Course Contents BS Mathematics (Spring-2024)

Semester-II (New Scheme of Study)			
Course Code	Course Title	Credit hours	Category
GEN-3201	Arabic/Kashmir Studies/Introduction to History	2(2-0)	General
GEN-3202	Quantitative Reasoning-I	3(3-0)	General
GEN-3203	Expository Writing	3(3-0)	General
MATH-3204	Calculus-II	3(3-0)	Major
MATH-3205	Introduction to Linear Algebra	3(3-0)	Major
PHY-3206	Electricity and Magnetism	3(3-0)	Interdisciplinary
PHY-3207	Physics Lab-II	1(0-1)	Interdisciplinary
Total		*18(17-1)*	

Semester-II

GEN-3201 **Arabic** **Credit Hrs :2(2-0)**

Objectives of the Course	۱۔ طلباء کو عربی زبان کی علوم اسلامیہ میں اہمیت سے آگاہ کرنا
	۲۔ طلباء کو علم صرف اور نحو کے بنیادی قواعد سے آگاہ کرنا تاکہ اسلامی علوم سے کما حقہ استفادہ کیا جا سکے
	۳۔ طلباء کو علم صَرف کے بنیادی اصولوں سے آگاہ کرنا
	۳۔ قرآن مجید سے قواعد عربیہ کی عملی مشق کروانا۔

Week	Lecture No.	قواعد	عملی مشق	
Week 1	Lecture 1	● اسم کی پہچان	● تعوّذ اور سورۃ الفاتحۃ (1-4)	
	Lecture 2	● ھُوَ، ھُمْ، ضمائر منفصلہ	● سورۃ الفاتحۃ (5-7)، تکبیر، ثناء، تسبیحات	
Week 2	Lecture 3	● لِ، مِنْ، عَنْ، مَعَ۔حروف جار	● تشھد، درودِ، دعا	

	Lecture 4	• فعل ماضى: فَعَلَ	• سورة الإخلاص	
Week 3	Lecture 5	• فعل مضارع: يَفْعَلُ	• سورة الفلق	
	Lecture 6	• فعل امر، فاعل، مفعول، فعل	• سورة النّاس	**Quiz # 01**
Week 4	Lecture 7	• نَصَرَ، عَبَدَ	• سورة النصر	**Assignment# 01**
	Lecture 8	• ضَرَبَ، ظَلَمَ، **سَمِعَ، عَلِمَ**	• سورة الكافرون	
		•	•	
Week 5	Lecture 9	• كمزور أفعال: وَهَبَ، وَعَدَ	• سورة البقرة: 1-5	
	Lecture 10	• كمزور أفعال: قَالَ، زَادَ	• سورة البقرة: 6-١٠	
		•	•	
		• **Mid Term**		
Week 6	Lecture 11	• ہمزہ والے أفعال: أَمَرَ	• سورة البقرة:11-13	
	Lecture 12	• يكسان حروف والے أفعال: ظَنَّ، ظَلَّ	• سورة البقرة: 14-١٨	
		•		
Week 7	Lecture 13	• فعل مجهول: نُصِرَ، جُعِلَ	• سورة البقرة: 20-19	
	Lecture 14	• فعل مجهول: وُعِدَ، أُمِرَ	• سورة البقرة: 22-21	
		•	•	
	Lecture 15	• مزيد في: حَاسَبَ	• سورة البقرة:25-23	

Week 8				
	Lecture 16	• مزيد في: أَسْلَمَ، إِخْتَلَفَ	• سورة البقرة: 26-٢٩	
		•		
Week 9	Lecture 17	• مزيد في: إِسْتَغْفَرَ	• سورة البقرة: 30	**Quiz # 02**
	Lecture 18	• مزيد في: تَدَبَّرَ، تَدَارَسَ، إِنْقَلَبَ	• سورة البقرة: 31-٣٥	
		•	•	
Week 10	Lecture 19	• مزيد في: وَلَّى	• سورة البقرة: 36-37	**Assignment# 02**
	Lecture 20	• مزيد في: نَادَى، أَقَامَ	• سورة البقرة: 38-٤٢	
		•	•	
Week 11	Lecture 21	• مزيد في: اِتَّقَى،ٖسْتَقَامَ	• سورة البقرة: 43-46	
	Lecture 22	• مؤنث ضمائر	• سورة البقرة: 47-٥٠	
Week 12	Lecture 23	• مؤنث فعل كا ٹيبل	• سورة البقرة: 51-53	
	Lecture 24	• مؤنث فعل كا ٹيبل، تثنيه (دو ٹيبل	• سورة البقرة: 54.٥٧	
		•	•	
	Lecture 25	• فعل مجهول (مزيد في) عُلِّمَ، أُنْزِلَ	• سورة البقرة: 58-59	

Week 13	Lecture 26	• فعل: كَرُمَ،مَمْ اور فعل مضارع	• سورة البقرة: 60-۶۱	
		•	•	
Week 14	Lecture 27	• لَمْ اور مضارع مزيد في افعال	• سورة البقرة: 62	
	Lecture 28	• لَنْ اور فعل مضارع ,اسم مكان	• سورة البقرة: 63-۶۶	
		•	•	
Week 15	Lecture 29	• اسم مكان	•	
	Lecture 30	• جمع تكسير ، جمله اسميه	• سورة البقرة: 67-۷۰	
		•	•	
Week16	Lecturer 31	• جملہ فعليہ	• سورة البقرة: 71-۷۳	
	Lecturer 32	• مضاف، مضاف اليه، موصوف، صفت	• سورة البقرة: 74	
		•	•	
Week 17		**Terminal Examination**		

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نصابى كتب

نام كتاب	نام مصنف	نمبر شمار
عربى كا معلم (چاروں حصے)	عبدالستار خان	1
تمرين صرف	معين الله ندوى	2
تمرين النحو	محمد مصطفى ندوى	3
معلم الانشاء	مولانا عبدالماجد ندوى	4
مختار النحو	مولانا مختار احمد	5

حوالہ جاتى كتب

نام كتاب	نام مصنف	نمبر شمار
النحو الواضح	على جارم	1
اساس عربى	نعيم الرحمن	2
مبادئ العربية في الصرف و النحو	رشيد الشرطوتى	3

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كتاب النحو	عبدالرحمن امرتسری	4
تمرين النحو	محمد مصطفی ندوی	5
قواعد القرآن	عبدالرحمن طاہر	6
اللغة العربية لغير الناطقين بها	جامعة الملک السعود، رياض	7
قرآنی عربیک	ڈاکٹر ابراہیم سورتی	8

OR

GEN-3201   **Kashmir Studies**   **Credit Hours: 2**

Objectives: To impart the knowledge about the multicultural historical legacy, religious and cultural heritage.

Course Contents:

Unit I: Geographic and Administrative Profile of divided State of Jammu & Kashmir

a. Geographic and Administrative Profile of Azad Jammu & Kashmir and Gilgit Baltistan.
b. Geographic and Administrative Profile of Indian Occupied Jammu and Kashmir.

 c. Geographic and Administrative Profile of Indian Occupied Jammu and Kashmir,

d. Current Political Status of divided regions of disputed state of Jammu and Kashmir,

Unit II: Sources of Kashmir History:

a. Famous ancient and Medieval historians

b. Famous books on ancient and Medieval history of Kashmir Ancient

Unit III: Ruling Dynasties in Kashmir

   a. Earlier inhabitants and Introduction to ancient ruling dynasties up to 1320 (selective Famous Ancient Rulers)

   b. Introduction to ancient Religions of Kashmir,

   c. Rise and fall of Buddhism in Kashmir

   d. Causes for decline of Hindu Rule in Kashmir

Unit IV: Muslim Rule in Kashmir

   a. Advent of Islam in Kashmir

   b. First Muslim Rule in Kashmir (1320-23)

 Unit V: Shah Miri Dynasty

   a) Rise of Muslims in Kashmir

   b) Shahmir and his successors

   c) Zainul-ul-Abidin

      a) Successors of Zainulabidin

b) Rule and development of Kashmir

Unit VI: Development of Art and Culture during Shahmiri dynasty

    a- Development of Art and Culture during Shahmiri dynasty
    b- Development of Industries
    c- Causes for the decline of Shahmiri dynasty

Unit VII: Role of Sufi Saints for spread of Islam in Kashmir

a. Role of Shah Hamdan for spread of Islam in Kashmir

b. Role of Shah other Saints for spread of Islam in Kashmir

c. Development of Islamic Culture in Kashmir and role of Sufi Saints

Unit VIII: Chak Rule in Kashmir

    a- Causes for decline of Chak Rule in Kashmir and Mughals' occupation of Kashmir
    b- Ruling Era of Mughals and governing methods
    c- Condition of Kashmir during Mughal Era
    d- Causes for decline of Mughal Rule in Kashmir

Unit IX : Kashmir under Afghans

a) Ruling Era of Afghans and governing methods
b) Condition of Kashmir during Mughal Era
c) Causes for decline of Afghan Rule in Kashmir

Unit X: Occupation of Kashmir by Sikhs

a. Ruling Era of Sikhs and governing methods

b. Condition of Kashmiris during Sikh Rule

c. Rise of Dogras' Treaty of Lahore and Treaty of Amritsar

Unit XI: Kashmir under Dogra rule in Kashmir

a. Successors of Gulab Singh in Kashmir

b. Condition of Kashmiris during Dogra Rule, Muslim Subjects of Kashmir and Dogra rulers and Resistance movements in Kashmir during Dogra Rule

Unit XII: Jammu and Kashmir in after 1947

a. Indian occupation

b. Kashmir issue: genesis

c. Kashmir issue in the United Nations

d. Human rights violations in Indian Occupied Kashmir

Unit XIII: Economic Resources of Jammu and Kashmir Cultural Heritages of Kashmir

Unit XIV: Languages Spoken in Kashmir

Recommended Books:

1. Kalhana Pandit.(1991),Rajatarangint, Mirpur Verinag Publishers AJ& K

2. GMD Sufi (1962), Kashir, Lahore: University of Punjab

3. Somnath Dhar. Jammu & Kashmir. India: National Book Trust, 2013.

4. Ram Chandra Kak. Ancient Monuments in Kashmir. London: 1993.

5. Dr. S.C. Ray Early History and Cultural of Kashmir. New Dehli: 1969.

6. Dr. A.N. Rania. Geography & Jammu & Kashmir. New Dehli 1972.

7. Walter Lawrence. The Valley of Kashmir. London 1895.

8. G.M Rabani. Kashmir Social and Cultural History: Srinagar Gulshan Books 2007.

9. Muhammad Yusuf Saraf, Kashmiris Fight for Freedom.

OR

GEN-3201   **Introduction to History**   **Credit Hours: 2**

Course Objectives:

The purpose of this course is:

- To make students aware of the nature of historical knowledge and research.

