Minimum Contact Hours:45</b>

**Objective:** 

- To provide detailed knowledge of writing technicalities
- To provide understanding and acquiring the sense of effective writing, create and write different forms
- To enable students to use the mechanical tools of writing.

1	Applied and Basic Mathematics Knowledge	7	Communication
2	Problem Analysis	8	The Mathematician and Society
3	Investigation	9	Individual and Teamwork
4	Design/Development of Solutions	10	Project Management
5	Modern Tool Usage	11	Environment and Sustainability
6	Ethics	12	Lifelong Learning

#### **Contents:**

Introduction to Writing: approaches, practices, purposes and characteristics. Kinds of Writing. Informal Writing: Diaries and Journals, Strategies. Formal Writing: Grammar in context, Fiction, Autobiography, The Language of Reporting, Polemical Writing, Travel Writing, Instruction Texts, Focus on Emotive language, Focus on Persuasive Language. Writing Modes. The Process of Writing. Paragraph Writing: Structure and Characteristics. Forms of Writing: Story writing, Life stories, Letter writing, Advertisements and Persuasive texts, Descriptive Writing, Academic Writing, Essay Writing, Article Writing.

# **Recommended Books:**

- Webster's New World Student Writing Handbook, (2009) by Sharon Sorenson.
- Teaching Writing, (2008) by Gail E. Tompkins.
- Heath Grammar and Composition, (1988) by Carol Ann Bergman and J. A. Senn.
- Focus on Composition, (1978) by Ann Raimes.
- Writing as Learning, (2006) by Evelyn Rothstein and Gerald Lauber.

#### MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES

DEIA		DADIC DC		DBIUDILB
Title of Subject	: Pakistan S	Studies (Com	pulsory)	Code: PS 106
Discipline	: ME/CH/PO	G//MT/MN/IN	J/CRP/TE/TL	
	: EE/BM/S	W/ES/CE/C	S/EL/MTE	
Semester	: 1 <sup>st</sup> semester	r and 2 <sup>nd</sup> seme	ester	
Effective	: 17 Batch o	nwards		
Pre-requisites	: Social Sci	ence		
Assessment	: 20% sessi	onal work	Mid-sem. Exam: 20%	End-Sem Exam: 60%
Marks	: TH: 50	PR: 00		
Credit Hours	: TH: 02	PR: 00		
Min. Contact Hours	: TH: 30	PR: 00		

#### Course Learning Outcomes : After completion of this course the student should be able to

CLO	Description	Taxonomy	PLOs
		Level	
1	Trace the Muslim Nationalism in South Asia and the creation of	C2	8
	Pakistan		
2	Discuss the Constitutional and Political history of Pakistan and to	C2	11
	analyze contemporary challenges to Pakistan		

	Applied and Basic Mathematics		
1	Knowledge	7	Communication
2	Problem Analysis	8	The Mathematician and Society
3	Investigation	9	Individual and Teamwork
4	Design/Development of Solutions	10	Project Management
5	Modern Tool Usage	11	Environment and Sustainability
6	Ethics	12	Lifelong Learning

#### Contents

#### The Historical Background of Pakistan

Evolution and growth of Muslim society in Subcontinent

Muslim Revivalist and Reformist Movements

The Factors that shaped the Muslim Nationalism in the Subcontinent

The Factors that led birth to Pakistan

Ideology of Pakistan with special reference to Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah

Role of Sindh in Making of Pakistan

History of Internal and External Affairs of Pakistan:

The Constitutional and Political Developments in Pakistan (1947-1973)

The Constitution of 1973; Salient Features and Amendments

Political Development in Pakistan (1973 to date)

Determinants of Foreign Policy of Pakistan

Pakistan's Relations with Big Powers

Contemporary Pakistan (Issues and Challenges):

Geo-Strategic Significance of Pakistan

Economic Potential and its Utilization

Challenges to National Security of Pakistan

Internal Political, Economic and Legal Problems

# Futuristic Outlook of Pakistan

# **Books Recommended:**

- Abdul Sattar, (2017), *Pakistan's Foreign Policy 1947–2016 A Concise History* (4th ed.), Karachi: Oxford University Press.
- Cohen Stephen, (2011), *The Future of Pakistan*. Washington: Brookings Institute Press.
- Hussian, Zahid, (2007), *Front line Pakistan: The Struggle with Militant Islam*, New York: I.B.Tauris.
- Jalal, Ayesha, (2014), *The Struggle for Pakistan: A Muslim Homeland and Global Politics*, The Belknap Press of Harvard University Press.
- Kazimi, M. R., (2008), A Concise History of Pakistan, Karachi: Oxford University Press.
- Khan, Hamid, (2017), *Constitutional and Political History of Pakistan* (3rd ed.), Karachi: Oxford University Press.
- Long, Roger D., (2015), A History of Pakistan, Karachi: Oxford University Press.
- Rais, RasulBakhsh, (2017), Islam, Ethnicity, and Power Politics: Constructing Pakistan's National Identity, Karachi: Oxford University Press.
- Riedel, Bruce, (2011), *Deadly Embrace: Pakistan, America, and the Future of Global Jihad*, Washington: Brookings Institute Press.
- Sayeed, K. B., (1960), *Pakistan: The Formative Phase*, Karachi: Oxford University Press.
- Talbot, Ian, (2014), *Pakistan: A New History*, Karachi: Oxford University Press.
  - Wolpert, Stanley, (1997), Jinnah of Pakistan, Karachi: Oxford University Press.

MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY,							
	JAMSHORO						
DEPA	RTMENT OF BASIC SCIEN	NCE AND RELATED STUDIES					
Title of Subject	: Physics-II	Marks: 100					
Discipline	: Mathematics						
Code	:EL 127						
Pre-requisites	: Intermediate						
Assessment	: 20% Sessional work,	20% midterm, 60% final examination					
<b>Credit Hours</b>	: 03	<b>Minimum Contact Hours:45</b>					

Objective: Introduce the idea of Modern and Nuclear Physics

	Applied and Basic Mathematics		
1	Knowledge	7	Communication
2	Problem Analysis	8	The Mathematician and Society
3	Investigation	9	Individual and Teamwork
4	Design/Development of Solutions	10	Project Management
5	Modern Tool Usage	11	Environment and Sustainability
6	Ethics	12	Lifelong Learning

#### **Contents:**

#### PHYSICS OF ATOMIC STRUCTURE AND ELECTRICITY

Atomic structure. Atomic bonding. Electromotive force and potential difference. Current. Effects of electric current. Conductor. Insulator. Semiconductor. Electrical quantities. Resistance. Alternating Current.

#### ELECTROSTATICS AND CAPACITANCE

Coulomb's law. Electric charge. Electric field. Electric field strength and Electric Flux. Gauss's law. Electric potential. Dielectric. Capacitance. Charging and Discharging of Capacitor. Capacitors in series and in parallel. Energy in capacitor.

#### ELECTROMAGNETISM

Magnetic fields. Characteristic of lines of magnetic flux. Magnetic fields due to currents. Electromagnet. Force on current carrying conductor in magnetic field. Electromagnetic induction. Magnetomotive force., Permeability. Reluctance.

Self-inductance. Inductance of a coil, Air core and Iron cored inductor. L/R Time constant. Energy stored in inductance. Mutual inductance. Electromagnetic oscillations. Alternating current. Principle of transformer. Principles of dc generator and motor.

#### SEMICONDUCTOR PHYSICS

Energy levels in a semiconductor. Hole concept. Intrinsic and Extrinsic regions. PN junction. Doppler effect.

#### NUCLEAR PHYSICS

Nuclear properties. Alpha decay. Beta decay. Gamma decay. Medical uses of nuclear radiation. Fission and Fusion. Nuclear radiation and hazards.

#### **Recommended Books:**

Approved: Board of Studies, BSRS: 01/2019 Board of Faculty (FOST&H) 01/2019 Academic Council

Res. No. 02, Res. No. 04 Res. No 94.11(a)

- Modern quantum mechanics, by sakurai
- Introductory nuclear physics. by Krane
- Fundamentals of Applied Electromagnetics 7<sup>th</sup> Edition, Fawwaz T. UlabyUmebertoRavaioli, 2014
- Engineering Electromagnetics, Umran S. InanAzizInan, 1998.(Latest Edition)

Course code	Subject Name	Credit He	ours
<u>3rd Semester</u>		<b><u>Theory</u></b>	<b>Practical</b>
<u>MATH 205</u>	<b>Differential Equations &amp; Fourier Series</b>	<u>3</u>	<u>0</u>
<u>MATH 210</u>	Linear Algebra	<u>3</u>	<u>0</u>
<b>ECO 230</b>	<b>Economics</b>	<u>3</u>	<u>0</u>
<u>ENG 215</u>	<b>Technical Report Writing &amp; Presentation Skills</b>	<u>3</u>	<u>0</u>
<u>MATH 250</u>	<b><u>Classical Mechanics &amp; Vector Analysis</u></b>	<u>3</u>	<u>0</u>
-	<u>Total</u>	<u>15</u>	<u>00</u>

• Engineering Electromagnetics, Nathan Ida , 2015

# DEPARTMENT OF BASIC SCIENCES AND RELATED STUDIES Courses of 2<sup>nd</sup> Year of BS (Mathematics)

Course code	Subject Name	Credit Hou	<u>115</u>
4th Semester		<b>Theory</b>	<b>Practical</b>
<u>MATH 255</u>	Dynamics	<u>3</u>	<u>0</u>
<u>MATH 270</u>	Number Theory	<u>3</u>	<u>0</u>
<u>MATH 260</u>	C++ Programming & MATLAB	<u>3</u>	<u>0</u>
<u>MATH 265</u>	Group Theory	<u>3</u>	<u>0</u>
<u>MATH 275</u>	<b>Topology</b>	<u>3</u>	<u>0</u>
-	Total	<u>15</u>	<u>00</u>

Approved: Board of Studies, BSRS: 01/2019 Board of Faculty (FOST&H) 01/2019 Academic Council

Res. No. 02, Res. No. 04 Res. No 94.11(a)

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Res. No. 02, Res. No. 04 Res. No 94.11(a)

#### MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES

Title of Subject	: Differential Equations and Fourier series	Marks: 100 + 00
Discipline	: Mathematics	
Semester	: 3 <sup>rd</sup> semester	
Code	: MATH-205	
Pre-requisites	: Calculus-II	
Assessment	: 20% sessional work, 20% midterm, 60% fina	l examination
Credit Hours	: 03 Minimum (	Contact Hours:45

**Objectives:** To give an idea of the formation, solution, and the physical applications of Ordinary Differential Equations (ODEs) including the concept of Fourier series.

#### Course Learning Outcomes: After completing this course, the students able to be

-				
	CLO	Description	Maximum	PLOs
			Taxonomy	
			Level	
	1	Explain basic concepts of ODEs and classification	C2	1
	2	Solve higher order ODEs and use them for physical	C3	3
		problems		
	3	Solve ODEs in power series and expand various functions	C3	2
		in Fourier series		

#### **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning
ontents			

#### **Contents**

**First order linear and non-linear ordinary differential equations:** Introduction, Classification, Formation of ODEs, Function versus Solution, Existence and Uniqueness of Solution of ODEs, Solution of first order and first-degree ODEs. Solution of first order and higher-degree ODEs.

**Higher order linear ordinary differential equations:** Linear equations. IVPs and BVPs. Existence and uniqueness of solutions. Homogeneous linear equations with constant coefficients. Oscillatory solutions. Differential operators. Superposition principle. Linear dependence and independence. Wronskian. Fundamental set of solutions. Nonhomogeneous equations. Complementary function and particular integral. The reduction of order method. Undetermined coefficients-superposition approach. Undetermined coefficients-Annihilator approach. Variation of parameters and green's functions. Cauchy-Euler equation. Systems of linear differential equations and their solution by elimination method. Phase Plane

Applications of second order ODEs: Newton's second law of motion. Linear and nonlinear springs. A simple harmonic oscillator. Damped and Undamped Harmonic Oscillators. Linear and

nonlinear pendulum. Telephone wires. Rocket motion. Variable mass. A mass-spring-dashpot system without and with external forces.

