UNIVERSITY OF SARGODHA, SARGODHA

No. UOS/CE 986
Dated: 16/04/19

NOTIFICATION

No. UOS/Acad/530 Dated: 15.04.2019

On the recommendations of Academic Council dated 08.01.2019, the Syndicate in its meeting held on 16.02.2019 has approved the following recommendations of the Board of Faculty of Science, duly vetted by the Department concerned and Director Academics:

1. Splitting of existing B.Sc curriculum of Chemistry to New Format of Examination part-I (Chemistry I & II), part-II (Chemistry III & IV)
2. Approval of the course of Mathematical Economics for BS Mathematics four years program in addition to Spanish/French in semester four.

Muhammad Farooq
Deputy Registrar (Acad)
15/04/19

Distribution:

- Chairman, Department of Chemistry
- Chairman, Department of Mathematics
- Controller of Examinations
- Director Sub-Campuses (Minawali & Bhakkar)
- All Principals of affiliated college (concerned for BS Mathematics)
- Web-Developer *(for uploading on university web-site)*

C.C:

- Director Academics
- Director Quality Enhancement Cell
- Director Implementation
- Secretary to the Vice-Chancellor
- P.A to Registrar

For action please
16.4.19

Haji Nasir Ali
16.04.19

UNIVERSITY OF SARGODHA

Course Contents

BS Program

Department of Mathematics

(w.e.f Sessions 2016)

Chairman
Department of Mathematics
University of Sargodha

25/3/19

BS in Mathematics Curriculum

Scheme of Studies of BS Mathematics

Total Semesters:-08

Duration of each Semester: -18 weeks

Compulsory Courses			
Semester-I			
No	Course Code	Course Title	Cr. Hours
1	MATH-101	Calculus-I	3+0
2	MATH-103	Elements of Set Theory and Mathematical Logic	3+0
3	PHY-101	Physics-I	3+1
4	ENG –101	English-I(Functional English)	3+0
5	PKS-101	Pak Studies	2+0
6	Comp-101	Introduction to Computers	3+0
Total			18
Semester-II			
No	Course Code	Course Title	Cr. Hours
1	MATH-102	Calculus-II	3+0
2	MATH-104	Statistics	3+0
3	PHY-102	Physics-II	3+1
4	ENG – 102	English-II(Communication Skills)	3+0
5	ISL-102	Islamic Studies	2+0
6	Comp-102	Programming Languages for Mathematicains	1+2
Total			18
Semester-III			
No	Course Code	Course Title	Cr. Hours
1	MATH-201	Calculus-III	3+0
2	MATH-203	Algebra-I	3+0
3	PHY-201	Physics-III	3+1
4	ENG – 203	English-III(Technical Writing and Presentation Skills)	3+0
5	MATH-205	Probability Theory	3+0
Total			16
Semester-IV			
1	MATH-202	Vector Analysis & Mechanics	3+0
2	MATH-204	Linear Algebra	3+0
3	PHY-202	Thermodynamics and Statistical Mechanics	3+1
4	MATH-206	Discrete Mathematics	3+0
5	MATH-208/ECON-204	Spanish/French/Mathematical Economics	3+0
Total			16
Semester-V			

Chairman
Department of Mathematics
University of Sargodha
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1	MATH-301	Topology	3+0
2	MATH-303	Differential Geometry	3+0
3	MATH-305	Ordinary Differential Equations	3+0
4	MATH-307	Real Analysis-I	3+0
5	MATH-309	Algebra-II	3+0
Total			15
		Semester-VI	
1	MATH-302	Classical Mechanics	3+0
2	MATH-304	Mathematical Methods	3+0
3	MATH-306	Complex Analysis	3+0
4	MATH-308	Functional Analysis	3+0
5	MATH-310	Real Analysis-II	3+0
Total			15
		Semester-VII	
1	MATH-401	Numerical Analysis-I	3+0
2	MATH-403	Number Theory	3+0
3	MATH-405	Partial Differential Equations	3+0
4	MATH-xxx	Elective-I*	3+0
5	MATH-xxx	Elective-II*	3+0
Total			15
		Semester-VIII	
1	MATH-402	Numerical Analysis-II	3+0
2	MATH-404	Integral Equations	3+0
3	MATH-406	Project / Course**	3+0
4	MATH-xxx	Elective-III*	3+0
5	MATH-xxx	Elective-IV*	3+0
Total			15

Total Numbers of Credit Hours=128

* These four courses are optional and can be selected either from list A or B but cannot be mixed from both **or** any two courses can be selected from list C.

**In lieu of dissertation a course can be selected from list C.

*** Any other language can be added according to availability of resources.

Note

These courses will be offered by the department from the lists of concentration elective courses and free elective courses as per availability of the resources.

Chairman
Department of Mathematics
University of Sargodha
3/19

List of Concentration Elective Courses

A student must satisfactorily complete 12 credit hours of any one of the following concentration groups of Elective Courses namely, Pure or Applied Mathematics.

List A

Concentration Elective Courses in Pure Mathematics					
Course Code	Course Title	Cr. Hrs.	Course Code	Course Title	Cr. Hrs.
MATH-407	Advanced Group Theory-I	3+0	MATH-408	Advanced Group Theory-II	3+0
MATH-409	Modern Algebra-I	3+0	MATH-410	Modern Algebra-II	3+0
MATH-411	Algebraic Topology-I	3+0	MATH-412	Algebraic Topology-II	3+0
MATH-413	Advanced Functional Analysis	3+0	MATH-414	Theory of Modules	3+0

List B

Concentration Elective Courses in Applied Mathematics

Course Code	Course Title	Cr. Hrs.	Course Code	Course Title	Cr. Hrs.
MATH-415	Astronomy-I	3+0	MATH-416	Astronomy-II	3+0
MATH-417	Electromagnetism-I	3+0	MATH-418	Electromagnetism-II	3+0
MATH-419	Fluid Dynamics-I	3+0	MATH-420	Fluid Dynamics-II	3+0
MATH-421	Operations Research-I	3+0	MATH-422	Operations Research-II	3+0
MATH-423	Quantum Mechanics-I	3+0	MATH-424	Quantum Mechanics-II	3+0
MATH-425	Analytical Dynamics	3+0	MATH-426	Special Relativity	3+0

List C

List of Free Elective Courses

A student must also satisfactorily complete 06 credits of any one of the following free Elective Courses in Applied & Pure Mathematics

Course Code	Course Title	Cr. Hrs.	Course Code	Course Title	Cr. Hrs.
MATH-427	Numerical Solution of Partial differential equations	3+0	MATH-428	Elasticity Theory	3+0
MATH-429	History of Mathematics	3+0	MATH-430	Heat Transfer	3+0
MATH-431	Methods of Optimization-I	3+0	MATH-432	Methods of Optimization-II	3+0
MATH-433	Measure Theory	3+0	MATH-434	Special Functions	3+0
MATH-435	Theory of Splines-I	3+0	MATH-436	Theory of Splines-II	3+0
MATH-437	Bio-Mathematics	3+0	MATH-438	Theory of Automata	3+0
MATH-439	Control Theory	3+0	MATH-440	Applied Matrix Theory	3+0

Note: Other elective courses can be offered according to availability of resources.

Chairman
Department of Mathematics
University of Sargodha
25/3/19

ECON-204 Mathematical Economics

The course is intended for students who are wishing to obtain knowledge of mathematical techniques suitable for economic analysis. It assumes very little prerequisite knowledge. The approach is informal and aims to show students how to do and apply the mathematics practically. Economic applications are considered although this course aims to teach the mathematics rather than the economics. Topics include basic algebra, simple finance, calculus and matrix algebra.

Contents

1 Economic Applications of Graphs and Equations:, Demand and Supply Analysis, Isocost Lines, Income Determination Models, IS-LM Analysis.
2 Uses of the Derivative in Economics: Increasing and Decreasing Functions, Concavity and Convexity, Relative Extrema, Inflection Points, Optimization of Functions, Successive-Derivative Test for Optimization, Marginal Concepts, Optimizing Economic Functions, Relationship among Total, Marginal, and Average Concepts. Profit maximization under perfect competition including Tax/subsidy, Price discrimination under Monopoly.
3 Calculus of Multivariable Functions in Economics: Marginal Productivity, Income Determination, Multipliers and Comparative Statics, Income and Cross Price Elasticities of Demand, Differentials and Incremental Changes, Optimization of Multivariable Functions in Economics, Constrained Optimization of Multivariable Functions in Economics, Homogeneous Production Functions, Returns to Scale, Optimization of Cobb-Douglas Production Functions, Optimization of Constant Elasticity of Substitution Production Functions.
4 Exponential and Logarithmic Functions in Economics: Interest Compounding, Effective vs. Nominal Rates of Interest, Discounting, Converting Exponential to Natural Exponential Functions, Estimating Growth Rates.
5 Matrices, Determinants and their use in Economics: Jacobian, Hessian, Discriminant, Higher-Order Hessians, Bordered Hessian for Constrained Optimization, Input-Output Analysis, Characteristic Roots and Vectors (Eigen values, Eigenvectors). Linear programming also using graphic approach.

Recommended Books

1 Dowling E. T. *Introduction to Mathematical Economists*, Schaum's Outline Series, 3rd Edition (McGraw Hill Publishing Company, 2001).
2 Chiang, A. C. and Kevin Wainwright, *Fundamental Methods of Mathematical Economics*, 4th Edition (McGraw Hill Publishing Company, 2005).

Suggested Books

1 Weber E. Jean, *Mathematical Analysis, Business and Economic Application* (latest edition). (Harper and Row Publishers, New York, 1976).
2 Frank, Bud nick. *Applied Mathematics for Business, Economics and Social Sciences*, 4th Edition. (McGraw Hill Publishing Company, 1993).

CHAIRMAN 6/2/19
DEPARTMENT OF ECONOMICS
UNIVERSITY OF SARGODHA

Chairman 06/02/19.
Department of Mathematics
University of Sargodha

UOS/CE/No. 2946
7-9-17

UNIVERSITY OF SARGODHA, SARGODHA

NOTIFICATION

No. UOS/Acad/762 Dated: 30.08.2017

On the recommendation of Academic Council made in its meeting dated 23.08.2016, the Syndicate in its 1/2017 meeting held on 15-16.05.2017 has approved the curricula of following programs to be implemented from the session mentioned against each:-

1. *Revised Scheme of Studies for BS, M.Sc, M.Phil & Ph.D Botany w.e.f 2016 and onward (annex-**'A', 'B', 'C'** & **'D'**).*
2. *Addition of Elective Courses in MS (CS) Curriculum w.e.f 2016 (annex-**'E'**).*
3. *Addition of courses in scheme of studies of Ph.D program of Computer Science (annex-**'F'**). (already included and notified vide No.UOS/Acad/573 dated 19.06.2017)*
4. *Revised curriculum of BS 4-Year Mathematics program w.e.f 2016 & onward (annex-**'G'**).*
5. *Revised curricula of M.Sc and M.Phil / Ph.D Mathematics w.e.f 2016 (annex-**'H', 'I'**)*
6. *Revised Scheme of Studies for BS, M.Sc, M.Phil and Ph.D Zoology w.e.f 2016 (annex-**'J', 'K', 'L', 'M'**)*
7. *Addition of Elective Courses in the Scheme of Studies of MS(CS) program (annex-**'N'**)*
8. *No. of credit hours for MS (CS) Thesis in Computer Science department (annex-**'O'**)*
9. *Addition of Elective Courses BS (CS) program in Computer Science w.e.f 2016 s(annex-**'P'**)*
10. *Revised curricula of BS & M.Sc program in Biotechnology w.e.f 2016-17 (annex-**'Q'** & **'R'**)*

30/8/17

(AMJAD HUSSAIN JANJUA)
Deputy Registrar (Acad)

Distribution:

- Chairman / Incharges of the concerned departments
- Controller of Examinations
- Directors Sub-Campuses
- Principals Affiliated Colleges (concerned)
- Web-Developer ***(for uploading on university web-site)***

C.C:

- Dean, Faculty of Sciences
- Secretary to the Vice-Chancellor
- P.A to Registrar

Annex-G

Annex-

Scheme of Studies
BS Mathematics
From Session 2016

Chairman
Department of Mathematics
University of Sargodha

Scheme of Studies
BS - 4 years program
Session (From 2016)

Total Semesters:-08
Duration of each Semester: -18 weeks

1st Semester

Course Code	Course Title	Cr. Hrs.
MATH-101	Calculus-I D	3+0
MATH-103	Elements of Set Theory and Mathematical Logic New Paper	3+0
PHY-101	Physics-I Same as IN	3+1
ENG –101	English-I (Functional English) D	3+0
PKS-101	Pak Studies Same.	2+0
Comp-101	Introduction to Computers Same as it + New	3+0
	Total Cr. Hrs.	18

2nd Semester

Course Code	Course Title	Cr. Hrs.
MATH-102	Calculus-II D	3+0
MATH-104	Statistics D	3+0
PHY-102	Physics-II Same.	3+1
ENG – 102	English-II(Communication Skills) D	3+0
ISL-102	Islamic Studies Same	2+0
Comp-102	Programming Languages for Mathematicains D	1+2
	Total Cr. Hrs.	18

3rd Semester

Course Code	Course Title	Cr. Hrs.
MATH-201	Calculus-III D	3+0
MATH-203	Algebra-I D	3+0
PHY-201	Physics-III Same	3+1
ENG – 203	English-III(Technical Writing and Presentation Skills) D	3+0
MATH-205	Probability Theory D	3+0
	Total Cr. Hrs.	16

4th Semester

Course Code	Course Title	Cr. Hrs.
MATH-202	Vector Analysis & Mechanics	3+0
MATH-204	Linear Algebra	3+0
PHY-202	Thermodynamics and Statistical Mechanics	3+1
MATH– 206	Discrete Mathematics	3+0
MATH-208	Spanish/French	3+0
	Total Cr. Hrs.	16

5th Semester

Course Code	Course Title	Cr. Hrs.
MATH-301	Topology	3+0
MATH-303	Differential Geometry	3+0
MATH-305	Ordinary Differential Equations	3+0
MATH-307	Real Analysis-I	3+0
MATH-309	Algebra-II	3+0
	Total Cr. Hrs.	15

6th Semester

Course Code	Course Title	Cr. Hrs.
MATH-302	Classical Mechanics	3+0
MATH-304	Mathematical Methods	3+0
MATH-306	Complex Analysis	3+0
MATH-308	Functional Analysis	3+0
MATH-310	Real Analysis-II	3+0
	Total Cr. Hrs.	15

Chairman
Department of Mathematics
University of Sargodha.

7th Semester

Course Code	Course Title	Cr. Hrs.
MATH-401	Numerical Analysis-I	3+0
MATH-403	Number Theory	3+0
MATH-405	Partial Differential Equations	3+0
MATH-xxx	Elective-I*	3+0
MATH-xxx	Elective-II*	3+0
	Total Cr. Hrs.	15+0

8th Semester

Course Code	Course Title	Cr. Hrs.
MATH-402	Numerical Analysis-II	3+0
MATH-404	Integral Equations	3+0
MATH-406	Project / Course**	3+0
MATH-xxx	Elective-III*	3+0
MATH-xxx	Elective-IV*	3+0
	Total Cr. Hrs.	15+0

Total Numbers of Credit Hours=128

* These four courses are optional and can be selected either from list A or B but cannot be mixed from both
or any two courses can be selected from list C.
**In lieu of dissertation a course can be selected from list C.
*** Any other language can be added according to availability of resources.