- To introduce to the students, the basic concepts and controversies related to historical understanding.

Course Content:

Unit I: What is History?

Literal, terminological and conceptual meaning of history

History as Fact

History as Process

History as Narrative

Unit II: Memory, Record and History

Unit III: Nature of History:

Being and Becoming;

Continuity and Change; Evolution, Progress and Development Macrocosm & Microcosm: Time, Space, Causation, Facts and opinion/ objectivity & Subjectivity

Unit IV: Utility, Benefits & importance of History:

History as a corrective/cohesive force;

History as a repetitive force

Continuity of History from Past to Future

Lessons from Past

Historical determinism, etc.

History as Mother of All Sciences/Knowledge

Unit V: Epistemological nature of History:

Relationship of History with other forms of knowledge:

Natural Sciences

Social Sciences

Literature and Arts

Unit VI: Forms and Classification of History

Suggested Readings:

1. Burke, Varieties of Cultural History, Cornell University Press, 1977

2. Carlo, Ginzburg. Clues. Myths, and the Historical Method, John Hopkins: University Press, 1992

3. Carr, E. H., What is History? Harmondsworth: Penguin, 1961

4. Cohn, Bernard. An Anthropologist among Historians and Other Essay, Oxford University Press, 1988

5. Collingwood, R. G. The Idea of History. Oxford: Oxford University Press, 1978.

6. Daniels, Studying History: How and Why, New Jersey, 1981.

7. Gertrude Himmalfarb. The New History and the Old, Cambridge: Harvard University Press, 1987

8. Govranski. History Meaning and Methods, USA, 1969

9. Hegel. Elements of the Philosophy of Right. Cambridge University Press, 1991

10. Qadir, Khurram, Tarikh Nigari Nazriyat-o-Irtiqa, Lahore: Palgrave, 1994.

11. Qureshi, Muhammad Aslam. A Study of Historiography. Lahore: Pakistan Book Centre, Latest Edition.

12. Steedman. Caroline, Dust: The Archive and Cultural History, Manchester University Press, 2002

13. Stern Fritz, Varieties of History: from Voltaire to the Present, Vintage, 2nd Edition 1975

14. Tahir Kamran, The Idea of History Through Ages, Lahore: Progressive Publisher, 1993

15. Lemon, M. C., Philosophy of History, London: Routledge, 2003

16. Marwick, Arthur, The New Nature of History, London, 1989, pp.31-35.

17. Roberts, Geoffrey, ed., History and Narrative Reader, London: Routledge, 2001.

18. Shafique, Muhammad, British Historiography of South Asia: Aspects of Early Imperial Patterns and Perceptions, Islamabad, NIHCR, Quaid-i-Azam University, 2016

GEN-3202　　　　　Quantitative Reasoning-I　　　　Credit Hrs. 3(3-0)

Course Objectives:

Introduction, understanding of the basic mathematical and statistical tools, and real-life applications of quantitative reasoning.

Course Outlines:

Numerical Literacy: Number system and basic arithmetic operations; Units and their conversions, dimensions, area, perimeter and volume; Rates, ratios, proportions and percentages; Types and sources of data; Measurement scales; Tabular and graphical presentation of data; Quantitative reasoning exercises using number knowledge. **Fundamental Mathematical Concepts:** Basics of geometry (lines, angles, circles, polygons etc.); Sets and their operations; Relations, functions, and their graphs; Exponents, factoring and simplifying algebraic expressions; Algebraic and graphical solutions of linear and quadratic equations and inequalities; Quantitative reasoning exercises using fundamental mathematical concepts. **Fundamental Statistical Concepts:** Population and sample; Measures of central tendency, dispersion and data interpretation; Rules of counting (multiplicative, permutation and combination); Basic probability theory; Introduction to random variables and their probability distributions; Quantitative reasoning exercises using fundamental statistical concepts.

Recommended Books:

1. Quantitative Reasoning: Tools for Today's Informed Citizen by Bernard L. Madison, Lynn and Arthur Steen.

2. Quantitative Reasoning for the Information Age by Bernard L. Madison and David M. Bressoud.

3. Fundamentals of Mathematics by Wade Ellis.

4. Quantitative Reasoning: Thinking in Numbers by Eric Zaslow.

5. Thinking Clearly with Data: A Guide to Quantitative Reasoning and Analysis by Ethan Bueno de Mesquita and Anthony Fowler.

6. Using and Understanding Mathematics: A Quantitative Reasoning Approach by Bennett, J. O., Briggs, W. L., & Badalamenti, A.

7. Discrete Mathematics and its Applications by Kenneth H. Rosen.

8. Statistics for Technology: A Course in Applied Statistics by Chatfield, C.

9. Statistics: Unlocking the Power of Data by Robin H. Lock, Patti Frazer Lock, Kari Lock Morgan, and Eric F. Lock.

GEN-3203	Expository Writing	Credit Hrs. 3(3-0)

Course Objectives: The course is developed with the aim to enable the students to meet their real life communication needs by

- Helping them learn and understand basic concepts of communication process
- Practically implementing theoretical aspects in the real life situations

Course Contents:

What is Communication?

▪ Process of communication, effective steps of communication, basic communication skills

Paragraph Writing;

▪ Practice in writing a good, unified and coherent paragraphs

▪ Paragraph writing leading towards the writing of five to seven paragraphs long essay

▪ Stages of writing (brain storming, researching, drafting and editing)

▪ Methods of writing (cause and effect, problem solutions, comparison and contrast)

Essay Writing;

▪ Basic structure of essay, topic sentence, supporting sentence, concluding sentence, thesis statement

▪ Unity and Coherence, Introduction and Conclusion

CV and Job Application;

▪ Preparing a Curriculum Vitae

▪ Writing a formal job application

Translation Skills;

▪ Urdu to English

(Practice at advanced level)

Study Skills;

▪ Skimming and scanning, intensive, extensive and speed reading

▪ Summary and precis writing

- Comprehension (at advanced level)
- (sQ3R and Sq4r methods)

Academic Writing;

- Letter/ Memo writing, Minutes of Meeting, use of Dictionary, Library and Internet

Presentation Skills;

- Personality development (emphasis on content, style and pronunciation)
- Preparation stage, audience analysis, handling and asking questions, managing time, handling non-verbal means, feedback

Academic Writing;

- How to write a research proposal for research paper/term paper?
- How to write a research paper/ term paper?
- (Emphasis on style, content, language, form, clarity , consistency)

Report Writing;

- Technical Report writing
- Progress report writing
- Preparation and planning

E-mail writing;

- Creating e-mail account
- Writing and sending e-mails

Preparing for Interview and Research proposal/ research paper defense

Note: Documentaries to be shown for discussion and review

Recommended Books:

Communication Skills

a)   Grammar

1.   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-Christine Boutin, 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).

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

3. Study Skills by Richard York.

d) Speaking

4. Ellen, K. 2002. Maximize Your Presentation Skills: How to Speak, Look and Act on Your Way to the Top

5. Hargie, O. (ed.) Hand book of Communications Skills

6. Mandel, S. 2000. Effective Presentation Skills: A Practical Guide Better Speaking

7. Mark, P. 1996. Presenting in English. Language Teaching Publications

MATH-3204   Calculus-II   Credit Hrs. 3(3-0)

Course Objective:

This course extends the study of calculus to multivariable functions, including partial differentiation, multiple integration, and vector calculus.

Course Contents:

An Overview of the Area Problem, The Indefinite Integral, Integration by Substitution, The Definition of Area as a Limit, Sigma Notation, The Definite Integral, The Fundamental Theorem of Calculus, Rectilinear Motion Revisited Using Integration, Average Value of a Function and its Applications, Evaluating Definite Integrals by Substitution, Logarithmic and Other Functions Defined by Integrals, Area Between Two Curves, Length of a Plane Curve, Area of a Surface of

Revolution, An Overview of Integration Methods, Integration by Parts, Integrating Trigonometric Functions, Trigonometric Substitutions, Integrating Rational Functions by Partial Fractions.

Recommended books:

1. Calculus: Early Transcendentals" by Howard Anton, Irl Bivens and Stephen Davis
2. Calculus: Concepts and Contexts" by James Stewart
3. Calculus Volume 2" by Edwin Herman and Gilbert Strang

MATH-3205   Introduction to Linear Algebra   Credit Hr. 3(3-0)

Course Objective:

Basic understanding of matrices, vector space, and linear transformations.

Course Contents:

Vectors and Linear Combinations, Lengths and Dot Products, Matrices, Vectors and Linear Equations, The Idea of Elimination, Elimination Using Matrices, Rules for Matrix Operations, Inverse Matrices, Elimination, Transposes and Permutations, Spaces of Vectors, The Null space, The Rank and the Row Reduced Form, The Complete Solution to $Ax = b$, Independence, Basis and Dimension, Dimensions of the Subspaces, Orthogonality of the Subspaces, Projections, Orthogonal Bases and Gram-Schmidt, The Properties of Determinants, Permutations and Cofactors, Cramer's Rule, Inverses, and Volumes, Introduction to Eigenvalues, Diagonalizing a Matrix, Symmetric Matrices, Positive Definite Matrices, Similar Matrices, Singular Value Decomposition, The Idea of a Linear Transformation, The Matrix of a Linear Transformation.