**Series Solutions:** Power series, ordinary and singular points, Existence of power series solutions, power series solutions, types of singular points, Frobenius theorem, Existence of Frobenius series solutions, solutions about singular points.

**Fourier Series**: Periodic and non-periodic functions, Fourier coefficients. Convergence of Fourier series. Fourier expansions of non-periodic functions. Fourier series of odd and even functions. Fourier cosine series and Fourier sine series. Fourier half-range cosine series and Fourier series over any range.

# **Books Recommended (latest edition):**

- 1. Zill, D. G. (2016). *Differential equations with boundary-value problems*. Cengage Learning.
- 2. Zill, D. G. (2012). *A first course in differential equations with modeling applications*. Cengage Learning.
- 3. Zill, D. G. (2020). Advanced engineering mathematics. Jones & Bartlett Publishers.
- 4. Zill, D. G., & Cullen, M. R. (2009). *Differential equations*. Brooks/Cole, Cengage Learning..
- 5. Reshetnyak, V. Y., & Makarets, M. V. (1995). Ordinary differential equations and calculus of variations. World Scientific.
- 6. Nagle, R. K., Saff, E. B., & Snider, A. D. (2014). *Fundamentals of differential equations*. Pearson Education.
- 7. Brannan, J. R., & Boyce, W. E. (2015). *Differential equations: An introduction to modern methods and applications*. John Wiley & Sons.
- 8. Edwards, C. H. (2008). *Elementary differential equations*. Pearson Prentice Hall.
- 9. Bird, J. (2017). Higher engineering mathematics. Routledge.
- 10. Seeley, R. T. (2014). An introduction to Fourier series and integrals. Courier Corporation.

#### MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES

Title of Subject:	Linear Algebra	<b>Marks: 100</b>
Discipline:	Mathematics	
Semester	: 3 <sup>rd</sup> semester	
Code:	<b>MATH-210</b>	
Pre-requisites:	Intermediate	
Assessment:	20% Sessional work,	20% midterm, 60% final examination
Credit Hours:	03	Minimum Contact Hours: 45

Objective: To Develop the knowledge of matrix algebra and the system of linear equations,

#### Course Learning Outcomes

After completion of the course, student should be able to:

CLO	Description	Maximum	PLOs
		Taxonomy	
		Level	
1	Explain the basic concepts of matrix and determinant, and use of	C2	1
	some methods for linear systems		
2	Discuss the concept of vector space, its types, and operations	C2	2
3	Describe properties of linear mapping and inner product spaces	C2	3
	with related theorems		

#### **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

#### **Contents:**

**System of Linear Equations:** Representation in matrix form, Matrices, Operations on Matrices, Echelon and Reduced Echelon Form, Inverse of a matrix (by elementary row operations), Solution of linear systems, Gauss-Jordan method, and Gaussian elimination Methods.

**Determinants**: Permutations of order two and three, Definitions of determinants of the same order, Computing of determinant, Definition of higher order determinants, Properties and Expansion of determinants.

**Vector Spaces**: Definition and examples, Subspaces. Linear combination and spanning set. Linearly Independent sets. Finitely generated vector spaces. Bases and dimension of a vector space. Operations on subspaces, Intersections, sums, and direct sums of subspaces. Quotient Spaces.

**Linear mappings**: Definition and examples. Kernel and image of a linear mapping. Rank and nullity. Reflections, projections, and homotheties. Change of basis. Eigenvalues and eigen vectors. Theorem of Hamilton-Cayley.

**Inner product Spaces:** Definition and examples. Properties. Projection. Cauchy inequality. Orthogonal and orthonormal basis. Gram Schmidt Process. Diagonalization.

#### **Recommended Books:**

Approved: Board of Studies, BSRS: 01/2019 Board of Faculty (FOST&H) 01/2019 Academic Council

Res. No. 02, Res. No. 04 Res. No 94.11(a)

1. Ch. W. Curtis, Linear Algebra, Springer.(Latest Edition)

2. T. Apostol, *Multi Variable Calculus and Linear Algebra*, 2nd ed., John Wiley and sons.(Latest Edition)

3. H. Anton, C. Rorres, *Elementary Linear Algebra: Applications Version*, 10th Edition, John Wiley and sons, 2010.

4. S. Friedberg, A. Insel, Linear Algebra, 4th Edition, Pearson Education Canada.(Latest Edition)

5. S. I. Grossman, *Elementary Linear Algebra*, 5th Edition, Cengage Learning.(Latest Edition)

#### MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO

DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES							
Title of Subject	: Economics	<b>Marks: 100 + 00</b>					
Discipline	: Mathematics						
Semester	: 3 <sup>rd</sup> semester						
Code	: ECO-230						
Pre-requisites	: Intermediate						
Assessment	: 20% sessional wor	k, 20% midterm, 60% final examination					
<b>Credit Hours</b>	: 03	Minimum Contact Hours:45					

**Objectives:** To familiarize students with demands and supply analysis consumer and firm behavior, production cost and market structures.

#### **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

#### **Contents:**

#### **Introduction to Economics:**

Studying Choice in a World of Scarcity: The No-Free-Lunch Principle, The Cost-Benefit Principle, Reservation Prices, Economic Surplus, Opportunity Cost, The Role of Economic Models, To What Extent should an Activity be Perused, Micro Economic Versus Macro Economics, Economic Naturalism, Positive Versus Normative Economics, Some common Pitfalls for Decision Makers, Conclusion.

#### **Consumer Behavior:**

Cardinal Approach/Utility Analysis, Marginal Utility, Law of Diminishing Marginal Utility, Law of Equi-Marginal Utility, Consumer Equilibrium Ordinal Approach of Consumer Behavior, Indifference Curves, Features of Indifference Curves, Budget Line, Consumer Equilibrium, Comparison between two approaches Conclusion.

#### **Demand & Supply:**

Demand Function, Law of Demand, Shift in Demand, Change in Demand Factors Affecting Demand, Supply Function, Law of Supply, Changes in Supply Price Equilibrium, Market Equilibrium.

#### **Elasticity of Demand & Supply:**

Price Elasticity of Demand & Supply, Point Elasticity of Demand & Supply Arc Elasticity of demand & Supply, Income Elasticity of Demand & Supply, Cross Elasticity of demand & Supply, Conclusion.

#### **Efficiency and Exchange:**

Market Equilibrium and Efficiency, Economic Surplus, the Cost of Preventing Price Adjustments, Taxes and Efficiency, Conclusion.

#### The Theory of production & Theory of Cost:

The Production Function, Total, average, and marginal product, Laws of Returns to Scale, Short run Theory of Cost, Seven family cost curves, Relationship between Production and Cost Curves.

Long-run Theory of Cost: Graphical Representation of Long Run Cost Economies, Diseconomies and Constant Returns to Scale.

### **Market Structure:**

Perfect Competition vs. Pure Competition, Different Possibilities of SR firm Equilibrium, Profit Maximization in the Short-run and long-run Monopoly: Short run and long run Equilibrium under Monopoly. Conclusion (Comparison of both) Imperfect Competition: Monopolistic Competition, Price and output determination in monopolistic competition, Comparison perfect competition with monopolistic competition Oligopoly: Definition, Strategic behavior and game Theory, Price Rigidity and the kinked demand curve, Conclusion (Comparison of both) Labor Markets. The Market Demand for Labor, Supply of labor, Shifts in the market demand for and supply of labor, Inefficiency wages, monopsony

#### **Recommended Books:**

1. Mankiw, "Principles of Economics" 7th Edition, (2008), Southwest Publishers

**2.** Miller, R. L –EconomicsToday-14th Edition (2005) Addison Wesley. (Latest Edition) Supplementary Material:

Samuelson Nordons – Economics -18th edition (2004), McGraw-Hill, Inc.McConnell and Bruce-Principles of Economics -17th Edition, (2006), McGraw-Hill.(Latest Edition)

# MEHRAN UNIVERSITY OF ENGINEERING & TECHNOLOGY ENGLISH LANGUAGE DEVELOPMENT CENTRE FRM-003/00/QSP-004 Dec.01, 2001

**Title of Subject: Technical Report Writing & Presentation Skills Marks: 100 Discipline: Mathematics** 3<sup>rd</sup> semester Semester **ENG-215** Code: **Pre-requisites:** Intermediate **Assessment:** 20% Sessional work, 20% midterm, 60% final examination **Credit Hours: Minimum Contact Hours: 45** 03

**Objectives:** Enhance presentation skills- develop turn taking manners in professional settings Enable students to take part in discussions, ask questions, offer explanations and give comments. To write formal letters majorly including technical correspondence (Technical Reports)

#### PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge		7	Environment and Sustainability
2	Problem Analysis		8	Ethics
3	Design/Development of Solutions		9	Individual and Teamwork
4	Investigation		10	Communication
5	Modern Tool Usage		11	Task Management
6	The Mathematician and Society	e Mathematician and Society 🗆 12		
Content:	Reading: Text Analysis,	critical thir	king	

tent:	Reading: Text Analysis, critical thinking Skimming, scanning and detailed reading			
	Writing:	Academic Writing/Technical Report Writing Drafting letters with different types of messages with different registers and purposes, prepare CV's and covering letters according to job requirement		
	Listening:	Listening Comprehension Formal and informal lectures and presentations take notes ` and collect specific information		
	Speaking:	Speaking in real life situations Oral Fluency Conversational strategies, elements of public speaking: Giving lectures and presentation on specific topics Delivery Styles Ask questions and explain point of view in discussions (Demonstrate turn taking technique)		

#### **Contents:**

#### **Basics of Technical Writing**

- Introduction to Technical writing and communication,
- Rationale/Characteristics/Features of Technical Writing compared to other forms of writing.

Interview Skills

• Types of technical documents

Approved: Board of Studies, BSRS: 01/2019 Board of Faculty (FOST&H) 01/2019 Academic Council

Res. No. 02, Res. No. 04 Res. No 94.11(a)

#### **Introduction to Writing Process**

- Technical Writing Process: Pre-writing, Writing & Revising (Demonstration & Illustration)
- Context & technical writing
- Implicit vs Explicit features of writing/ Text
- Legal & Ethical communication in technical writing

#### Technical Correspondence

- Using Technical Terms, definitions & descriptions
- Electronic channels of communication and their applications.

#### Writing a Technical Document

- Analyzing, anticipating and adapting
- Researching, organizing and composing
- Revising, proofreading and evaluating
- Elements of technical document

#### **Formal Technical Reports**

- Problem solving documentation in formal reports
- Components of formal reports
- Feasibility report
- Recommendation report
- Evaluation Report
- Internship Reports

#### **Recommended Books & Readings**

- 1. Rise B. Axelrod and Charles R. Cooper,1996 The Concise Guide to Writing technique.
- 2. Yate Martin, 2004, The Ultimate Job Search Letters Book. Great Britian
- **3.** Perelman, L. C., J. Paradis, and E. Barrett. *Mayfield Handbook of Technical and Scientific Writing*, Mountain View, Mayfield, 1997
- 4. Sharma, S. D. A Text Book of Scientific and Technical Communication Writing for Engineers and Professionals. Sarup & Sons, 2007.
- 5. Glasman, Hilary. *Science research writing: For non-native speakers of English*. Imperial College Press: London, UK, 2010.
- 6. Van Aken, David C., and William F. Hosford. *Reporting Results*. Cambridge University Press, 2008.
- 7. Alred, Gerald J., Charles T. Brusaw, and Walter E. Oliu. *Handbook of technical writing*. Macmillan, 2009.
- 8. <u>Effective Communication Skills for Scientific and Technical Professionals</u> By Harry E. Chambers Perseus Publishing, 2001

#### <u>MEHRANUNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO</u> <u>DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES</u>

#### Title of Subject : Classical Mechanics & Vector Analysis Marks: 100+00

Discipline	: Mathematics			
Semester	: 3 <sup>rd</sup> semester			
Code	: MATH-250			
Pre-requisites	: Calculus II and Physics I			

Approved: Board of Studies, BS

Board of Studies, BSRS: 01/2019 Board of Faculty (FOST&H) 01/2019 Academic Council Res. No. 02, Res. No. 04 Res. No 94.11(a)

# Assessment: 20% sessional work, 20% midterm, 60% final examinationCredit Hours: 03 +00Minimum Contact Hours:45

**Objectives:** To give idea about classical mechanics (statics, dynamics, and vectors), and enable students to recognize quantum mechanics, statistical, continuum and fluid mechanics, spaceflight, and Astro dynamics.