Note

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MATH-411	Algebraic Topology-I	3+0	MATH-412	Algebraic Topology-II	3+0
MATH-413	Advanced Functional Analysis	3+0	MATH-414	Theory of Modules	3+0

List B

Concentration Elective Courses in Applied Mathematics

MATH-415	Astronomy-I	3+0	MATH-416	Astronomy-II	3+0
MATH-417	Electromagnetism-I	3+0	MATH-418	Electromagnetism-II	3+0
MATH-419	Fluid Dynamics-I	3+0	MATH-420	Fluid Dynamics-II	3+0
MATH-421	Operations Research-I	3+0	MATH-422	Operations Research-II	3+0
MATH-423	Quantum Mechanics-I	3+0	MATH-424	Quantum Mechanics-II	3+0
MATH-425	Analytical Dynamics	3+0	MATH-426	Special Relativity	3+0

Chairperson,
Department of Mathematics
University of Sargodha

List C

List of Free Elective Courses

A student must also satisfactorily complete 06 credits of any one of the following free Elective Courses in Applied & Pure Mathematics

MATH-427	Numerical Solution of Partial differential equations	3+0	MATH-428	Elasticity Theory	3+0
MATH-429	History of Mathematics	3+0	MATH-430	Heat Transfer	3+0
MATH-431	Methods of Optimization-I	3+0	MATH-432	Methods of Optimization-II	3+0
MATH-433	Measure Theory	3+0	MATH-434	Special Functions	3+0
MATH-435	Theory of Splines-I	3+0	MATH-436	Theory of Splines-II	3+0
MATH-437	Bio-Mathematics	3+0	MATH-438	Theory of Automata	3+0
MATH-439	Control Theory	3+0	MATH-440	Applied Matrix Theory	3+0

Note: Other elective courses can be offered according to availability of resources.

Chairman
Department of Mathematics
University of Sargodha

SYLLABUS

BS 4 years in Mathematics

Course contents for the mathematics courses are given below semester wise.

SEMESTER-I

Course Code: MATH-101
Calculus-I
Prerequisite(s): None
Credit Hours: 3+0
Objectives of the course:
This is the first course of the sequence, Calculus-I, II and III, serving as the foundation of advanced subjects in all areas of mathematics. The sequence, equally, emphasizes basic concepts and skills needed for mathematical manipulation. Calculus I and II focus on the study of functions of a single variable.

Course Contents:
Limits and continuity: Limit of a function, graphical approach, properties of limits. limits of polynomials, rational and transcendental functions, limits at infinity. infinite limits, one-sided limits, continuity.
Derivatives: Definition, techniques of differentiation, derivatives of polynomials and rational, exponential, logarithmic and trigonometric functions, the chain rule, implicit differentiation, rates of change in natural and social sciences, related rates. linear approximations and differentials, higher order derivatives,
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, Curve sketching, Rolle's theorem, the mean value theorem, indeterminate forms and L'Hopitals rule, inverse functions and their derivatives.
Integration: Anti derivatives and integrals, Riemann sums and the definite integrals. properties of Integrals. the fundamental theorem of calculus, the substitution rule.

Recommended Books:

1. Thomas, Calculus, latest Edition. Addison Wesley Publishing Company.
2. Anton H., Bevens I., Davis H., Calculus, latest Edition, John Wiley & Sons, Inc.
3. Larson E. Calculus, latest edition, Brooks/Cole Cengage Learning.
4. Hallett H. Gleason, McCallum, et al, Calculus Single and Multivariable, latest Edition. John Wiley & Sons, Inc.
5. Swokowski E. W., Calculus with Analytic Geometry latest edition PWS Publishers, Boston, Massachusetts.
6. Liebeck M. A Concise introduction to pure Mathematics, CRC Press. 2011.
7. A. Kaseberg. Intermediate Algebra, Thomson Brooks/cole, 2004.
8. Stewart J., Calculus, latest edition Brooks/COLE.

Chairperson,
Department of Mathematics
University of Sargodha.

Course Code: MATH-103
Elements of Set Theory and Mathematical Logic
Prerequisite(s): None
Credit Hours: 3+0
Objectives of the course:
Everything mathematicians do can be reduced to statements about sets, equality and membership which are basics of set theory. This course introduces these basic concepts. The course aims at familiarizing the students with cardinals, relations and fundamentals of propositional and predicate logics.

Course Contents:
Set theory: Sets, subsets, operations with sets: union, intersection, difference, symmetric difference, Cartesian product and disjoint union.Functions: graph of a function. Composition; injections, surjections, bijections, inverse function. Computing cardinals: Cardinality of
Cartesian product, union. Cardinality of all functions from a set to another set. Cardinality of all injective, surjective and bijective functions from a set to another set. Infinite sets, finite sets. Countable sets, properties and examples. Operations with cardinal numbers. Cantor-Bernstein theorem.
Relations: Equivalence relations, partitions, quotient set; examples. parallelism, similarity of triangles. Order relations, min, max, inf, sup; linear order. Examples: N, Z, R, P(A). Well ordered sets and induction. Inductively ordered sets and Zorn's lemma. Mathematical logic: Propositional Calculus. Truth tables. Predicate Calculus.

Recommended Books:

1. Liebeck M. A Concise introduction to pure Mathematics, CRC Press, 2011.
2. Biggs N. L., Discrete Mathematics, Oxford University Press, 2002.
3. Garnier R., Taylor J., Discrete Mathematics, Chapters 1,3,4,5. CRC Press, 2010.
4. Fraenkal A.A., Abstract Set Theory, North-Holland Publishing Company, 1966.
5. Suppes P., Axiomatic Set Theory, Dover Publication, 1972.
6. Halmos P.R., Naive Set Theory, New York, Van Nostrand 1950.
7. Rotman B., Kneebone G.T., The Theory of sets and Transfinite Numbers, Oldbourne
London, 1968.
8. Smith D., Eggen M., Andre R.S., A Transition to Advanced Mathematics, Brooks/Cole,
2001.

Course Code: PHY-101
Physics-I
Cr. Hours 3+1
Course Contents:
Vector Analysis, Particle Dynamics, Work, Power and Energy, System of Particles, Collissions, Waves and Oscillations, Harmonic Oscillations, Waves in Physical Media, Sound Light interface, Diffraction, Polarization.

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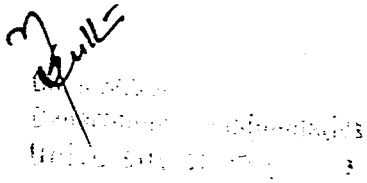
University of Sargodha.

Lab-I

1. Modulus of rigidity by static and dynamic method (Maxwell's needle, Barton's Apparatus).
2. Determination of moment of inertia of a solid/hollow cylinder and a sphere etc.
3. To study the conservation of energy (Hook's Law)

Recommended Books:

1. Giancoli, Douglas C. Physics for Scientist and Engineers with Modern Physics. 2nd ed. Prentice Hall Inc, 1988.
2. Beiser A. Concepts of Modern Physics. 4th ed. McGraw-Hill Book Co, 1987.
3. Sear and Zemansky. University Physics with Modern Physics, 12th ed. Pearson, 2008.



ENG-101 ENGLISH-I (FUNCTIONAL ENGLISH) **3(3-0)**

COURSE OBJECTIVES

To enhance language skills and develop critical thinking.

COURSE CONTENTS

Basics of Grammar: Parts of speech and use of articles; Sentence structure, active and passive voice; Practice in unified sentence; Analysis of phrase, clause and sentence structure; Finite and Non-finite verbs; Transitive and intransitive verbs; Punctuation and spelling.

Comprehension: Answers to questions on a given text (practice passages shall be selected by the instructor).

Discussion: General topics and every-day conversation (topics for discussion to be at the discretion of the teacher keeping in view the level of students)

Listening: To be improved by showing documentaries/films carefully selected by subject teachers

Translation skills: Urdu to English

Paragraph writing: Topics to be chosen at the discretion of the teacher

Presentation skills: Introduction, structure of presentation

Functional vocabulary: Academic vocabulary; Professional vocabulary; Active vs passaive vocabulary

RECOMMENDED BOOKS

a) Grammar

1. Structure and Meaning in English. Graeme Kennedy, Pearson Longman, 2003.
2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 1.Third edition.Oxford University Press. 1997. ISBN 0194313492
3. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2.Third edition.Oxford University Press. 1997. ISBN 0194313506

b) Writing

1. Writing. Intermediate by Marie-Christine Boutin, Suzanne Brinand and Francoise Grellet.Oxford Supplementary Skills.Fourth Impression 1993. ISBN 0 19 435405 7 Pages 20-27 and 35-41.
2. College Writing Skills with Readings. John Langan, McGraw Hill Higher Education, 9th Edition, 2013.

c) Reading/Comprehension

1. Reading. Upper Intermediate.Brain Tomlinson and Rod Ellis.Oxford Supplementary Skills.Third Impression 1992.ISBN 0 19 453402 2.

18/5/16

Chairperson,
Department of Mathematics
University of Sargodha.

Course Code: PKS-101
Pakistan Studies
Cr. Hours: 2+0
Objectives of the course
The objectives of this course are to acquaint the students with Ideological, Political and economic development of Pakistan. Diplomatic interaction of Pakistan with other countries of the world.

Course Contents:
Two nation theory and ideology of Pakistan: Historical background of the creation of Pakistan, Two-nation theory in its historical context, definition and interpretations, Quaid-I-Azam and his political ideas, Political Dynamics of Pakistan, Constitution development in Pakistan(1947-73), Salient features of 1973 constitution of Pakistan, Institutions of Pakistan: political parties, bureaucracy, army, and judiciary and media, Problems of Pakistan as a federal state. Socio-Economic issues of Pakistan: Economical problems, Social and demographic issues. Diplomatic dynamics of Pakistan: Determinants and objectives of Pakistan's foreign policy, Pakistan's relations with its neighboring country, Pakistan and the Muslim world(Comprehensive review of foreign policy of Pakistan)

Recommended Books:
1. Sheikh J.A. *Pakistan's Political, economic, and diplomatic dynamics. 2nd ed. Lanore:* Kitabistan Paper Products, 2004.
2. Other relevant readings for the individual subjects shall be recommended by the teacher during the course.

Course Code: COMP-101
Introduction to Computers
Cr. Hours: 3+0

Course Contents:
Fundamental concepts of computers Systems: basic computer organization, number systems and codes, processor and memory, secondary storages, input(output) units computer softwares internet basics history and classification of computers. practically using windows, practically using software packages (MS Word and MS excell), practically using some computer algebra system CAS (Matlab\Maple etc).

Recommended Books:

1. Sinha P.K.. Computer Fundamentals. 3rd ed. PBS Publication, 2003.
2. Gilat A. An Introduction with Applicaton. 3rd ed. NY: John Wiley, 2008.
3. Lafore R. Programming using Turbo C++. 2nd ed. The Waite Group, 1993.
4. Kuo S.S. Computer Applications of Numerical Methods. 1st ed. NY: Assison Wesley, 1972.
5. Gilate, A., MATLAB: An Introduction with Applications, 2nd Ed. John Wiley & Sons Inc. 2004.

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Department of Mathematics
University of Sargodha.

SEMESTER-II

Course Code: MATH-102
Calculus-II
Prerequisite(s): Calculus-I
Credit Hours: 3+0
Objectives of the course:
This is the second course of the basic sequence CalculusI, II and III, serving as the foundation of advanced subjects in all areas of mathematics. The sequence, equally, emphasizes basic concepts and skills needed for mathematical manipulation. As continuation of Calculus-I, it focuses on the study of functions of a single variable.

Course Contents:
Techniques of integration: Integrals of elementary, hyperbolic, trigonometric, logarithmic and exponential functions, integration by parts, substitution and partial fractions, improper integrals.
Applications of integrals: Area between curves, average value, volumes, arc length, area of a surface of revolution.
Infinite series: Sequences and series, convergence and absolute convergence, tests for convergence, divergence test, integral test, p series test, comparison test, limit comparison test, alternating series test, ratio test, root test, power series, convergence of power series, representation of functions as power series, differentiation and integration of power series, Taylor and McLaurin series.
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

1. Thomas, Calculus, latest Edition, Addison Wesley Publishing Company.
2. Anton H., Bevens I., Davis H., Calculus, latest Edition, John Wiley & Sons, Inc.
3. Larson E. Calculus, latest edition. Brooks/Cole Cengage Learning.
4. Hallett H. Gleason, McCallum, et al, Calculus Single and Multivariable, latest Edition. John Wiley & Sons, Inc.
5. Swokowski E. W., Calculus with Analytic Geometry latest edition PWS Publishers, Boston, Massachusetts.
6. Liebeck M, 2011. A Concise introduction to pure Mathematics, CRC Press.
7. A. Kaseberg, 2004. Intermediate Algebra, Thomson Brooks/cole.
8. Stewart J., Calculus, latest edition Brooks/COLE.

Course Code: MATH-104
Statistics
Prerequisite(s): Calculus-I
Credit Hours: 3+0

Course Contents:
Mathematical Expectation: Moments, moment generating functions, cummulants, cumulative functions,Continuous Probability Distributions: Continuous Probability distributions, beta, gamma, binomial, exponential, Poisson, hypergeometric and normal distributions.

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Sampling theory: Sampling distributions; sampling procedures, estimation of parameters, estimation of mean, variance, confidence intervals. Decision theory: Hypothesis testing and decision making, types of errors in tests, quality control, control charts for mean, standard deviation, variance, range; goodness of fit, chi-square test.

Recommended Books:

1. DeGroot M. H., Schervish M.J.. *Probability and Statistics*. 3rd ed. USA: Addison- Wesley, 2002.
2. Johnson R.. *Probability and Statistics for Engineers*, 1st ed.USA: Prentice-Hall,1994.
3. Papoulis A., 1991.*Probability, Random Variables, and Stochastic Processes*. 3rd ed. NY: McGraw Hill.
4. Sincich T. *Statistics by Examples*. 1st ed. Dellen Publication Company, 1990.
5. Chaudhry, S.M. and Kamal, S. "Introduction to Statistical Theory" Part I, II, 8th ed, Ilmi Kitab Khana, Lahore, Pakistan, 2008.

Course Code: PHY-102
Physics-II
Prerequisites: Physics-I
Cr. Hours 3+1

Course Contents:
Electric Field, Electric Potential, Capacitors and Dielectrics, DC Circuits, Magnetic Field Effects and Magnetic Properties of Matter, Electronics

Lab-II

1. To determine Horizontal/Vertical distance by Sextant.
2. The determination of wavelength of Sodium –D lines by Newton's ring.
3. The determination of wavelength of light/laser by diffraction grating.
4. To study the laws of vibration of stretched string-using sonometer.
5. To determine the stopping potential by photocell.

Recommended Books:

1. Beiser A. Concepts of Modern Physics. 4th ed. McGraw-Hill Book Co. 1987.
2. Grobe. Basic Electronics. 7th ed. McGraw Hill Book Co, 1993.
3. Reitz, John R. and Milford Fredrick, J. Foundations to Electromagnetic Theory. 2nd ed. Addison-Wesley Publishing Co, 1970.
4. Sear and Zemansky. University Physics with Modern Physics. 12th ed. Pearson, 2008.

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ENG-102 ENGLISH-II (COMMUNICATION SKILLS) 3(3-0)

COURSE OBJECTIVES

To enable the students to meet their real life communication needs.

COURSE CONTENTS

Paragraph writing: Topics/thesis sentences, Structure of a good paragraph, Practice in writing a good, unified and coherent paragraph

Essay writing: Introduction to essay writing, writing introductory paragraph

CV and job application: CV formats and resume writing, solicited and unsolicited job application

Study skills: Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension

Academic skills: Letter/memo writing, minutes of meetings, use of library and internet resources

Presentation skills: Personality development (emphasis on content, style and pronunciation)

Note: Recordings of presentations to be shown for discussion and review

RECOMMENDED BOOKS

a) Grammar

1. Structure and Meaning in English. Graeme Kennedy, Pearson Longman, 2003.
2. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2.Third edition.Oxford University Press 1986.ISBN 0 19 431350 6.

b) Writing

1. Writing. Intermediate by Marie-ChrisitineBoutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 7 Pages 45-53 (note taking).
2. Writing. Upper-Intermediate by Rob Nolasco. Oxford Supplementary Skills. Fourth Impression 1992. ISBN 0 19 435406 5 (particularly good for writing memos, introduction to presentations, descriptive and argumentative writing).
3. College Writing Skills with Readings. John Langan, McGraw Hill Higher Education, 9th Edition, 2013.

c) Reading

1. Reading. Advanced.Brian Tomlinson and Rod Ellis.Oxford Supplementary Skills.Third Impression 1991.ISBN 0 19 453403 0.
2. Reading and Study Skills by John Langan
4. Study Skills by RiachardYorky.