Recommended Books:

1. Introduction to Linear Algebra" by Gilbert Strang, 5th Edition
2. Linear Algebra for Everyone" by Gilbert Strang, September 2020
3. Linear Algebra and Learning from Data" by Gilbert Strang, 2019

PHY-3206   Electricity and Magnetism   Credit Hrs. 3(3-0)

Course Objectives

1. To give the concept of the electric field, electrical potential, and dielectrics
2. To understand the DC circuits
3. To know the effect of magnetic field and basic magnetic properties of materials

Course Contents:

Electric Field:

Coulomb's law, Field due to a point charge: due to several point charges. Electric dipole. Electric field of continuous charge distribution e.g. Ring of charge, disc of charge, an infinite line of charge. Point charge in an electric field. Dipole in an electric field, Torque and energy of a dipole in a uniform field. Electric flux: Gauss's law; (Integral and differential forms) and its application. Charge in isolated conductors, conductor with a cavity, field near a charged conducting

Electric Potential:

Potential due to point charge, potential due to collection of point charges, potential due to dipole. The electric potential of continuous charge distribution. Field as the gradient or derivative of potential. Potential and field inside and outside an isolated conductor.

Capacitors and dielectrics:

Capacitance, calculating the electric field in acapacitor. Capacitors of various shapes, cylindrical, spherical etc. and calculation of their capacitance. Energy stored in an electric field. Energy per unit volume. Capacitor with Dietetic, Electric field of dielectric. An atomic view. Application of Gauss's Law to capacitor with dielectric.

Magnetic Field Effects and Magnetic Properties of Matter:

Magnetic force on a charged particle, magnetic force on a current, Recall the previous results. Do not derive. Torque on a current loop. Magnetic dipole: Energy of magnetic dipole in the field, Lorentz Force, Biot-Savart Law: Analytical treatment and applications to a current loop, force on two parallel current changing conductors. Ampere's Law, Integral and differential forms, applications to solenoids and toroids. (Integral form).

Inductance:

Faraday's Law of Electromagnetic Induction, Review of emf, Faraday Law and Lenz's Law, Induced electric fields, Calculation and application using differential and integral form, Inductance, "Basic definition". Inductance of a Solenoid; Toroid.

Alternating Current Circuits:

Alternating current, AC current in resistive, inductive, and capacitative elements. Single loop RLC circuit, Series and parallel circuits, Analytical expression for time-dependent solution. Graphical analysis, phase angles, Power in A.C circuits: phase angles, RMS values, power factor.

Recommended Books:

1. F. J. Keller, W. E. Gettys, M. J. Skove *Physics Classical and Modern (2nd edition)*, McGraw-Hill, Inc., 1993.
2. A. F. Kip Fundamentals of Electricity and Magnetism (2nd Ed.), McGraw-Hill Book Co., 1969.
3. D. Halliday, R. Resnick, K. S. Krane Physics (Vol-II), John Willey & Sons, Inc., 1992.
4. D. N. Vasudeva Magnetism and Electricity, S. Chand & Co., 1959.

5. J. A. Edminister Schaum's Outline Series; Theory and Problems of Electromagnetism, McGraw-Hill Book Co., 1986.

| PHY-3207 | Physics Lab-II | Credit Hrs. 1(0-1) |

Course Objectives

To develop the understanding of students in measuring the thermal and optical parameters and to remove the fear of students using various gadgets in the laboratory.

List of experiments:

1. To determine the frequency of A.C supply by Melde's experiment.
2. To determine the frequency of A.C. supply by electric sonometer
3. To study the combinations of harmonic motion (Lissajous figures).
4. To study the parameters of waves (Beats phenomenon).
5. To determine the frequency of AC supply by CRO
6. The determination of the wavelength of Sodium -D lines by Newton's Ring.
7. Determination of wavelength of sodium light by Fresnel's bi-prism.
8. The determination of the resolving power of a diffraction grating.
9. Study of the parameter of wave i.e. amplitude, phase, and time period of a complex signal by CRO.
10. Specific rotation of cane-sugar solution with Laurent's half-shade polarimeter

Recommended Books:

1. D. H. Marrow, Selected Experiments in Physical Sciences, Longman.

2. Nelkon and Ogborn, Advanced Level Practical Physics, Heimann Educational Books

3. Nolan and Bigliani, Experiments in Physics, Surjeet Pub Ind.

4. C. K. Bhattacharya, University Practical Physics, CBS Publishing

Semester-II (Old Scheme of Study)

Course Code	Course title	Credit hours
MAT-3201	Plane Curves and Analytical Geometry	3(3-0)
MAT-3202	Introduction to Dynamics	3(3-0)
PHY-3203	Physics-II	4(3-1)
ENG-3204	English-II	3(3-0)

ARB-3205	Introduction to Arabic	3(3-0)
SOC-3206	Introduction to Sociology	3(3-0)
	Total	**19**(18-1)

Semester-IV

Course Code	Course Title	Credit hours
MAT-4401	Discrete Structures	3(3-0)
MAT-4402	Numerical Analysis-I	3(3-0)
MAT-4403	Number Theory	3(3-0)
MAT-4404	Classical Mechanics	3(3-0)
PHY-4405	Modern Physics & Electronics	4(3-1)
MAT-4406	Mathematical Computation	3(2-1)
PST-4407	Pakistan Studies	2(2-0)
	Total	**21(19-2)**

Semester-VI

Course Code	Course Title	Credit hours
MAT-5201	Real Analysis-II	3(3-0)
MAT-5202	Complex Analysis	3(3-0)
MAT-5203	Algebra-II	3(3-0)
MAT-5204	Functional Analysis-I	3(3-0)
MAT-5205	Ring Theory	3(3-0)
	Total	**15**

Semester-VIII

Note: Any five courses or three courses and thesis from the following elective courses.

Course Code	Course Title	Credit hours
MAT-6401	Numerical Analysis-II	3(3-0)
MAT-6402	Differential Geometry-II	3(3-0)
MAT-6403	Mathematical Physics	3(3-0)
MAT-6404	Fluid Mechanics-II	3(3-0)
MAT-6405	Quantum Mechanics	3(3-0)
MAT-6406	Integral Equations	3(3-0)

MAT-6407	An Introduction to Convex Analysis	3(3-0)
MAT-6408	Calculus of Variation and Optimal Control	3(3-0)
MAT-6409	Dynamical Systems	3(3-0)
MAT-6410	Computer Language C/C^{++}	3(2-1)
MAT-6411	Electromagnetism	3(3-0)
MAT-6412	Special Theory of Relativity	3(3-0)
MAT-6413	Topology-II	3(3-0)
MAT-6414	Theory of Elasticity	3(3-0)
MAT-6415	Decomposition of Modules	3(3-0)
MAT-6416	Thesis	6(6-0)
	Total	**15**

Courses for Semester-II

MAT-3201 **Plane Curves and Analytical Geometry** **3(3-0)**
 Prerequisite(s): Calculus- I
 Specific Objectives of the Course:
Upon successful completion, the student will demonstrate proficiency and understanding in the following topics: Plane analytic geometry; applications of integration; and analytic geometry of three dimensions.
Course Outline:
Conic section and quadratic equations; Classification of conic section by eccentricity; Translation and rotation of axis; Properties of circle, parabola, ellipse and hyperbola; Polar coordinates; Conic sections in polar coordinates; Graphing in polar coordinates; Tangents and normal, pedal equations, parametric representations of curves; Asymptotes; Relative extrema, points of inflection and concavity; Singular points, tangents at the origin; Graphing of Cartesian and polar curves; Area under the curve, area between two curves; Arc length and intrinsic equations; Curvature, radius and center of curvature; Involute, evolute and envelope; Rectangular coordinates system in a space; Cylindrical and spherical coordinate system; Direction ratios and direction cosines of a line; Equation of straight lines and planes in three dimensions; Shortest distance between skew lines; Equation of sphere, cylinder, cone, ellipsoids, paraboloids, hyperboloids; Quadric and ruled surfaces; Spherical trigonometry; Direction of Qibla.
Recommended Books:
[1] Anton H, Bevens I, Davis S, Calculus: A New Horizon (8th edition), 2005, John Wiley, New York.
[2] Stewart J, Calculus (3rd edition), 1995, Brooks/Cole.
[3] Thomas GB, Finney AR, Calculus (11th edition), 2005, Addison-Wesley, USA.
[4] Edward CH, Penney ED, Calculus and Analytics Geometry, 1988, Prentice Hall.
[5] Swokowski EW, Calculus and Analytic Geometry, 1983, PWS Publishers, Boston.

MAT-3202   **Introduction to Dynamics**   **3(3-0)**
 Prerequisite(s): Introduction to Vector Analysis and Statics
 Specific Objectives of the Course:
Upon successful completion, the student will demonstrate proficiency and understanding in the following topics: Kinematics; Kinetics; Simple Harmonic Motions; Central Forces and planetary Motions; and Centre of Mass and Gravity.

Course Outline:
Rectilinear motion of particles, Uniform rectilinear motion, Uniformly accelerated rectilinear motion, Curvilinear motion of particle, Rectangular components of velocity and acceleration, Tangential and normal components, Radial and transverse components, Projectile motion, Work, Power, Kinetic energy, Conservative force fields, Conservation of energy, impulse, torque, Conservation of linear and angular momentum, Non-conservative forces, Simple harmonic oscillator, Amplitude, Period, Frequency, Resonance and Energy, The damped harmonic oscillator, Over damped, Critically damped and Under damped motion, Central forces and Planetary motions, Central force fields, Equations of motion, Potential energy, Orbits, Kepler's laws of planetary motion, Centre of mass and gravity, Discrete and continuous systems, Density of rigid and elastic bodies, Centroid, Discrete and continuous systems, Solid region, Region bounded by planes, Semi-circular regions, Sphere, Hemisphere, Cylinder and Cone.

Recommended Books:
[1] Fowles GR, Cassiday GL, Analytical Mechanics, 2005, Thomson Brook Cole.
[2] Jafferson B, Beasdsworth T, Further Mechanics, 2001, Oxford University Press.
[3] Murray R Spiegel, Theoretical Mechanics, 1967, Schaum's Outline Series, McGraw Hill Book Company.
[4] Anand DK, Cunnif PF, Statics and Dynamics, 1984, Allyn and Becon, Inc.
[5] Ferdinand PB, Johnston ER, Statics and Dynamics, 1977, Mc-Graw Hill Book Company.