**Course Learning Outcomes** 

After completion of the course, student should be able to:

CLO	Description	Maximum	PLOs
		Taxonomy	
		Level	
1	Understand basics of Kinematics and kinetics, and solve related	C3	1
	problems		
2	Discuss the basics of harmonic oscillators, central forces,	C3	4
	planetary motion and solve related problems		
3	Describe basic concepts of vector calculus and extension to	C3	2
	gradient, divergence, and curl with physical applications		

#### **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

		 	-8
1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

# **Contents:**

**Kinematics:** Rectilinear motion of particles, Uniform rectilinear motion, uniformly accelerated rectilinear motion. Curvilinear motion of particle, rectangular components of velocity and acceleration. Tangential and normal components. Radial and transverse components. Projectile motion.

**Kinetics:** Work, power, kinetic energy, conservative force fields. Conservation of energy, impulse, torque. Conservation of linear and angular momentum. Non-conservative forces.

**Simple Harmonic Motion:** The simple harmonic oscillator, period, frequency. Resonance and energy. The damped harmonic oscillator, over damped, critically damped and under damped. Motion, forces, and vibrations.

**Central Forces and Planetary Motion:** Central force fields, equations of motion, potential energy, orbits. Kepler's law of planetary motion. Apsides and apsidal angles for nearly circular orbits. Motion in an inverse square field.

Vector Analysis: Gradient, Divergence, Curl, and their applications.

# **Recommended Books:**

1. E. DiBenedetto, *Classical Mechanics. Theory and Mathematical Modeling*, ISBN: 978-0-8176-4526-7, Birkhauser Boston, 2011.

2. John R. Taylor, *Classical Mechanics*, ISBN: 978-1-891389-22-1, University of Colorado.(Latest Edition)

3. H. Goldstein, Classical Mechanics, Addison-Wesley PublishingCo.(Latest Edition)

4. C. F. Chorlton, Text Book of Dynamics, Ellis Horwood.(Latest Edition)
5. M. R. Spiegel, *Theoretical Mechanics*, 3rd Edition, Addison-Wesley Publishing Company.(Latest Edition)

6. G. R. Fowles and G. L. Cassiday, *Analytical Mechanics*, 7<sup>th</sup>Edition, Thomson Brooks/COLE, USA.(Latest Edition)

Res. No. 02, Res. No. 04 Res. No 94.11(a)

	KINLENI OF DASI	C SCIENCE AND RELATED STUDIES
Title of Subject	: Dynamics	Marks: 100+00
Discipline	: Mathematics	
Semester	: 4 <sup>th</sup> semester	
Code	: MATH-255	
Pre-requisites	: Differential Equ	ations & Fourier Series
Assessment	: 20% sessional w	ork, 20% midterm, 60% final examination
<b>Credit Hours</b>	: 03 +00	<b>Minimum Contact Hours:45</b>

**Objectives:** To give idea about Dynamics, and enable students to recognize quantum mechanics, statistical, continuum mechanics and fluid, space-flight, astro dynamics.

# **Course Learning Outcomes**

After completion of the course, student should be able to:

CLO	Description	Maximum	PLOs
		Taxonomy	
		Level	
1	Discuss planar motion of rigid bodies and related theorems	C3	1
2	Explain motion of rigid bodies in three dimensions and solve	C3	1
	related problems		
3	Understand free rotation of rigid bodies and the Euler Equation	C3	1
	and related derivations		

The course is designed so that students will achieve the following PLOs:

	e	0	
1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

# **Course Contents:**

**Planer Motion of Rigid Bodies:** Introduction to rigid and elastic bodies, degree of freedom, translations, rotations, instantaneous axis and center of rotation, motion of the center of mass. Euler's theorem and Chasles' theorem. Rotation of a rigid body about a fixed axis, moments and products of inertia. Parallel and perpendicular axis theorem.

Motion of Rigid Bodies in Three Dimensions: General motion of rigid bodies in space. The momental ellipsoid and equi-momental systems. Angular momentum vector and rotational kinetic energy. Principal axes and principal moments of inertia. Determination of principal axes by diagonalizing the inertia matrix.

**Euler Equations of Motion of a Rigid Body:** Force free motion. Free rotation of a rigid body with an axis of symmetry. Free rotation of a rigid body with three different principal moments. The Eulerian angles, angular velocity, and kinetic energy in terms of Euler angles. Motion of a spinning top and gyroscopes-steady precession, sleeping top.

# **Recommended Books:**

1. E. DiBenedetto, *Classical Mechanics. Theory andMathematical Modeling*, ISBN: 978-0-8176-4526-7, Birkhauser Boston, 2011.

Res. No. 02, Res. No. 04 Res. No 94.11(a)

2. John R. Taylor, *Classical Mechanics*, ISBN: 978-1-891389-22-1, University of Colorado.(Latest Edition)

3. H. Goldstein, Classical Mechanics, Addison-Wesley PublishingCo.(Latest Edition)

4. C. F. Chorlton, Text Book of Dynamics, Ellis Horwood.(Latest Edition)

5. M. R. Spiegel, *Theoretical Mechanics*, 3rd Edition, Addison-Wesley Publishing Company.(Latest Edition)

6. G. R. Fowles and G. L. Cassiday, *Analytical Mechanics*, 7<sup>th</sup>Edition, Thomson Brooks/COLE, USA.(Latest Edition)

# MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES

Title of Subject: Number TheoryDiscipline: MathematicsSemester: 4th semester

Approved: Board of Studies, BSRS: 01/2019 Board of Faculty (FOST&H) 01/2019 Academic Council

Res. No. 02, Res. No. 04 Res. No 94.11(a) Dated: 07-02-2019 Dated: 07-03-2019 Dated: 27-03-2019

Marks: 100 + 00

# Code: MATH-270Pre-requisites: Linear AlgebraAssessment: 20% sessional work, 20% midterm, 60% final examinationCredit Hours: 03Minimum Contact Hours:45

**Objectives:** To give idea of numbers system and basic theorems, Diophantine equations and the theory of congruence.

Course Learning Outcomes

After completion of the course, student should be able to:

CLO	Description	Maximum	PLOs
		Taxonomy	
		Level	
1	Discuss principle of induction and divisibility theory	C3	1
2	Solve linear congruences using the Diophantine equations, explain	C3	1
	arithmetic function, and prove related theorems		
3	Explain primitive roots, indices, and quadratic residues with	C2	1
	examples		

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

# **Course Contents:**

Preliminaries: Well-ordering principle. Principle of finite induction.

**Divisibility theory:** The division algorithms. Basis representation theorem. Prime and composite numbers. Canonical decomposition. The greatest common divisor. The Euclidean algorithm. The fundamental theorem of arithmetic. Least common multiple.

**Linear Diophantine equations:** Congruences. Linear congruences. System of linear congruences. The Chinese remainder theorem. Divisibility tests. Solving polynomial congruences. Fermat's and Euler's theorems. Wilson's theorem.

**Arithmetic functions:** Euler's phi-function. The functions of J and sigma. The Mobius functions. The sieve of Eratosthenes. Perfect numbers. Fermat and Mersenne primes.

**Primitive Roots and Indices:** The order of an integer mod n. Primitive roots for primes. Composite numbers having primitive roots.

Quadratic residues: Legendre symbols and its properties. The quadratic reciprocity law.

Quadratic congruences with composite moduli. Pythagorean triples. Representing numbers as sum of two squares.

# **Recommended Books:**

1. D.M. Burton, Elementary Number Theory, McGraw-Hill, 2007.

2. W.J. Leveque, Topics in Number Theory, vols. I and II, Addison- Wesley.(Latest Edition)

3. S.B. Malik , Basic Number Theory, Vikas Publishing house. (Latest Edition)

4. K.H. Rosen, *Elementary Number Theory and its Applications*, 5th edition, Addison-Wesley.(Latest Edition)

5. I. Niven, H.S. Zuckerman, H.L. Montgomery, *An Introduction to the theory of Numbers*, John Wiley and Sons.(Latest Edition)

Res. No. 02, Res. No. 04 Res. No 94.11(a)

6. A. Adler, J.E. Coury, The Theory of Numbers, Jones and Bartlett Publishers.(Latest Edition)

Approved: Board of Studies, BSRS: 01/2019 Board of Faculty (FOST&H) 01/2019 Academic Council

Res. No. 02, Res. No. 04 Res. No 94.11(a)

Title of Subject	: C++ Programming & M	ATLAB	Marks: 100
Discipline	: Mathematics		
Semester	: 4 <sup>th</sup> semester		
Code	: MATH-260		
<b>Pre-requisites</b>	: Intermediate		
Assessment	: 20% Sessional work,	20% midte	rm, 60% final examination
<b>Credit Hours</b>	: 03	Min	imum Contact Hours: 45
<b>Objective:</b> To give	basic idea of programming.		

# **Course Learning Outcomes**

After completion of the course, student should be able to:

Modern Tool Usage

The Mathematician and Society

CLO	O Description					PLOs	
1	Understand basic concepts of C++ and execute	function	alities of C	:++	C3	5	
	programming						
2	Understand basic concepts and execute function	onalities o	of MATLA	В	C3	5	
The course is designed so that students will achieve the following PLOs:							
1	Mathematics Knowledge		7	Envi	ronment and Susta	inability	
2	Problem Analysis		8		Ethics		
3	Design/Development of Solutions		9	In	dividual and Teamwork		
4	Investigation		10		Communication	1	

# **Contents:**

5

6

**Introduction to C++:** Getting started, parts of a C++ Program, variable and constant, expression and statements, functions,

11

12

Task Management

Lifelong Learning

Classes: Basic Classes, more about classes, advanced program flow,

Memory Management: Pointers, Advanced pointers, references, advances reference and pointers.

Power Tools: Advanced functions, Operator overloading, Arrays

**MATLAB:** Introduction, Basic features, starting MATLAB, using MATLAB as a calculator, quitting MATLAB, creating MATLAB variables, overwriting variables, error message, making correction, managing workspace, entering multiple statements per line, creating simple plots, adding titles, axis labels, and annotations, multiple data sets in one plot, Entering matrix and vectors, matrix generators.

# **Recommended Books (latest edition):**

- 1. Houcque, D. (2005). Introduction to Matlab for engineering students. *Northwestern University*, (1).
- 2. Dukkipati, R. V. (2008). *MATLAB: an introduction with applications*. New Age International.
- 3. Sarma, K. K. (2010). *Matlab: Demystified Basic Concepts and Applications*. Vikas Publishing House.
- 4. Valentine, D. T., & Hahn, B. (2019). *Essential MATLAB for engineers and scientists*. Academic Press.
- 5. Katsikis, V. (Ed.). (2012). *MATLAB: A Fundamental Tool for Scientific Computing and Engineering Applications-Volume 3*. BoD–Books on Demand.

Title of Subject:	Group Theory	Marks: 100			
Discipline:	Mathematics				
Semester	4 <sup>th</sup> semester				
Code:	<b>MATH-265</b>				
Pre-requisites:	Set Theory				
Assessment:	20% sessional work,	20% midterm, 60% final examination			
<b>Credit Hours:</b>	03	Minimum Contact Hours: 45			

Objective: Introduce the basic concepts of groups and homomorphism

# Course Learning Outcomes

After completion of the course, student should be able to:

CLO	Description	Maximum	PLOs
	1	Taxonomy	
		Level	
1	Discuss groups and its types with theoretical description	C2	1
2	Explain group morphism (homo, iso, and auto) and permutations	C2	1
	with examples		
The	urse is designed so that students will achieve the following PLOs:		

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

# **Contents:**

**Groups:** Definition of a group, subgroup, subgroup generated by a set. The cyclic groups, cosets and Lagrange's theorem. Normalizer centralizer. The center of a group. Equivalence relation in a group, conjugacy classes. Normal subgroups, quotient group.