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نصاب چار سالہ اسلامیات لازمی کلاس BS 4 Years

باب اول: مطالعہ قرآن وحدیث

باب دوم: مطالعہ سیرت

باب سوم: مطالعہ تہذیب وتمدن

باب اول: مطالعہ قرآن وحدیث (Topical Study of Quran & Hadith)

موضوعات

۱۔ توحید (دلائل کا عقلی ونقلی مطالعہ تفکر وتدبر)

آیات

۱. للہ مافی السموٰت وما فی الارض وان تبدوا مافی انفسکم او تخفوہ یحاسبکم بہ اللہ فیغفر لمن یشاء ویعذب من یشاء واللہ علی کل شیء قدیر۔ (البقرۃ: ۲۸۴)

۲. الم ترو ان اللہ سخر لکم مافی السموٰت ومافی الارض واسبغ علیکم نعمہ ظاہرۃ و باطنۃ ومن الناس من یجادل فی اللہ بغیر علم ولا ھدی ولا کتاب منیر۔ (لقمان: ۲۰)

۳. ربنا لاتواخذنا ان نسینا او اخطانا ربنا ولا تحمل علینا اصرا کما حملتہ علی الذین من قبلنا ربنا ولا تحملنا مالا طاقۃ لنا بہ واعف عنا واغفر لنا وارحمنا انت مولانا فانصرنا علی القوم الکافرین (البقرۃ: ۲۸۶)

۴. سنریھم ایاتنا فی الآفاق وفی انفسھم حتی یتبین لھم انہ الحق اولم یکف بربک انہ علی کل شیء شھید (حم السجدۃ: ۵۳)

۵. ان فی خلق السموٰت والارض واختلاف اللیل والنھار لایٰت لاولی الالباب۔ (آل عمران: ۱۹۰)

۶. الذین یذکرون اللہ قیاما وقعودا وعلی جنوبھم ویتفکرون فی خلق السموٰت والارض ربنا ما خلقت ھذا باطلا سبحانک فقنا عذاب النار۔ (آل عمران: ۱۹۱)

احادیث

عن عمر بن الخطابؓ قال: قال رسول اللہ ﷺ حین سئل عن الایمان ان تومن باللہ وملائکتہ وکتبہ ورسلہ والیوم الاخر وتومن بالقدر خیرہ وشرہ (متفق علیہ)

۲: رسالت (الہامی کتب، وملائکہ پر ایمان، آداب نبوی، اطاعت رسول اور ختم نبوت)

آیات:

۱. امن الرسول بما انزل الیہ من ربہ والمومنون کل امن باللہ وملائکتہ ورسلہ لا نفرق بین احد من رسلہ وقالوا سمعنا واطعنا غفرانک ربنا والیک المصیر (البقرۃ: ۲۸۵)

۲. یاایھا الذین امنوا لا تقدموا بین یدی اللہ ورسولہ واتقوا اللہ ان اللہ سمیع علیم۔ (الحجرات: ۱)

چیئرمین
شعبہ علوم اسلامیہ
یونیورسٹی آف سرگودھا

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۲. یاایها الذین امنوا لا ترفعوا اصواتکم فوق صوت النبی ولا تجهروا له بالقول کجهر بعضکم لبعض ان تحبط اعمالکم و انتم لا تشعرون (الحجرات:۲)

۳. ان الذین یغضون اصواتهم عند رسول الله اولئک الذین امتحن الله قلوبهم للتقوی لهم مغفرة و اجر عظیم. (الحجرات: ۳)

۴. ولو انهم صبروا حتی تخرج الیهم لکان خیرا لهم و الله غفور رحیم. (الحجرات: ۴)

۵. ان الذین ینادونک من وراء الحجرات اکثرهم لا یعقلون. (الحجرات ۵)

~~۶. یاایها الذین امنوا ان جاءکم فاسق بنبا فتبینوا ان تصیبوا قوما بجهالة فتصبحوا علی ما فعلتم نادمین (الحجرات ۶)~~

۷. واعلموا ان فیکم رسول الله لو یطیعکم فی کثیر من الامر لعنتم ولکن الله حبب الیکم الایمان وزینه فی قلوبکم و کره الیکم الکفر و الفسوق و العصیان اولئک هم الراشدون (الحجرات: ۷)

~~۸. فضلا من الله و نعمة والله علیم حکیم. (الحجرات ۸)~~

۹. النبی اولی بالمؤمنین من انفسهم و ازواجه امهتهم و اولوا الارحام بعضهم اولی ببعض فی کتاب الله من المؤمنین المهاجرین الا ان تفعلوا الی اولیاءکم معروفا. کان ذلک فی الکتاب مسطورا. (الاحزاب: ۶)

۱۰. ان الله و ملائکته یصلون علی النبی یاایها الذین امنوا صلوا علیه و سلموا تسلیما. (الاحزاب: ۵۶)

۱۱. ان الذین یؤذون الله و رسوله لعنهم الله فی الدنیا و الاخرة و اعد لهم عذابا مهینا. (الاحزاب ۵۷)

۱۲. لقد کان لکم فی رسول الله اسوة حسنة لمن کان یرجوا الله و الیوم الآخر و ذکر الله کثیرا. (الاحزاب: ۲۱)

۱۳. ما کان محمد ابا احد من رجالکم و لکن رسول الله و خاتم النبیین و کان الله بکل شیء علیما. (الاحزاب: ۴۰)

احادیث

عن العباس بن عبد المطلب قال: قال رسول الله ﷺ ذاق طعم الایمان من رضی بالله ربا و بالاسلام دینا و بمحمد رسولا

۳ آخرت

آیات

۱. یاایها الذین امنوا اتقوا الله ولتنظر نفس ما قدمت لغد و اتقوا الله ان الله خبیر بما تعملون. (الحشر: ۱۸)

۲. و لا تکونوا کالذین نسوا الله فانسهم انفسهم اولئک هم الفاسقون (الحشر: ۱۹)

حدیث:

عن ابن مسعود: عن النبی ﷺ لا تزول قدما ابن آدم حتی یسئل عن خمس عن عمره فیما افناه و عن شبابه فیما ابلاه و عن ماله من این اکتسبه و فیم انفقه و ما ذا عمل فیم علم (جامع ترمذی)

۴ عبادات (نماز، زکوٰۃ، روزہ، حج، جہاد)

۱. قد افلح المؤمنون الذین هم فی صلاتهم خاشعون. (المؤمنون: ۱)

۲. و الذین هم عن اللغو معرضون. (المؤمنون ۳)

۳. و الذین هم للزکوة فاعلون. (المؤمنون: ۴)

۴. یاایها الذین امنوا هل ادلکم علی تجارة تنجیکم من عذاب الیم. (الصف: ۱۰)

۵. تؤمنون بالله و رسوله و تجاهدون فی سبیل الله باموالکم و انفسکم ذلکم خیر لکم ان کنتم تعلمون. (الصف ۱۱)

یغفر لکم ذنوبکم و یدخلکم جنات تجری من تحتها الانهر و مساکن طیبة فی جنت عدن ذلک الفوز العظیم. (الصف: ۱۲)

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واخرى تحبونها نصر من الله وفتح قريب وبشر المؤمنين .(الصف. ١٣)

احادیث

١. عن ابن عمر قال: قال رسول الله ﷺ بنى الاسلام على خمس شهادة ان لا اله الا الله وان محمدا عبده ورسوله واقام الصلوة وايتاء الزكوة والحج وصوم رمضان (متفق عليه)

٢. عن شرحبيل بن سعيد قال: قال رسول الله ﷺ مروا الصبي الصلوة اذا بلغ سبع سنين واضربوه عليها اذا بلغ عشر سنين (ابو داود، جامع ترمذي)

٣. عن ابي هريرة قال: قال رسول الله ﷺ من اتاه الله مالا فلم يؤد زكوته مثل له ماله يوم القيامة شجاعا اقرع له زبيبتان يطوقه يوم القيامة ياخذ بلهزمتيه (يعني شدقيه) ثم يقول انا مالك وانا كنزك ثم تلا ولا يحسبن الذين يبخلون بما آتاهم الله من فضله هو خيرا لهم بل شر لهم سيطوقون ما بخلوا به يوم القيامة..... الخ (بخاري)

٣. عن علي قال: قال رسول الله ﷺ من ملك زادا وراحلة تبلغه الى بيت الله ولم يحج فلا عليه ان يموت يهوديا او نصرانيا وذلك قول الله تبارك وتعالى يقول ولله على الناس حج البيت من استطاع اليه سبيلا (جامع ترمذي).

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٥. صفات مومنين

آيات

١. و عباد الرحمن الذين يمشون على الارض هونا و اذا خاطبهم الجاهلون قالوا سلما. (الفرقان: ١)

٢. والذين يبيتون لربهم سجدا و قياما. (الفرقان: ٢)

٣. والذين يقولون ربنا اصرف عنا عذاب جهنم ان عذابها كان غراما. (الفرقان: ٣)

٤. انها ساءت مستقرا و مقاما. (الفرقان: ٤)

٥. والذين اذا انفقوا لم يسرفوا ولم يقتروا و كان بين ذلك قواما. (الفرقان: ٥)

٦. والذين لا يدعون مع الله الها آخر ولا يقتلون النفس التي حرم الله الا بالحق ولا يزنون ومن يفعل ذلك يلق اثاما. (الفرقان: ٦)

٧. يضاعف له العذاب يوم القيمة و يخلد فيه مهانا. (الفرقان: ٧)

٨. الا من تاب و امن وعمل صالحا فاولئك يبدل الله سياتهم حسنت و كان الله غفورا رحيما. (الفرقان: ٨)

٩. ومن تاب وعمل صالحا فانه يتوب الى الله متابا. (الفرقان: ٩)

١٠. والذين لا يشهدون الزور واذا مروا باللغو مروا كراما. (الفرقان: ١٠)

١١. والذين اذا ذكروا بايت ربهم لم يخروا عليها صما و عميانا. (الفرقان: ١١)

١٢. والذين يقولون ربنا هب لنا من ازواجنا و ذرياتنا قرة اعين و اجعلنا للمتقين اماما. (الفرقان: ١٢)

١٣. اولئك يجزون الغرفة بما صبروا و يلقون فيها تحية وسلما. (الفرقان: ١٣)

١٤. خلدين فيها حسنت مستقرا و مقاما. (الفرقان: ١٤)

١٥. قل ما يعبؤا بكم ربي لو لا دعاؤكم فقد كذبتم فسوف يكون لزاما. (الفرقان: ١٥)

٣. والذين هم لفروجهم حافظون. (المومنون: ٣)

٥. الا على ازواجهم او ما ملكت ايمانهم فانهم غير ملومين. (المومنون: ٥)

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۵. الذین هم علی صلوتهم یحافظون. (المومنون: ۹)

۷. والذین هم الزکوٰۃ فاعلون. (المومنون: ۴)

۸. الذین یرثون الفردوس. (المومنون: ۸)

۹. هم فیها خالدون. (المومنون: ۹)

احادیث

۱. عن انسؓ قال: قال رسول اللہ ﷺ والذی نفسی بیدہ لا یؤمن عبد حتی یحب لاخیہ ما یحب لنفسہ (متفق علیہ)

۲. عن النعمان بن بشیرؓ قال: قال رسول اللہ ﷺ ترٰی المؤمنین فی تراحمهم و توادهم و تعاطفهم کمثل الجسد اذا اشتکی عضو تداعی له سائر الجسد بالسهر والحمی (متفق علیہ)

۶. آداب مجالست

۱. وان طائفتان من المؤمنین اقتتلوا فاصلحوا بینهما فان بغت احداهما علی الاخری فقاتلوا التی تبغی حتی تفیء الی امر اللہ فان فاءت فاصلحوا بینهما بالعدل و اقسطوا ان اللہ یحب المقسطین. (الحجرات: ۹)

۲. انما المؤمنون اخوۃ فاصلحوا بین اخویکم و اتقوا اللہ لعلکم ترحمون. (الحجرات: ۱۰)

۳. یاایها الذین امنوا لا یسخر قوم من قوم عسی ان یکونوا خیرا منهم ولا نساء من نساء عسی ان یکن خیرا منهن ولا تلمزوا انفسکم ولا تنابزوا بالالقاب بئس الاسم الفسوق بعد الایمان ومن لم یتب فاولئک هم الظالمون. (الحجرات: ۱۱)

۴. یا ایها الذین امنوا اجتنبوا کثیرا من الظن ان بعض الظن اثم ولا تجسسوا ولا یغتب بعضکم بعضا ایحب احدکم ان یاکل لحم اخیه میتا فکرهتموه واتقوا اللہ ان اللہ توابٌ رحیم. (الحجرات: ۱۲)

۵. یاایها الناس انا خلقناکم من ذکر وانثی وجعلناکم شعوبا وقبائل لتعارفوا ان اکرمکم عند اللہ اتقاکم ان اللہ علیم خبیر. (الحجرات: ۱۳)

احادیث

۱. عن ابی هریرۃؓ ان رسول اللہ ﷺ قال: ان المفلس من امتی من یاتی یوم القیامۃ بصلاۃ و صیام و زکوٰۃ، ویاتی قد شتم هذا، وقذف هذا، واکل مال هذا، وسفک دم هذا، وضرب هذا، فیعطی هذا من حسناته، و هذا من حسناته، فان فنیت حسناته قبل ان یقضی ما علیه اخذ من خطایاهم فطرحت علیه ثم طرح فی النار

۷. دعوت واقامت دین

۱. ومن اظلم ممن افتری علی اللہ الکذب و هو یدعیٰ الی الاسلام واللہ لا یهدی القوم الظالمین. (الصف: ۷)

۲. یریدون لیطفئوا نور اللہ بافواههم، واللہ متم نوره ولو کره الکافرون. (الصف: ۸)

۳. هو الذی ارسل رسوله بالهدیٰ و دین الحق لیظهره علی الدین کله ولو کره المشرکون. (الصف: ۹)

احادیث

۱. عن ابی سعید نِ الخدریؓ عن رسول اللہ ﷺ قال من رای منکم منکراً فلیغیره بیده فان لم یستطع فبلسانه فان لم یستطع فبقلبه، وذالک اضعف الایمان (مسلم)۔

۲. عن عبداللہ بن عمرؓ قال قال رسول اللہ ﷺ الا کلکم راع و کلکم مسؤل عن رعیته فالامام الذی علی الناس راع وهو مسؤل عن رعیته والرجل راع علی اهل بیته وهو مسؤل عن رعیته والمراۃ راعیة علی بیت زوجها وولده وهی مسؤلة عنهم وعبد الرجل راع علی مال سیده وهو مسؤل عنه الا فکلکم راع وکلکم مسؤل عن رعیته (متفق علیہ)

Chairperson,
Department of Mathematics
University of Sargodha

۹ کے

کلکم راع و کلکم مسؤل عن رعیتہ (متفق علیہ)

یقبل رسول اللہ ﷺ سماء الرجل یوم القیامۃ فیلقی فی النار فتندلق اقتابہ فی النار فیطحن فیہا کطحن الحمار برحاہ فیجتمع اہل النار علیہ فیقولون: ای فلان ماشانک، الیس کنت تامر بالمعروف وتنہانا عن المنکر؟ قال کنت امرکم ولا اتیہ وانہاکم عن المنکر واتیہ

احادیث

۱۔ عن عبداللہ قال: قال رسول اللہ ﷺ طلب کسب الحلال فریضۃ بعد الفریضۃ (بیہقی: شعب الایمان)

۲۔ عن ابی سعید قال: قال رسول اللہ ﷺ التاجر الصدوق الامین مع النبیین والصدیقین والشہداء (جامع ترمذی)

باب دوم: مطالعہ سیرت (Seerah Study)

۱۔ مطالعہ سیرت کی اہمیت

۲۔ تزکیہ، نفس اور تعمیر شخصیت کا نبوی منہاج

۳۔ تشکیل معاشرت اور اسوۂ حسنہ

۴۔ ہجرت مدینہ، مواخات اور میثاق مدینہ

۵۔ غزوات النبی ﷺ مقاصد و حکمت

۶۔ خطبہ حجۃ الوداع

باب سوم: مطالعہ تہذیب و تمدن (Study of Culture)

۱۔ تہذیب کا مفہوم، اسلامی تہذیب کی خصوصیات

۲۔ بنیادی انسانی حقوق

۳۔ تہذیب انسانی کے ارتقاء میں مسلمانوں کا کردار

۴۔ اسلام کا تصور علم

۵۔ طبیعی علوم، ریاضیاتی علوم اور معاشرتی علوم میں مسلمانوں کا کردار

۶۔ مکالمہ بین المذاہب

پرچہ میں نمبروں کی تقسیم درج ذیل ہو گی

- قرآن و حدیث و نصوصاتی مطالعہ : ۲۰
- مطالعہ سیرت ۲۰
- مطالعہ تہذیب و تمدن ۲۰

چیئرمین بورڈ آف سرگودھا

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Course Code: COMP-102
Programming Languages for Mathematicains
Prerequisite(s): None
Credit Hours: 2+1
Objectives of the course:
A practical introduction to most widely used Mathematical computing software's namely, MATHEMATICA or MAPLE.
Contents:
MATHEMATICA

- Introduction to the basic environment of MATHMATICA and its syntax
- Running MATHEMATICA and Numerical/Algebraic Calculations
- Vectors, Matrices, Sets, Lists, Tables, arrays.
- Symbolic Mathematics in MATHEMATICA
- Functions and functional programming
- Procedural programming, Do, for and while loops, Flow controls.
- Graphics, Plots of 2D and 3D functions.
- Packages within MATHEMATICA.