PHY-3203:   Physics-II   Credit Hrs: 3(3-0)

Objective:
1. To understand the basics of waves, mechanism of wave production, propagation and interaction with other waves.
2. Use of basic concept of waves in their application in daily life.

Course outlines:
Harmonic Oscillations:
Simple harmonic motion (SHM), Obtaining and solving the basic equations of motion x(t), v(t), a(t), Longitudinal and transverse Oscillations, Energy considerations in SHM. Application of SHM, Torsional oscillator, Physical pendulum, simple pendulum, SHM and uniform circular motion, Combinations of harmonic motions, Lissajous patterns, Damped harmonic motion, Equation of damped harmonic motion, Quality factor, discussion of its solution, Forced oscillations and resonances, Equation of forced oscillation, Discussion of its solution, Natural frequency, Resonance, Examples of resonance.

Waves in Physical Media:
Mechanical waves, Travelling waves, Phase velocity of traveling waves, Sinusoidal waves, Group speed and dispersion, Waves speed, Mechanical analysis, Wave equation, Discussion of solution, Power and intensity in wave motion, Derivation & discussion, Principle of superposition (basic ideas), Interference of waves, Standing waves. Phase changes on reflection.

Sound:
Beats Phenomenon, Analytical treatment.

Coupled Oscillators and Normal modes:
Two coupled pendulums, General methods of finding normal modes, Beats in coupled oscillations, Two coupled masses, Two coupled LC circuits, Energy relations in coupled oscillations, Forced oscillations of two coupled oscillators, Many coupled oscillator.
Normal Modes of Continuous systems:
Transverse vibration of a string, Longitudinal vibrations of a rod, Vibrations of air columns, Normal modes, Fourier methods of analyzing general motion of a continuous system, Atomic vibrations.
Recommended Books:

1. Halliday, D. Resnick, Krane, Physics, Vol. I & II, John Wiley, 5th ed. 1999.
2. N.K. Bajaj, The Physics of Waves & Oscillations, Tata McGraw-Hill Publishing company Limited, 1986.

3. H. J. Pain, The Physics of Vibrations and Waves, 5th Edition 1999.

PHY-3203:   Lab   Credit Hrs: 1(0-1)

Objectives
To develop the understanding of students in measuring the thermal and optical parameters and to remove the fear of students to use various gadgets in laboratory
List of experiments:

1. To determine the frequency of A.C supply by Melde's experiment.
2. To determine the frequency of A.C. supply by electric sonometer
3. To study the combinations of harmonic motion (Lissajous figures).
4. 11. To study the parameters of waves (Beats phenomenon).
5. To determine frequency of AC supply by CRO
6. The determination of wavelength of Sodium –D lines by Newton's Ring.
7. Determination of wavelength of sodium light by Fresnel's bi-prism.
8. The determination of resolving power of a diffraction grating.
9. Study of the parameter of wave i.e. amplitude, phase and time period of a complex signal   by CRO.
10. Specific rotation of cane – sugar solution with Laurent's half shade polarimeter

Recommended Books:
1. D. H. Marrow, Selected Experiments in Physical Sciences, Longman.
2. Nelkon and Ogborn, Advanced Level Practical Physics, Heimann Educational Books
3. Nolan and Bigliani, Experiments in Physics, Surjeet Pub Ind.
4. C. K. Bhattacharya, University Practical Physics, CBS Publishing

ENG-3204   English-II (Scientific Writing & Communication Skill)   3(3-0)
 Objectives: Enable the students to meet their real life communication needs.

 Course Contents:

 Paragraph writing:

        Practice in writing a good, unified and coherent paragraph

 Essay writing:

Introduction

CV and job application:

Translation skills, Urdu to English

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

Presentation skills:

Personality development (emphasis on content, style and pronunciation)

Note: documentaries to be shown for discussion and review

Recommended books:

1. Practical English Grammar by A.J. Thomson and A.V. Martinet. Exercises 2.Third Edition. Oxford University Press 1986. ISBN 0 19 431350 6.

2. Writing. Intermediate by Marie-Chrisitine Boutin, Suzanne Brinand and Francoise Grellet. Oxford Supplementary Skills. Fourth Impression 1993. ISBN 019 435405 Pages 45-53 (note taking). 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. Advancedd. Brian Tomlinson and Rod Ellis. Oxford Supplementary Skills.
4. Reading and Study Skills by John Langan
5. Study Skills by Riachard Yorky.

Introduction to Arabic   ARB-3205   3(3-0)

یونیورسٹی آف پونچھ راولاکوٹ، آزاد کشمیر

۱۔ اجزائے کلام، اسم، فعل، حرف، وضاحت اور مثالیں

۲۔ ضمائر متصل و منفصل میں فرق، ضمیر متصل کی وضاحت

۳۔ مرکبات کی تعریف، مرکب اضافی وضاحت

۴۔ مرکب توصیفی بالتفصیل نیز مرکب اضافی و توصیفی کا فرق

۵۔ ضمائر مفصلہ بالتفصیل بیان، ضمیر متصل و منفصل کا فرق

۶۔ حروف جر، ضمائر و حروف جر مماثلت و امتیاز

۷۔ وحدت۔ تثنیہ و جمع، منفرد و مرکب جملوں انکا استعمال

۸۔ جملہ و مرکب کا فرق

۹۔ جملہ اسمیہ و جملہ فعلیہ کی وضاحت اور دونوں میں فرق

۱۰۔ فعل ماضی بالتفصیل

۱۱۔ فعل مضارع بالتفصیل نیز ماضی و مضارع کا فرق

Recommended Book:

Noman Muhammad, Al-Lisaan-al-Arabi, Allama Iqbal Open University,

Islamabad.

SOC-3206   **Introduction to Sociology**   **3(3-0)**

Prerequisite(s): NA

Specific Objectives of the Course:

The course is designed to introduce the students with sociological concepts and the discipline. The focus of the course shall be on significant concepts like social systems and structures, socio-economic changes and social processes. The course will provide due foundation for further studies in the field of sociology.

Course Outline: Introduction: Definition, Scope, and Subject Matter, Sociology as a Science, Historical back ground of Sociology. Basic Concepts: Group, Community, Society, Associations, Non-Voluntary, Voluntary, Organization, Informal, Formal, Social Interaction, Levels of Social Interaction, Process of Social Interaction, Cooperation, Competition, Conflict, Accommodation, Acculturation and diffusion, Assimilation, Amalgamation. Social Groups: Definition & Functions, Types of social groups, In and out groups, Primary and Secondary group, Reference groups, Informal and Formal groups, Pressure groups. Culture: Definition, aspects and characteristics of Culture, Material and non-material culture, Ideal and real culture, Elements of culture, Beliefs,Values, Norms and social sanctions, Organizations of culture, Traits, Complexes, Patterns, Ethos, Theme, Other related concepts, Cultural Relativism, Sub Cultures, Ethnocentrism and Xenocentrism, Cultural lag. Socialization & Personality: Personality, Factors in Personality Formation, Socialization, Agencies of Socialization, Role & Status. Deviance and Social Control: Deviance and its types, Social control and its need, Forms of Social control, Methods & Agencies of Social control. Collective Behavior: Collective behavior, its types, Crowd behavior, Public opinion, Propaganda, Social movements, Leadership.

Recommended Books:

1. Anderson, Margaret and Howard F. Taylor. 2001. *Sociology the Essentials*. Australia: Wadsworth.
2. Brown, Ken 2004. *Sociology*. UK: Polity Press
3. Gidden, Anthony 2002. *Introduction to Sociology*. UK: Polity Press.
4. Macionis, John J. 2006. 10th Edition *Sociology* New Jersey: Prentice-Hall
5. Tischler, Henry L. 2002. *Introduction to Sociology* 7th ed. New York: The Harcourt Press.
6. Frank N Magill. 2003. *International Encyclopedia of Sociology*. U.S.A: Fitzroy Dearborn Publishers
7. Macionis, John J. 2005. *Sociology* 10th ed. South Asia: Pearson Education
8. Kerbo, Harold R. 1989. *Sociology: Social Structure and Social Conflict.* New York: Macmillan Publishing Company.
9. Koening Samuel. 1957. *Sociology: An Introduction to the Science of Society*. New York: Barnes and Nobel..
10. Lee, Alfred Mclung and Lee, Elizabeth Briant 1961. *Marriage and The family.* New York: Barnes and Noble, Inc.
11. Leslie, Gerald et al. 1973. *Order and Change: Introductory Sociology* Toronto: Oxford University Press.
12. Lenski, Gevbard and Lenski, Jeam. 1982. *Human Societies*. 4th edition New York: McGraw-Hill Book Company.
13. James M. Henslin. 2004. *Sociology: A Down to Earth Approach*. Toronto: Allen and Bacon.

MAT-4401   **Discrete Structures**   **3(3-0)**

  Prerequisite(s): Mathematics at intermediate level

Specific Objectives of the Course:

This course shall assume background in number theory. It lays a strong emphasis on understanding and utilizing various strategies for composing mathematical proofs.

Course Outline:

Set and Relations: Basic notions, set operations, Venn diagrams, extended-set operations, indexed family of sets, countable and uncountable sets, relations, cardinality, equivalence relations, congruence, partitions, partial order, representation of relations, mathematical induction.

Elementary Logic: Logics of order zero and one, Propositions and connectives, truth tables, conditionals and biconditionals, quantifiers, methods of proof, proofs involving quantifiers.

Recommended Books:

[1] Rosen KH, Discrete Mathematics and its Applications, 1999, McGraw Hill, New York.

[2] Ross KA, Wright CRB, *Discrete Mathematics*, 2003, Prentice Hall, Englewood Cliffs, NJ, USA.