**Group homomorphism**: Homomorphism and isomorphism and Automorphism. Kernel and image of homomorphism. Isomorphism theorems. Permutation groups. The cyclic decomposition of a permutation group. Cayley's theorem. Direct product of two groups and examples.

# **Recommended Books:**

1. J. Rose, A Course on Group Theory, Cambridge University Press.(Latest Edition)

2. I. N. Herstein, Topics in Algebra, Xerox Publishing Company.(Latest Edition)

3. P. M. Cohn, Algebra, John Wiley and Sons, London.(Latest Edition)

4. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, *Basic Abstract Algebra*, Cambridge University Press. (Latest Edition)

5. J. B. Fraleigh, *A First Course in Abstract Algebra*, Addison- Wesley Publishing Company.(Latest Edition)

6. VivekSahai and VikasBist, *Algebra*, Narosa Publishing House.(Latest Edition)
7. D. S. Dummit and R. M. Foote, *Abstract Algebra*, 3<sup>rd</sup> Edition, Addison-Wesley Publishing Company.(Latest Edition)

2 DI II		
Title of Subject:	Topology	<b>Marks: 10</b> 0
Discipline:	Mathematics	
Semester	4 <sup>th</sup> semester	
Code:	<b>MATH-275</b>	
Pre-requisites:	Set Theory	
Assessment:	20% sessional work,	20% midterm, 60% final examination
<b>Credit Hours:</b>	03	Minimum Contact Hours: 45

Objective: Introduce the concept of topological and metric space

# **Course Learning Outcomes**

After completion of the course, student should be able to:

	1 ,		
CLO	Description	Maximum	PLOs
		Taxonomy	
		Level	
1	Describe basic concepts of topological spaces, and use these for	C3	1
	maps and homeomorphism		
2	Extend basic concepts to demonstrate metric, compact and	C3	2
	connected spaces		

The course is designed so that students will achieve the following PLOs:

		-	
1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

# **Course Outline:**

**Topological spaces:** Introduction to topology; open and closed subsets, metric spaces, neighborhoods. Limit points and accumulation points. Interior, closure, dense subsets. Constructing new topological spaces: Cartesian products, induced topology, and quotient topology. Continuous maps, open and closed maps, homeomorphisms. Examples: R, RxR, S<sup>1</sup>, S<sup>2</sup>, torus and cylinder.

Cauchy sequences, complete metric spaces. Separation axioms. Compact spaces. Properties. Power of Compactness. Image of a compact's set through a continuous map. Compactness and completeness of metric spaces Connected spaces, connected components. Properties. Image of a connected set through a continuous map. Path-connectedness.

# **Recommended Books:**

- 1. J. Kelly, General Topology, Springer. (Latest Edition)
- 2. K. Janich, *Topology*, Springer. (Latest Edition)
- 3. J. Hocking, G. Young, *Topology*, Dover Publications. (Latest Edition)
- 4. J. R. Munkres, Topology A First Course, Prentice-Hall. (Latest Edition)
- 5. G. Simmons, Topology and modern analysis, McGraw-Hill. (Latest Edition)
- 6. S. Lipschutz, General Topology, McGraw-Hill. (Latest Edition)
- 7. J. Dugundji, Topology, Allyn and Bacon,.(Latest Edition)



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ROUTINE 🗌

URGENT IMMEDIATE

# <u>department of basic sciences and related studies</u> Courses of 3<sup>rd</sup> Year of BS (Mathematics) <u>for Approval</u>

Third y	Third year					
First Se	mester					
S.#	Course Title	Course Code	Cr. Hr	Marks		
1	Algebraic Topology	MATH 305	3	100		
2	Differential Geometry & Tensor Analysis	MATH 310	3	100		
3	Partial Differential Equations	MATH 315	3	100		
4	Real Analysis- I	MATH 320	3	100		
5	Rings & Fields	MATH 350	3	100		
		Total	15			

Third y	Third year						
Second	Semester						
S.#	Course Title	Course Code	Cr. Hr	Marks			
1	Introduction to Simulation Software	MATH 370	2+1	100			
2	Transforms	MATH 355	3	100			
3	Complex Analysis	MATH 360	3	100			
4	Analytical Dynamics	MATH 375	3	100			
5	Real Analysis-II	MATH 365	3	100			
		Total	15				

Title of Subject:	Algebraic Topology	<b>Marks: 100</b>
Discipline:	Mathematics	
Semester	5 <sup>th</sup> semester	
Code:	MATH 305	
<b>Pre-requisites:</b>	Topology	
Assessment:	20% sessional work, 20% midterm, 60%	final examination
<b>Credit Hours:</b>	03 Min	imum Contact Hours: 45

**Objective:** To give basic idea of Bases, Spaces, Homotopy and Simplicial Complexes. **Course Learning Outcomes:** After completing this course, the students able to be

CLO	Description	Maximum	PLOs
	,		
		Level	
1	Discuss different types of bases and spaces with related axioms, theorems,	C3	1
	and examples		
2	Explain basic concepts of homotopy, simplicial complexes, and	C2	1
	homeomorphism		

# **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management

Approved:

Board of Studies, BSRS: 01/2019 Board of Faculty (FOST&H) 01/2019 Academic Council Res. No. 02, Res. No. 04 Res. No 94.11(a)

6

The Mathematician and Society

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# **Contents:**

# **Bases and Spaces**

Bases and Sub-bases. Sub-spaces. First and second axiom of countability. Continuous functions and Homeomorphisms. Product Spaces. Separation axioms. Completely regular spaces. Normal spaces. Connected spaces. Convergence and completeness. Analytic topology. Baire's theorem.

# Homotopy and Simplicial Complexes

Introduction. The classification problem. Homotopy. Simplicial complexes, homotopy and homeomorphism of polyhedral.

# **BOOKS RECOMMENDED**

- 1. Algebraic Topology; C. R. F Maunder; Cambridge University Press 1980
- 2. Yahya, S. M: Point Set Topology; Time Press Karachi.
- 3. Mohammad Amin: Introduction to General Topology; Lahore, Ilmi Kitab Khana, 1973.
- 4. Simmons, G. LF: Introduction to Topology and Modern Analysis McGraw Hill.
- 5. Armstrong M. A: Basic Topology M. Y. McGraw Hill.
- 6. Sims, B. T: Fundamentals of Topology N. Y. Machillan.
- 7. Baum: Elementary Topology; Prentice-Hall.
- 8. Sutter Land, W. A: Introduction to Metric & Topological Spaces; Oxford: Clarendon Press.
- 9. Gemignani, M. C: Elementary Topology; Reading; Mass, Addison Wesley.
- **10.** Gall: Point Set Topology; Academic Press.

Approved:

Board of Studies, BSRS: 01/2019 Board of Faculty (FoST&H) 01/2019 Academic Council Res. No. 02 Res. No. 04 Res. No. 100.15

Title of Subject:	Differential Geometry and Tensor A	nalysis Marks: 100
Discipline:	Mathematics	
Semester	5 <sup>th</sup> semester	
Code:	MATH 310	
Pre-requisites:	Calculus-I	
Assessment:	20% sessional work, 20% midterm,	60% final examination
Credit Hours:	03	Minimum Contact Hours: 45

**Objective:** To give classical concepts in local theory of curves and surfaces along with tensors of different ranks

# Course Learning Outcomes: After completing this course, the students able to be

CLO	Description	Maximum	PLOs
		Taxonomy	
		Level	
1	Explain basic concepts of space curves with related	C3	1
	theorems and examples		
2	Discuss different types of surfaces and fundamental	C3	1
	forms with examples		
3	Explain basic concepts of Tensor theory with properties,	C2	1
	operations and theorems		

# **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

# **Contents:**

# **Theory of Space Curves**

Introduction, index notation and summation convention. Space curves, arc length, tangent, normal and binormal. Osculating, normal, and rectifying planes. Curvature and Torsion. The Frenet-Serret theorem. Natural equation of a curve. Involutes and evolutes, helices. Fundamental existence theorem of space curves.

# **Theory of Surfaces**

Coordinate transformation. Tangent plane and surface normal. The first fundamental form and the metric tensor. The second fundamental form. Principal, Gaussian, mean, geodesic, and normal curvatures. Gauss and Weingarten equations. Gauss-Codazzi equations.

# **Tensor Analysis**

Einstein summation convention. Tensors of different ranks. Contravariant, covariant, and mixed tensors. Addition, subtraction, inner and outer products of tensors. Contraction theorem, quotient law. The line element and metric tensor. Christoffel symbols.

# **Recommended Books**

R. S. Millman and G. D. Parker, *Elements of Differential Geometry*, Prentice-Hall, New Jersey.(Latest Edition)
 A. Goetz, *Introduction to Differential Geometry*, Addison-Wesley.(Latest Edition)

3. E. Kreyzig, Differential Geometry, Dover.(Latest Edition)

4. M. M. Lipschutz, Schaum's Outline of Differential Geometry, McGraw Hill.(Latest Edition)

5. Nawazish Ali Shah, Vector and Tensor Analysis, A – One Publisher, Lahore, 2005

Approved: Board of Studies, BSRS: 01/2019 Board of Faculty (FoST&H) 01/2019 Academic Council

Res. No. 02 Res. No. 04 Res. No. 100.15

Title of Subject:	Partial Differential E	quations Marks: 100
Discipline:	Mathematics	-
Semester	5 <sup>th</sup> semester	
Code:	<b>MATH 315</b>	
<b>Pre-requisites:</b>	Ordinary differential	equations
Assessment:	20% sessional work,	20% midterm, 60% final examination
<b>Credit Hours:</b>	03	Minimum Contact Hours: 45

Objective: To give an idea about methods of solution of PDEs

# Course Learning Outcomes: After completing this course, the students able to be

	$\frac{1}{1}$		
CLO	Description	Maximum	PLOs
		Taxonomy	
		Level	
1	Explain basic concepts of PDEs and use separation variables method in	C3	2
	cartesian and cylindrical coordinates with applications		
2	Solve in series some important types of ODEs with examples	C3	3
3	Understand and classify Sturm-Liouville problems and solve related	C3	3
	examples		

# **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

# Contents:

#### **First order PDEs**

Introduction, formation of PDEs, solutions of PDEs of first order. The Cauchy's problem for quasilinear first order PDEs, First order nonlinear equations, Special types of first order equations

#### Second order PDEs

Basic concepts and definitions, Mathematical problems, Linear operators, Superposition, Mathematical models: The classical equations, the vibrating string, the vibrating membrane, conduction of heat solids, canonical forms, and variable, PDEs of second order in two independent variables with constant and variable coefficients, Cauchy's problem for second order PDEs in two independent variables.

#### Methods of separation of variables

Solutions of elliptic, parabolic, and hyperbolic PDEs in Cartesian and cylindrical coordinates.

#### **Sturm-Liouville problems**

The Bessel, modified Bessel Legendre and Hermite equations and their solutions. Introduction to Eigen value problem, adjoint and self-adjoint operators, self-adjoint differential equations, Eigen values and Eigen functions, Sturm-Liouville (S-L) boundary value problems, regular and singular S-L problems, properties of regular S-L problems.

#### Recommended Books (latest edition)

- Dennis G. Zill and Michael R., Differential equations with boundary-value problems by Cullin 5<sup>th</sup> Edition Brooks/Cole. (Latest Edition)
- William E. Boyce and Richard C. Diprima, Elementary differential equations and boundary value problems, Seventh Edition John Wiley & Sons, Inc

Res. No. 02, Res. No. 04 Res. No 94.11(a)

- 3. Jeffrey, A. (2003). *Applied partial differential equations: an introduction*. Academic Press.
- 4. Coleman, M. P. (2016). *An introduction to partial differential equations with MATLAB*. CRC Press.
- 5. Wazwaz, A. M. (2002). Partial differential equations. CRC Press.
- 6. Shah, N. H. (2015). Ordinary And Partial Differential Equations: Theory and *Applications*. PHI Learning Pvt. Ltd.
- 7. Articolo, G. A. (1998). *Partial Differential Equations & Boundary Value Problems with Maple V* (Vol. 1). Academic Press.