MAPLE

- Introductory Demonstration of Maple, Symbolic computations in MAPLE
- Vectors, Matrices, Sets, Lists, Tables, arrays and Arrays.
- Toolbars and Palettes
- Operators, Constant, Elementary Functions, Procedures
- If clauses, selection and conditional execution
- Looping, for and while loop, looping commands.
- Recursion
- Plots of 2D and 3D functions
- Packages within MAPLE

Recommended Books

1. Wellin P, Kamin S, Gaylord R, An introduction to programming with Mathematica, 3rd edition, Cambridge university press, 2011.
2. Maeder R. E, Programming in Mathematica, 3rd edition, Addision-Weseley, 1997.
3. Hoste J., Mathematica Demystified, McGraw Hill, 2009.
4. Monagan M. B, Geddes K. O, Maple Introductory Programming Guide,
5. Aladjev V. Z, Bogdivicus M. A, Maple: Programming, Physical and Engineering Problems, Fultus Publishing, 2006.

SEMESTER-III

Course Code: MATH-201
Calculus-III
Prerequisite(s): Calculus-II
Credit Hours: 3+0
Objectives of the course:
This is the third course of the basic sequence Calculus-1, II and III, serving as the foundation of advanced subjects in all areas of mathematics.
Course Contents:
Vectors and analytic geometry in space: Coordinate systems, rectangular, cylindrical and spherical coordinates, the dot product, the cross product, equations of lines and planes, quadric surfaces, vector-valued functions, and space curves, derivatives and

integrals of vector valued functions, arc length, curvature, normal and binormal vectors.
Multivariable functions and partial derivatives: Functions of several variables, limits and Continuity, partial derivatives, composition and chain rule, directional derivatives and the gradient vector, maximum and minimum values, optimization problems, Lagrange Multipliers.
Multiple integrals: Double integrals over rectangular domains and iterated integrals, Non-rectangular domains, double integrals in polar coordinates, triple integrals in rectangular, cylindrical and spherical coordinates, applications of double and triple integrals, change of variables in multiple integrals.
Vector calculus: Vector fields, line integrals, Green's theorem, curl and divergence, surface integrals over scalar and vector fields, divergence theorem, Stokes' theorem.

Recommended Books

1. Thomas, Calculus, latest Edition. Addison Wesley Publishing Company.
2. Anton H., Bevens I., Davis H., Calculus, latest Edition, John Wiley & Sons, Inc.
3. Larson E. Calculus, latest edition, Brooks/Cole Cengage Learning.
4. Haliett H. Gleason, McCallum, et al, Calculus Single and Multivariable, latest Edition. John Wiley & Sons, Inc.
5. Swokowski E. W., Calculus with Analytic Geometry latest edition PWS Publishers, Boston, Massachusetts.
6. Liebeck M. A Concise introduction to pure Mathematics, CRC Press. 2011.
7. A. Kaseberg. Intermediate Algebra, Thomson Brooks/cole. 2004.
8. Stewart J., Calculus, latest edition Brooks/COLE.

Course Code: MATH-203
Algebra-I
Prerequisite(s): None
Credit Hours: 3+0
Objectives of the course:
Prerequisites: Elements of Set Theory and Mathematical Logic
Objectives of the course: This course introduces basic concepts of groups and their homomorphisms. The main objective of this course is to prepare students for courses which require a good back ground in group theory like Rings and Modules, Linear Algebra, Group Representation, Galois Theory etc.

Course Contents:
Groups: Definition of a group, subgroup, subgroup generated by a set. The cyclic groups, Cosets and Lagrange's theorem. normalizer,centralizer, center of a group, equivalence relation in a group, conjugacy classes, normal subgroups, quotient group.
Grouphomomorphism: Homomorphism, isomorphism and automorphism, kernel and image of homomorphism, isomorphism theorems, permutation groups, cyclic decomposition of a permutation group, Cayley's theorem, direct product of two groups and examples.

Recommended Books:

1. Galllian J. A. Contemporary Abstract Algebra, 8th Ed, 2013.
2. Rose J. *A Course on Group Theory*, Cambridge University Press, 1978.
3. Herstein I. N. *Topics in Algebra*, 2nd Ed., Xerox Publishing Company, 1964.
4. Cohn P. M. *Algebra*, John Wiley and Sons, London, 1974.

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5. Bhattacharya P. B. Jain S. K. and Nagpaul S. R. *Basic Abstract Algebra*. Cambridge University Press, 1986.
6. Fraleigh J. B. *A First Course in Abstract Algebra*, Addison-Wesley Publishing Company, 2002.
7. Vivek Sahai and Vikas Bist. *Algebra*, Narosa Publishing House, 1999.
8. Dummit D. S and Foote R. M. *Abstract Algebra*, 3rd Edition, Addison-Wesley Publishing Company, 2004.
9. Malik D.S, Mordeson J. M., Sen M.K. Fundamentals of Abstract Algebra, McGraw-Hill, 1997.

Course Code: PHY-201
Physics-III
Prerequisites: Physics-II
Cr. Hours 3+1

Course Contents:
Rotational Dynamics, Angular Momentum, Gravitation, Bulk Properties of Matters, Special Theory of Relativity, Inductance, Alternating Current Circuits, Electro-Magnetic Waves (Maxwell's Equations)

Lab-III

1. Measurement of resistance using a Neon flash bulb and condenser
2. Conversion of a galvanometer into voltmeter & an ammeter
3. Measurement of low resistance coil by a Carey Foster Bridge.
4. Resonance frequency of an acceptor circuit
5. Resonance frequency of a Rejecter Circuit.
6. Study of the parameter of wave i.e. amplitude, phase and time period of a complex signal by CRO.

Recommended Books:

1. Beiser A. Concepts of Modern Physics. 4th ed. McGraw-Hill Book Co.s.1987
2. Giancoli, Dougias, C. Physics for Scientist and Engineers with Modern Physics. 2nd ed. Prentice Hall Inc, 1988.
3. Sear and Zemansky. University Physics with Modern Physics. 12th ed. Pearson, 2008.

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ENG-203 ENGLISH-III (TECHNICAL WRITING AND PRESENTATION SKILLS) 3(3-0)

COURSE OBJECTIVES

Enhance language skills and develop critical thinking

COURSE CONTENTS

Presentation skills

Essay writing: Descriptive, narrative, discursive, argumentative

Academic writing: How to write a proposal for research paper/term paper

How to write a research paper/term paper (emphasis on style, content, language, form, clarity, consistency)

Technical Report writing

Progress report writing

Note: Extensive reading is required for vocabulary building

RECOMMENDED BOOKS

a) Essay Writing and Academic Writing

1. Writing. Advanced by Ron White.Oxford Supplementary Skills.Third Impression 1992.ISBN 0 19 435407 3 (particularly suitable for discursive, descriptive, argumentative and report writing).
2. College Writing Skills by John Langan. McGraw-Hill Higher Education. 2004.
3. Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.

b) Presentation Skills

c) Reading

The Mercury Reader.A Custom Publication.Compiled by Northern Illinois University. General Editors: Janice Neulib; Kathleen Shine Cain; Stephen Ruffus and Maurice Scharton. (A reader which will give students exposure to the best of twentieth century literature, without taxing the taste of engineering students).

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Course Code: MATH-205
Probability Theory
Prerequisite(s): Statistics
Credit Hours: 3+0
Objectives of the course:
A prime objective of the course is to introduce the students to the fundamentals of probability theory and present techniques and basic results of the theory and illustrate these concepts with applications. This course will also present the basic principles of random variables and random processes needed in 24 applications.

Course Contents:
Finite probability spaces: Basic concept, probability and related frequency, combination of events, examples, independence, random variables, expected value, standard deviation and Chebyshev's inequality, independence of random variables, multiplicatively of the expected value, additivity of the variance, discrete probability distribution.Probability as a continuous set function: Sigma-algebras, examples, continuous random variables, expectation and variance, normal random variables and continuous probability distribution.
Applications: De Moivre-Laplace limit theorem, weak and strong law of large numbers, the central limit theorem, Markov chains and continuous Markov process.

Recommended Books:

1. Capinski M., Kopp E. *Measure, Integral and Probability*. Springer-Verlag, 1998.
2. Dudley R. M. *Real Analysis and Probability*, Cambridge University Press, 2004.
3. Resnick S. I., *A Probability Path*, Birkhauser, 1999.
4. Ross S. *A first Course in Probability Theory*. 5th ed., Prentice Hall, 1998.
5. Robert B. Ash, *Basic Probability Theory*, Dover. B, 2008.
6. Chaudhry, S.M. and Kamal, S. (2008). *Introduction to Statistical Theory*, Part I, II, 8th ed, Ilmi Kitab Khana, Lahore, Pakistan.

SEMESTER-IV

Course Code: MATH-202
Vector Analysis and Mechanics
Prerequisite(s): Calculus-I and Calculus-II
Credit Hours: 3+0
Objectives of the course:
This course shall assume background in calculus. It covers basic principles of vector analysis, which are used in mechanics.

Course Contents:
Vector Analysis: Scalar and vector triple product, differentiation and integration of vector functions. gradient, divergence. and curl of vector point functions.
Mechanics: Composition and resolution of co-planar forces. moments, couples and conditions of equilibrium under the action of co-planar forces, frictional forces, laws of friction, equilibrium of bodies on rough surfaces, principle of virtual work and related problems, center of gravity, center of mass of various bodies, kinematics of a particle in Cartesian and polar co-ordinates, linear and angular velocity, rectilinear motion with uniform and variable acceleration, simple harmonic motion, projectile

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motion, motion along horizontal and vertical circles, orbital motion, planetary motion and keplar laws, conservative forces, damped and forced vibrations.

Recommended Books:

1.Munawar H., Saeed S.M. Ahmed C.B. Elementary Vector Analysis. 1st ed. Lahore:The Caravan Book House.
2. Yousuf S.M. Vector analysis. Lahore: Ilmi Ketab Khana.
3. Ashraf M. Vector analysis. Lahore: Ilmi Ketab Khana.
4. Ghori Q.K., Mechanics. Lahore: West Pakistan Publishing Company.
6. Mir K.L. Mechanics. Lahore: Ilmi Ketab Khana.
7. Young E.C. Vector and Tensor Analysis, Mareel Dekker, Inc, 1993

Course Code: MATH-204
Title of the Course: Linear Algebra
Credit Hours: 3+0
Prerequisites: Calculus I
Objectives of the course:

Linear algebra is the study of vector spaces and linear transformations. The main objective of this course is to help students learn in rigorous manner, the tools and methods essential for studying the solution spaces of problems in mathematics, engineering, the natural sciences, and social sciences and develop mathematical skills needed to apply these to the problems arising within their field of study, and to various real world problems.

Course 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 system, Gauss-Jordan method, Gaussian elimination.
Determinants: Permutations of order two and three and definitions of determinants of the same order. Computing of determinants. Definition of higher order determinants. Properties. 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. Eigen-values and eigenvectors. Theorem of Hamilton-Cayley.
Inner product Spaces: Definition and examples. Properties, Projection. Cauchy inequality. Orthogonal and orthonormal basis. Gram Schmidt Process. Diagonalization.

Recommended Books:

1. Curtis C. W., *Linear Algebra*, Springer 2004.
2. Apostol T., *Multi Variable Calculus and Linear Algebra*, 2nd ed., John Wiley and sons, 1997.
3. Anton H., Rorres C. , *Elementary Linear Algebra: Applications Version*, 10th Edition, John Wiley and sons, 2010.
4. Friedberg S., Insel A., Linear Algebra, 4th Edition, Pearson Education Canada, 2003.
5. Grossman S. I., *Elementary Linear Algebra*, 5th Edition, Cengage Learning, 2004.
6. Herstein I.N. Topics in Algebra, Xerox Publishing Company, 1975.

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7. Dr. Malik, Mordeson J.N., Sen M.R. Fundamental of Abstract Algebra, McGraw Hill companies. Inc. 1987.
8. Cohn P.M. Algebra, Vol.I, London: John Wiley, 1989.
9. Burton D. Abstract and Linear Algebra, Addison-Wesley publishing Co. 1986.
10. Jacobson N. Basic Algebra, Vol.II Freeman, 1989.
11. Dr. Karamat Hussain, Linear Algebra, 1st edition, 2007.

Course Code: PHY-202
Thermodynamics and Statistical Mechanics
Prerequisites: Physics-III
Credit Hours: 3+1
Course Contents:
Statistical Mechanics, Temperature, Thermodynamics, Origin in Quantum Theory, Wave nature of matter, Atomic Physics, Quantum Mechanics, Nuclear Physics, Nuclear Reaction, Introduction to Quantum Optics (laser) and Pleasma Physics.

Lab-IV

1. Determination of ionization potential of mercury.
2. Characteristics of a semiconductor diode (Compare Si with Ge diode)
3. Setting up of half & full wave rectifier & study of following factors
   i. Smoothing effect of a capacitor
   ii. Ripple factor & its variation with load.
   iii. Study of regulation of output voltage with load.
4. To set up a single stage amplifier & measure its voltage gain and bandwidth.
5. To set up and study various logic gates (AND, OR, NAND etc) using diode and to develop their truth table.

Recommended Books:

1. Giancoli, Douglas, C.. Physics for Scientist and Engineers with Modern Physics. 2nd ed. Prentice Hall Inc, 1988.
2. Murray S. R.. Outline of Theory and Problems of Vector Analysis and Introduction to Tensor Analysis. McGraw Hill, 1959.
3. Beiser A.. Concepts of Modern Physics. 4th ed. McGraw-Hill Book Co, 1987.
4. Grobe. Basic Electronics. 7th ed. McGraw Hill Book Co, 1993.
5. Reitz, John R. and Milford Fredrick, J.. Foundations to Electromagnetic Theory. 2nd ed. Addison-Wesley Publishing Co, 1970.
6. Paul L. & Corson. Waves. 2nd ed. Freeman and Co, 1970.
7. Marker, Zemausty, Heat and Thermodynamics, 5th ed. McGraw Hill Inc.
8. Hugh & Young, University Physics, 5th Ed. Addison, Wesley Pub. Co.
9. Sear and Zemansky. University Physics with Modern Physics. 12th ed. Pearson, 2008

Course Code: MATH-206
Discrete Mathematics
Prerequisite(s): Mathematics at Intermediate Level
Credit Hours: 3+0
Objectives of course:
Discrete Mathematics is study of distinct, un-related topics of mathematics; it embraces topics from early stages of mathematical development and recent additions to the discipline as well. The present course restricts only to counting methods, relations and graphs. The objective of the course is to inculcate in the students the skills that are necessary for decision making in non-continuous

situations.