MAT-4402   **Numerical Analysis-I**   **3(3-0)**

  Prerequisite(s): Linear Algebra, Calculus-II

Specific 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 Outline:

Computer arithmetic, approximations and errors; methods for the solution of nonlinear equations and their convergence: bisection method, regula falsi method, fixed point iteration method, Newton-Raphson method, secant method; error analysis for iterative methods. Interpolation and polynomial approximation: Lagrange interpolation, Newton's divided difference, forward-difference and backward-difference formulae, Hermite inter-polation. Numerical integration and error estimates: rectangular rule, trapezoidal rule, Simpson's one-three and three-eight rules. Numerical solution of systems of algebraic linear equations: Gauss-elimination method, Gauss-Jordan method; matrix inversion; LU-factorization; Doolittle's, Crount's, Cholesky's methods; Gauss-Seidel and Jacobi methods.

Recommended Books:

[1] Atkinson KE, An Introduction to Numerical Analysis (2nd edition), 1989, John Wiley, New York (suggested text).

[2] Burden RL, Faires JD, *Numerical Analysis* (5th edition), 1993, PWS Publishing Company.

[3] Chapra SC, Canale RP, *Numerical Methods for Engineers*, 1988, McGraw Hill, New York.

MAT-4403   **Number Theory**   **3(3-0)**

  Prerequisite(s): Calculus- I

Specific Objectives of the Course:

This course shall assume no experience or background in number theory or theoretical mathematics. The course introduces various strategies for composing mathematical proofs.

Course Outline:

Divisibility, Euclidean algorithm, GCD and LCM of 2 integers, properties of prime numbers, fundamental theorem of arithmetic (UFT), congruence relation, residue system, Euler's phi-function, solution of system of linear congruences, congruences of higher degree, Chinese remainder theorem, Fermat's little theorem, Wilson's theorem and applications, primitive roots and indices; integers belonging to a given exponent (mod p), primitive roots of prime and composite moduli, indices, solutions of congruences using indices., quadratic residues, composite moduli, quadratic residues of primes, the Legendre symbol, the Quadratic reciprocity law, the Jacobi symbol, Diophantine equations.

Recommended Books:

[1] Burton DM, Elementary Number Theory, Allyn and Bacon Grosswald E, Topics from the Theory of Numbers, The Macmillan Company.
[2] LeVeque WJ, Topics in Number Theory, Vol.1, Addison-Wesley, Reading, Ma, USA.
[3] Niven I, Zuckerman HS, An Introduction to The Theory of Numbers, Wiley Eastern.
[4] Rosen KH, Elementary Number Theory and its Applications (4th edition), 2000, Addison-Wesley, Reading, Ma, USA (suggested text).

MAT-4404   **Classical Mechanics**   **3(3-0)**

Prerequisite(s): Vector Analysis

Specific Objectives of the Course:

This course builds grounding in principles of classical mechanics, which are to be used while studying quantum mechanics, statistical mechanics, electromagnetism, fluid dynamics, space-flight dynamics, astrodynamics and continuum mechanics.

Course Outline:

Particle kinematics, radial and transverse components of velocity and acceleration, circular motion, motion with a uniform acceleration, the Newton laws of motion (the inertial law, the force law and the reaction law), newtonian mechanics, the newtonian model of gravitation, simple-harmonic motion, damped oscillations, conservative and dissipative systems, driven oscillations, nonlinear oscillations, calculus of variations, Hamilton's principle, lagrangian and hamiltonian dynamics, symmetry and conservation laws, Noether's theorem, central-force motion, two-body problem, orbit theory, Kepler's laws of motion (the law of ellipses, the law of equal areas, the harmonic law), satellite motion, geostationary and polar satellites, kinematics of two-particle collisions, motion in non-inertial reference frame, rigid-body dynamics (3-D-rigid bodies and mechanical equivalence, motion of a rigid body, inverted pendulum and stability, gyroscope).

Recommended Books:

[1] Bedford A, Fowler W, *Dynamics: Engineering Mechanics*, Addision-Wesley, Reading, Ma, USA.
[2] Chow TL, *Classical Mechanics*, 1995, John Wiley, New York.
[3] Goldstein H, *Classical Mechanics* (2nd edition), 1980, Addison-Wesley, Reading, Ma, USA.
[4] Marion JB, *Classical Dynamics of Particles and Fields* (2nd edition), 1970, Academic Press, New York (suggested text).

PHY-4405:   Modern Physics and Electronics   Credit Hrs: 3(3-0)

Objectives:
1. To give the concept of modern physics
2. To know the nuclear structure and radioactivity

3. To know some nuclear reactions and production of nuclear energy
4. To give basic understanding of Plasma and LASER

Electronics:
Basic crystal structure, free electron model, energy band in solid and energy gaps, p-type, n-type semiconductor materials, p-n junction diode, its structure. Characteristics and application as rectifiers. Transistor, its basic structure and operation, transistor biasing for amplifiers, characteristics of common base, common emitter, common collector, load line, operating point, hybrid parameters (common emitter), Transistor as an amplifier (common emitter mode), Positive & negative feed-back R.C. Oscillators, Monostable multi- vibrator (basic), Logic gates OR, AND, NOT, NAND, NOR and their basic applications.

Origin of Quantum Theory:
Black body radiation, Stefan Boltzmann-, Wiens- and Planck's law, consequences. The quantization of energy, Photoelectric and Compton effect, Line spectra, Explanation using quantum theory.

Wave Nature of Matter:
Wave behaviour of particle **(**wave function etc.) its definition and relation to probability of particle, d'Broglie hypothesis and its testing, Davisson-Germer Experiment and J.P. Thomson Experiment, Wave packets and particles, localizing a wave in space and time.

Atomic Physics:
Bohr's theory (review), Frank-Hertz experiment, energy levels of electron, Atomic spectrum, Angular momentum of electrons, Vector atom model, Orbital angular momentum. Spin quantization, Bohr's Magnetron. X-ray spectrum (continuous and discrete) Moseley's law, Pauli's exclusion principle and its use in developing the periodic table.

Recommended Books:
1. Robert M Eisberg, Fundamentals of Modern Physics, John Wiley & Sons 1961
2. Sanjiv Puri, Modern Physics, Narosa Publishing House, 2004.
3. Paul A. Tipler and Ralph A. Llewellyn, Modern Physics 3rd edition, W H Freeman and Company 2000.
4. Arthur Beiser, Concepts of Modern Physics (fifth edition) McGraw-Hill 1995.
5. Robert M. Eisberg and Robert Resnick, Quantum Physics of Atoms, molecules, Solids, Nuclei and Particles, 2nd edition, John Wiley & Sons, 2002.
6. D. Halliday, R. Resnick, K. S. Krane, *Physics,* John Willey & sons, Inc.

PHY-4405: **Lab** **Credit Hrs: 1(0-1)**

List of Experiments:
1. 1. To develop understanding and uses of electronic devises including GATS, Transistors.
2. Determination of ionization potential of mercury.
3. Characteristics of a semiconductor diode (Compare Si with Ge diode)
4. 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.
5. To set up a single stage amplifier & measure its voltage gain and bandwidth.

6. To set up transistor oscillator circuit and measure its frequency by an oscilloscope.
7. To set up and study various logic gates (AND, OR, NAND etc) using diode and to develop their truth table.
8. To set up an electronic switching circuit using transistor LDR and demonstrate its use as a NOT Gate.
9. Characteristics of a transistor.
10. Use of computer in the learning of knowledge of GATE and other experiments.

Recommended Books:

1. G L Squires, Practical Physics, 3rd Edition, Cambridge University Press.
2. Nolan and Bigliani, Experiments in Physics, Surjeet Pub Ind.
3. C K Bhattacharya, University Practical Physics, CBS Publishing.

MAT-4406   **Mathematical Computation**   **Credit Hours: 3**(2-1)
Pre-requisites: None
Course Objectives: A practical introduction to most widely used Mathematical computing softwares namely, MATLAB, MATHEMATICA and MAPLE. Students will study two of these three softwares.
Core Contents: Two of these softwares: MATLAB, MATHEMATICA and MAPLE.
Course Outline:
MATLAB:
    Introduction to the basic environment, MATLAB Desktop, syntax, variables, strings, Vectors, Matrices
    Basic program writing in MATLAB, Loops (do, for, while, if)
    Symbolic toolbox.
    Array operations, solving systems of linear equations
    Differentiation, integration, areas
    Two and three dimensional plots in MATLAB.
    Animations in MATLAB
MATHEMATICA
    Introduction to the basic environment of MATHMATICA and its syntax
    Running MATHEMATICA and Numerical/Algebraic Calculations
    Symbolic Mathematics in MATHEMATICA
    Functions and Programs
    Graphics
    Calculus, Linear Algebra
MAPLE
    Introductory Demonstration of Maple
    Vectors, Matrices
    Toolbars and Palettes
    Operators, Constant, Elementary Functions
    Plots of 2D and 3D functions
    Packages within MAPLE
Course Outcomes:
On successful completion of this course, students will be able to:
    use above mentioned softwares
    plot, modify and present graphs of expressions of any kind

solve systems of linear equations
write simple codes
use the built-in functions efficiently
use a number of techniques that are useful in calculus as well as in other areas of mathematics

Recommended Books:
1. Stephen J. Chapman, MATLAB Programming for Engineers, 2008
2. *The MATHEMATICA Book, built in MATHEMATICA Software*

PST-4407   Pakistan Studies   2(2-0)
Introduction/Objectives:

Develop vision of historical perspective, government, politics, contemporary Pakistan, ideological background of Pakistan. Study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.
Course Outlines:

1. **Historical Perspective**

Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam M. Ali Jinnah. Factors leading to Muslim separatism. PEOPLE AND LAND: Indus Civilization, Muslim advent, Location and geo-physical features. GOVERNMENT AND POLITICS IN PAKISTAN: Political and constitutional phases, 1947-58, 1958-71, 1971-77, 1977-88, 1988-99 and 1999 onward, CONTEMPORARY PAKISTAN: Economic institutions and issues, Society and social structure, Ethnicity, Foreign policy of Pakistan and challenges, Futuristic outlook of Pakistan

Books Recommended:
1. Burki, Shahid Javed. State & Society in Pakistan, The Macmillan Press Ltd 1980.

