CURRICULUM
OF
SPACE SCIENCES
FOR
BS
MS
(Revised 2012)

HIGHER EDUCATION COMMISSION,
ISLAMABAD
CURRICULUM DIVISION, HEC

Dr. Syed Sohail H. Naqvi  Executive Director
Mr. Muhammad Javed Khan  Adviser (Academic)
Malik Arshad Mahmood  Director (Curri)
Dr. M. Tahir Ali Shah  Deputy Director (Curri)
Mr. Farrukh Raza  Assist. Director (Curri)
Mr. Abdul Fatah Bhatti  Assist. Director (Curri)

Composed by: Mr. Zulfiqar Ali, HEC, Islamabad
## CONTENTS

1. Introduction .............................................................................................................. 6  
2. Scheme of Studies for BS (4-Year) in Space Sciences ........................................... 10  
3. Detail of Courses-Semester-wise  
   (First Semester to Eight Semester) ........................................................................... 12  
4. Scheme of Studies for MS (2-Year) in Space Sciences ............................................ 35  
5. Detail of Courses MS in Space Sciences .................................................................. 36  
6. Annexure A to C (Compulsory Courses) ................................................................. 44  
7. Recommendations/Suggestions ............................................................................... 53
PREFACE

The curriculum of subject is described as a throbbing pulse of a nation. By viewing curriculum one can judge the stage of development and its pace of socio-economic development of a nation. With the advent of new technology, the world has turned into a global village. In view of tremendous research taking place world over new ideas and information pours in like of a stream of fresh water, making it imperative to update the curricula after regular intervals, for introducing latest development and innovation in the relevant field of knowledge.

In exercise of the powers conferred under Section 3 Sub-Section 2 (ii) of Act of Parliament No. X of 1976 titled “Supervision of Curricula and Textbooks and Maintenance of Standard of Education” the erstwhile University Grants Commission was designated as competent authority to develop, review and revise curricula beyond Class-XII. With the repeal of UGC Act, the same function was assigned to the Higher Education Commission under its Ordinance of 2002 Section 10 Sub-Section 1 (v).

In compliance with the above provisions, the HEC undertakes revamping and refurbishing of curricula after regular intervals in a democratic manner involving universities/DAIs, research and development institutions and local Chamber of Commerce and Industry. The intellectual inputs by expatriate Pakistanis working in universities and R&D institutions of technically advanced countries are also invited to contribute and their views are incorporated where considered appropriate by the National Curriculum Revision Committee (NCRC).

A committee of experts comprising of conveners from the National Curriculum Revision of HEC in Basic, Applied Social Sciences and Engineering disciplines met in April 2007 and developed a unified template to standardize degree programs in the country to bring the national curriculum at par with international standards, and to fulfill the needs of the local industries. It also aimed to give a basic, broad based knowledge to the students to ensure the quality of education. The BS degree shall be of 4 years duration, and will require the completion of 130-136 credit hours.

In line with above, NCRC comprising senior university faculty and experts from various stakeholders and the respective accreditation councils has revised the curriculum for Space Sciences. The same is being recommended for adoption by the universities/DAIs channelizing through relevant statutory bodies of the universities.

MUHAMMAD JAVED KHAN
Adviser Academics

April, 2012
CURRICULUM DEVELOPMENT

STAGE-I
- CURRI. UNDER CONSIDERATION
  - COLLECTION OF EXP NOMINATION UNI, R&D, INDUSTRY & COUNCILS
    - CONS. OF NCRC.
      - PREP. OF DRAFT BY NCRC

STAGE-II
- CURRI. IN DRAFT STAGE
  - APPRAISAL OF 1ST DRAFT BY EXP
    - FINALIZATION OF DRAFT BY NCRC
      - PRINTING OF CURRI.

STAGE-III
- FINAL STAGE
  - PREP. OF FINAL CURRI.
    - QUESTIONNAIRE
      - COMMENTS

STAGE-IV
- FOLLOW UP
  - PRINTING OF CURRI.
    - IMPLE. OF CURRI.
      - ORIENTATION COURSES BY LI, HEC
  - REVIEW
    - BACK TO STAGE-I

Abbreviations Used:
- NCRC: National Curriculum Revision Committee
- VCC: Vice-Chancellor’s Committee
- EXP: Experts
- COL: Colleges
- UNI: Universities
- PREP: Preparation
- REC: Recommendations
- LI: Learning Innovation
- R&D: Research & Development Organization
- HEC: Higher Education Commission
INTRODUCTION

The final meeting of National Curriculum Revision Committee on Space Sciences was held at HEC Regional Centre, Karachi from January 30- Feb 01, 2012 to review the BS and MS Space Sciences Curriculum 2004. The following members attended the meeting:

Prof. Dr. Badar Ghauri                                            Convener
Head, Department of RS&GIS
Institute of Space Technology, Karachi Campus
National Centre for Remote Sensing and Geo-informatics, SUPARCO HQs. Sector 28, Gulzar-e-Hijri
Off University Road, P. O. Box 8402,
Karachi-75270.

Mr. Javed Sami                                                   Secretary
Assistant Professor
Department of Space Sciences
University of the Punjab
Lahore-54590.

Prof. Dr. Muhammad Ayub Khan Yousufzai                          Member
Department of Applied Physics
Institute of Space Science & Planetary Atmosphere
University of Karachi, Karachi.

Dr. Ghulam Jaffer                                                Member
Assistant Professor
Department of Electrical Engineering
Institute of Space Technology (IST)
Islamabad 44000.

Prof. Dr. Rashid Kamal Ansari                                   Member
Director, Mathematical Sciences
Research Centre, Federal Urdu University of Arts, Sciences & Technology, Karachi.

Dr. Nazish Rubab                                                 Member
Assistant Professor
Department of Material Science & Engineering
Institute of Space Technology (IST)
Islamabad 44000.