Course Contents:
Counting methods: Basic methods: product, inclusion-exclusion formulae. Permutations and combinations. Recurrence relations and their solutions. Generating functions. Double counting. Applications. Pigeonhole principle, applications. Relations: Binary relations, n-ary Relations. Closures of relations. Composition of relations, inverse relation. Graphs: Graph terminology. Representation of graphs. Graphs isomorphism. Algebraic methods: the incidence matrix. Connectivity, Eulerian and Hamiltonian paths. Shortest path problem. Trees andspanning trees. Complete graphs and bivalent graphs.

Recommended Books:
1. Bollobas, B. Graph Theory, Springer Verlag, New York, 1979.
2. Parthasarathy K.R. Basic Graph Theory, McGraw-Hill, 1994.
3. Rosen K.H. Discrete Mathematics and its Application, McGraw-Hill, 6th edition, 2007.
4. Kolman B., Busby R.C., Ross S.C. Discrete Mathematical Structures, Prentice-Hall of India, New Delhi, 5th edition, 2008.
5. Tucker A. Applied Combinatorics. John Wiley and Sons, Inc New York, 2002.
6. Diestel R. Graph Theory, 4th edition, Springer- Verlag, New York, 2010.
7. Brigs N.L. Discrete Mathematics, Oxford University Press, 2003
8. Ross K.A., Wright C.R.B.. Discrete Mathematics, Prentice Hall, New Jersey, 2003.

Course Code: MATH-208
Spanish Language Course (Basic 1 & 2)
Credit Hours: 3+0
Objectives of the course: Spanish course develops the ability to communicate directly and effectively with people from Spanish culture. The focus of the curriculum is the progressive development of the skills of listening, speaking, reading and writing in the Spanish language. This course will be fruitful for the students who are seeking opportunities for higher studies in Spanish countries.

Course Contents:
This introductory course is designed for the studentthose have no previous study of Spanish. This course teaches basic language patterns and vocabulary. Important components of this course at basic level 1 will be:

- Identify Spanish alpha batiks sounds
- Identify numbers
- Listening
- Speaking
- Reading
- Writing
- Understanding description about daily life
- Basic Grammar Rules

For basic concept and understanding; culture is an integral part of the course and is introduced through the use of media and class discussions. In addition to written tests and quizzes, students may also be assessed by means of aural activities. Homework assignments are an integral part of this which enable students to participate in class in a meaningful way. Completion of homework assignments is a

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must. Active participation is required.After completing the basic the following ancillary materials will be considered to expert the students in Spanish language (level 2):

- Total Physical Response
- Storytelling materials,
- Novels
- Newspapers (Spanish)
- Magazines
- SAT II Spanish (Exams)

Recommended Books:

1. Spanish Level 1&2: BuenViaje 1 (Glencoe Publications)

Course Code: MATH-208
French Language – Level A1* (Beginners)
Credit Hours: 3+0
Objectives of the course:

- Improving oral and written comprehension, oral and written expression in various real-life situations such as social interaction, speaking in front of an audience, argumentation, etc.
- Encouraging linguistic autonomy for more advanced students who must perform communicative tasks in a professional or academic context.
- Reinforcing basic linguistic structures: grammar, vocabulary, spelling, punctuation, etc.
- Developing fluency and building confidence when speaking.

Course Contents:

ACTES DE COMMUNICATION: Saluer et prendre congé, Demander et donner l'identité
d'une personne, Faire comprendre qu'on n'a pas compris, Se présenter de façon informelle, Épeler, Téléphoner, Aborder quelqu'un, Situer et se situer dans l'espace et dans le temps, Fixer des rendez-vous, Donner un emploi du temps, Inviter, accepter et refuser une invitation, Offrir et remercier, Décrire un logement.
MORPHOSYNTAXE: Les articles définis, indéfinis, contractés et partitifs, Conjugaison à
l'indicatif présent des verbes du 1 er et du 2ème groupes, Conjugaison à l'indicatif présent
des auxiliaires et de quelques irréguliers : faire, venir, aller, prendre, partir, sortir, dormir,
servir, sentir, suivre, savoir, devoir, vouloir et pouvoir, Les pronoms personnels sujets 1 ère
et 2ème formes (atones et toniques), Les formes interrogative et négative. Le genre et le
nombre des noms et adjectifs, Le passé composé, Le futur proche, Les principales prépositions et adverbes de lieu.
PHONETIQUE: Les phonèmes du français, L'intonation dans les phrases affirmative, négative et interrogative, Les accents et groupes rythmiques, Distinction entre les différents sons vocaliques.
LEXIQUE: Les nombres et l'heure, Les nationalités, Les professions, Les transports, L'alimentation, La famille, Le calendrier, L'habitation.

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Recommended Books:

1. Chalaron. Marie-Laure, and Dominique, La grammaire des premiers temps, niveau 2 : corrigé des exercices. Grenoble.
2. Y. Delatour, D. Jennepin, M. Léon-Dufour and B. Teyssier, Nouvelle Grammaire du Français (cours de Civilisation française de la SORBONNE), Hachette FLE, 2004, quai de Grenelle, 75905, PARIS.
3. Grégoire, Maïa, Grammaire progressive du français, niveau débutant avec 400 exercices. Paris.
4. E. Bérard, G. Breton, Y. Canier, C. Lavenne, C. Tagliante, Studio 100, niveau 1, méthode de français, 2001, Didier

SEMESTER-V

Course Code: MATH-301
Topology
Credit Hours: 3+0

Course Contents:
Topological spaces, bases and sub-bases, first and second axiom of countability, separability, continuous functions and homeomorphism, finite product space. Separation axioms (T_0, T_1, T_2), Techonoff space, Regular spaces, completely regular spaces, normal spaces, compact spaces, connected spaces.

Recommended Books:

1. Sheldon W. D. Topology. 1st ed. NY: McGraw Hill, 2005.
2. Lipschutz S. General Topology, Schaum's outline series. NY:McGraw Hill,1968.
3. Munkers J.R.Topology. 2nd ed. NJ: Pearson Prentice Hall, 2006.
4. Simon G.F.Introduction to Topology and Modern Analysis. 1st ed. NY: McGraw Hill, 1963.
5. Willard J. General Topology. 1st ed. NY:Addison-Wesley,1970.
6. Armstrong M. A. Basic Topology. 1st ed. NY: McGraw Hill., 1979.

Course Code: MATH-303
Differential Geometry
Credit Hours: 3+0
Objectives of the course:
The course provides a foundation to solve partial differential equations with special emphasis on wave, heat and laplace equations. Formulation and some theory of these equations are also intended.

Course Contents:
Space Curves: Arc length, Tangent, Normal and Binormal, Curvature and Torsion of a Curve, Tangent Surface, Spherical Indicatrix, Involutes and Evolutes, Envelopes, Existence Theorem for a Space Curve, Helices, Curves on Surfaces, Surfaces of Revolution, Helicoids, Families of Curves, Developable associated with Space Curves, Developable associated with Curves on Surfaces, The First and Second Fundamental form, Principle Curvatures, Lines of Curvature, Geodesics.

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Recommended Books:

1- Millman R.S. and Parker G.D.,1997. Elements of Differential Geometry. 2nd ed. NJ:Prentice Hall.
2- Wilmore T.J.,1959. An Introduction to Differential Geometry. 1st ed. Oxford Calarendo Press.
3- Weatherburn C.E., 1961. Differential Geometry. 1st ed. Cambridge University Press.
4- Pressley A., 2001. Elementary Differential Geometry, 1st ed. Springer Verlag.
5- Somasundaran D., 2005. Differential Geometry. 1st ed. New Delhi: Narosa Publishing House.

Course Code: MATH-305
Ordinary Differential Equations
Prerequisite(s): Calculus-III
Credit Hours: 3+0
Objectives of the course:

To introduce students to the formulation, classification of differential equations and existence and uniqueness of solutions. To provide skill in solving initial value and boundary value problems. To develop understanding and skill in solving first and second order linear homogeneous and nonhomogeneous differential equations and solving differential equations
using power series methods.

Course Contents:

Preliminaries: Introduction and formulation, classification of differential equations, existence and uniqueness of solutions, introduction of initial value and boundary value problems
First order ordinary differential equations: Basic concepts, formation and solution of differential equations. Separable variables. Exact Equations. Homogeneous Equations. Linear equations, integrating factors. Some nonlinear first order equations with known solution, differential equations of Bernoulli and Ricaati type, Clairaut equation, modeling with first-order ODEs. Basic theory of systems of first order linear equations, Homogeneous linear system with constant coefficients, Non homogeneous linear system Second and higher order linear differential equations: Initial value and boundary value problems. Homogeneous and non-homogeneous equations, Superposition principle, homogeneous equations with constant coefficients, Linear independence and Wronskian, Nonhomogeneous equations, undetermined coefficients method, variation of parameters, Cauchy-Euler equation, Modeling. Sturm-Liouville problems: 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 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, The Bessel, modified Bessel Legendre and Hermite equations and their solutions.

Recommended Books:

1. Dennis G. Zill and Michael R., Differential equations with boundary-value problems by

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Cullin 5th Edition Brooks/Cole. 1997.
2. William E. Boyce and Richard C. Diprima, Elementary differential equations and boundary value problems, Seventh Edition John Wiley & Sons, Inc
3. Arnold V. I., *Ordinary Differential Equations*, Springer, 1991.
4. Apostol T., *Multi Variable Calculus and Linear Algebra*, 2nd ed., John Wiley and sons, 1997.

Course Code: MATH-307
Real Analysis-I
Credit Hours: 3+0
Objectives of the course:
This is the first course in analysis. It develops the fundamental ideas of analysis and is aimed at developing the students' ability in reading and writing mathematical proofs. Another objective is to provide sound understanding of the axiomatic foundations of the real number system, in particular the notions of completeness and compactness.

Course Contents:
Number Systems: Ordered fields, rational, real and complex numbers, Archimedean property, supremum, infimum and completeness. 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'Hopital's Rule, Taylor's theorem.

Recommended Books:
1. Lang S., Analysis *I*, Addison-Wesley Publ. Co., Reading, Massachusetts, 1968.
2. Rudin W., *Principles of Mathematical Analysis*, 3rd Ed., McGraw-Hill, 1976.
3. Habibullah G. M., Real Analysis, *Ilmi Kitab Khana*, Lahore, Pakistan, 2002.
4. Royden H.L, FitzPatrick P.M. Real Analysis, 4th ed, 2009

Course Code: MATH-309
Algebra-II (Ring Theory)
Credit Hours: 3+0
Prerequisites: Algebra I
Objectives of the course:
This is a course in advanced abstract algebra, which builds on the concepts learnt in Algebra I. The objectives of the course are to introduce students to the basic ideas and methods of modern algebra and enable them to understand the idea of a ring and an integral domain, and be aware of examples of these structures in mathematics; appreciate and be able to prove the basic results of ring theory; appreciate the significance of unique factorization in rings and integral domains.

Course Contents:
Rings: Definition, examples. Quadratic integer rings. Examples of non-commutative rings. The Hamilton quaternions. Polynomial rings. Matrix rings. Units, zero-divisors,

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nilpotents. 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. Galllian J. A. Contemporary Abstract Algebra, 8th Ed, 2013.
2. Rose J. *A Course on Group Theory*, Cambridge University Press, 1978.
3. Herstein I. N. *Topics in Algebra*, 2nd Ed., Xerox Publishing Company, 1964.
4. Cohn P. M. *Algebra*, John Wiley and Sons, London, 1974.
5. Bhattacharya P. B, Jain S. K. and Nagpaul S. R. *Basic Abstract Algebra*, Cambridge University Press, 1986.
6. Fraleigh J. B. *A First Course in Abstract Algebra*, Addison-Wesley Publishing Company, 2002.
7. Vivek Sahai and Vikas Bist. *Algebra*, Narosa Publishing House, 1999.
8. Dummit D. S and Foote R. M. *Abstract Algebra*, 3rd Edition, Addison-Wesley Publisning Company, 2004.
9. Malik D.S, Mordeson J. M., Sen M.K. Fundamentals of Abstract Algebra, McGraw-Hill, 1997.

SEMESTER-VI

Course Code: MATH-302
Classical Mechanics
Prerequisite(s): Vector Analysis and Mechanics
Credit Hours: 3+0
Objectives of the course:
To provide solid understanding ofclassical mechanics and enable the students to use thisunderstanding while studying courses on quantum mechanics,statistical mechanics, electromagnetism, fluid dynamics, space-flightdynamics, astrodynamics and continuum mechanics.

Course Contents:
Kinematics: Rectilinear motion of particles.Uniformly accelerated rectilinear motion. Curvilinear motion of particle,rectangular components of velocity and acceleration, tangential andnormal componentsof velocity and acceleration, radial and transverse components of velocity and acceleration. Projectile motion with air resistance.
Kinetics: Work, power, kinetic energy and energy principal, conservative force fields, conservation of energy theorem, impulse, torque. Conservation of linear andangular momentum. Non-conservative forces.
Resisted Motion and Damped Forced Oscillator: Vertical motion with air resistance. Damped harmonic oscillator. Resonance frequency. Damped forced oscillations.

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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 aninverse square field. Escape velocity. Planer Motion of Rigid Bodies: Introduction to rigidbodies, translations, rotations. Linear and angular velocity of a rigid body about a fixed axis, moments and products of inertia. Parallel and perpendicular axistheorem.
Motion of Rigid Bodies in Three Dimensions: General motion ofrigid bodies in space. Angular momentum and moment of inertia.Principal axes and principal moments of inertia. Determination ofprincipal axes by diagonalizing the inertia matrix.Equimomental systems.
Euler Equations of Motion of a Rigid Body:Rotating axes theorem. Euler;s dynamical equations. Free rotation of arigid body with three different principal moments,torque free motion of a symmetrical top.The Eulerian angles,angular velocity and kinetic energy in terms of Euler angles..

Recommended Books:

1. DiBenedetto E. Classical Mechanics. Theory and Mathematical Modeling,Birkhauser Boston, (2011).
2. John R. Taylor. Classical Mechanics. University of Colorado,(2005).
3. Goldstein H. Classical Mechanics. Addison-Wesley Publishing Co, (1980).
4. Spiegel M. R. Theoretical Mechanics, 3rd Edition, Addison-Wesley Publishing Company,(2004).
5. Fowles G. R. and Cassiday G. L. Analytical Mechanics, 7thedition, Thomson Brooks/COLE, USA.(2005).
6. Richard Fitzpatrick. Classical Mechanics,The University of Texas at Austin,(2006).
7. Mir K.L. Theoretical Mechanics:Ilmi Ketab Khana. Lahore, (2007).
8. Ashraf M. Vector analysis and Mechanics: Ilmi Ketab Khana. Lahore, (2006).

Course Code: MATH-304
Mathematical Methods
Credit Hours: 3+0
Prerequisite(s): Calculus-III
Specific Objectives of course:
The main objective of this course is to provide the students with a range of mathematical methods that are essential to the solution of advanced problems encountered in the fields of applied physics and engineering. In addition this course is intended to prepare the students with mathematical tools and techniques that are required in advanced courses offered in the applied physics and engineering programs.

Course 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

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equations. Necessary conditions for existence of an extremum of a functional. Constrained maxima and minima.

Recommended Books:

1. Powers D. L., Boundary Value Problems and Partial Differential Equations, 5th edition, Academic Press, 2005.
2. Boyce W. E., Elementary Differential Equations, 8th edition, John Wiley and Sons, 2005.
3. Krasnov M. L. Makarenko G. I. and Kiselev A. I, Problems and Exercises in the Calculus of Variations, Imported Publications, Inc., 1985.
4. J. W. Brown and R. V. Churchil, Fourier Series and Boundary Value Problems, McGraw Hill, 2006.
5. A. D. Snider, Partial Differential Equations: Sources and Solutions, Prentice Hall Inc., 1999.