Approved:			
Board of Studies, BSRS: 01/2019	Res. No. 02	Dated: 07-02-2019	
Board of Faculty (FoST&H) 01/2019	Res. No. 04	Dated: 07-03-2019	
Academic Council	Res. No. 100.15	Dated: 24-08-2021	

Title of Subject:	Real Analysis-I	<b>Marks: 100</b>
Discipline:	Mathematics	
Semester	5 <sup>th</sup> semester	
Code:	MATH 320	
Pre-requisites:	Calculus-II	
Assessment:	20% sessional work,	20% midterm, 60% final examination
<b>Credit Hours:</b>	03	Minimum Contact Hours: 45

**Objective:** To give the idea of fundamental concepts of analysis and axiomatic foundation of real number system

#### Course Learning Outcomes: After completing this course, the students able to be

CLO	Description	Maximum	PLOs
		Taxonomy	
		Level	
1	Explain basic concepts of number system and topology of real numbers with	C2	1
	related theory		
2	Discuss sequences and series, and apply convergence tests with examples	C3	1
3	Understand uniform continuity, monotone functions, discontinuity, and	C2	1
	differentiation with related theorems and examples		

# **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

# Contents:

Number Systems: Ordered fields. Rational, real, and complex numbers. Archimedean property, supremum, infimum, and completeness.

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**Topology of real numbers:** Convergence, completeness, completion of real numbers. Open sets, closed sets, compact sets. Heine-Borel Theorem. Connected sets.

**Sequences and Series of Real Numbers:** Limits of sequences, algebra of limits. Bolzano Weierstrass Theorem. Cauchy sequences, liminf, limsup. Limits of series, convergences tests, absolute and conditional convergence. Power series.

**Continuity:** Functions, continuity and compactness, existence of minimizers and maximizers, uniform continuity. Continuity and connectedness, Intermediate mean Value Theorem. Monotone functions and discontinuities.

Differentiation: Mean Value Theorem, L'Hôpital's Rule, Taylor's Theorem.

#### **Recommended Books**

1. S. Lang, Analysis I, Addison-Wesley Publ. Co., Reading, Massachusetts.(Latest Edition)

2. W. Rudin, Principles of Mathematical Analysis, 3rd ed., Mc. Graw Hill.(Latest Edition)

3. B. S. Thomson, J. B. Bruckner and A. M. Bruckner, *Elementary Real Analysis*, 2<sup>nd</sup> Ed. 2008.

4. G. Boros, V. Moll, Irresistible Integrals: Symbolics, Analysisan Experiments in the Evaluation of Integrals, Cambridge University Press. (Latest Edition)

5. J. Borwein, D. Bailey, R. Girgenson, *Experimentation in Mathematics: Computational Paths to discovery*, Wellesley, MA,A.K. Peters.(Latest Edition)

6. G. Bartle, R. Sherbert, Introduction to Real Analysis, 3rdedition, John Wiley, New York.(Latest Edition)

Approved:

Board of Studies, BSRS: 01/2019 Board of Faculty (FoST&H) 01/2019 Academic Council Res. No. 02 Res. No. 04 Dated: 07-02-2019 Dated: 07-03-2019 Res. No. 100.15 Dated: 24-08-2021

Approved: Board of Studies, BSRS: 01/2019 Board of Faculty (FOST&H) 01/2019 Academic Council

Res. No. 02, Res. No. 04 Res. No 94.11(a)

Title of Subject:	<b>Rings and Fields</b>	Marks: 100
Discipline:	Mathematics	
Semester	5 <sup>th</sup> semester	
Code:	MATH 350	
<b>Pre-requisites:</b>	Algebra-I	
Assessment:	20% Sessional work,	20% midterm, 60% final examination
<b>Credit Hours:</b>	03	Minimum Contact Hours: 45

**Objective:** Introduce the basic concepts of rings and fields.

**Course Learning Outcomes:** After completing this course, the students able to be

	8 1 0	/	
CLO	Description	Maximum Taxonomy	PLOs
		Level	
1	Explain basic concepts of Rings and Ideals with	C2	1
	operations, properties, types, and theorems		
2	Discuss basic concepts of integral domain and	C2	1
	fields with related properties and theorems and		
	their extension to polynomials		

# **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

# **Contents:**

Rings: Introduction, Quadratic integer rings. Examples of non-commutative rings. The Hamilton quaternions. Polynomial rings. Matrix rings. Units, zero-divisors, nilpotent, idempotents. Subrings, Ideals. Maximal and prime Ideals. Left, right and two-sided ideals. Operations with ideals. The ideal generated by a set. Quotient rings. Ring homomorphism. The isomorphism theorems, applications. Finitely generated ideals. Rings of fractions.

Integral Domain: The Chinese remainder theorem. Divisibility in integral domains, greatest common divisor, least common multiple. Euclidean domains. The Euclidean algorithm. Principal ideal domains. Prime and irreducible elements in an integral domain. Gauss Lemma, irreducibility criteria for polynomials. Unique factorization domains. Finite fields. Polynomials in several variables. Symmetric polynomials. The fundamental theorem of symmetric polynomials.

#### **Recommended Books**

1. J. Rose, A Course on Group Theory, Cambridge UniversityPress.(Latest Edition)

2. I. N. Herstein, Topics in Algebra, Xerox Publishing Company.(Latest Edition)

3. P. M. Cohn, Algebra, John Wiley and Sons, London.(Latest Edition)

4. P. B. Bhattacharya, S. K. Jain and S. R. Nagpaul, BasicAbstract Algebra, Cambridge University Press.(Latest Edition)

5. J. B. Fraleigh, A First Course in Abstract Algebra, Addison-Wesley Publishing Company. (Latest Edition) 7. VivekSahai and VikasBist, Algebra, NarosaPublishingHouse.(Latest Edition)

Approved: Board of Studies, BSRS: 01/2019 Board of Faculty (FOST&H) 01/2019 Academic Council

Res. No. 02. Res. No. 04 Res. No 94.11(a)

Dated: 07-02-2019 Dated: 07-03-2019 Dated: 27-03-2019 0

8. D. S. Dummit and R. M. Foote, *Abstract Algebra*, 3<sup>rd</sup>Edition, Addison-Wesley Publishing Company.(Latest Edition)

Approved: Board of Studies, BSRS: 01/2019 Board of Faculty (FoST&H) 01/2019 Academic Council

Res. No. 02 Res. No. 04 Res. No. 100.15 Dated: 07-02-2019 Dated: 07-03-2019 Dated: 24-08-2021

Res. No. 02, Res. No. 04 Res. No 94.11(a)

Title of Subject:	Introduction to Simulation Sof	ftware Marks: (50+50)
Discipline:	Mathematics	
Semester	6 <sup>th</sup> semester	
Code:	MATH 370	
Pre-requisites:	Introduction to computers	
Assessment:	20% sessional work, 20% mid	term, 60% final examination
<b>Credit Hours:</b>	02 M	inimum Contact Hours: 30+30

**Objectives:** To explore the applications of Mathematics using various packages. **Course Learning Outcomes:** After completing this course, the students able to be

CLO	Description	Maximum Taxonomy	PLOs
		Level	
1	Solve problems from matrix theory in linear algebra	C3	5
	using MATLAB		
2	Explain basic concepts of SPSS and use them for	C3	5
	descriptive statistics and regression analysis		
3	Explain basic concepts of MATHEMATICA and use	C3	5
	them for matrix theory in linear algebra using		
	MATHEMATICA		
4	Utilize programming knowledge of simulation	Р3	12
	software for applied problems		

# **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

# **Contents:**

**MATLAB:** Introduction of MATLAB, Arithmetic operations, percentage, ratios, addition, subtraction, multiplication and inverse of matrices, and linear algebra on MATLAB (Finding inverses, determinants, powers and exponentials, eigenvalues and eigenvectors Solving linear systems of equations, etc.), Sparse matrices, Solving algebraic and transcendental equations numerically, Polynomials and interpolations.

Data analysis and curve fitting on MATLAB (Descriptive statistics, linear regression, correlation analysis, Time series methods and tools, Basic curve fitting)

Finding the roots of equations, limit of functions, derivative and integration, maximum, minimum of functions, symbolic summations, solving ordinary differential equations (ODEs) using different solvers. Plotting 2D and 3D graphs of functions, Annotating and editing graphs, Figure properties, Creating specialized plots, Creating mesh and Contour plots, Animation and animation Control.

**SPSS:** Environment of SPSS and basic Commands, Averages: arithmetic Mean, Median, Mode, standard deviation. Regression analysis.

**Mathematica:** Environment of Mathematica, Basic operations and commands of MATHEMATICA to manipulate numbers, Mathematical functions, Equations, Calculus, Series and Residues, Linear algebra and data analysis, Formula gallery, Graphics gallery, and Standard packages of MATHEMATICA

#### **Recommended Books (latest edition)**

Approved: Board of Studies, BSRS: 01/2019 Board of Faculty (FOST&H) 01/2019 Academic Council

Res. No. 02, Res. No. 04 Res. No 94.11(a)

- 1. Mirza, S. M. (2010). Introduction to Matlab®. Beginner Resource.
- 2. Pratap, R. (1998). *Getting Started with MATLAB 5-A Quick Introduction for Scientists and Engineers* (p. 240).
- 3. Sarma, K. K. (2010). *Matlab: Demystified Basic Concepts and Applications*. Vikas Publishing House.
- 4. Enns, R. H., & McGuire, G. C. (2001). *Nonlinear physics with Mathematica for scientists and engineers*. Springer Science & Business Media.
- 5. Hoste, J. (2008). Mathematica demystified. McGraw Hill Professional.
- 6. Salcedo, J., & McCormick, K. (2020). SPSS Statistics for Dummies. John Wiley & Sons.
- 7. Yockey, R. D. (2016). SPSS demystified: A simple guide and reference. Routledge.
- 8. te Grotenhuis, M., & Matthijssen, A. (2015). Basic SPSS tutorial. Sage Publications.

Approved: Board of Studies, BSRS: 01/2019 Board of Faculty (FoST&H) 01/2019 Academic Council

Res. No. 02 Res. No. 04 Res. No. 100.15

DEFA	KIMENI OF DASIC SU	CIENCE AND RELATED STUDIES
Title of Subject:	Transforms	<b>Marks: 100</b>
Discipline:	Mathematics	
Semester	6 <sup>th</sup> semester	
Code:	MATH 355	
Pre-requisites:	Ordinary and partial	differential equations.
Assessment:	20% Sessional work,	20% midterm, 60% final examination
<b>Credit Hours:</b>	03	Minimum Contact Hours: 45

**Objective:** Introduce the basic concepts of Laplace& Fourier transforms **Course Learning Outcomes:** After completing this course, the students able to be

CLO	Description	Maximum Taxonomy	PLOs
		Level	
1	Explain basic concepts of Laplace transform and	C3	3
	related properties with examples and applications		
2	Explain basic concepts of Fourier transform and	C3	3
	related properties with examples and applications		

# **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

# **Contents:**

**Laplace transform:** Introduction and properties of Laplace transform, transforms of elementary functions, periodic functions, error function and Dirac delta function, inverse Laplace transform, convolution theorem, solution of PDEs by Laplace transform, Diffusion, and wave equations

**Fourier transform**: Fourier integral representation, Fourier sine and cosine representation, Fourier transform pair, transform of elementary functions and Dirac delta functions, finite Fourier transforms, solutions of heat, wave and by Fourier transforms.