Dr. Sheikh Saeed Ahmad                                          Member
Assistant Professor
Department of Environmental Sciences
Fatima Jinnah Women University, The Mall,
Rawalpindi.
The meeting started with recitation from the Holy Quran by Dr. Muhammad Ayub Yousuf Zai. Mr. Muhammad Javed Khan, adviser (Acad.) welcomed the participants and briefed the participants on the aim and objectives of the meeting with a particular focus on revising the course outlines of BS (4-year) and MS Space Sciences to make them compatible with international standards and demands as well as ensuring the uniformity of academic standard within the country.

Dr Muhammad Ali, Professor Department of Space Science, University of Punjab who attended as Secretary during the preliminary meeting could not attend the final meeting due to his pre-occupation at Lahore. As such the committee unanimously agreed that Mr. Javed Sami, Assistant Professor Department of Space Sciences, University of Punjab should act as a secretary of the final meeting. The Adviser (Acad.) then requested the convener and secretary to conduct proceedings of all technical sessions of meeting for three days. On the request of the convener all members gave their perspective on the implementation of the BS (4-year) and MS programme in their respective universities/institutions.

The committee during its deliberation, considered the following objectives:

1. Finalize the curriculum in the discipline of Space Sciences and to bring it at par with international standards.
2. Incorporate latest reading & writing material against each course.
3. Bring uniformity and develop minimum baseline courses in each and every course of study.
4. Consider and incorporate the inputs given by the expatriate Pakistani in the discipline of Space Science where necessary.
5. Make recommendations for promotion/development of the discipline.

After three day long deliberation the committee unanimously approved the draft final curriculum of the BS (4-year) and MS Space Sciences degree programmes. Malik Arshad Mahmood, Director Curriculum, HEC thanked the Convener, Secretary and all members of the Committee for sparing their valuable time and for their quality contribution towards preparation of the preliminary draft curriculum of the BS (4-year) and MS Space Sciences
programme. He acknowledged that their efforts will go long way in developing workable, useful and comprehensive degree programmes in Space Sciences.

The committee appreciated the contributions of Dr. Mahmood Khalid (foreign expert from Canada) for critical review of the first draft of the revised curriculum. The committee, after thorough discussions, incorporated his suggestions in the final curriculum.

The committee highly admired the efforts made by the officials of HEC Regional Centre, Karachi, and Malik Arshad Mahmood, Director Curriculum for making excellent arrangements to facilitate the forming of the committee and their accommodation at Karachi.

The meeting ended with the vote of thanks to the HEC officials for providing an ideal environment to discuss the agenda. The convener of the NCRC also thanked the members for their inputs in re-engineering the teaching/learning landscape of the country to make it more practical, competitive and effective.
Mission Statements

Rapidly growing subjects of Space Sciences in the present era of information technology are in process of evolution from the state of infancy to the advanced levels in academic and research institutions. The significant subjects falling under the umbrella of Space Science comprise Remote Sensing, Satellite Applications, Space Physics, Astrodynamics, Atmospheric Sciences etc. Most of the courses have been retailored by enhancing scope and flexibility through introduction of specialized/ elective courses and modules. The courses recently introduced are main building blocks of Space Sciences. Emphasis has also been given to research and applications oriented areas such as Flight Dynamics and Control, Space Mission Design and Analysis, Space Data Processing and Geoinformatics, Guidance, Navigation and Control (GNC), Space Propulsion, Meteorology/ Environmental Sciences, Astronomy and Astrophysics. The Space Science uses new space-age technologies like satellite positioning, space data visualizations, analysis tools and space data interpretation to greatly advance scientific understanding of Earth and beyond. With the launch of Earth resource exploration satellites such as micro & nano satellites in Low Earth Orbit and Communication Satellites in Geostationary orbits around the Earth. The last decade has witnessed a wide spectrum of applications in diverse fields subject to the need and quality of imagery datasets acquired from the Earth orbiting satellites. The advances in computing technology and techniques have also contributed a lot in the development of more sophisticated sensors capable of observing the Earth with the help of satellite constellations.

The recommended curricula have been designed in a manner to significantly enhance our understanding of natural processes, resources, space mission analysis and data processing techniques for the betterment of mankind.
SCHEME OF STUDIES  
BS (4-YEAR) SPACE SCIENCES