Course Code: MATH-306
Complex Analysis
Prerequisite(s): Calculus-II
Credit Hours: 3+0
Objectives of the course:

This is an introductory course in complex analysis, giving the basics of the theory along with
applications, with an emphasis on applications of complex analysis and especially conformal mappings. Students should have a background in real analysis (as in the course Real Analysis I), including the ability to write a simple proof in an analysis context.

Course 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, Lioville's theorem, Morerea'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. Churchill R. V., J. W. Brown. Complex Variables and Applications ,5th edition, McGraw Hill, New York, 1989.
2. Mathews J. H. and R. W. Howell. Complex Analysis for Mathematics and Engineering, 2006.
3. Lang S. Complex Analysis, Springer-Verlag, 1999.
4. Remmert R., Theory of Complex Functions, Springer-Verlag, 1991.
5. Rudin W., Real and Complex Analysis, McGraw-Hill, 1987.

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Course Code: MATH-308
Functional Analysis
Prerequisite(s): Complex Analysis
Credit Hours: 3+0
Objectives of the course:
This course extends methods of linear algebra and analysis to spaces of functions, in which the interaction between algebra and analysis allows powerful methods to be developed. The course will be mathematically sophisticated and will use ideas both from linear algebra and analysis.

Course Contents:
Metric Spaces: A quick review, completeness and convergence, completion, Normed Spaces: linear spaces, normed spaces, difference between a metric and a normed space, banach spaces, bounded and continuous linear operators and functionals, dual spaces, finite dimensional spaces, F. Riesz Lemma, the Hahn-Banach theorem, the HB theorem for complex spaces, The HB theorem for normed spaces, the open mapping theorem, the closed graph theorem uniform bounded-ness principle and its applications.
Banach-Fixed-Point Theorem: Applications in differential and integral equations
Inner-Product Spaces: Inner-Product space, Hilbert Space, orthogonal and orthonormal sets, orthogonal complements, Gram-Schmidt orthogonalization process, representation of functionals, Reiz-representation theorem, and weak* convergence.

Recommended Books:

1. Kreyszig E. Introductory Functional Analysis with Applications. 1st ed. NY:John Wiley, 1989
2. Dunford N. and Schwartz J.T. Linear Operators (part-1 General theory), Interscience publishers, New York, 1958.
3. Seymour Lipschutz, Outline of General Topology, 2011.
4. Curtain R.F., Pritchard A.J., Functional Analysis in Modern Applied Mathematics, 1st ed. NY: Academic Press, 1977.
5. Friedman A. Foundations of Modern Analysis. 1st ed. Dover, 1982.
6. Rudin W. Functional Analysis. 1st ed. NY: McGraw Hill, 1973.

Course Code: MATH-310
Real Analysis-II
Prerequisite(s): Real Analysis-I
Credit Hours: 3+0
Objectives of the course:
A continuation of Real Analysis I, this course will continue to cover the fundamentals of real analysis, concentrating on the Riemann-Stieltjes integrals, Functions of Bounded Variation, Improper Integrals, and convergence of series. Emphasis would be on proofs of main results.

Course 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

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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 point-wise and uniform convergence, uniform convergence and continuity, uniform convergence and differentiation, examples of uniform convergence.

Recommended Books:

1. Lang S., Analysis *I*, Addison-Wesley Publ. Co., Reading, Massachusetts, 1968.
2. Rudin W., *Principles of Mathematical Analysis*, 3rd Ed., McGraw-Hill, 1976.
3. Habibullah G. M., Real Analysis, *Ilmi Kitab Khana*, Lahore, Pakistan, 2002.
4. Royden H.L, FitzPatrick P.M. Real Analysis, 4th ed, 2009
5. Davidson K. R. and A. P. Donsig, *Real Analysis with Real Applications*, Prentice Hall Inc., Upper Saddle River, 2002.
6. Folland G. B. *Real Analysis*, 2nd Edition, John Wiley and Sons, New York, 1999.
7. Hewitt E and Stromberg K. *Real and Abstract Analysis*, Springer-Verlag, Berlin Heidelberg New York, 1965.
8. Bartle G., Sherbert R., *Introduction to Real Analysis*, 3rd edition, John Wiley, New York, 1999.

SEMESTER-VII

Course Code: MATH-401
Numerical Analysis-I
Credit Hours: 3+0
Prerequisite(s): Calculus-I, Linear Algebra
Objectives of the course:
This course is designed to teach the students about numerical methods and their theoretical bases. The course aims at inculcating in the students the skill to apply various techniques in numerical analysis, understand and do calculations about errors that can occur in numerical methods and understand and be able to use the basics of matrix analysis. It is optimal to verifying numerical methods by using computer programming (MatLab, Maple, C++, etc).

Course Contents:
Floating point arithmetic, approximations and errors. Bisection method, regula-falsi method, fixed point iteration method, Newton-Raphson method, secant method, error analysis for iterative methods. Direct methods: Gaussian elimination method for solving system of equations, Gauss-Jordan method; matrix inversion; LU-factorization; Doolittle's, Crout's and Cholesky's methods, Iterative methods: Jacobi, Gauss-Seidel and SOR. Introduction, Power Method, Jaccobi's Method. The use of software packages/ programming languages for above mentioned topics is recommended.

Recommended Books:

1. Gerald C.F. and Wheatley P.O., Applied Numerical Analysis, Pearson Education, Singapore, 2005.
2. Burden R. L. and Faires J. D.: Numerical Analysis, latest edition, PWS Pub. Co.
3. Mathews J.H., Numerical Methods for Mathematics, latest Edition, Prentice Hall International.
4. Chapra S. C. and Canale R. P.: Numerical Methods for Engineers, 6th edition, McGraw Hill.

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5. Sankara K. Numerical Methods for Scientists and Engineers. 2nd ed. New Delhi: Prentice Hall, 2005.

Course Code: MATH-403
Number Theory
Credit Hours: 3+0
Prerequisites: Linear Algebra
Objectives of course:
The focus of the course is on study of the fundamental properties of integers and develops ability to prove basic theorems. The specific objectives include study of division algorithm, prime numbers and their distributions, Diophantine equations and the theory of congruences.

Course Contents:
Divisibility, Euclid's theorem, Congruences, Elementary properties, Residue classes and Euler's function. Linear congruence and congruence of higher degree, Congruences with prime moduli, The theorems of Fermat, Euler and Wilson., Primitive roots and indices, Integers belonging to a given exponent, composite moduli Indices, Quadratic Residues, Composite moduli, Legendre symbol, Law of quadratic reciprocity, the Jacobi symbol, Number-Theoretic Functions, Mobius function, the function [x], Diophantine Equations, Equations and Fermat's conjecture for $n = 2$, $n = 4$.

Recommended Books:
1.Rosen K.H.,2000. Elementary Number theory and its Applications. 4th ed. USA:Addison-Wesley.
2. Apostal T.M., 2010. Introduction to Analytic Number Theory. 3rd ed. NY: Springer.
3. Griffin H., 1954. Elementary Theory of Numbers. 1st ed. NY Mc Graw Hill.
4. William J. Leveque, Topics in Number Theory. Volumes I and II.
5. D.M. Burton. Elementary Number Theory. McGraw-Hill, 2007.
6. S.B. Malik . Basic Number Theory. Vikas Publishing house, 1995.

Course Code: MATH-405
Partial Differential Equations
Prerequisite(s): Ordinary-Differential Equations
Credit Hours: 3+0
Objectives of the course:
Partial Differential Equations (PDEs) are at the heart of applied mathematics and many other scientific disciplines. The course aims at developing understanding about fundamental concepts of PDEs theory, identification and classification of their different types, how they arise in applications, and analytical methods for solving them. Special emphasis would be on wave, heat and Laplace equations.

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

Recommended Books:

1.Humi M, Miller W.B; Boundary Value Problems and Partial Differential Equations. PWS-KENT Publishing Company, 1991.
2. Myint UT, *Partial Differential Equations for Scientists and Engineers*, 3rdedition, North
Holland, Amsterdam, 1987.
3. Dennis G. Zill. Michael R. Cullen, *Differential equations with boundary value* problems. Brooks Cole, 2008.
4. John Polking, Al Boggess, *Differential Equations with Boundary Value Problems*, 2nd
Edition, Pearson,July 28, 2005.
5. J. Wloka, *Partial Differential Equations*, Cambridge University press, 1987.

SEMESTER-VIII

Course Code: MATH-402
Numerical Analysis-II
Credit Hours: 3+0
Prerequisite(s): Calculus-I, Linear Algebra, Numerical Analysis-I
Objectives of the course:
This course is designed to teach the students about numerical methods and their theoretical bases. The students are expected to know computer programming to be able to write program for each numerical method. Knowledge of calculus and linear algebra would help in learning these methods

Course Contents:
Forward, backward and centered difference formulae, Lagrange interpolation, Newton's divided difference formula, Interpolation with a cubic spline, Hermite interpolation, least squares approximation. Richardson's extrapolation, Newton-Cotes formulae, Numerical integration: Rectangular rule, trapezoidal rule, Simpson's 1/3 and 3/8 rules, Boole's and Weddle's rules, Gaussianquadrature. Difference and Differential Equation: Formulation of difference equations, solution of linear(homogeneous and inhomogeneous) difference equations with constant coefficients. The Euler and modified Euler method, Runge-Kutta methods and predictor-corrector type methods for solving initial value problems along with

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convergence and instability criteria. Finite difference. collocation and variational method for boundary value problems.

Recommended Books:

1. Gerald C.F. and Wheatley P.O. Applied Numerical Analysis, Pearson Education, Singapore, 2005.

2. Burden R. L. and Faires J. D. Numerical Analysis, latest edition, PWS Pub. Co.

3. Mathews J.H. Numerical Methods for Mathematics, latest Edition, Prentice Hall International.

4. Chapra S. C. and Canale R. P. Numerical Methods for Engineers, 6th edition, McGraw Hill.

5. Sankara K. Numerical Methods for Scientists and Engineers. 2nded. New Delhi: Prentice Hall, 2005.

Course Code: MATH-404
Integral Equations
Prerequisite(s): O.D.E and Real Analysis-I
Credit Hours: 3+0
Objectives of the course:

Many physical problems that are usually solved by differential equation methods can be solved more effectively by integral equation methods. This course will help students gain insight into the application of advanced mathematics and guide them through derivation of appropriate integral equations governing thebehavior of several standard physical problems.

Course 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. Eigenvalues and eigenvectors. 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. Jerri A. J. Introduction to Integral Equations with Applications second edition. Sampling Publishing 2007.
2 . Lovitt W. V. Linear Integral Equations, Dover Publications, 2005
3. Baker C. T. H., Integral Equations, Clarendon Press, 1977.
4. Smithies F. Integral Equations, Cambridge University Press, 1989.
5. Wazwaz A. M. A first Course in Integral Equations, World Scientific Pub., 1989.

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Contents of Pure Mathematics Concentration Elective Courses

Course Code: MATH-407
Course Title: Advanced Group Theory-I
Prerequisite: Abstract Algebra
Credit Hours: 3+0

Course Contents:
Group of automorphisms, direct products and normal products of groups, holomorph of a group, characteristic and fully invariant subgroups, cyclic permutations and orbits, the alternating groups, generators of symmetric and alternating groups, permutation groups, Simple groups, simplicity of A_n, $n \geq 5$, series in groups, the stabilizer subgroups, Zassenhau's Lemma, normal series and their refinements, composition series, principal or chief series, finitely generated abelian groups, double Cosets, Sylow's theorems, applications of Sylow Theorem.

Recommended Books:

1. Rottman J.J..The Theory of Groups: An Introduction. 1st ed. Boston :Allyn & Bacon , 1965.
2. Mac Donald I.. The Theory of Groups. 1st ed. Oxford University Press, 1968.
3. Cohn P.M. Algebra, Vol.I, London: John Wiley, 1974.
4. Burton D. Abstract and Linear Algebra. 1st ed. Addison-Wesley, 1972.
5. Battacharya P.B., Jain S.K. and Nagpaul S.R., 1994. Basic abstract Algebra. 2nd ed. C.U.P.

Course Code: MATH-409
Course Title: Modern Algebra-I
Prerequisite: Abstract Algebra
Credit Hours: 3+0

Course Contents:
Rings, examples and basic properties; integral domains and fields; ideals and factor rings; ring homomorphisms; polynomials; factorization of polynomials over a field; factor rings of polynomials over a field; factorization in integral domains; principal ideal domains. Ring of endomorphisms of an abelian group.

Books Recommended:

1. Nicholson. Intermediate Microeconomics. Ist ed. NY:The Drydon Press, 1994.
2. Ames, D.B. Introduction to Abstract Algebra. 1st ed. Pennsylvania : International text book co, 1968.
3. Northcott D.D. A first course of Homological Algebra. 1st ed. Cambridge University Press, 1973.

Course Code: MATH-411
Course Title: Algebraic Topology-I
Credit Hours: 3+0

Course Contents:
Homotopy theory, Homotopy theory of path and maps, Fundamental group of circle, Covering spaces, Lifting criterion, Loop spaces and higher homotopy group.

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Homotopy Theory: Affin spaces, Singular theory, Chain complexes, Homotopy invariance of homology, Relation between π_1 and H_1,relative homology The exact homology sequence.

Recommended Books:

1. Kosniowski C. A.. First course in algebraic topology. 1st ed. Cambridge University Press, 1980.
2. Greenberg M.J. & Harper J.R. Algebraic Topology, A First Course. 1st ed. The Bonjan Cunning Pub,Co, 1987.
3. Croom F.H. Basic Concept of algebraic theory. 1st ed. NY: Spinger-Verlag, 1975.

Course Code: MATH-413
Course Title: Advanced Functional Analysis
Credit Hours: 3+0

Course Contents:

Fundamental Theorems: Zorn's lemma, statement of Hahn-Banach theorem for real vector spaces, Hahn-Banach theorem for complex vector spaces and normed spaces, Uniform boundedness theorem, Open mapping theorem, Closed graph theorem.

Spectral Theory: Spectral properties of bounded linear operations on Normed Spaces, Further properties of Resolvent and spectrum, use of complex Analysis in spectral theory, compact linear operations on Normed Spaces.

Recommended Books:

1. Kreyszig, E.. Introductory Functional Analysis with applications. 1st ed. John Wiley, 1978.
2. Brown, A.L. A , Elements of Functional Analysis. 1st ed. Von Nostrand and Reinhold Company, 1970.
3. Ocen,J.T. Applied Functional Analysis. 1st ed. Prentice-Hall Inc. 1979.

Course Code: MATH-408
Course Title: Advanced Group Theory-II
Credit Hours: 3+0

Course Contents:

Solvable groups definition and examples, theorems on solvable groups, nilpotent groups, characterization of finite nilpotent groups, upper and lower central series, the Frattini subgroups, free groups, basic theorems, definition and examples of free products of groups, linear groups, types of linear groups, representation of linear groups, group algebras and representation modules.

Recommended Books:

1. MacDonald I. The Theory of Groups. 1st ed. Oxford University Press, 1968.
2. Cohn P.M. Algebra, Vol.I, London: John Wiley, 1974.
3. Burton D. Abstract and Linear Algebra. 1st ed. Addison-Wesley, 1972.
4. Battacharya P.B., Jain S.K. and Nagpaul S.R., 1994. Basic abstract Algebra. 2nd ed. C.U.P.
5. Jacobson .N. Basic Algebra, Vol.II. 2nd ed. Freeman,1989.

Course Code: MATH-410
Course Title: Modern Algebra-II
Credit Hours: 3+0

Course Contents:
Finite and finitely generated obelian groups, definition and examples of solvable and nilpotent groups, fields, finite fields, field extension, Galois theory, Galois theory of equations, construction with straight-edge and compass, splitting field of polynomials, the Galio groups, some results on finite groups, symmetric group as Galois group, constructable regular n-gones, the Galois group as permutation group.