2. Akbar, S. Zaidi. Issue in Pakistan's Economy. Karachi: Oxford University Press, 2000.

3. S.M. Burke and Lawrence Ziring. Pakistan's Foreign policy: An Historical analysis. Karachi: Oxford University Press, 1993.

4. Mehmood, Safdar. Pakistan Political Roots & Development. Lahore, 1994.

5. Wilcox, Wayne. The Emergence of Bangladesh., Washington: American Enterprise, Institute of Public Policy Research, 1972.

6. Mehmood, Safdar. Pakistan Kayyun Toota, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, nd.

7. Amin, Tahir. Ethno - National Movement in Pakistan, Islamabad: Institute of Policy Studies, Islamabad.

8.   Ziring, Lawrence. Enigma of Political Development. Kent England: WmDawson & sons Ltd, 1980.

9.   Zahid, Ansar. History & Culture of Sindh. Karachi: Royal Book Company, 1980.

10. Afzal, M. Rafique. Political Parties in Pakistan, Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.

11. Sayeed, Khalid Bin. The Political System of Pakistan. Boston: Houghton Mifflin, 1967.

12. Aziz, K.K. Party, Politics in Pakistan, Islamabad: National Commission on Historical and Cultural Research, 1976.

13. Muhammad Waseem, Pakistan Under Martial Law, Lahore: Vanguard, 1987.

14. Haq, Noor ul. Making of Pakistan: The Military Perspective. Islamabad: National Commission on Historical and Cultural Research, 1993.

15. Amin, Tahir. *Ethno - National Movement in Pakistan,* Islamabad: Institute of Policy Studies, Islamabad.

16. Ziring, Lawrence. *Enigma of Political Development.* Kent England: WmDawson & sons Ltd, 1980.

17. Zahid, Ansar. *History & Culture of Sindh.* Karachi: Royal Book Company, 1980.

18. Afzal, M. Rafique. *Political Parties in Pakistan,* Vol. I, II & III. Islamabad: National Institute of Historical and cultural Research, 1998.

19. Sayeed, Khalid Bin. *The Political System of Pakistan.* Boston: Houghton Mifflin, 1967.

20. Aziz, K.K. *Party, Politics in Pakistan,* Islamabad: National Commission on Historical and Cultural Research, 1976.

21. Muhammad Waseem, Pakistan Under Martial Law, Lahore: Vanguard, 1987.

22. Haq, Noor ul. *Making of Pakistan: The Military Perspective.* Islamabad: National Commission on Historical and Cultural Research, 1993.

Courses for Semester-VI

MAT-5201   **Real Analysis-II**   **3(3-0)**

Prerequisite(s): Real Analysis-I

Specific Objectives of the Course:

A continuation of Real Analysis I, this course rigorously develops integration theory. Like Real Analysis-I, Real Analysis-II emphasizes proofs.

Course Outline:

Series of numbers and their convergence; Series of functions and their convergence; Dabroux upper and lower sums and integrals; Dabroux integrability; Riemann sums and the Riemann integral; Riemann integration in R^2; change of order of variables of integration; Riemann integration in R^3 and R^n; Riemann-Steiltjes integration; Functions of bounded variation; The length of a curve in R^n.

Recommended Books:

[1] Bartle RG, Sherbert DR, Introduction to Real Analysis (3rd edition), 1999, John Wiley, New York.

[2] Brabenec RL, *Introduction to Real Analysis*, 1997, PWS Publishing Company.

[3] Fulks W, *Advanced Calculus*, John Wiley, New York (suggested text).

[4] Gaughan ED, *Introduction to Analysis* (5th edition), 1997, Brooks/Cole.

[5] Rudin W, *Principles of Mathematical Analysis* (3rd edition), 1976, McGraw Hill, New York.

MAT-5202   **Complex Analysis**   **3(3-0)**

Prerequisite(s): Real Analysis-I

Specific 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 Outline:

The algebra and the geometry of complex numbers, Cauchy-Riemann equations, harmonic functions, elementary functions, branches of the logarithm, complex exponents. Contours and contour integrals, the Cauchy-Goursat Theorem, Cauchy integral formulas, the Morera Theorem, maximum modulus principle, the Liouville theorem, fundamental theorem of algebra. Convergence of sequences and series, the Taylor series, the Laurent series, uniqueness of representation, zeros of analytic functions. Residues and poles and the residue theorem, evaluation of improper integrals involving trigonometric functions, integrals around a branch point., the argument principle, the Roche theorem.

Recommended Books:

[1] Churchill RV, Brown JW, Complex Variables and Applications (5th edition), 1989, McGraw Hill, New York.

MAT-5203   **Algebra-II**   **3(3-0)**

Prerequisite(s): Introduction to Linear Algebra

Specific Objectives of the Course:

This is a course in advanced linear algebra, which builds on the concepts learnt in Linear Algebra.

Course Outline:

Review of elementary concepts of vector spaces, Linear dependence and independence of vectors. Vector spaces and subspaces, Quotient Spaces, Direct sum of spaces, Linear transformation, Rank and Nullity of linear transformations, Algebra of linear transformation and representation of linear transformation of matrices, Change of bases, Linear functionals, Dual spaces and Annihilators, Eigenvectors and eigenvalues and Cayley-Hamilton Theorem, Diagonalization of matrices, Inner product spaces, Matrices for point group operations.

Recommended Books:

[1] Shilov GE, Linear Algebra, 1997, Dover Publications, Inc. New York.
[2] Zill DG, Cullen MR, Advanced Engineering Mathematics, 1996, PWS Publishing Company Baston.
[3] Herstein IN, Topics in Algebra, 1975, John-Wiley.
[4] Trooper AM, Linear Algebra, 1969, Thomas Nelson and Sons.
[5] Lang S, Linear Algebra, 2005, Thomas Nelson and Sons.
[6] Scheick JT, Linear Algebra with Applications, 1997, McGraw Hill.

MAT-5204   Functional Analysis-I   3(3-0)

Prerequisite(s): Complex Analysis

Specific 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 Outline:

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 boundedness 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, weak and weak* Convergence.

Recommended Books:

[1] Curtain RF, Pritchard AJ, Functional Analysis in Modern Applied Mathematics, Aademic Press, New York.
[2] Friedman A, *Foundations of Modern Analysis*, 1982, Dover.
[3] Kreyszig E, *Introductory Functional Analysis with Applications*, John Wiley, New York.
[4] Rudin W, *Functional Analysis*, 1973, McGraw Hill, New York.

MAT-5205   Ring Theory   3(3-0)

Prerequisite(s): Algebra-I

Specific Objectives of the Course:

Upon successful completion of this course students will be able to: demonstrate knowledge of the syllabus material; write precise and accurate mathematical definitions of objects in ring theory; use mathematical definitions to identify and construct examples and to distinguish examples from non-examples; validate and critically assess a mathematical proof; use a combination of theoretical knowledge and independent mathematical thinking to investigate questions in ring theory and to construct proofs; and write about ring theory in a coherent, grammatically correct and technically accurate manner.

Course Outline:

Definitions and basic concepts, Homomorphisms, Homomorphism theorems, Polynomial rings, Unique factorization domain, Factorization theory, Euclidean domains, Arithmetic in Euclidean domains, Extension, Algebraic and Transcendental elements, Simple extension, Introduction to Galois theory.

Recommended Books:

[1] Fraleigh JA, A first course in Abstract Algebra, 1982, Addison-Wesley publishing Company.
[2] Herstein IN, *Topics in Algebra*, 1975, John Wiley & Sons.
[3] Lang S, *Algebra*, 1975, Addison–Wesley.
[4] Hartley B, Hawkes TO, Rings, Modules and Linear Algebra, 1980, Chapman and Hall.

Courses for Semester-VIII

MAT-6401   **Numerical Analysis-II**   **3(3-0)**

 Prerequisite(s): Numerical Analysis-I

 Specific Objectives of the Course:

The most phenomena in our World are essentially non-linear or desire by non-linear equations may be PDE and ODE since that appearance of high performance digit computers it becomes easier to solve the problem. However, Generally Spacing it is still difficult to obtained or get an analytical approximations then a numerical one of a given non-Linear problem. The numerical techniques generally can be applied to non-linear problems in complicated computational domain. This is obvious of advantage on numerical methods over analytical one that often handle non-linear problem in simple domain. Numerical method gives discontinuous points of a curve. Thus it is often costly or time consuming to get a complete of those results. Besides from numerical results it is hard to have whole and essential understanding of non-linear problems. A number of software package has been developed to produce symbolic mathematical computations such as Mathematica and Matlab.

Course Outline:

Osculating polynomials; Differentiation and integration in multidimensional; Predicator methods; Modified Euler's Method; Truncation error and stability; The Taylor Series method; Runge-Kutta methods; Differential equations of higher order system of differential equations; Runge-Kutta methods; Shooting methods; Finite difference methods; Elliptic, hyperbolic and parabolic equations; Explicit and implicit finite difference methods; Stability; Convergence and consistency analysis; The method of characteristic; Estimation of eigenvalues and corresponding error bounds; Gerschgorin's theorem and its applications; Power method; Shift of origin; Deflation method for the subdominant eigenvalues.

Recommended Books:

[1] Conte SD, De Boor, Elementary Numerical Analysis, 1972, McGraw-Hill.
[2] Gerald CF, Applied Numerical Analysis, 2006, Addison Wesley.
[3] Froberg CE, Introduction to Numerical Analysis, 1972, Addison Wesley.

[4] Gourlay AR, Watson GA, Computational Methods of Matrix Eigen Problems, 1973, John Wiley & Sons.
[5] Smith GD, Numerical Solution of Partial Differential Equations, 1986, Oxford University Press.
[6] Mitchel AR, Griffith DE, The Finite Difference Methods in Partial Differential Equations, 1980, John Wiley & Sons.

MAT-6402   **Differential Geometry-II**   **3(3-0)**

Prerequisite(s): Differential Geometry-I

Specific Objectives of the Course:

Differential geometry is a main branch of analysis and geometry. It is impossible to solve any problem of physical life without clear understanding of basic ideas of differential geometry. Particularly, modern physics is written in the language of differential geometry. This course aims to introduce this language.