**Duration:** 4-year (8-semester)

**Eligibility Criteria**  
Intermediate (12-year education) with Physics and Math or equivalent (A-level)

**Credit Hours**  
Committee proposes 124-136 Credit Hours for the award of BS (Space Sciences) degree.

### Course Contents for BS

<table>
<thead>
<tr>
<th>Semester /Year</th>
<th>Name of Subject</th>
<th>Lec-CH</th>
<th>Lab-CH</th>
<th>Total CH</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>English-I (Grammar and Composition)</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Pakistan Studies</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Algebra</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Social Science-I (Geography)</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Computer Programming</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Mechanics and Thermodynamics</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td><strong>First</strong></td>
<td></td>
<td></td>
<td></td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>English-II (Communication/Presentation Skills)</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Islamic Studies/Ethics</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Calculus</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective-I (Astrobiology/ Chemistry/ Environmental Sc )</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Statistical Analysis</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Electromagnetic Theory</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td><strong>Second</strong></td>
<td></td>
<td></td>
<td></td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>English-III (Technical Writing)</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Fundamentals of Remote Sensing</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Geometry and Vector Analysis</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Atmospheric Sciences</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Classical Mechanics and Modern Physics</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Spherical Astronomy and Geodesy</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td><strong>Third</strong></td>
<td></td>
<td></td>
<td></td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>Mathematical Methods</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Geographical Information System (GIS)</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Gravitational Physics</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Astronomy</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Year</td>
<td>Course</td>
<td>Credits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>------------------------------------------------------------------------</td>
<td>---------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fifth</td>
<td>Numerical Computing</td>
<td>2 1 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Statistical and Space Plasma Physics</td>
<td>3 0 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Space Flight Dynamics-I</td>
<td>3 0 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Solar and Ionospheric Physics</td>
<td>3 0 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Computer Applications in Project Design</td>
<td>1 2 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Digital Image Processing</td>
<td>2 1 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Meteorology</td>
<td>2 1 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sixth</td>
<td>Quantum Mechanics</td>
<td>3 0 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Astrophysics</td>
<td>3 0 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Space Flight Dynamics-II</td>
<td>3 0 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Analog and Digital Electronics</td>
<td>3 1 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Navigation and Space Instrumentation</td>
<td>2 1 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Research Methodology</td>
<td>2 0 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seventh</td>
<td>Space Mission Design</td>
<td>3 0 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Semiconductor Device Fabrication</td>
<td>2 1 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ELECTIVE-I</td>
<td>2 1 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ELECTIVE-II</td>
<td>2 1 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Projects / Thesis</td>
<td>0 3 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eighth</td>
<td>Seminar</td>
<td>0 3 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Social Science-II (Elective-II/ Foreign Language/ Space Law)</td>
<td>3 0 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ELECTIVE-III</td>
<td>3 0 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ELECTIVE-IV</td>
<td>3 0 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Projects / Thesis</td>
<td>0 3 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>133</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DETAIL OF COURSES
SEMESTER-WISE

First Semester

English-I (Grammar and Composition) 3-0
[Annex-A]

Pakistan Studies 2-0
[Annex-C]

Algebra 3-0

*Group Theory*: Groups, group of residue classes, cyclic group, order of a group, subgroup, coset, Lagrange’s theorem, introduction to permutation, cycles, length of cycles, transpositions, symmetric group, alternating groups. Rings, fields, vector space, subspace, linear dependence and independence, bases and dimension of a vector space, kernel space, image space.

*Linear Algebra*: Linear transformation and Matrices, algebra of matrices, determinants of matrices, various kind of matrices, Matrix of a linear transformation, elementary row and column operations on matrices, rank of a matrix, inverse of matrices, solution of homogeneous and non-homogeneous equations, orthogonal transformation and orthogonal matrices, eigenvalue and eigenvector.

*Linear Programing*: Concept of mathematical modeling and formulation of linear programming (LP), graphical solution of LP and Simplex method. Transportation models and networks.

**Recommended Books:**
- Hadley G. (1973), *Linear Algebra*
Definitions and scope of geography, climate: an introduction to atmosphere, solar and terrestrial radiation, temperature (vertical and horizontal distribution), moisture and atmospheric stability, forms of condensation and precipitation, air pressure and wind circulation, air masses, disturbances, climatic regions, natural vegetation: major types of vegetation, world pattern of natural vegetation, ocean: global oceans and seas, structure of the ocean floor, salinity and its distribution, Sea temperature, oceanic surface and subsurface currents, tides, oceanic deposits. The dynamic planet: internal structure of the earth, earthquakes, plate tectonics, major landforms.

**Recommended Books:**

**Computer Programming**

Introduction to operating System, Exploring print, building blocks, variables, input/output, operators, loops: for loops, while loop, do while loop, decisions, if statement, if else statement, else if construct switch statement, conditional statement, function, function that return a value using argument to pass data to a function, external variable, arrays and strings, pointers, structure, files and Introduction to C++ concepts, introduction to database management system.
Recommended Books:
• Lafore R. (1990), C Programming Using Turbo C., Howard and W. Sams
• Microsoft Disk Operating System Manual
• Shildt H., Turbo C/C++
• Bloom E. P., Turbo C++
• Hein J. L. (1996), Theory of Computation: An Introduction

Mechanics and Thermodynamics

Mechanics

Thermodynamics

Recommended Books:
• Alonso and Finn, (1999), “Physics”, Addison-Wesley, Reading, USA.
SECOND SEMESTER

English-II (Communication/Presentation Skills) 3-0
[Annex-A]

Islamic Studies/Ethics 2-0
[Annex-B]

Calculus 3-0

A review of real number system and complex numbers (De Moivre’s theorem), upper and lower bound of sequence, Limit of a sequence, functions and their graphical representation, logarithmic, exponential and hyperbolic functions, limit and continuity of a function, derivative of a function and its applications, optimization problems, mean value theorem, Taylor series of a function, indeterminate forms, Integration of a function, fundamental theorem of calculus, definite integral and its application, technique of integration: reduction formulae, beta and gamma functions, vector valued, improper integrals. Function of several variables, partial derivatives, chain rule, Euler’s theorem and implicit functions, Maxima and minima of two variables functions, relative extrema, Lagrange multipliers, double and multiple integrals, volume and area of surface revolution.

Recommended Books:

Elective-I (Astrobiology/Chemistry/Environmental Sc.) 2-1

Statistical Analysis 2-1

Statistical measure, statistical description and graphical representation of data set, introduction to probability theory, permutation and combinations, random variables, probability distributions, mean, standard deviation, variance, expectation, Expectation Binomial, Poisson, hyper-geometric and normal distributions, conditional and joint distribution. Sampling analysis, inferential statistics for one and two population mean, hypothesis testing for one sample and two samples, Chi-square distribution, test of normality: Chi-square test and Kolmogrov test, test of randomization, test of homogeneity. Regression analysis, correlation analysis, inferential method in regression and correlation, analysis of variance.
Labs:
Data analysis using statistical packages (i.e. MINITAB, SPSS, SAS, R, ITSM, STATISTICA etc).