Recommended Books:

1. Nicholson. Intermediate Microeconomics. Ist ed. NY:The Drydon Press, 1994.
2. Ames, D.B. Introduction to Abstract Algebra. 1st ed. Pennsylvania : International text book co, 1968.
3. Northcott D.D. A first course of Homological Algebra. 1st ed. Cambridge University Press, 1973.
4. Jacobson N. Basic Algebra I. 1st ed. NY: Freeman and Co, 1985.

Course Code: MATH-412
Algebraic Topology-II
Credit Hours: 3

Course Contents:
Relative homology, The exact homology sequences, Excion theorem and application to spheres, Mayer Victoris sequences, Jordan-Brouwer separation theorem, Spherical complexes, Betti number and Euler characteristic, Cell Complexes and adjunction spaces.

Recommended Books:

1. Kosniowski C. A.. First course in algebraic topology. 1st ed. Cambridge University Press, 1980.
2. Greenberg M.J. & Harper J.R. Algebraic Topology, A First Course. 1st ed. The Bonjan Cunning Pub.Co, 1987.
3. Croom F.H. Basic Concept of algebraic theory. 1st ed. NY: Spinger-Verlag, 1975.

Course Code: MATH-414
Theory of Modules
Credit Hours: 3+0

Course Contents:
Elementary notions and examples, Modules, submodules, quotient modules, finitely generated and cyclic modules, exact sequences and elementary notions of homological algebra, Noetherian and Artinian rings and modules, radicals, semisimple rings and modules, tensor product of modules, bimodules, algebra and coalgebra, torsion module, primary components, invariance theorem.

Recommended Books:

1. Adamson, J. Rings and modules 1st ed. NY, Chelsea,1976.
2. Blyth, T.S. Module Theory. 1st ed. Oxford University Press, 1977.

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3. Hartley, B. and Hawkes, T.O. Rings, Modules and Linear algebra. 1st ed. Chapman and Hall, 1980..
4. Herstein I.N. *Topics in Algebra with Application.* 3rd ed. Books/Cole, 1995.
5. Jacobson .N. Basic Algebra, Vol.II. 2nd ed. Freeman,1989.

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Contents of Applied Mathematics Concentration Elective Courses

Course Code: MATH-415
Astronomy-I
Credit Hours: 3+0

Course Contents:
Introduction, The great and small circles, spherical angle and spherical triangle, applications to the Earth, longitude and latitude, basics of spherical trigonometry, the celestial sphere, horizontal and equatorial systems of coordinates, observer's meridian and diurnal motion, circumpolar stars, right ascension, the equation of time.

Recommended Books:
1. Smart W. M. Textbook on Spherical Astronomy. 1st ed. Cambridge University Press, 1977.
2. Roy A. E. Astronomy: Principles and Practice. 1st ed. Bristor: Adam Hilger Ltd,1982.
3. Wooland E. W. & Clemence G. M. Spherical Astronomy, 1st ed. Boston: Academic Press, 1966.

Course Code: MATH-417
Electromagnetism-I
Credit Hours: 3+0

Course Contents:
Electrostatics: Coulomb's law, electric field and potential. lines of force and equipotential surfaces. Gauss's law and deduction. conductor condensers, dipoles, forces dipoles, dielectrics, polarization and apparent charges, electric displacement, energy of the field, minimum energy, magnetostatic field, the magnetostatic law of force. magnetic shells, force on magnetic doublets. magnetic induction, para/dia and magnitism, steady and slowly varying currents. electric current, linear conductors, conductivity. resistance, Kirchoff's laws, heat production, current density vector, magnetic field of straight and circular current, magnetic flux.

Recommended Books:
1. Ferraro. Electromagnetic Theory. Revised ed. The Athlon Press, University of London, 1956.
2. Reitz J.R. & Milford. Foundations of Electromagnetic theory. 3rd ed. Addison-Wesley, 1960.
3. Pugh & Pugh. Electricity and Magnetism. 1st ed. Addison-Wesley, 1960.

Course Code: MATH-419
Fluid Mechanics-I
Credit Hours: 3+0

Course Contents:
Introduction: Definition of Fluid, basics equations, Methods of analysis, dimensions and units. Fundamental concepts, Fluid as a continuum, velocity field, stress field, viscosity, surface tension, description and classification of fluid motions.
Fluid Statics: The basic equation of fluid static, The standard atmosphere, pressure variation in a static fluid, fluid in rigid body motion. Basic equation in integral form for

a control volume. basic laws for a system, relation of derivatives to the control volume formulation, conservation of mass, momentum equation for inertial control volume, momentum equation for control volume with rectilinear acceleration, momentum equation for control volume with arbitrary acceleration, the angular momentum principle, the first law of thermodynamics, the second law of thermodynamics. Introduction to differential analysis of fluid motion: conservation of mass, stream function for two dimensional incompressible flow, motion of a fluid element (kinematics), momentum equation.

Recommended Books:

1. Fox R. W. & McDonald A. T. Introduction to Fluid Mechanics 6th ed. John Wiley & Sons, 2004.
2. White F. M. Fluid Mechanics. 5th ed. Mc Graw Hill, 2006.
3. Schichting H. Boundary Layer Theory. 6th ed. Mc. Graw Hill, 1964.
4. Milne-Thomson L. M. Theoretical Hydrodynamics, 6th ed. NY: Macmillan, 2006.

Course Code: MATH-421
Operations Research-I
Credit Hours: 3+0

Course Contents:

Linear Programming: formulation and graphical solution, simplex method. M-technique and two-phase technique. special cases sensitivity analysis. the dual problem, primal dual relationship, the dual simplex method, sensitivity and post optimal analysis, transportation model, Northwest corner, least cost and Vogel's approximation methods, the method of multipliers, the assignment model. the transshipment model, network minimization, shortest route algorithms for variables.

Recommended Books:

1. Hamdy A. T. Operations Research an Introduction. 6th ed. NY: Macmillan, 2006.
2. Gillet B.E. Introduction to Operations Research. 1st ed. New Delhi: McGraw Hill, 1979..
3. HARVY C.M. Operations Research. 1st ed. North Holland, 1979.
4. Hillier F.S. & Liebraman G.J. Operations Research. 8th ed., CBS, 2000.

Course Code: MATH-423
Quantum Mechanics–I
Credit Hours: 3+0

Course Contents:

Inadequacy of classical mechanics: black body radiation, photoelectric effect. compton effect, Bohr's theory of atomic structure, wave-particle duality, the de-Broglie postulate, the uncertainty principle, uncertainty of position and momentum, statement and proof of the uncertainty principle, energy-time uncertainty. eigenvalues and eigenfunctions, operators and eigenfunctions, linear operators, operator formalism in quantum mechanics, orthonormal systems, Hermitian operators and their properties, simultaneous eigenfunctions, parity operators, postulates of quantum mechanics, the Schrödinger wave equation.

Motion in one dimension: step potential, potential barrier, potential well, and harmonic oscillator.

Recommended Books:

1. Taylor G. Quantum Mechanics. 1st ed. George Allen and Unwin, 1970..
2. Powell T.L and Crasemann B. Quantum Mechanics. 1st ed. Addison Wesley, 1961.
3. Merzdacker E. Quantum Mechanics. 1st ed. John Wiley,1988.
4. Eisberg R.M. Fundamental of Modern Mechanics. 1st ed. Willey, 1961.

Course Code: MATH-425
Analytical Dynamics
Credit Hours: 3+0

Course Contents:

Generalized coordinates, Constraints, Degree of freedom, D' Alembert principle, Holonomic and non-Holonomic systems, Hamilton's principle, Derivation of Lagrange equation from Hamilton's principle, and Derivation of Hamilton's equation from a variational principle. Equations and Examples of Gauge transformations, Equations and examples of canonical transformations, Orthogonal Point transformations, The Principle of Least Action, Applications of Hamilton's equation to central force problems, Applications to Harmonic oscillator, Hamiltonian formulism, Lagrange bracket and Poisson brackets with application, The Hamilton Jacobi theory, Hamilton Jacobi Theorem, The Hamilton Jacobi equation for Hamilton characteristic functions, Bilinear co-variant, Quasi coordinates, transpositional relations for Quasi coordinates, Lagrange's equation for Quasi coordinates, Appel's equation for quasi coordinates, Whittaker equation with applications, Chaplygian system and Chaplygian equation.

Recommended Books:

1. Greenwood D.T. Classical Dynamics, Prentice-Hall, Inc. 1965.
2. Chorlton F. Textbook of Dynamics, Van Nostrand.
3. Chester W. Mechanics, George Allen and Unwin Ltd. London.
4. Goldstein H. Classical Mechanics, Cambridge, Mass Addison-Wesely.
5. Pars L.A., Treatise of Analytical Dynamics, Heimann Press, London.
6. Sankara Rao K., Classical Mechanics.
7. Panaf P.V. Classical Mechanics, Narosa Publishing House Delhi, 2005.

Course Code: MATH-416
Astronomy-II
Pre Requisite: Astronomy-I
Credit Hours: 3+0

Course Contents:

Introduction to celestial navigation on earth; celestial sphere; time-keeping system; refraction; parallax and triangulation, aberration; precession, nutation; tropical measurements, magnitude systems; Naked Eye Observations; Observational techniques; optics and telescopes; Radio telescopes and Doppler imaging.

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Recommended Books:

1. Smart W. M. Textbook on Spherical Astronomy. 1st ed. Cambridge University Press, 1977.
2. Roy A. E. Astronomy: Principles and Practice. 1st ed. Bristor: Adam Hilger Ltd,1982.
3. Wooland E. W. & Clemence G. M. Spherical Astronomy, 1st ed. Boston: Academic Press, 1966.
4. Roy A. E., 1989. *Astronomy: Structure of the Universe.* 1st ed. Adam Hilger Ltd., Bristol.

Course Code: MATH-418
Electromagnetism-II
Credit Hours: 3+0

Course Contents:

Vector potential, forces on a circuit in magnetic field, magnetic field energy, law of electromagnetic induction, Co-efficient of self and mutual induction, alternating current and simple I.C.R circuits in series and parallel, power factor, the equations of electromagnetism, Maxwell's equations in free space and material media, solution of Maxwell's equations, plane electromagnetic waves in homogeneous and isotropic media, reflection and refraction of plane waves, wave guides Laplace' equation in plane, polar and cylindrical coordinates, simple introduction to Legendre polynomials, method of images, images in a plane, images with spheres and cylinders.

Recommended Books:

1. Ferraro. 1956. Electromagnetic Theory. Revised ed. The Athlon Press, University of London.
2. Reitz J.R. & Milford. 1960. Foundations of Electromagnetic theory. 3rd ed. Addison-Wesley.
3. Pugh & Pugh. 1960. Electricity and Magnetism. 1st ed. Addison-Wesley.

Course Code: MATH-420
Fluid Mechanics-II
Credit Hours: 3+0

Course Contents:

Incompressible inviscid flow, momentum equation for frictionless flow, Euler's equations, Euler's equations in streamline coordinates, Bernoulli equation-Integration of Euler's equation along a streamline for steady flow, relation between first law of thermodynamics and the Bernoulli equation, unsteady Bernoulli equation-Integration of Euler's equation along a streamline, irrotational flow. Internal incompressible viscous flow, Part-A Fully developed laminar flow, fully developed laminar flow between infinite parallel plates, fully developed laminar flow in a pipe, Part-B Flow in pipes and ducts, shear stress distribution in fully developed pipe flow, turbulent velocity profiles in fully developed pipe flow, energy consideration in pipe flow. External incompressible viscous flow, Part-A, Boundary layers, the boundary concept, boundary thickness, laminar flat plate boundary layer: exact solution,

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momentum, integral equation, use of momentum integral equation for flow with zero pressure gradient, pressure gradient in boundary-layer flow.

Recommended Books:

1. Fox R. W. & McDonald A. T. Introduction to Fluid Mechanics 6th ed. John Wiley & Sons, 2004.
2. White F. M. Fluid Mechanics. 5th ed. Mc Graw Hill, 2006.
3. Schichting H. Boundary Layer Theory. 6th ed. Mc. Graw Hill, 1964.
4. Milne-Thomson L. M. Theoretical Hydrodynamics, 6th ed. NY: Macmillan, 2006.

Course Code: MATH-422
Operations Research-II
Credit Hours: 3+0
Course Contents:

Algorithm for cyclic network, maximal flow problems, matrix definition of LP-problems, revised simplex methods, bounded variables decompositions algorithm, parametric linear programming, application of integer programming, cutting plane algorithm, mixed fractional cut algorithm, branch and bound methods, zero-one implicit enumeration, element of dynamics programming, problems of dimensionality, solutions of linear program by dynamics programming,

Recommended Books:

1. Hamdy A. T. Operations Research an Introduction. 6th ed. NY: Macmillan, 2006.
2. Gillet B.E. Introduction to Operations Research. 1st ed. New Delhi: McGraw Hill, 1979..
3. HARVY C.M. Operations Research. 1st ed. North Holland, 1979.
4. Hillier F.S. & Liebraman G.J. Operations Research. 8th ed., CBS, 2000.

Course Code: MATH-424
Quantum Mechanics–II
Credit Hours: 3+0

Course Contents:

Motion in three dimensions, angular momentum, commutation relations between components of angular momentum, and their representation in spherical polar coordinates, simultaneous Eigen functions of Lz and L2, Spherically symmetric potential and the hydrogen atom.

Scattering Theory: The scattering cross-section, scattering amplitude, scattering equation, Born approximation, partial wave analysis. Perturbation Theory: Time independent perturbation of non-degenerate and degenerate cases. Time-dependent perturbations.

Identical Particle: Symmetric and anti-symmetric Eigen function, The Pauli exclusion principle.

Recommended Books:

1. Taylor G. Quantum Mechanics. 1st ed. George Allen and Unwin, 1970..
2. Powell T.L and Crasemann B. Quantum Mechanics. 1st ed. Addison Wesley, 1961.
3. Merzdacker E. Quantum Mechanics. 1st ed. John Wiley,1988.
4. Eisberg R.M. Fundamental of Modern Mechanics. 1st ed. Willey, 1961.

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Course Code: MATH-426
Special Relativity
Credit Hours: 3+0

Course Contents:
Historical background and fundamental concepts of special theory of relativity, Galilean transformations, Lorentz transformations (for motion along one axis), length contraction, time dilation and simultaneity, velocity addition formulae.3-dimensional, Lorentz transformations, introduction to 4-vector formalism. Lorentz transformations in the 4-vector formalism, the Lorentz and Poincare groups, introduction to classical mechanics, Minkowski space-time and null cone, 4-velocity and 4-momentum and 4-force, application of special relativity to Doppler shift and Compton effect, aberration of light, particle scattering, binding energy, particle production and decay, special relativity with small acceleration.

Recommended Books:
1. Qadir. An introduction to the Special Relativity theory. 1st ed. World scientific, 1989.
2. D'Inverno R. Introducing Einstein's Relativity. 1st ed. Oxford University Press, 1992.
3. Rindler W. Essential Relativity. 2nd ed. Springer Verlag, 1977.

Course Contents of Free Elective Courses

Course Code: MATH-427
Numerical Solutions of Partial Differential Equations
Credit Hours: 3+0

Course Contents:
Introduction and Finite-Difference Formulae. Parabolic Equations: Finite difference methods, convergence, and stability. Parabolic Equations: Alternative derivation of difference equations and miscellaneous topics. Hyperbolic equations and characteristics. Elliptic equations and systematic iterative methods.

Recommended Books:
1. Smith G.D. Numerical Solution of Partial Differential Equations: Finite Difference Methods, 3rd ed, Oxford University Press, 1986.
2. Ames, W.F. Numerical Methods for Partial Differential Equations. 3rd ed. NY: Academic Press 1992.

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Course Code: MATH-429
History of Mathematics
Credit Hours: 3

Course Contents:
History of numerations; Egyptian, Babylonian, Hindu and Arabic contributions. Algebra: Including the contributions of Al-Khwarzmi and Ibn Kura. Geometry: areas, the work of Al-Toussi on Euclid's axioms. Analysis: The CalculusNewton, Lebnitz, Gauss. The concept of limit: Cauchy, Laplace. An introduction to some famous old open problems.