# **Recommended Books**

- 1. McLachlan, N. W. (2014). *Laplace transforms and their applications to differential equations*. Courier Corporation.
- 2. Spiegel, M. R. (1965). *Schaum's Outline of Laplace Transforms*. McGraw Hill Professional.
- 3. Beerends, R. J., ter Morsche, H. G., Van den Berg, J. C., & Van de Vrie, E. M. (2003). *Fourier and Laplace transforms* (p. 458).
- 4. Laplace, Fourier And Z Transforms with Application for BS 4 Years by ZR Bhatti

Approved: Board of Studies, BSRS: 01/2019	Res. No. 02	Dated: 07-02-2019	
Approved: Board of Studies, BSRS: 01/2019 Board of Faculty (FOST&H) 01/2019 Academic Council	Res. No. 02, Res. No. 04 Res. No 94.11(a)	Dated: 07-02-2019 Dated: 07-03-2019 Dated: 27-03-2019	

Board of Faculty (FoST&H) 01/2019 Academic Council Res. No. 04 Res. No. 100.15 Dated: 07-03-2019 Dated: 24-08-2021

Res. No. 02, Res. No. 04 Res. No 94.11(a)

Title of Subject:	<b>Complex Analysis</b>	<b>Marks: 100</b>
Discipline:	Mathematics	
Semester	6 <sup>th</sup> semester	
Code:	<b>MATH 360</b>	
Pre-requisites:	Real Analysis-I	
Assessment:	20% Sessional work,	20% midterm, 60% final examination
<b>Credit Hours:</b>	03	Minimum Contact Hours:45

**Objective:** Introduce the concept of complex numbers and complex variables. **Course Learning Outcomes:** After completing this course, the students able to be

CLO	Description	Maximum Taxonomy	PLOs
		Level	
1	Explain basic concepts of complex numbers and	C2	1
	functions of complex variables with operations,		
	properties, theorems, and examples		
2	Discuss complex integrals over different contours	C3	2
	and apply the complex integral theorems to solve		
	related examples		
3	Explain basics of complex series and types of	C3	2
	singularities with related theorems and applications		

# **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

# **Contents:**

**Introduction**: The algebra of complex numbers, Geometric representation of complex numbers, Powers, and roots of complex numbers.

**Functions of Complex Variables:** Definition, limit and continuity, Branches of functions, Differentiable and analytic functions. The Cauchy-Riemann equations, Entire functions, Harmonic functions, Elementary functions: The exponential, Trigonometric, Hyperbolic, Logarithmic, and Inverse elementary functions, Open mapping theorem. Maximum modulus theorem.

**Complex Integrals:** Contours and contour integrals, Cauchy-Goursat theorem, Cauchy integral formula, Liouville's theorem, Morera's theorem.

**Series:** Power series, Radius of convergence and analyticity, Taylor's and Laurent's series, Integration, and differentiation of power series. Singularities, Poles and residues: Zero, singularities, Poles and Residues, Types of singular points, Calculus of residues, contour integration, Cauchy's residue theorem with applications. Mobius transforms, conformal mappings, and transformations.

#### **Recommended Books**

1. R. V. Churchill, J. W. Brown, *Complex Variables and Applications*, 5th edition, McGraw Hill, New York. (Latest Edition)

2. J. H. Mathews and R. W. Howell, Complex Analysis for Mathematics and Engineering.(Latest Edition)

3. S. Lang, Complex Analysis, Springer-Verlag. (Latest Edition)

Res. No. 02, Res. No. 04 Res. No 94.11(a) 4. R. Remmert, Theory of Complex Functions, Springer-Verlag. (Latest Edition)

5. W. Rudin, Real and Complex Analysis, McGraw-Hill. (Latest Edition)

6. Zill, D. G., & Shanahan, P. D. (2013). *Complex analysis: A first course with applications*. Jones & Bartlett Publishers.

Approved: Board of Studies, BSRS: 01/2019 Board of Faculty (FoST&H) 01/2019 Academic Council

Res. No. 02 Res. No. 04 Res. No. 100.15 Dated: 07-02-2019 Dated: 07-03-2019 Dated: 24-08-2021

Res. No. 02, Res. No. 04 Res. No 94.11(a)

Title of Subject:	Analytical Dynamics	Marks: 100
Discipline:	Mathematics	
Semester	6 <sup>h</sup> semester	
Code:	MATH 375	
Pre-requisites:	Calculus-I	
Assessment:	20% sessional work, 20% m	idterm, 60% final examination
<b>Credit Hours:</b>	03	Minimum Contact Hours:45

**Objective:** To understand the idea of various coordinate systems and their use. **Course Learning Outcomes:** After completing this course, the students able to be

CLO	Description	Maximum	PLOs
		Taxonomy	
		Level	
1	Extend basic concepts of dynamics to understand variable motion,	C3	4
	forced oscillations and variable mass problems with applications		
2	Discuss advanced topics of analytical dynamics and related theorems	C3	4
	with examples and applications		

# **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

#### Contents:

Kinematics:

Moving axes Velocity and Acceleration Components in cylindrical and spherical polar coordinates.

#### **Particle Dynamics:**

Damped and forced vibrations. Resisted motion. Changing mass problems.

#### Mechanics of a Rigid Body:

Coordinate transformations and the rotation matrix. Euler's theorem for rotation about a fixed point. Euler's angles and angular velocity components in terms of Euler's angles and their derivatives. Moments and product of Inertia tensor and inertia ellipsoid. Motion of a rigid body about an axis parallel to a plane. Euler's dynamical equations and their solution in special cases. Motion relatives to the rotating earth. Motion of a top. Conservation Laws. Constraints. Lagrange's Generalized coordinates. Real and virtual displacements. Principle of virtual work and equilibrium problems. D' Alembert's principle. Holonomic and Non-holonomic systems. Lagrange's equations of motion. Ignorable coordinates and Routh's equations of motion. Hamilton's canonical equations of motion. Hamilton's Principle. Central forces. Small oscillations. Normal coordinates and normal modes. Principle of least action. Canonical transformations. Lagrange's and Poisson Brackets. Hamilton-Jacobi theory and action-angle variables.

#### **<u>RECOMMENDEDBOOKS</u>**:

- 1. Goldstein, H: Classical Mechanics; Addison Wesley.
- 2. Synge and Griffth: Principles of Mechanics; McGraw Hill.
- 3. Rosenberg, R. M: Analytical Dynamics of Discrete systems; Plenu.
- 4. Pars, L. A: Analytical Dynamics; Heixemann Press, London.
- 5. Saletan, E. J: Theoretical Mechanics; John Wiley and Cromer A. A.
- 6. Neimark, Ju, I. and Fuvev, M.A: Dynamics of non-holonomic systems.

Approved:

Board of Studies, BSRS: 01/2019 Board of Faculty (FOST&H) 01/2019 Academic Council Res. No. 02, Res. No. 04 Res. No 94.11(a)

Symon: Mechanics; Addison Wesley.
 8.Marion, J. B: Classical Dynamics of Particle and systems; Academic Press

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Board of Studies, BSRS: 01/2019	Res. No. 02	Dated: 07-02-2019	
Board of Faculty (FoST&H) 01/2019	Res. No. 04	Dated: 07-03-2019	
Academic Council		Res. No. 100.15	Dated: 24-08-2021

Res. No. 02, Res. No. 04 Res. No 94.11(a)

# MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO

Title of Subject:	Real Analysis-II	Marks: 100
Discipline:	Mathematics	
Semester	6 <sup>th</sup> semester	
Code:	MATH 365	
Pre-requisites:	Real Analysis-I	
Assessment:	20% Sessional work,	20% midterm, 60% final examination
Credit Hours:	03+00	Minimum Contact Hours:45

**Objective:** Introduce the advanced concepts of Real Analysis.

#### Course Learning Outcomes: After completing this course, the students able to be

CLO	Description	Maximum Taxonomy	PLOs
		Level	
1	Explain basic concepts of the Riemann-Stieltjes Integrals and	C2	2
	functions of bounded variation, existence theory, properties, and		
	related examples		
2	Extend the concept of integrals to improper integrals and	C2	2
	convergence tests with examples		
3	Extend the concept of convergence of sequences and series of	C2	4
	functions to pointwise and uniform convergence		

# **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning
<b>~</b>			

# **Contents:**

**The Riemann-Stieltjes Integrals:** Definition and existence of Integrals. Properties of integrals. Fundamental theorem of calculus and its applications. Change of variable theorem. Integration by parts.

**Functions of Bounded Variation:** Definition and examples. Properties of functions of bounded variation.

**Improper Integrals:** Types of improper integrals, tests for convergence of improper integrals. Beta and gamma functions. Absolute and conditional convergence of improper integrals.

**Sequences and Series of Functions:** Power series, definition of pointwise and uniform convergence. Uniform convergence and continuity. Uniform convergence and differentiation. Examples of uniform convergence.

# **Recommended Books**

1. S. Lang, Analysis I, II, Addison-Wesley Publ. Co., Reading, Massachusetts. (Latest Edition)

2. W. Rudin, Principles of Mathematical Analysis, 3rd Ed., McGraw-Hill. (Latest Edition)

3. K. R. Davidson and A. P. Donsig, *Real Analysis with Real Applications*, Prentice Hall Inc., Upper Saddle River. (Latest Edition)

4. G. B. Folland, Real Analysis, 2nd Edition, John Wiley and Sons, New York. (Latest Edition)

5. E. Hewitt and K. Stromberg, *Real and Abstract Analysis*, Springer-Verlag, Berlin Heidelberg New York. (Latest Edition)

6. H. L. Royden, Real Analysis, 3rd Edition, Macmillan, New York. (Latest Edition)

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7. G. Bartle, R. Sherbert, Introduction to Real Analysis, 3rdEdition, John Wiley, New York. (Latest Edition)

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Res. No. 02 Res. No. 04 Res. No. 100.15 Dated: 07-02-2019 Dated: 07-03-2019 Dated: 24-08-2021

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 MEHRANUNIVERSITY OF ENGINEERING & TECHNOLOGY

 Internal office memo
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 Sept. 20, 2003
 Sept. 20, 2003



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# **DEPARTMENT OF BASIC SCIENCES AND RELATED STUDIES**

# <u>Courses of 4<sup>th</sup> Year of BS (Mathematics)</u> <u>for Approval</u>

URGENT

Fourth Year						
First Semester						
<b>S.</b> #	<b>Course Title</b>	<b>Course Code</b>	C.H.	Marks		
1	Numerical Analysis-I	MATH 405	3+1	150		
2	Functional Analysis	MATH 410	3	100		
3	Fluid Mechanics	MATH 415	3	100		
4	Optimization Techniques	MATH 420	3	100		
5	Mathematical Physics	MATH 425	3	100		
	Total	16				

Fourth Year							
Second Semester							
<b>S.</b> #	Course Title		<b>Course Code</b>	C.H.	Marks		
Approved: Board of Studies, BSRS: 01/2019 Board of Faculty (FOST&H) 01/2019 Academic Council		Res. No. 02, Res. No. 04 Res. No 94.11(a)	Dated: 07-02- Dated: 07-03- Dated: 27-03-	2019 2019 2019			

1	Inferential Statistics	MATH 470	3	100
2	Numerical Analysis-II	MATH 480	3+1	150
3	Integral Equations	MATH 465	3	100
4	Econometrics	MATH 455	3	100
5	Operation Research	MATH 460	3	100
6	Comprehensive Examination	MATH 499	3	100
	Total	19		

#### **MEHRANUNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO**

DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES					
Title of Subject	: Numerical Analysis-I	Marks: 100+50			
Discipline	: Mathematics				
Semester	: 7 <sup>th</sup> semester				
Code	: MATH 405				
Pre-requisites	: Calculus-I, Linear Algebra.				
Assessment	: 20% sessional work, 20% midt	erm, 60% final examination			
<b>Credit Hours</b>	: 03 +01	Minimum Contact Hours:45+45			

#### **Objectives:** Introduce the concept of numerical computation.

CLO	Description		PLOs
1	Asses the root of non-linear equations $f(x) = 0$ with numerical computation, and iterative methods for the solution of simultaneous linear algebraic	C4	2
	equations		
2	Apply and evaluate methods of interpolation and extrapolation, numerical	C4	2
	differentiation, and integration		
3	Compute and analyze numerical solution of ordinary differential equations		4
4	Perform computations of the numerical schemes in software environment	P3	9

#### **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

#### **Contents**

Error analysis: Introduction, floating points, errors, types of errors.