Recommended Books:

Electromagnetic Theory 3-0

Recommended Books:
THIRD SEMESTER

English-III (Technical Writing) 3-0

[Annex-A]

Fundamentals of Remote Sensing 2-1

Introduction to Remote Sensing, Remote Sensing and its Physical Principles, Electromagnetic Radiation, EM Spectrum, Interaction of Electromagnetic Radiation with Atmosphere and with the Earth’s Surface, Atmospheric Windows, Signatures in Remote Sensing, Significance of Multi Spectral Imagery, Resolutions and its meanings (Spectral, Spatial, Temporal and Radiometric), Colours and Human Vision, Colour Models, Types of Photographic Films, Sensors and their types, optical, microwave, hyper spectral and ultraspectral sensors, imaging systems (RBV, MSS, TM, HRV, HRPT/APT/AVHRR, ETM, HRV, QuickBird, GeoEye, EO-1 etc.) non-imaging systems (Radarsat, SAR, SIR,etc.), satellites: types and functions, unmanned satellites (generations, meteorological satellites, earth resources satellites, telecommunication satellites, spy satellites, scientific satellites) manned satellites, space shuttles, platforms, ground receiving stations and reception of data, Data Acquisition (Ground Receiving Stations), Image Processing (Continuous and Discrete), Image Interpretation and Analysis

Labs:

Introduction to labs, single band image interpretation, false color predictions, false color composite images interpretation, visual interpretation of aerial photographs, various sensors data comparison, thermal infrared image interpretation, introduction to image processing software (e.g. ERDAS IMAGINE), display, geo-linking, zooming, identification of targets, field trip.

Recommended Books:

Geometry and Vector Analysis

Vector Analysis: Three dimensional vectors, coordinate systems and their bases, scalar and vector triple products, differentiation and integration of vectors, scalar and vector point functions, concepts of gradient, divergence and curl operator along with their applications.

Geometry: Two dimensional analytical geometry; Tangent Lines and Arc Length for Parametric and Polar Curves, Area in Polar Coordinate, general equation of the second degree and classification of conic section, conic section in polar coordinates. Three-dimensional geometry; rectangular coordinate system, parametric equations of lines, planes in 3-space. Curve Theory, change of parameter, Unit tangent, Normal and Binomial Vectors, curvature and Torsion. Motion along a curve. spherical and cylindrical coordinate systems, standard form of the equation of a sphere, cylinder, cone ellipsoid, paraboloid and hyperboloid, symmetry, intercepts and sections of a surface, tangent plane and normals.

Recommended Books:

Atmospheric Sciences


Books Recommended:
- Frederick J. E. (2008), Principles of Atmospheric Sciences, Jones and Bartlett Publisher
- Holton J. R. (2004), An Introduction to Dynamics Meteorology, Elsevier

Classical Mechanics and Modern Physics

Classical Mechanics:

Modern Physics:

Recommended Books:
Spherical Astronomy and Geodesy

Spherical Astronomy
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. Elements of spherical Astronomy, The celestial sphere, Parallax, Aberration and Precession.

Geodesy
Concepts of geodesy and surveying, Earth’s gravity field and the geoid, and measurement techniques applied to Geomatics are examined. Field studies include the use of the level, the total station, and GPS for doing distance and angle measurements, leveling, traversing and topographic surveying. Principles of global positioning system (GPS) and its applications.

Books Recommended:


FOURTH SEMESTER

Mathematical Methods 3-0

Infinite Series: Sequences of numbers and their convergence, algebra of convergent sequences, infinite series and their convergence, convergence tests for infinite series.

Fourier series: Periodic and piecewise continuous functions, Fourier series, Fourier sine and cosine series, Fourier integrals and Laplace transform.


Recommended Books:
• Thomas Jr., G. B. and Finney R L (2002), Calculus, 10 / e, Addison Wesley, Reading. Massachusetts.

Geographical Information System 2-1

Introduction and overview of GIS: introduction, definitions, components, functional sub-science. Evolution and application of GIS, data models (raster data model, vector data model, attribute data model), data acquisition techniques (data sources, map and data sources in Pakistan, data capturing
techniques and procedures), data transformation, visualization of spatial data (layers and projections), map design: (symbols to portray points, lines and volumes, graphic variables, visual hierarchy), data classification graphic approach, mathematical approach spatial relationships (topology), spatial analysis: overlay analysis, spatial analysis, neighborhood functions, network and overlay analysis, buffering, spatial data quality: components of data quality, micro level, components, macro level components, usage components, sources of error, and accuracy. Digital Surface Modeling in GIS, Applications of GIS for Land Resource Management, Regional Planning and Land Use Change Analysis, Errors and Uncertainty, Global Positional System (GPS), Future of GIS, GIS in Pakistan (Data Sources and Applications)

Labs:
The lab, exercises based on hands-on desktop GIS state-of-art software (e.g. MapInfo and ArcGIS) will provide extensive training in data collection, database development and image processing for any real world example, following are the activities involved: introduction to GIS lab. (hardware/software), introduction to GIS software, raster/vector/attribute data display, scanning, digitization, co-ordinate based point mapping, raster/vector conversion, data layer integration and display of different projections, map layout, data classification and thematic mapping, handling with topological errors, overlay analysis, network analysis.

Recommended Books:
Gravitational Physics


Recommended Books:

- Woodhouse, (1992), Special relativity, Springer-Verlag, Berlin
Astronomy


Recommended Books:
- Vols. 1-9, Chicago University Press, USA.

Numerical Computing

Error analysis, Round-Off Error; Absolute, Relative and Percentage Error; Significant Digits; Propagated Error; Error in Original Data, etc. Truncation Errors. Solution of Nonlinear Equations, Approximation of Functions, Bisection Method, Linear Interpolation, Newton's Method, Quasi-Linearisation. Solving System of Linear Equations, Gaussian Elimination, Crout's Decomposition Scheme, QD-Algorithm, Efficient Computation and Use of Determinants; Matrix Inversion; Iterative Methods. System of Nonlinear Equations.