Recommended Books:
1. Boyer C.B. and Mersbach U.V. The History of Mathematics. 2nd ed. John Wiley, 1989.
2. David M. Burton, The History of Mathematics: An Introduction, 7th Ed. McGraw-Hill, 2010

Course Code: MATH-431
Methods of Optimization-I
Credit Hours: 3+0

Course Contents:
Introduction to optimization and review of related mathematical concepts. unconstrained optimization, conditions for local minimizers, one dimensional search methods, gradient methods, Newton's method (analysis and modifications), conjugate direction methods, Quasi Newton method. application to neural network, Single Neuron Training, Linear integer programming, introduction, Genetic algorithms, Real number genetic algorithm.

Recommended Books:
1. Sundaram R. K. A first course in optimization theory. 3rd ed. Cambridge University Press, 1996.
2. Edwin K. P Chong and Stanislaw H. Zak. An Introduction to Optimization. 4th ed. Wiley Series in Discrete Mathematics and Optimization, , 2012.
3. Singiresu S. Rao. Optimization Theory and Applications. 2nd ed. Wiley Eastern Ltd, 1992.

Course Code: MATH-433
Measure Theory
Credit Hours: 3+0

Course Contents:
Lebesgue measure: introduction, outer measure, measurable sets and Lebesgue measure, a non-measurable set. Measurable functions. Lebesgue integration: the Lebesgue integral of a non-negative function. The general Lebesgue integral; general measure and integration measure spaces, measurable functions, integration, general convergence theorems.

Recommended Books:
1. Roydon H.L. Real Analysis. 1st ed. NY:Collier Macmillan Co, 1986..
2. Barra G. De. Measure Theory and Integration. 1st ed. Ellis, Harwood Ltd, 1981.

3. Philip E.R. An introduction to Analysis and Integration Theory. 1st ed. USA: Intext Educational Publications, 1978.
4. P.R.Halmos, Measure Theory, 1st Ed. Springer, New York. 1975.
5. W.Rudin, Real & Complex Analysis, 3rd Ed. McGraw Hill Book Company, New York, 1987.
6. Bartle R.G, The Elements of Integration and Lebesgue Measure, 1st Ed. Wiley-Interscience. 1995.

Course Code: MATH-435
Theory of Splines-I
Credit Hours: 3+0

Course Contents:
Euclidean Geometry: basic concepts of Euclidean geometry, scalar and vector functions, bar centric coordinates, convex hull, matrices of affine maps, translation, rotation, scaling, reflection and shear. Approximation using Polynomials: curve fitting, least squares line fitting, least squares power fit, data linearization method for exponential functions, nonlinear least-squares method for exponential functions, transformations for data linearization, linear least squares, Polynomial fitting. Interpolation: basic concepts of interpolation, Lagrange's method, error terms and error bounds of Lagrange's method, divided differences method. Newton polynomials, error terms and error bounds of Newton polynomials, central difference interpolation formulae, Gauss's forward interpolation formula, Gauss's backward interpolation formula, Hermite's methods.

Recommended Books:
1. Sudaran R.K. A first course in optimization theory. 3rd ed. CUP, 1996.
2. Chang E.K.P and Zak, S.I.I. An Introduction to Optimization. 3nd ed. Wiley, 2004.
3. Rao S.S. Optimization Theory and Applications. 2nd ed. Wiley Eastern Ltd, 1992.

Title of the Course: Bio-Mathematics
Credit Hours: 3+0
Code: MATH-437
Prerequisites: Basic Biology and Differential Equations
Specific objective of course: The objective of this course is to meet the current and future needs for the interaction between mathematics and biological sciences. Mathematical modeling is being applied in every major discipline in the biomedical sciences. A very different applications, and surprisingly successful, is in psychology, modeling of various human interactions, blood flow and functioning of different organs in human body.

Course Outline:
This course provides an introduction to the use of continuous and discrete differential equations in the biological sciences. Biological topics will include single species and interacting population dynamics, modeling infectious and dynamic diseases, regulation of cell function, molecular interactions, neural and biological oscillators, and an introduction to biological pattern formation. Mathematical tools such as phase portraits, bifurcation diagrams, perturbation theory, and parameter estimation techniques that are necessary to analyze and interpret biological models will also be covered.

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Recommended Books:

1. Murray J. D., *Mathematical Biology*, Springer-Verlag, 2001.
2. Keener J. and Sneyd J., *Mathematical Physiology*. Springer, New York, 1998.
3. Murray J. D., *Nonlinear Differential Equation Models in Biology*. Clarendon Press, Oxford, 1977.

Course Title: Control Theory
Course Code: MATH-439
Credit Hours: 3+0

System dynamics and differential equations, some system equations, System Control, Mathematical methods and differential equations, The classical and modern control theory, Transfer functions and block diagram, Review of Laplace Transforms, Applications to differential equations, Transfer functions and Block diagrams, State space formations, State space forms, using transfer functions to define state variables, direct solution of the state equation, Solutions of the state equation by Laplace transforms, the transformation from companion to the diagonal state form, The transform function from the state equation, Transient and steady state response analysis, Response of first order system, Response of second order system, Response of higher order systems, Steady state error, Feedback control.
Stability: The concept of stability, Routh stability criterion, Introduction to Liapunor's method. Quadratic form, Determination of liapunov's function, the Nyquist stability criterion, the frequency response, An introduction to conformal mapping. Applications of conformal mappings to the frequency response, Controllability and Observability: Controllability, Observability, Decomposition of system state, A transformation into the companion form, Multivariable Feedback and pole location: State feedback of SISO system, Multivariable system observations.

Books Recommended:

1. Burghes D. and Graham A. Introduction to Control Theory including optimal control. Ellis Horwood, 1980.
2. Barnett S. and Camron R.G. Introduction to Mathematical Control Theory (2nd Ed.) Oxford V.P. 1985.

Course Code: MATH-428
Elasticity Theory
Credit Hours: 3+0

Course Contents:

Cartesian tensors, analysis of stress and strain, generalized Hook's law, crystalline structure, point groups of crystals, reduction in the number of elastic moduli due to crystal symmetry; equations of equilibrium, boundary conditions, compatibility equations, plane stress plane strain problems, two dimensional problems in rectangular and polar coordinates, torsion of rods and beams.

Recommended Books:

1. Sokolinikoff. Mathematical Theory of Elasticity. 2nd ed. NY:McGraw Hill, 1956.
2. Dieulesaint E. and Royer D. Elastic Waves in solids. 1st ed. NY: Wiley, 1974..
3. Funk Y. C. Foundations of Solid Mechanics. 1st ed. Prentice – Hall, 1965.

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Course Code: MATH-430
Heat Transfer
Credit Hours: 3+0

Course Contents:
Introduction, Steady-State Conduction-One Dimension, Steady-State Conduction-Multiples Dimensions, Unsteady-State Conduction, Principles of Convection, Empirical and practical Relations or Forced –Convection Heat Transfer, Natural Convection Systems, Radiation Heat Transfer.

Recommended Books:
1. Holman J.P., Heat Transfer. 8th ed. McGraw Hill.
2. Kays W.M. & Crawford, M.E. Convective Heat & Mass Transfer. 3rd ed, 1993. NY: McGraw Hill.
3. Incropera F.P. & Dewitt, D.P. Fundamentals of Heat & Mass Transfer. 2nd ed. NY: Wiley, 1985.

Course Code: MATH-432
Methods of Optimization-II
Credit Hours: 3+0

Course Contents:
Non-linear constrained optimization, Problems with equality constraints, Introduction, Problem Formulation, Tangent and Normal spaces, Lagrange condition, Second-order conditions. Problems with inequality constraints, Karush-Kuhn-Tucker Condition, Second-order conditions. Convex optimization problems, Introduction, convex functions. Algorithms for constrained optimization, Lagrangian algorithms.

Recommended Books:
1. Sundaram R. K. A first course in optimization theory. 3rd ed. Cambridge University Press, 1996.
2. Edwin K. P Chong and Stanislaw H. Zak. An Introduction to Optimization. 4th ed. Wiley Series in Discrete Mathematics and Optimization, , 2012.
3. Singiresu S. Rao. Optimization Theory and Applications. 2nd ed. Wiley Eastern Ltd, 1992.

Course Code: MATH 434
Special Functions
Credit Hours:3+0

Course Contents:
The Gamma function: The Weierstrass gamma function, Euler integral representation of gamma function, relations satisfied by gamma function, Euler's constant, the order symbols o and O, properties of gamma function. Beta function: Definition, integral representation of beta function, relation between gamma and beta functions, properties of beta function, Legendre's duplication formula, Gauss' multiplication theorem. Hypergeometric function : Hypergeometric series, the functions F(a,b;c;z) and F(a,b;c;l), integral representation of hypergeometric function, the hypergeometric differential equation, the contiguous relations, simple transformations, a theorem due to Kummer. Confluent Hypergeometric Function:

Confluent hypergeometric series, integral representation of confluent hypergeometric function, the confluent hypergeometric differential equation, Kummer's first formula. Orthogonal polynomials: Simple sets of polynomials, orthogonality, the three term recurrence relation, the Christofell-Darboux formula, normalization, Bessel's inequality, generating functions, differential equations, recurrence relations.

Recommended Books:

1. Rainville, E.D. Special Functions. 2nd ed. Chelsea Publishing Co, 1971.
2. Lebedev, N.N. Special Functions and their Applications. 2nd ed. Prentice Hall, 1972.
3. Whittaker & Watson. A Course in Modern analysis. 2nd ed. Cambridge, University Press, 1978.

Course Code: MATH-436
Theory of Splines-II
Credit Hours: 3+0

Course Contents:

Parametric curves (scalar and vector case), algebraic form, Hermite form, control point form, Bernstein Bezier form, matrix forms of parametric curves, algorithms to compute B.B. form, convex hull property, affine invariance property, variation diminishing property, rational quadratic form, rational cubic form, tensor product surface, B.B. cubic patch, quadratic by cubic B.B. patch, B.B. quartic patch. Spline Functions: splines, cubic splines, end conditions of cubic splines: clamped conditions, natural conditions, second derivative conditions, periodic conditions, Not a knot conditions, general splines, natural splines, periodic splines, truncated power function, representation of spline in terms of truncated power functions, odd degree interpolating splines.

Recommended Books:

1. Farin G. Curves and Surfaces for Computer Aided Geometric Design A Practical Guide. 5th ed. Academic Press, 2002.
2. Faux I.D. Computational Geometry for Design and Manufacture. 1st ed. Ellis Horwood, 1979.
3. Bartle H.R, Beatly C.J. An Introduction to Spline for use in Computer Graphics and Geometric Modeling. 4th ed. Morgan Kaufmann, 2006..
4. Boor C.D. A Practical Guide to Splines. Revised ed. Springer Verlag, 2001..

Course Title: Theory of Automata
Course Code: MATH-438
Credit Hours: 3+0

Regular expressions and Regular Languages Finite Automata. Context-free Grammars and Context-free languages, Push down automata. Decision Problems. Parsing, Turing Machines.

Recommended Books:

1. Martin, Introduction to Languages and Theory of compution, Mc Graw Hill, 4th Ed. 2010.
2. Cohen. Introduction to Computer theory, Wiley, 2nd Ed. 1996.

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Course Title: Applied Matrix Theory
Course Code: MATH-440
Credit Hours: 3+0

Review of the Theory of Linear System: Eigen values and Eigen vectors, The Jordan canonical forms, Bilinear and quadratic forms, Matrix analysis of differential equations, Variational principles and perturbation theory, the Courant minimax theorem, Weyl's inequalities, Gershgorin's theorem, perturbations of the spectrum, vector norms and related matrix norms, the condition number of a matrix.

Recommended Books:

1. Strang G. Linear Algebra and its Applications, Academic Press, 2005.
2. William G. Linear Algebra with Applications, Allyn and Bacon, Inc., 7th Ed. 2009.
3. Stewart G.W. Introduction to Matrix Computations, Academic Press, INC, New York, 1973.

Note: The other courses will also be offered on the availability of teachers.

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UOS/CE/No. 428
05-2-18

UNIVERSITY OF SARGODHA, SARGODHA

NOTIFICATION

No. UOS/Acad/136 Dated: 02/02/2018

In continuation of this office Notification No. UOS/Acad/ 762 dated 30.08.2017, on the recommendation of Board of Studies and Chairperson, Department of Mathematics, the Vice Chancellor is pleased to include the course "(POL-204) International Relation Since 1945" in the scheme of studies of BS Mathematics program as optional course in lieu of Spanish/French for implementation from Spring Semester-2018 at main Campus/Sub-Campuses/Affiliated Colleges of University of Sargodha. Copy of the same is attached herewith.

2/2/18

(AMJAD HUSSAIN JANJUA)
Deputy Registrar (Acad)

02/02/18

Distribution:

- Chairperson, Department of Mathematics
- The Controller of Examinations
- Directors of Sub-Campuses
- Principal Affiliated Colleges
- Web Developer (for uploading on university web-site)

C.C:

- Dean, Faculty of Sciences
- Secretary to the Vice-Chancellor
- PA to Registrar
- Notification File

DCS

8/2/18

DCES

ACES

3. Socio-political change and Modernization: Major Theories and their Functional Implications;
4. Major Issues of National Identity and Integration: Legitimacy, Role of Bureaucracy and Military Elite, Charismatic Leadership.

RECOMMENDED BOOKS:

1. Arthur Hughes, American Government, 3rd Edition, 1980
2. David Easton, The System Analysis of Political Life, New York, Wilde, Latest edition
3. G.A Almond and J. Coleman, The Politics of Developing Areas, Princeton University Press, Latest edition
4. G.A Almond, Comparative Politics, Princeton University Press, 1966.
5. G.M. Career, Major Foreign Powers, New York, 1972.
6. J.C. Johari, New Comparative Government, New Delhi, Lotus Press, 2006
7. Leonard Binder, Crisis and Sequences in Political Development, Princeton University Press, 1971.
8. Roy C. Macridis, Comparative Politics, London, The Dorsey Press, 1972.
9. Ward and Macridis, Modern Political Systems (Asia), New Jersey, Prentice Hall, 1976.

INTERNATIONAL RELATIONS: SINCE 1945

(POL – 204)

OBJECTIVES:

The course deals with the study of important events in International Relations and provides a survey on different empirical perspectives of International Relations. The main objective is to integrate theory and policy in the context of specific historical cases in international politics.

COURSE CONTENTS:

1. Origin and development of International Relations;
2. International Relations between the two world wars;
3. Origin and causes of World Wars I and II;
4. Developments in International Politics in the Post-World War- II era;
5. Origin and causes of the Cold War;

6. End of Cold War and its implications;
7. Collapse of the Soviet Union and the New World Order;
8. Characteristics of the International Politics after 9/11.
9. Contemporary issues in International Relations:
   a). Terrorism;
   b). Religion and Politics;
   c). Globalization;
   d). Nuclear Proliferation.

RECOMMENDED BOOKS:

1. David W. Clonton, The Two Faces of National Interest, Baton Rouge, Louisiana State University Press 1994.
2. K. J. Holsti, International Politics: A Framework for Analysis, New Jersey, Prentice Hall, 2004.
3. Lea Brilmayer, American Hegemony: Political Morality in a One Super Power, New Heaven, Yale University Press, 2004.
4. Martin Griffiths, Realism, Idealism and International Politics, New York, Routledge, 1995.
5. Montserrat Guibernau, Nationalism: The Nation State and Nationalism in the Twentieth Century, Cambridge, Polity Press, 2003.
6. Paul Kennedy, The Rise and Fall of the Great Powers, New York, Random House, 2001.
7. Peter Beckman, World Politics in the Twentieth Century, New Jersey, Prentice Hall, 2004.
8. Steven L Spiegel, and Fred L. Wehling, World Politics in a New Era, New York, Harcourt Brace College Publishers, 1999.
9. William Keylor and Jerry Bannister (Ed.) Twentieth Century World: An International History, London, Pall-Mall, 2005.

PUBLIC INTERNATIONAL LAW – I

(POL – 205)

OBJECTIVES:

Objective of this course is to generate awareness among the students regarding the nature, evolution, development and application of International Law among the members of the international community