Solution of non-linear equation: Bisection method, Regula-Falsi method, Newton-Raphson method, Fixed-Point iterative method.

Solution of System of Linear Algebraic equation: Iterative methods: Jacobi's method, Gauss-Seidel method.

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Eigen values and Eigen vectors: Power method.

**Interpolation and Extrapolation:** Differences: Forward, backward, central, operators and their relations. Newton's forward interpolation formula. Newton's backward interpolation formula, Newton's divided difference formula, Lagrange's interpolation formula. Stirling's formula.

Numerical differentiation: Newton's forward and backward differentiation formulae.

Numerical quadrature: Trapezoidal rule, Simpson's one-third rule, Simpson's three-eighth rule, Weddle's rule, Gaussian quadrature.

**Numerical solution of ordinary differential equations:** Taylor series method, Euler's, and its modified methods, Runge-Kutta methods, Predictor Corrector Methods; Milline's method, Adam-Bash forth method.

**Books Recommended (Latest Edition)** 

- Chapra, S. C., & Canale, R. P. (2011). *Numerical methods for engineers* (Vol. 1221). New York: Mcgrawhill.
- Gerald, C. F. (2004). *Applied numerical analysis*. Pearson Education India.
- Kreyszig, E., Stroud, K., & Stephenson, G. (2008). Advanced engineering mathematics. *Integration*, *9*, 4.Dr.SaeedAkhterBhatti, A first course in numerical analysis.
- Van Iwaarden, J. L. (1985). Ordinary differential equations with numerical techniques. Harcourt.

# MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO

	<u>DEPARIMENT OF BASIC SCIENCE AND RELATED STUDIES</u>		
Title of Subject:	<b>Functional Analysis</b>	Marks: 100	
Discipline:	Mathematics		
Semester	7 <sup>th</sup> semester		
Code:	MATH 410		
Pre-requisites:	Analysis-I		
Assessment:	20% Sessional work,	20% midterm, 60% final examination	
Credit Hours: 03		Minimum Contact Hours: 45	

**Objective:** To develop idea of normal & inner product spaces

Course Learning Outcomes: After completing this course, the students able to be

CLO	Description	Maximum Taxonomy	PLOs
		Level	
1	Extend the concept of metric spaces to explain convergence,	C2	1
	complete metric and separable spaces, and Baire category theorem		
2	Explain normed linear spaces with examples, properties and	C2	1
	applications to Banach spaces		
3	Explain inner product spaces with examples, properties and	C2	1
	applications to Hilbert spaces		

# **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

#### **Contents:**

Metric Space: Review of metric spaces, Convergence in metric spaces, Complete metric spaces, Dense sets and separable spaces, No-where dense sets, Baire category theorem.

Normed Spaces: Normed linear spaces, Banach spaces, Equivalent norms, Linear operator, Finite dimensional normed spaces, Continuous and bounded linear operators, Dual spaces.

**Inner Product Spaces:** Definition and examples, Orthonormal sets and bases, Annihilators, projections, Linear functionals on Hilbert spaces. Reflexivity of Hilbert spaces.

#### Recommended Books (Latest Edition):

- 1. A. V. Balakrishnan, Applied Functional Analysis, 2<sup>nd</sup>edition, Springer-Verlag, Berlin.
- 2. J. B. Conway, A Course in Functional Analysis, 2nd ed., Springer-Verlag, Berlin.

3. K. Yosida, Functional Analysis, 5th ed., Springer-Verlag, Berlin.

4. E. Kreyszig, Introduction to Functional Analysis with Applications, John Wiley and Sons, 2004.

Fitle of Subject: Fluid Mechanics						
Discipline:	Mathematics					
Semester	7 <sup>th</sup> semester					
Code:	<b>MATH 415</b>					
Pre-requisites:	Statics and Vector analysis					
Assessment:	20% Sessional work,					
Credit Hours:	03					

Marks: 100

20% midterm, 60% final examination Minimum Contact Hours:45

**Objective:** To develop idea of Kinetics and Kinematics of fluids **Course Learning Outcomes:** After completing this course, the students able to be

 e Dear ming			
CLO	Description	Maximum	PLOs
		Level	
1	Understand and use basic concepts of Kinematics of fluids and solve	C3	2
	related applied problems		
2	Explain conservation laws and equations of momentum with proofs and	C3	1
	examples		
3	Understand different concepts and theorems on irrotational motion of	C2	4
	fluids with applications		

#### **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

#### **Contents:**

**Kinematic:** Lagrangian and Eulerian methods of specification in continuous media, local convective and total rates of change; acceleration; conservation of mass. Incompressible fluids. Stream functions and streamlines. Boundary conditions. Vortex lines and tubes; Circulation; Vortex sheet; line vortices. Rate of change of circulation (Kelvin's theorem). Irrotational or potential motion, the velocity potential. Two dimensional and axially symmetric motion; stokes stream function.

**Equation of Motions:** Conservation of linear momentum. Equation of Motion. Bernoulli's theorem and its applications. Impulsive motion.

**Irrotational Motion:** General Theory. Kelvin's minimum energy theorem. Complex potential and some potential flows; sources, sinks and doublets; Circle theorem. Method of images. Blasius theorem. Aerofoils and the theorem of Kutta and Joukowski. Moving cylinders. Vortex Motion, Karman's Vortex Street.

#### **BOOKS RECOMMENDED:**

- 1. Besant, W.H. & A.S. Ramsey: A Treatise on Hydro-mechanics Part-II; paper Back C.U.P.
- 2. J. Williams: Fluid Mechanics; George Allen and Unwin ltd. London.
- 3. Milne-Thomson, L.M.: Theoretical Hydrodynamics; MacMillan
- 4. D. F. Lawden: A course of Applied Mathematics
- 5. D. E. Rutherford: Fluid Dynamics; Oliver and Boyd.
- 6. Aris, R. Vectors, Tensors and Basic Equations of Fluid Mechanics; Prentice Hall. 7. Merzkersh, W.: Flow Visualisation; Academic Press.
- 8. Massey, B. S.: Mechanics of Fluids; Van NostrandRenhild.
- 9. Allen, T & Ditsworth, R.L. Kogakusha: Fluid Mechanics; McGraw-Hill
- 10. Streeter, V.L. & Kogakusha, Wylie, E. B.: Fluid Mechanics; Mcgraw Hill.
- 11. Goldstein, S. & Burgers, J.M.: Lectures of Fluid mechanics; Providence, AMS R.I
- 12. Landan, L. D. Lifshitz, E.M.: Fluid Mechanics; Pergamon Press.
- 13. Curle, W& Davies, H.J.: Modern Fluid Dynamics, vol. I. Van Nostrand Reinhold.
- 14. Batchelor, G. K.: An introduction to Fluid Dynamics; C.U.P.

Approved: Board of Studies, BSRS: 01/2019 Board of Faculty (FOST&H) 01/2019 Academic Council

Res. No. 02, Res. No. 04 Res. No 94.11(a)

#### MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO

	<u>DEPARTMENT OF BASIC S</u>	CIENCE AND RELATED STUDIES
Title of Subject:	<b>Optimization Techniques</b>	Marks: 100
Discipline:	Mathematics	
Semester	7 <sup>th</sup> semester	
Code:	<b>MATH 420</b>	
Pre-requisites:	Calculus-I, Linear Algebra	a.
Assessment:	20% Sessional work,	20% midterm, 60% final examination
<b>Credit Hours:</b>	03	Minimum Contact Hours:45

Objective: To give idea of optimization problems and their solution methods.

#### Course Learning Outcomes: After completing this course, the students able to be

CLO	Description	Maximum Taxonomy Level	PLOs
1	Understand basics of optimization problems and techniques, derive existence conditions, and solve application problems	C3	2
2	Understand and apply line, direct and univariate search methods for unconstrained optimization	C3	1
3	Understand optimization of functionals, solve variational problems, and use Rayleigh-Ritz method with applications	C3	4

#### PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

#### **Contents:**

**Introduction:** Definition of Optimization problems and techniques. Mathematical Models. Local and global Extrema (Optima) of a function of one and more than one variable and inflexion points. Types of optimization techniques. Derivation of Necessary and Sufficient conditions for an extremum of a function of one and more than one variable. Lagrange's Multipliers techniques.

#### Unconstrained Optimization for Functions: Decent methods (line search methods):

Gradient of a function. Quadratic forms of a function. Hessian matrix. Positive and negative definite matrices indefinite matrices. Steepest-Descent method. Newton's Method. Convergence criteria. Variable metric method. Avidon-Fletcher –Powell Method.

**Direct Search Methods:** Unimodal function. Simplex Method of Nelder - Mead Method. Hook-Jeaves method. Fibonacci Method. Quadratic Interpolation Powell's method. Univariate search and Powell's method.

**Optimization of Functionals:** Functionals. Extrema of a functional. Variational Problems. Variational Problems in n-dimensions. The Euler-Lagrange's equation. Rayleigh-Ritz Method.

#### BOOKS RECOMMENDED (Latest Edition):

- 1. S.S.Rao: Optimization theory and applications; Wiley Eastern limited New Delhi.
- 2. M.A.Wolf: Numerical Methods for Unconstrained Optimization an introduction; Van Nostrand Reinhold Company.
- **3.** G.R.Walsh: Methods of optimization; John Wiley & Sons.
- 4. Delia, Koo: Elements of optimization with Applications in Economics & Business; Springer-Verlag New York Inc.
- 5. Sagan, H.: Boundary and Eigenvalue problems in Mathematical Physics.
- 6. Butkov, E.: Mathematical Physics; Addison Wesley.

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7. L. Elsgolt: Differential Equations and the Calculus of Variations; Mir Publishers Moscow.

DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES					
Title of Subject:	Mathematical Physics	Marks: 100			
Discipline:	Mathematics				
Semester	7 <sup>th</sup> semester				
Code:	<b>MATH 425</b>				
Pre-requisites:	Transform				
Assessment:	20% Sessional work,	20% midterm, 60% final examination			
<b>Credit Hours:</b>	03	Minimum Contact Hours:45			

# MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO

**Objective:** To develop idea of solution of physical models.

# Course Learning Outcomes: After completing this course, the students able to be

		Maximum	PLOs
CLO		Taxonomy	
	Description	Level	
1	Apply Fourier methods for analysis of generalized and Green's	C3	2
	functions, and solve partial differential equations with applications		
2	Use perturbation methods for algebraic and differential equations, and	C3	3
	apply variational methods for Euler-Lagrange equations		

# PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

#### **Contents:**

**Fourier Methods:** The Fourier transforms. Fourier analysis of the generalized functions. The Laplace transforms. Hankel transforms for the solution of PDEs and their application to boundary value problems.

Green's Functions and Transform Methods: Expansion for Green's functions. Transform methods. Closed form Green's functions.

**Perturbation Techniques:** Perturbation methods for algebraic equations. Perturbation methods for differential equations.

Variational Methods: Euler-Lagrange equations. Integrand involving one, two, three and n variables. Special cases of Euler-Lagrange's equations. Necessary conditions for existence of an extremum of a functional. Constrained maxima and minima.

#### Recommended Books (Latest Edition):

1. D. L. Powers, Boundary Value Problems and PartialDifferential Equations, 5th edition, Academic Press.

2. W. E. Boyce, *Elementary Differential Equations*, 8<sup>th</sup>edition, John Wiley and Sons.

3. M. L. Krasnov, G. I. Makarenko and A. I. Kiselev, *Problemsand Exercises in the Calculus of Variations*, Imported Publications, Inc.