Lab:
Solving and implementing Numerical Algorithms using Matlab.

Recommended Books:
- Palm, (2004) Introduction to MATLAB 7 for Engineers

FIFTH SEMESTER

Statistical and Space Plasma Physics 3-0

Statistical Physics
Statistical probability, canonical and micro canonical ensemble, partition function, Entropy, equipartition theorem, free energy, Statistical Distribution and Mean values: Mean free path and microscopic calculations of mean free path. Distribution of Molecular speeds, Distribution of energies: Maxwell distribution; Maxwell-Boltzmann energy distribution; Internal energy of an ideal gas. Brownian motion, Qualitative description. Diffusion, Conduction and Viscosity. Liouville’s equation.

Space Plasma Physics
Introduction to Plasmas, Single-Particle Motions, Plasmas as Fluids, Elementary Plasma Waves, Diffusion and Resistivity, Dusty Plasmas.

Books Recommended:
- F. Reif, (2008), Statistical Physics

**Space Flight Dynamics-I**


**Books Recommended:**
- Tewari A (2007), Atmospheric and Space Flight Dynamics.
- Francis J, Hale (1994) Introduction to Spaceflight

**Solar and Ionospheric Physics**

**Solar Physics**
Magneto-ionic theory, Maxwell’s equations, propagation of electromagnetic waves in isotropic medium, constitutive relations for anisotropic medium, polarization, phase and group velocities, solar atmosphere, structure of sun, motion of charged particles in magnetic field, solar oscillations, convection and rotation, solar wind and heliosphere, solar eruptions.

**Ionospheric Physics**
Ionosphere and radio wave propagation, plasma and Alfven waves, formation of Chapman layers, ion chemistry, Appleton-Hartree equation and its applications in ionosphere, steady-state conductivity of ionosphere, ionospheric phenomena and measurements, auroras, conversion of vertical to oblique incidence, ionogram scaling techniques, use of incoherent data for ionospheric research, HAARP.
Books Recommended:
- Margaret G. Kivelson (Ed.), Christopher T. Russell (Ed.), (Latest Edition), Introduction to Space Physics

Computer Applications in Project Design

Usage of computer software for data analysis, processing and simulation tools such as MATLAB, Simulink, Mathematica, Statistica, Satellite Tool Kit etc.

Books Recommended:
- Palm, (2004) Introduction to MATLAB 7 for Engineers
- Bruce F. Torrence and Eve A. Torrence, (Feb 2, 2009), The Student's Introduction to MATHEMATICA ®: A Handbook for Pre-calculus, Calculus, and Linear Algebra.

Digital Image Processing (DIP)

Labs:
- Image Import and Export
- Band Combination
- Compute univariate and multivariate statistics of the given data
- Image Enhancement
- Image Filtering
- Band ratios
- Rectification
- Grey level transformation
- Spatial enhancement
- Supervised
- Un-Supervised Classification
- DEM/DTM generation
- Thematic map designing

Books Recommended:

Meteorology


Books Recommended:
- Lutgens and Tarbuck (2009), The Atmosphere: An Introduction to Meteorology, 9/E; Pearson Education.
- Moran J M and M D Morgan (1994), Meteorology, 4/e, Macmillan
SIXTH SEMESTER

Quantum Mechanics 3-0


Books Recommended:

Astrophysics 3-0


Books Recommended:
- M. Peterson, B. Ryden, (2009), Foundations of Astrophysics.
Space Flight Dynamics-II


Books Recommended:
- Birhauser Tewari A (2007), Atmospheric and Space Flight Dynamics
- Schmidt L. V. (1998), Introduction to Aircraft Flight Dynamics, AIAA Education Series
- William E. Wiesel (2010), Spaceflight Dynamics

Analog and Digital Electronics

Analog Electronics
P-N Junction, Diode, Amplifiers, h and y parameters, Oscillators, Op-Amp based filters, FET, MOSFET, IGFET, Transistor, Classification of amplifiers

Digital Electronics
Different number systems and their inter-conversions, different codes. Basic Logic Gates, Boolean algebra, Truth Tables, Karnaugh Map Minimization, Combinational Logic devices. Combinational Logic Devices: Adder, Subtractor, Decoders, Encoders and Multiplexers-Demultiplexers, Flip Flops, Sequential logic circuits (Registers Counters, A to D and D to A converters), Programmable Logic Devices.

Recommended Books:
- Malvino, (2001), Digital Fundamentals
- Lloyd R. Fortney, (2005), Principles of Electronics: Analog and Digital

**Recommended Books:**
- Tyler, (1996), Celestial Navigation
- B. Hofmann-Wellenhof and H. Lichtenegger (2007), GNSS
- P. Groves, (2008), Principles of GNSS, Inertial and Multi-sensor integrated navigation systems

**Research Methodology**

Introduction to Research, Types of Research, Research Problem, Review of Related Literature, Research Hypothesis or Questions, Sampling, Research Instruments, Research Types (Detail Description), Collection and Analysis of Data, Statistics in Science, Writing Research Proposals and Reports, Evaluation Criteria.
**Recommended Books:**


**SEVENTH SEMESTER**

**Space Mission Design**

3-0

Fundamentals of systems engineering, identification and problems definition, Synthesis, analysis, and evaluation activities during conceptual and preliminary system design phases, Articulation through examples and case studies, Real-world application of the entire space systems engineering discipline, Basic mission objectives and principles and practical methods for mission design and operations in depth. Interactive discussions focus on initial requirements definition, operations concept development, architecture tradeoffs, payload design, bus sizing, subsystem definition, system manufacturing, verification and operations.