Course Outline:

Extension of analytical geometry to n-dimensional flat space, Cartesian tensors, Curved space and manifolds, Tangent and cotangent spaces, Vector fields and their flows, Lie derivatives of vector fields and dual vector fields, Metric connection, Tensors on manifolds and their Lie and covariant differentials, Killing vector fields, Curvature tensor and the Bianchi identities, Geodesics and the exponential map, Heuristic to integration on manifolds.

Recommended Books:

[1] Laugwitz D, Differential and Riemannian Geometry, 1970, Academic Press.
[2] Livelock D, Rund H, Tensors: Differential forms and Variational Principles, 1975, John Wiley.
[3] Eisenhart LP, Riemannian Geometry, 1964, Princeton University Press.
[4] Eisenhart LP, An Introduction to Differential Geometry with use of the Tensor Calculus, 1947, Princeton University Press.

MAT-6403   **Mathematical Physics**   **3(3-0)**

Prerequisite(s): Partial Differential Equations

Specific Objectives of the Course:

There are several distinct branches of mathematical physics; these roughly correspond to particular historical periods. In this course we shell study the Lap lace transform, Fourier transform and variational techniques. Laplace transform reduces the solution of an ordinary differential equation to an algebraic equation. In fact this method has a particular advantage in finding the general solution and the using for evaluating the arbitrary constant with appropriate initial conditions without finding the general solution and then using initial conditions for evaluating the arbitrary constants. Also when the Laplace transform technique is applied to partial differential equations, it reduces the number of independent variables by one. Fourier transform techniques have been widely used to solve problems involving semi-infinite or totally infinite range of variables or unbounded regions. The one of most interesting method used in mathematical physics is the calculus of variations. The theory of partial differential equations, the related areas of variational calculus and Fourier analysis are closely related with mathematical physics.

Course Outline:

Definitions and properties of Laplace transforms with proofs, The inversion problems, Convolution and inversion theorem with illustrative examples. Applications of Laplace transforms to ordinary and partial differential equations, Definition and basic properties of Fourier Transforms

with proofs, Fourier integrals, Convolution theorem. Persaval's theorems, Fourier sine and cosine transforms with illustrative examples, Fourier sine and cosine transforms of derivatives, Applications of Fourier transforms to boundary value problems.

Recommended Books:
[1] Butkov EL, Mathematical physics, Addison-Wesley.
[2] Sagan H, Boundary and Eigen value Problems in Mathematical Physics.
[3] Arfken G, Mathematical Methods for Physics, Academic press.

MAT-6404   **Fluid Mechanics-II**   **3(3-0)**

Prerequisite(s): Fluid Mechanics-I

Specific Objectives of the Course:

Fluid mechanics is an exciting and fascinating subject with unlimited practical applications ranging from microscopic biological systems to modern technological developments in engineering and industry. Fluid mechanic has historically been one of the most challenging subjects for Graduate/Undergraduate students. Fluid mechanics is a very broad filed. A small library of books would be required to cover all of the topics that could be included in it. In this course we shall be interested mainly in flows of interest to daily life science/engineering problems but even that is very broad area so we shall classify the types of problems that may be encountered. The original aims of this course to develop the basic ideas/concepts, fundamental laws, equations (Constitutive) for viscous / Newtonian fluids. After presenting the basic concepts of fluid mechanics we than discuss how mathematical models for physical/engineering problems are prepare and how to interpret the result obtain from the analysis of such models than a systematic problem-solving techniques/ method that can be used to solve those problems in detail.

Course Outline:

Constitutive equations, Navier-Strokes equations, Exact solutions of Navier-Strokes equations, Steady unidirectional flow, Poiseuille flow, Couette flow , Unsteady unidirectional flow , Sudden motion of a plane boundary in a fluid at rest , Flow due to an oscillatory boundary , Equations of motion relative to a rotating system, Ekman flow , Dynamical similarity and the Reynold's number, Flow over a flat plate (Blasius solution). Reynold 's equations of turbulent motion.

Recommended Books:
[1] Landau LD, Lifshitz EM, Fluid Mechanics, 1966, Pergamon Press.
[2] Batchelor GK, An introduction to Fluid Dynamics, 1969, Cambridge University Press.
[3] Jaunzemies W, Continuum Mechanics, 1967, Macmillan Company.
[4] Milne Thomson, Theoretical Hydrodynamics, 1967, Macmillan Company.
[5] Schlichting H, Boundary Layer Theory, 1979, McGraw Hill.
[6] Streeter, Hand Book of Fluid Dynamics, McGraw Hill.
[7] Charlton F, Textbook of fluid Dynamics, 1967, D. Van Nostrand Co. Ltd.

MAT-6405   **Quantum Mechanics**   **3(3-0)**

Prerequisite(s): Classical Mechanics

Specific Objectives of the Course:

The mathematical formulation of quantum mechanics is abstract and its implications are often non-intuitive. The centerpiece of this mathematical system is the wave function. The wave function is a mathematical function of time and space that can provide information about the position and momentum of a particle, but only as probabilities, as dictated by the constraints imposed by the uncertainty principle. Mathematical manipulations of the wave function usually involve the

bracket notation, which requires an understanding of complex numbers and linear functional. Many of the results of Quantum Mechanics can only be expressed mathematically and do not have models that are as easy to visualize as those of classical mechanics. For instance, the ground state in quantum mechanical model is a non-zero energy state that is the lowest permitted energy state of a system, rather than a more traditional system that is thought of as simple being at rest with zero kinetic energy.

Course Outline:
Basic postulates of quantum mechanics, State vectors, Formal Properties of quantum mechanical operators. Eigenvalues and Eigen-states, Simple harmonic oscillator, Schordinger representation, Heisenberg equation of motions, Schrodinger equation, Potential step, Potential barrier, Potential well, Orbital angular momentum motion in a centrally symmetric field, Hydrogen atom, Matrix representation of angular momentum and spin, Time independent perturbation theory, Degeneracy, The stark effect, Introduction to relativistic quantum mechanics.

Recommended Books:
[1] Fayyazuddin, Riazuddin, Quantum Mechanics, 1990, World Scientific.
[2] Merzebacher E, Quantum Mechanics, 1970, John Wiley.
[3] Liboff RL, Introduction Quantum Mechanics, 1991, Addison-Wesley.
[4] Dirac PMA, Principles of Quantum Mechanics, 1985, Oxford University Press.

MAT-6406   **Integral Equations**   **3(3-0)**
Prerequisite(s): Ordinary Differential Equations
Specific Objectives of the Course:
Many physical problems which are usually solved by differential equation methods can be solved more effectively by integral equation method. Indeed, the latter have been appearing in current literature with increasing frequency and have provided solutions to problems heretofore not solvable by standard methods of differential equations, and the type of solutions explored in this course will be useful particularly in applied mathematics, theoretical mechanics, and mathematical physics. If the kernel is separable, the problem of solving an integral equation of second kind reduces to that of solving an algebraic system of equations. Unfortunately, integral equations with degenerate kernel do not occur frequently in practice. But they are easily treated, and furthermore, the results derived in this course for such questions lead to better understanding of integral equations of more general type, it is worthwhile to study them. When an integral equation cannot be solved in closed form, then recourse has to be taken to approximate methods can be applied with confidence only if the existence of the solution is assured in advance. The Fredholm theory included in this course provides such an assurance. We shall study the Hilbert-Schmidt theory, the Wiener-Hopf technique which is very useful in solving problems in science and engineering.

Course Outline:
Integral equation formulation of boundary value problems, Classification of integral equations, Method of successive approximation, Hilbert-Schmidt theory, Schmidt's solution of non-homogeneous integral equations, Fredholm theory, Care of multiple roots of characteristic equation, Degenerate kernels, Introduction to Wiener-Hopf technique.

Recommended Books:
[1] Lovitt WV, Linear Integral Equations, 1950, Dover Publication.
[2] Smith F, Integral Equations, 2003, Cambridge University Press.
[3] Tricomi FG, Integral Equations, 1957, Interscience.
[4] Noble B, Methods Based on the Wiener-Hopf Technique, 1958, Pergamon Press.

[5] Abdul JJ, Introduction to Integral Equations with Applications, 1985, Marcel Dekker Inc. New York.

MAT-6407   **An Introduction to Convex Analysis**   **3(3-0)**

Prerequisite(s): Functional Analysis-I

Specific Objectives of the Course:

The main purpose of this course is to introduce the convexity. The prerequisites are mainly linear algebra and linear programming (LP) including the duality theorem and the simplex algorithm. The second, and final, part of the course is to go into convexity. The plenty of material in convexity is presented in this course.

Course Outline:

The basic concepts, Convex hulls and Caratheodory's theorem, Projection and separation, Representation of convex sets, Convex functions, Nonlinear and convex optimization.

Recommended Books:

[1] Jean-Baptiste Hiriart-Urruty, *Fundamentals of Convex Analysis*, 2003, Springer.
[2] Magaril-Ilyaev GG, Tikhomirov VM, *Convex Analysis*: Theory and Applications, 2003, AMS.

MAT-6408   **Calculus of Variation & Optimal Control**   **3(3-0)**

  Prerequisite(s): Optimization Theory

Specific Objectives of the Course:

A huge amount of problems in the calculus of variations have their origin in physics where one has to minimize the energy associated to the problem under consideration. Nowadays many problems come from economics. Here is the main point that the resources are restricted. There is no economy without restricted resources. The calculus of variations is concerned with the construction of optimal shapes, states, or processes where the optimality criterion is given in the form of an integral involving an unknown function. The task of the calculus of variations then to demonstrate the existence and to deduce the properties of some function that realizes the optimal value for this integral. Such problems occur in many-fold applications, in particular physics, engineering, economics and variational integral may represents some action, energy, or cost functional. The calculus of variations also has deep and important connections with other fields of mathematics. For instance, in geometrically defined classes of objects, a variational principle often permits the selection of a unique optimal representative and the properties of can frequently be used to much advantage to deduce additional information about its class. For these reasons, the calculus of variations is a rich mathematical subject.