4. J. W. Brown and R. V. Churchil, Fourier Series and Boundary Value Problems, McGraw Hill.

5. A. D. Snider, Partial Differential Equations: Sources and Solutions, Prentice Hall Inc.

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# MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO

	DEPARTMENT OF DASIC 5	CIENCE AND RELATED STUDIES
Title of Subject:	Inferential Statistics	Marks: 100
Discipline:	Mathematics	
Semester	8 <sup>th</sup> semester	
Code:	<b>MATH 470</b>	
Pre-requisites:	Statistics and Probability	
Assessment:	20% Sessional work,	20% midterm, 60% final examination
<b>Credit Hours:</b>	03	Minimum Contact Hours:45

**Objective:** To develop idea about Probability Distribution, Hypothesis and Estimation

#### Course Learning Outcomes: After completing this course, the students able to be

		Maximum Taxonomy	
CLO	Description	Level	PLOs
1	Understand sampling distribution of means with replacement,	C3	2
	without replacement for finite and infinite population with		
	applications		
2	Classify and use special probability distributions for parameter	C3	2
	estimation with applications		
3	Classify and use special probability distributions for hypothesis	C3	2
	testing and associations with applications		

#### **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

#### **Contents:**

Sampling distribution: Sampling distribution of means with replacement and without replacement; central limit theorem.

**Estimation of parameters:** Confidence interval of one population mean, estimation a population mean; estimating the difference between two population means. The Chi-square distribution; estimating a population standard deviation. The f-distribution; estimating the ratio of two variances.

Testing of Hypothesis: Testing a statistical hypothesis, Type I & II errors, one and two

tailed tests, test concerning means and variances, testing the difference between two means, Good-ness of fit test; test of independence.

#### **Books Recommended:**

- M. Anwar Solangi; Statistical Methods and Estimations
- Ronald Walpole, Introductory Statistics
- Sher Muhammad Choudhry, Introduction to Statistics vol. I & II
- Iqbal Bhatti, Elements of Statistics
- Douglas C. Montgomery, Applied Statistics and Probability for Engineering.
- Statistical Methods and Probability;(Latest Edition) M.U Shaikh

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#### MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO

#### DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES

Title of Subject:	Numerical Analysis-II	Marks: 100
Discipline:	Mathematics	
Semester	8 <sup>th</sup> semester	
Code:	MATH 480	
Pre-requisites:	Partial differential equa	tions; Numerical Analysis-I
Assessment:	20% Sessional work,	20% midterm, 60% final examination
<b>Credit Hours:</b>	03	Minimum Contact Hours

**Objective:** To develop idea of formation, solution and physical applications of partial differential equations **Course Learning Outcomes:** After completing this course, the students able to be

CLO	Description	Maximum Taxonomy	PLOs
		Level	
1	Understand numerical solution of partial differential	C3	2
	equations and use finite difference method with		
	applications		
2	Solve applied boundary-value problems for Laplace,	C3	4
	Poisson, Heat, Wave and Burger equations		
3	Perform computations of the numerical schemes in	P4	5
	software environment		

#### **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

#### **Contents:**

Introduction to partial differential equations and numerical methods for solving PDE's Forward, Backward, and central finite difference approximation. Iterative techniques for solving linear system of equations. Finite difference solution of Elliptic, parabolic, and hyperbolic partial differential equations employing Euler, Modified Euler, two-step predicator-corrector and Runge-Kutta (third and fourth order) algorithms. Explicit, implicit and Crank-Nicolson finite difference methods.

Applications of partial differential equations with boundary value problems such as Heat (Diffusion) equation. Laplace equation. Poisson equation, Wave equation. Linear and non-linear Burger equations.

#### **Recommended Books:**

- 1. Burden, R.L. and Faires , J.D., Numerical Analysis, PWS Publishing Company Boston.(Latest Edition)
- 2. Kreyszig, E., Advanced Engineering Mathematics, Sixth Edition. John Wiley & Sons.(Latest Edition)
- 3. G.D.Smith: Numerical Solution of P.D.E. (Finite Difference Merthod), Oxford University Press.

Res. No. 02, Res. No. 04 Res. No 94.11(a) Dated: 07-02-2019 Dated: 07-03-2019 Dated: 27-03-2019 45
MEHR	AN UNIVERSITY OF ENGIN	VEERING AND TECHNOLOGY, JAMSHORO
	DEPARTMENT OF BASIC	SCIENCE AND RELATED STUDIES
Title of Subject:	Integral Equations	Marks: 100
Discipline:	Mathematics	
Semester	8 <sup>th</sup> semester	
Code:	MATH 465	
Pre-requisites:	Ordinary Differential E	quations
Assessment:	20% Sessional work,	20% midterm, 60% final examination
<b>Credit Hours:</b>	03	Minimum Contact Hours:45

Objective: To give idea about solving physical problems by using integral equations.

Course Learning Outcomes	After com	pleting this co	ourse, the stud	ents able to be
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CLO	Description	Maximum Taxonomy	PLOs
		Level	
1	Explain basic concepts of integral equations and relationship	C2	1
	with differential equations		
2	Solve Fredholm and Volterra integral equations under various	C3	2
	conditions with applications		
3	Solve Abel's integral equations and understand Hilbert-	C3	1
	Schmidt theory and regularization techniques		

### **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

## **Contents:**

Linear integral equations of the first kind, linear integral equations of the second kind. Relationship between differential equation and Volterra integral equation. Neumann series. Fredholm Integral equation of the second kind with separable Kernels. Eigen values and Eigen vectors. Iterated functions. Quadrature methods. Least square methods. Homogeneous integral equations of the second kind. Fredholm integral equations of the first kind. Fredholm integral equations of the second kind. Abel's integral equations. Hilbert Schmidt theory of integral equations with symmetric Kernels. Regularization and filtering techniques.

## **Recommended Books:**

1. C. T. H. Baker, Integral Equations, Clarendon Press.(Latest Edition)

2. F. Smithies, Integral Equations, Cambridge University Press.(Latest Edition)

3. A. M. Wazwaz, A first Course in Integral Equations, WorldScientificPub.(Latest Edition)

4. W. V. Lovitt, Linear Integral Equations, Dover Publications. (Latest Edition)

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## **MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO** DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES

		Semile in a Remine Stephes
Title of Subject:	Econometrics	<b>Marks: 100</b>
Discipline:	Mathematics	
Semester	8 <sup>th</sup> semester	
Code:	MATH 455	
Pre-requisites:	Calculus-I, Linear Alge	bra, Probability
Assessment:	20% Sessional work,	20% midterm, 60% final examination
<b>Credit Hours:</b>	03	Minimum Contact Hours: 45

**Objective:** Introduce concepts of Regression Analysis and Simultaneous equation models.

#### Course Learning Outcomes: After completing this course, the students able to be

CLO	Description	Maximum Taxonomy	PLOs
		Level	
1	Understand basic concepts of econometric modelling, and apply multiple regression and correlation for simple and general linear model with applications	C3	2
2	Classify different problems in regression analysis and their causes, and solve simultaneous equations models with applications	C3	2

## **PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

## **Contents:**

#### Introduction to Econometric and Econometric model:

Nature and scope of Econometrics. Multiple Regression. Correlation. Estimators and their properties. Simple linear Model. General Linear Model. Ordinary and General least squares Estimators.

#### **Problem in Regression Analysis:**

Serial correlation. Applications. Heteroskedasticity. Multicollinearity Errors in variables.

#### Simultaneous equation models:

Simultaneous Equations models. Identification (Rank and order conditions). Two-stage and three-stage least squares.

### **BOOKS RECOMMENDED:**

- Henri Thail: Principles of Econometrics; Wiley. 1.
- 2. Malin Vaud: Statistical Methods of Econometrics
- Wonnacott, R and Wonnacott, T.: Econometric; Wiley. 3.
- Johnston: Econometric Methods; McGraw Hill New York. 4.
- 5. Graybill: An Introduction to Linear Statistical Models McGraw Hill New York.
- 6. Gold berger: Econometric Theory; John Wiely New York.
- 7. Dominick Salvatore: Statistics & Econometrics; Schaum's outline series in Economics, McGraw Hill Book Co.
- 8. P.J. Dhrymes: Econometrics, Statistical Foundation and Applications.
- Klein, L. R., A Text Book of Econometric, Illinois. 9.

**Approved:** Board of Studies, BSRS: 01/2019 Board of Faculty (FOST&H) 01/2019 Academic Council

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- **10.** Madansky A.: Foundation of Econometrics.
- 11. Surrey, M. J. C.: An Introduction of Econometrics.

#### MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES

	DEFACINENT OF DASIC	SCIENCE AND RELATED STUDIES
Title of Subject:	<b>Operations Research</b>	Marks: 100
Discipline:	Mathematics	
Semester	8 <sup>th</sup> semester	
Code:	<b>MATH 460</b>	
Pre-requisites:	Linear Algebra	
Assessment:	20% Sessional work,	20% midterm, 60% final examination
<b>Credit Hours:</b>	03	Minimum Contact Hours: 45
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**Objective:** To introduce concept of Dual Simplex and L.P Problems. **Course Learning Outcomes:** After completing this course, the students able to be

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CLO	Description	Maximum Taxonomy	PLOs
		Level	
1	Apply Simplex method and variants for solution of linear programming problems with applications	C3	2
2	Solve integer programming problems by different methods with applications	C3	2
3	Use dynamic programming and network analysis methods for shortest route, project scheduling, control, and time chart simulation	C3	4

## PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

### Contents

Dual Simplex method and revised simplex methods for the solution of L.P problems. Integer programming, dynamic programming network (shortest route) project scheduling (PERT-CPM) methods. Project control, Time chart Simulation.

### **BOOKS RECOMMENDED:**

- 1. H.A. Taha: operation Research: An introduction; Macmillan publisher.
- 2. Saaty: Mathematical methods of operation Research; McGraw Hill Book company, New York.
- 3. Churchman, Cheff: Introduction to operation Research; &Arnoff John Wiley and Sons
- 4. G. Hadley: Linear Programming; Addison Wesley Publishing Company.
- 5. Dont. Phillips, A. Ravindran& James Solberg: Operations Research Principles and practice; Wiley & Sons.
- 6. Hillier & Lieberman: Introduction to Operation Research; Holden-Day, Inc.
- 7. Richard Schaum's Outline Theory and Problems of Operations Research; McGrawHill Schaum's Outline Series.

# MEHRAN UNIVERSITY OF ENGINEERING AND TECHNOLOGY, JAMSHORO

	DEPARTMENT OF BASIC SCIENCE AND RELATED STUDIES			
Title of Subject:	<b>Comprehensive Examination</b>	Marks: 100		
Discipline:	Mathematics			
Semester:	8 <sup>th</sup> semester			
Code:	MATH 499			
Pre-requisites:	All Courses			
Assessment:	40% Project work, 30% Comprehensive	e Test, and 30% Comprehensive Viva-voce		
<b>Credit Hours:</b>	03	Minimum Contact Hours: 45		
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**Objective:** To introduce concept of Dual Simplex and L.P Problems. **Course Learning Outcomes:** After completing this course, the students able to be

CLO	Description	Maximum Taxonomy	PLOs
		Level	
1	Carry out a mini project and presentation on an	Р3	6, 7 9,11, 12
	approved topic under supervision of the		
	concerned supervisor.		
2	Analyze the knowledge gained throughout the BS	C4	1
	program in form of objective type test		
3	Evaluate the knowledge gained throughout the BS	C5	1,6
	program in form of viva-voce		

# PROGRAM LEARNING OUTCOMES (PLOs):

The course is designed so that students will achieve the following PLOs:

1	Mathematics Knowledge	7	Environment and Sustainability
2	Problem Analysis	8	Ethics
3	Design/Development of Solutions	9	Individual and Teamwork
4	Investigation	10	Communication
5	Modern Tool Usage	11	Task Management
6	The Mathematician and Society	12	Lifelong Learning

# Contents

# **Project and Presentation**

To carry out a mini project and presentation on an approved topic under supervision of the concerned supervisor.

# **Comprehensive Test**

MCQs/True-False/Blanks on all courses of BS (Mathematics)

# **Comprehensive Viva-voce**

Viva-voce from all courses of BS (Mathematics).