**Recommended Books:**

- W. Larson and J. Wertz, (1999), Space Mission Analysis and Design
- J. J. Pocha (1987), An introduction to mission design for geostationary satellites
- M. Griffin, R. French (2004), Space Vehicle Design
- Rudolph X. Meyer, (1999), Elements of Space Technology

**Semiconductor Device Fabrication**

2-1

Fabrication Techniques, Formation of Thin Films, Binary, tertiary, ternary compounds, Simple evaporation techniques, Chemical vapor, Molecular Beam Epitaxy (MBE), Molecular Orbital Chemical, Vapor Deposition (MOCVD).
Recommended Books:
• M. Sze and Ming-Kwei Lee (2012), Semiconductor Devices: Physics and Technology
• Sima Dimitrijev (2011), Principles of Semiconductor Devices
• S. H. Naygi, (2001), Semiconductors
• S. M. Zhe, (1998), Semiconductor Devices

Elective-I 2-1
Elective-II 2-1
Projects/Thesis 0-3

EIGHTH SEMESTER
Seminar 0-3
Social Science-II (Elective-II/ Foreign Language/ Space Law) 3-0
Elective-III 3-0
Elective-IV 3-0
Project/Thesis 0-3

ELECTIVES:

GeolInformatics (GI)
1. Remote Sensing Applications
2. GeolInformatics for Environmental applications
3. GIS Customization for Web Based applications
4. Decision Support System
5. Natural Resource Management
6. GIS for Urban Planning
7. Disaster Monitoring and Management
8. Air and Space-Borne Sensors
9. Photogrammetry Analysis
10. Special Topics in GeolInformatics

Atmospheric and Environmental Sciences (AES)
1. Weather Analysis and Forecasting
2. Numerical Weather Modeling and Prediction
3. Radar/Satellite Meteorology
4. Atmospheric Dynamics
5. Climate Change
6. Atmosphere Phenomena Modeling
7. Geomagnetism and Seismology
8. Oceanography and Ocean Wave Dynamics
9. Physics and Chemistry of Aerosols
10. Physics and Chemistry of Upper Atmosphere
11. Special Topics in Atmospheric Sciences

Satellite and Space Communication (SSC)
1. Radar Technology
2. Data Communication and Networks
3. Navigation and Satellite Positioning
4. RF Engineering
5. Analog and Digital Signal Processing
6. Advanced Orbital Mechanics
7. Space Medicines and Life Support Systems
8. Spacecraft System Engineering
9. Satellite Communication Systems
10. Satellite Launch Systems
11. Software Defined Radio
13. Rocket and Spacecraft Propulsion
14. Material Applications for Space Technology
15. Astrobiology and Extraterrestrial Life
16. Special Topics in Space Systems

**Space Physics (SP)**
1. Astrophysical Techniques
2. Solar System Astrophysics
3. Stellar Astronomy
4. High Energy Astrophysics
5. Magnetospheric Physics
6. Plasma Dynamics
7. Analysis and Interpretation of Space Data
8. Radio Astronomy
9. Computational Astrophysics
10. Electrodynamics
11. Cosmology
12. Asteroids, Meteorites, Comets
13. Solar-Terrestrial Physics
14. Magnetohydrodynamics (MHD)
15. Vacuum Science and Technology
16. Special Topics in Astronomy/ Astrophysics: Seminars

**Note:**
- The above curriculum is a guideline. The institutes should prepare their own detailed course contents as per requirement.
- Latest editions of the books/ teaching material should preferably be followed.
- Currency and recency of the literature should be maintained.
SCHEME OF STUDIES
MS (2-Year) in Space Sciences

Duration: 2-years (4-semesters)

Eligibility Criteria

- BS (Space Sciences) from any recognized university
- B.S./ B.E. (Electrical/Electronics/Computer Science/Photonics/Optronics/ Mechanical/Mechatronics/Aerospace/Aeronautics/Avionics/Robotics) alongwith Physics and Math.
- MSc. (Space Sciences) with deficiency courses, if any.
- MSc. Physics/Math or any other equivalent having 16-year education with deficiency courses.
- BS Ed. (16-years) with Physics and Math.

Credit Hours
Committee proposes 30 (24+6) Credit Hours for the award of MS (Space Sciences) degree.

Scheme of Studies

<table>
<thead>
<tr>
<th>Semester/Year</th>
<th>Name of Subject</th>
<th>Lec-CH</th>
<th>Lab-CH</th>
<th>Total CH</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>Modeling and Simulation Techniques</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Advanced Research Methods</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Core-I</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective-I</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>12</strong></td>
</tr>
<tr>
<td>Second</td>
<td>Core-II</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective-II</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective-III</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Elective-IV</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>12</strong></td>
</tr>
<tr>
<td>Third</td>
<td>Thesis</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Fourth</td>
<td>Thesis</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>

Note: Maximum “Two Elective Courses” may be opted from any module.
DETAIL OF COURSES

Course Contents:

Compulsory Courses (6)

Modeling and Simulation Techniques 1-2

Overview of MATLAB, Simulink and other supporting software tools, Modeling and numerical simulation for deterministic, stochastic, deterministic and stochastic dynamical systems using numerical solution methods, Overview and Definitions; mathematical physical modeling/simulation by means of ordinary and partial physical modeling/simulation by means of ordinary and partial Differential equations, random processes, semi-stochastic equations, discrete differential equations, random processes, semi-discrete stochastic equations, Machines; empirical modeling/simulation using linear regression, weak and Machines; weak empirical modeling/simulation using linear regression and highly non-linear regression, neural networks

Recommended Books:

- Palm, (2004), Introduction to MATLAB 7 for Engineers.