Course Outline:

Variation of the functionals, Euler-Lagrange equation and its particular cases, Lagrange problem with free end points, Lagrange problem with more than one functionals, Variational problems with constraints,from Calculus of Variations to Optimal Control, The Maximum Principle, The Hamilton-Jacobi-Bellman equation, The Linear Quadratic Regulator.

Recommended Books:

[1] Moser J, *Selected Chapters in the Calculus of Variations*, 2003, Birkhauser-Verlag, Switzerland.
[2] Liberzon D, *Calculus of Variations & Optimal Control Theory*, 2012, Princeton University Press.

MAT-6409   **Dynamical Systems**   **3(3-0)**

Prerequisite(s): Ordinary Differential Equations, Linear Algebra
Specific Objectives of the Course:
After taking this course it is expected that the students will learn about the linear and nonlinear dynamical systems. They will be able to construct and analyze the models of real time-dependent systems in several different areas of study. Moreover, this course will be helpful to use Mathematica for the investigation of different properties of dynamical systems.

Course Outline:
Introduction: Preliminary ideas, Autonomous equations, Autonomous systems in plane, Linear systems: Linear changes of variables, Similarity types for 2×2 real matrices, Phase portraits for canonical systems in the plane, Classification of simple linear phase portraits in the plane. Nonlinear systems in the plane: Local and global behavior, Linearization at a fixed point, The linearization theorem, Non-simple fixed points, Stability of fixed points, Ordinary points and global behavior. Applications: Linear models, Nonlinear models, Relaxation oscillation, Piecewise modeling. Dynamical systems with Mathematica: Differential equations, Planar systems, Interacting species.
Recommended Books:
[1] Lynch S, Dynamical systems with Applications using Mathematica, 2007, Birkhauser Boston.
[2] Alligood TK, Sauer DT, Yorke AJ, Chaos: An Introduction to Dynamical Systems, 1996, Springer.
[3] Arrowsmith KD, Place MC, Dynamical Systems, Differential Equations, Maps and Chaotic Behavior, 1992, Chapman & Hall.

MAT-6410   **Computer Language C/C^{++}**   **3(3-0)**
Prerequisite(s): Programming Languages for Mathematicians
Specific Objectives of the Course:
The main objectives of this course are:
To present the material one simple step at a time, so the students can easily digest each concept before moving on. To explore the issues of when and how to use in lines, references, operator overloading, inheritance and dynamic objects. To introduce advanced topics such as the proper use of templates, exceptions and multiple inheritance.
Course Outline:
Introduction to objects, Making & using objects, The C in C++, Data abstraction, Hiding the implementation, Initialization & cleanup, Function overloading & default arguments, Constants, Inline functions, Name control, References & the copy-constructor, Operator overloading, Dynamic object creation, Inheritance & composition, Polymorphism & virtual functions, Introduction to templates.
Recommended Books:
[1] Ackel B, Thinking in C++, 2000, Prentice Hall.
[2] Anderson, C++ Programming & Fundamental Concepts, Prentice Hall.
[3] Lam, A Jump Start Course in C++ Programming, Wiley.

MAT-6411   **Electromagnetism**   **3(3-0)**
Prerequisite(s): Fluid Mechanics-I
Specific Objectives of the Course:

Electromagnetism is the branch of science concerned with the forces that occur between electrically charged particles. In electromagnetic theory these forces are explained using electromagnetic fields. Electromagnetic force is one of the four fundamental interactions in nature, the other three being the strong, the weak interaction and gravitation. Electromagnetism is the interaction responsible for practically all the phenomena encountered in daily life, with the exception of gravity. Ordinary matters takes its form as a result of intermolecular forces between individual molecules in matter. Electromagnetism manifests as both electric fields magnetic fields. Both fields are simply different aspects of electromagnetism and hence intrinsically related. Thus, a charging electric field generates a magnetic field; conversely a charging magnetic field generates an electric field. This effect is called electromagnetic induction, and is the basis of operations for electrical generators, induction motors and transformers.

Course Outline:
Electrostatics and the solution of problems in vacuum and in media, Electrostatic energy, Electric currents, The magnetic fields of steady currents, Magnetic properties of matter and its Applications, Magnetic energy, Electromagnetic induction, Maxwell's Equations and Applications, Boundary value potential problems in two dimensions and Applications, Electromagnetic waves, Radiation, Motion of electric charges and their Applications.

Recommended Books:
[1] Reitz JR, Milford FJ, Foundation of Electromagnetic Theory, 1969, Addison-Wesley.
[2] Panofsky KH, Philips M, Classical Electricity and Magnetism, 1962, Addison-Wesley.
[3] Corson D, Lerrain P, Introduction to Electromagnetic Fields and Waves, 1962, Freeman.
[4] Ferraro VCA, Electromagnetic Theory, 1968, The Athlone Press.

MAT-6412   **Special Theory of Relativity**   **3(3-0)**
Prerequisite(s): Classical Mechanics
Specific Objectives of the Course:
General relativity or the general theory of relativity is the geometric theory of gravitation published by Albert Einstein in 1915. It is the current description of gravitation in modern physics. It unifies special relativity and Newton's law of universal gravitation, and describes gravity as a geometric property of space and time. In particular, the curvature of space and time is directly related to the four-momentum (mass-energy and linear momentum) of whatever matter and radiation are present. The relation is specified by the Einstein field equations, a system of partial differential equations. To learn general relativity which differ significantly from those of classical physics, especially concerning the passage of time, the geometry of space, the motion of bodies in free fall, and the propagation of light.
Course Outline:
Historical background and fundamental concepts of special theory of Relativity, Lorentz Transformations (For motion along one axis), Length contraction, Time dilation and Simultaneity, Velocity addition formulae 3-dimensional Lorentz transformation, 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 con, 4-velocity, 4-momentum and 4-force, Application of special relativity to Doppler shift and Compton effect, Particle scattering, Binding energy, Particle production and decay, Electromagnetism in relativity. Electric current, Maxwell's equations and electromagnetic waves, 4-vector formulation of Maxwell's equations, Special relativity with small acceleration.

Recommended Books:

[1] Qadir A, Relativity: An Introduction to the Special Theory, 1989, World Scientific.
[2] Goldstein H, Classical Mechanics, 1962, Addison-Wesley, New York.
[3] Jackson JD, Classical Electrodynamics, 1962, John Wiley, New York.
[4] Rindler W, Essential Relativity, 1977, Springer-Verlag.

MAT-6413   **Topology-II**   **3(3-0)**

  Prerequisite(s): Topology-I
 Specific Objectives of the Course:
This is a continuation of the study of topology and how it extends the ideas of geometry, place, location and analysis, as well as some of the newer applications of topology.

Course Outline:
Compactness in metric spaces, Limit point compactness, Sequential compactness and their various characterization, Equivalence of different notions of compactness. Connectedness with examples, Various characterizations of connectedness and its Application, Connectedness and T_2-spaces, Local connectedness, Path-connectedness, Components and its Application. Homotopic maps with examples, Homotopic paths, Loop spaces and its Application, Fundamental groups, Covering spaces, The chain complexes, Notion of homology.

 Recommended Books:
[1] Greenberg MJ, Algebraic Topology, A First Course, 1967, The Benjamin/Commings publishing Company.
[2] Wallace AH, Algebraic Topology, Homology and Cohomology, 1968, New York.
[3] Gemignani MC, Elementary Topology, 1972, Addison-Wesley Publishing Company.
[4] Ahmad B, Introduction to General Topology, 2004, Ideal Publishers.

MAT-6414   **Theory of Elasticity**   **3(3-0)**

  Prerequisite(s): Classical Mechanics
 Specific Objectives of the Course:
Linear elasticity is the mathematical study of how solid objects deforms and become internally stressed due to prescribed condition. It relies upon the continuum hypothesis and in applicable at macroscopic (and sometime microscopic) length seals. It is a branch of continuum mechanics. The fundamental (linearizing) assumptions of linear elasticity are infinitesimal strain or small deformations and linear relationship between stress & rate of strain. In addition linear elasticity is only valid for stress state, that do not produce yielding. These assumptions are reasonable for many engineering materials. Linear elasticity in therefore used extensively in structural analysis and engineering design. We hope that at the end of the course the student will understand the concepts / basic of elasticity and have a working knowledge as well as creative thinking.

Course Outline:
Cartesian tensors, Analysis of stress and strain, Generalized Hooke'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 equation, plane stress and plane strain problems, Two dimensional problem in rectangular and polar co-ordinates, Torsion of rods and beams.

 Recommended Books:
[1] Sokolinikoff, Mathematical Theory of Elasticity, McGraw-Hill, New York.
[2] Dieulesaint E, Royer D, Elastic Waves in Solids, 1980, John Wiley and Sons, New York.
[3] Funk YC, Foundations of Solid Mechanics, 1965, Prentice-Hall, Englewood Cliffs.

MAT-6415   **Decomposition of Modules**   **3(3-0)**

  Prerequisite(s): Ring Theory
 Specific Objectives of the Course:

In graph theory, the modular decomposition is a decomposition of an undirected graph into subsets of vertices called modules. A module is a generalization of connected component of a graph. Unlike connected components, however, one module can be proper subset of another. Modules therefore lead to a recursive (hierarchical) decomposition of graph, instead of just a partition. For each undirected graph, this decomposition is unique. At the end of the course we expect that the students understand the concepts of Decomposition of Modules.

Course Outline:

Rings and modules with examples, decomposition of modules and their Applications, Decomposition theorem, The primary Decomposition theorem, The primary Decomposition, Abelian groups as z-modules, Abelian groups, Sylow's theorem, Linear transformation and matrices, Invariants and the Jordan canonical form, The rational canonical form theorem (linear transformation version), The Jordan canonical form theorem, Conjugacy classes in general linear groups.

Recommended Books:

[1] Blyth T, Modules theory, 1977, O.U.P., Oxford.
[2] Hartley B, Hawkes T, Rings, Modules and linear Algebra, Chapman G. Lecture Notes on Modules, Michigan University Press.