Advanced Research Methods 3-0

Introduction to Research, Research Problem, Review of Related Literature, Research Hypothesis or Questions, Sampling, Research Instruments, Research Types (Detail Description), Skills and knowledge required to pursue any research/scientific study/investigation, collection and analysis of data, qualitative and quantitative measurement techniques, surveys and sampling procedures, data interpretation and analysis, writing Research Proposals and Reports, Evaluation Criteria. Standards methods and steps followed in any research activity right from the evolution of idea, validation of results and accuracy assessment. Focus on the research undertakings in the field of Space Science.
Recommended Books:

List of Core Courses

GeoInformatics 2-1

In depth understanding of image processing, analysis and interpretation. Topics include human vision and colour, the construction, arithmetic operations, empirically based image transformations, filtering of images, discrete Fourier transformations, principal components analysis, and spatial modeling, advanced image classifications such as fuzzy classifications, neural classifiers, spatial and spectral segmentation, sub pixel classification. SAR interferometry, applications of SAR interferometry, image spectrometry, Feature Extraction from Hyperspectral data, Image Residuals, Spectral Fingerprints, Absorption-band Parameters, Spectral Derivative Ratio, Classification Algorithms for Hyperspectral Data, radar remote sensing, speckle noise and suppression, texture analysis, data Fusion, DEM extraction from stereo SAR. Computer-based exercises are an essential part of this course, Application of photogrammetry, geographic information systems, and cartography. Theory and techniques for statistical analysis of point patterns, spatially continuous data, and data in spatial zones.

Lab:
Image Composition Development for Multi Spectral, Image Enhancement and Filters, Image Fusions, Image Classification: Supervised and Unsupervised Classification, Classification Schemes, Indices Development: Normalized Difference Vegetation Index, Leaf Area Index in ERDAS Imagine, Hyperspectral Imaging, Microwave Applications.
Recommended Books:

Astrodynamics

Space-Vehicle Attitude Control: typical sensor and actuator devices, strategies for attitude control, application of classical control. Launch Vehicle Considerations: various rocket configurations, staging, ascent to orbit. Additional topics may be covered as time permits.

**Recommended Books:**

**Space and Satellite Communication**


Principles of Satellite Communication, Electromagnetic Spectrum, Interactions of Microwaves with Atmosphere, Communication Satellite System and Sub-Systems (Attitude and orbit control system), Telemetry, Tracking and Command (TTandC) Power Sub-System, Communication Sub-Systems, Spacecraft Antenna, Satellite Link Design (Basic transmission theory, RF Links, Optimization of RF Link, System Noise Temperature, Noise Figure, G/T Ratio, Down/Uplink Design and Complete Link Budget for LEO, MEO and GEO Satellites), Earth Station Parameters, Base Band Formation, Multiple Access Techniques, Post-launch space operations, Virtual Ground Station Development, Special Purpose Communication Satellites (DBS, INMARSAT, VSAT, SARSAT and LEO Satellites etc.).

**Recommended Books:**
• C. A. Balanis (2005) “Antenna Theory Analysis and Design”
• C. A. Balanis (Latest Ed.) “Advanced Engineering and Electromagnetics

Astrophysical Techniques


Recommended Books:
Atmospheric Sciences


Recommended Books:
- Frederick J. E. (2008), Principles of Atmospheric Sciences, Jones and Bartlett Publisher.

Atmospheric Dynamics

Momentum Equation, Scale Analysis of Equation of Motion, Continuity Equation, Thermodynamics Energy Equation, Basic Equation in Isobaric Coordinates, Vertical Motion, Circulation and Vorticity, Planetary Boundary Layer, Quasi Geostrophic Analysis, Atmospheric Waves, Baroclinic Instability, Mesoscale Circulation and General Circulation.

Recommended Books:

Advances in Space Plasma Physics

Quasilinear Theory, Non-linear wave interaction, MHD turbulence, Landau Damping, Shocks, Chaos, Vortices, Plasma Diagnostic Techniques

Books Recommended:

Recommended Books:
- James R. Wertz. (Latest Ed) Space Attitude Determination and Control, Edited Published by D. Reidel Publishing Company.
- Timodthy Pratt, Charles W. Bostian, (1986), Satellite Communication, John Wiley and Sons, N.Y
Electives’ Modules (Select 2 courses from any module):

<table>
<thead>
<tr>
<th>Module 1: (Advanced GeoInformatics)</th>
<th>CH</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Advanced GeoInformatics</td>
<td>3</td>
</tr>
<tr>
<td>2. Photogrammetry</td>
<td>3</td>
</tr>
<tr>
<td>3. Advanced Digital Image Processing</td>
<td>3</td>
</tr>
<tr>
<td>4. GIS Customization</td>
<td>3</td>
</tr>
<tr>
<td>5. GeoInformatics Applications</td>
<td>3</td>
</tr>
<tr>
<td>6. Selected Topics In Geomatics/GeoInformatics</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 2: (Specialization in Astrodynamics)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Orbital Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>2. Flight Dynamics and Control</td>
<td>3</td>
</tr>
<tr>
<td>3. Flight structure</td>
<td>3</td>
</tr>
<tr>
<td>4. Space Materials</td>
<td>3</td>
</tr>
<tr>
<td>5. Guidance Navigation and Control</td>
<td>3</td>
</tr>
<tr>
<td>6. Selected Topics In Astrodynamics</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 3: (Space and Satellite Communications)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Space Mission Analysis</td>
<td>3</td>
</tr>
<tr>
<td>2. Spacecraft Operations</td>
<td>3</td>
</tr>
<tr>
<td>3. System Engineering in Aerospace Applications</td>
<td>3</td>
</tr>
<tr>
<td>4. Space Instrumentation and Applications</td>
<td>3</td>
</tr>
<tr>
<td>5. Space Data Systems and Processing</td>
<td>3</td>
</tr>
<tr>
<td>6. Rocket and Spacecraft Propulsion</td>
<td>3</td>
</tr>
<tr>
<td>7. Selected Topics In Space and Satellite Communications</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 4: (Astrophysics)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Relativistic Quantum Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>2. Advanced Cosmology</td>
<td>3</td>
</tr>
<tr>
<td>3. Group Theoretical Techniques</td>
<td>3</td>
</tr>
<tr>
<td>4. Gravitational Physics</td>
<td>3</td>
</tr>
<tr>
<td>5. Galactic Simulation</td>
<td>3</td>
</tr>
<tr>
<td>6. Stellar and Galactic Astrophysics</td>
<td>3</td>
</tr>
<tr>
<td>7. Selected Topics In Astrophysics</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Module 5: (Atmospheric &amp; Environmental Sciences)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Weather analysis and forecasting</td>
<td>3</td>
</tr>
<tr>
<td>2. Numerical Weather Modeling and Predictions</td>
<td>3</td>
</tr>
<tr>
<td>3. Climate Change Modeling</td>
<td>3</td>
</tr>
<tr>
<td>4. Environmental Sciences</td>
<td>3</td>
</tr>
<tr>
<td>5. Atmospheric Chemistry</td>
<td>3</td>
</tr>
<tr>
<td>6. Hydrology</td>
<td>3</td>
</tr>
<tr>
<td>7. Selected Topics in Atmospheric Sciences</td>
<td>3</td>
</tr>
</tbody>
</table>

**Thesis:** 6
Annex “A”

COMPULSORY COURSES IN ENGLISH FOR BE/BS IN ENGINEERING DISCIPLINE

Semester-I

Functional English

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
- Transitive and intransitive verbs
- Punctuation and spelling

Comprehension
Answers to questions on a given text

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

Note: Extensive reading is required for vocabulary building

Recommended Books:

1. Functional English
   a) Grammar
b) Writing

c) Reading/Comprehension

d) Speaking

SEMESTER II

Communication Skills

Objectives:
To 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 and minutes of the meeting, use of library and internet recourses

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

Note: documentaries to be shown for discussion and review
Recommended Books: 
Communication Skills

a) Grammar

b) Writing

c) Reading
2. John Langan, (Latest Edition), Reading and Study Skills

Semester III

Technical Writing and Presentation Skills

Objectives:
To enable the students to write a research paper/technical report in a succinct manner according to a specified format.

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

Note: Extensive reading is required for vocabulary building
Recommended Books:

Technical Writing and Presentation Skills

a) Essay Writing and Academic Writing

Presentation Skills

Reading

<table>
<thead>
<tr>
<th>NAM OF COURSE</th>
<th>ISLAMIC STUDIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>CREDIT HOURS</td>
<td>2</td>
</tr>
<tr>
<td>TOTAL TEACHING</td>
<td>16 WEEKS</td>
</tr>
<tr>
<td>PERIOD OF COURSE</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COURSE OBJECTIVES:</th>
<th>This course is aimed at:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>providing Basic information about Islamic Studies</td>
</tr>
<tr>
<td>2.</td>
<td>enhancing understanding of the students regarding Islamic Civilization</td>
</tr>
<tr>
<td>3.</td>
<td>improving Students skill to perform prayers and other worships</td>
</tr>
<tr>
<td>4.</td>
<td>enhancing the skill of the students for understanding of issues related to faith and religious life.</td>
</tr>
</tbody>
</table>

UNIT NO.1: INTRODUCTION TO QURANIC STUDIES

Basic Concepts of the Holy Quran
History of the Quran
Ulum-ul -Quran

UNIT No.2: STUDY OF SELECTED TEXT OF HOLLY QURAN

Verses of Surah Al-Baqra Related to Faith (Verse No-284-286)
Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
Verses of Surah Al-Inam Related to Ihkam (Verse No-152-154)

UNIT No.3: STUDY OF SELECTED TEXT OF THE HOLLY QURAN

Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.)
Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No-1,14)

UNIT NO.4: SEERAT OF HOLY PROPHET (S.A.W) I

Life of Muhammad Bin Abdullah (Before Prophet Hood)
Life of the Holy Prophet (S.A.W) in Makkah
Important Lessons Derived from the life of Holy Prophet in Makkah

UNIT NO. 5: SEERAT OF HOLY PROPHET (S.A.W) II

Life of Holy Prophet (S.A.W) in Madina
Important Events of Life Holy Prophet in Madina
Important Lessons Derived from the life of Holy Prophet in Madina

UNIT NO. 6: INTRODUCTION TO SUNNAH
Basic Concepts of Hadith
History of Hadith
Kinds of Hadith
Uloom-ul-Hadith
Sunnah and Hadith
Legal Position of Sunnah

UNIT NO. 7: SELECTED STUDY FROM TEXT OF HADITH

UNIT NO. 8: INTRODUCTION TO ISLAMIC LAW AND JURISPRUDENCE
Basic Concepts of Islamic Law and Jurisprudence
History and Importance of Islamic Law and Jurisprudence
Sources of Islamic Law and Jurisprudence
Nature of Differences in Islamic Law
Islam and Sectarianism

UNIT NO. 9: ISLAMIC CULTURE AND CIVILIZATION
Basic Concepts of Islamic Culture and Civilization
Historical Development of Islamic Culture and Civilization
Characteristics of Islamic Culture and Civilization
Islamic Culture and Civilization and Contemporary Issues

UNIT NO. 10: ISLAM AND SCIENCE
Basic Concepts of Islam and Science
Contributions of Muslims in the Development of Science
Quranic and Science

UNIT NO. 11: ISLAMIC ECONOMIC SYSTEM
Basic Concepts of Islamic Economic System
Means of Distribution of wealth in Islamic Economics
Islamic Concept of Riba
Islamic Ways of Trade and Commerce

UNIT NO. 12: POLITICAL SYSTEM OF ISLAM
Basic Concepts of Islamic Political System
Islamic Concept of Sovereignty
Basic Institutions of Govt. in Islam
UNIT NO.13: ISLAMIC HISTORY

PERIOD OF KHLAFT-E-RASHIDA
PERIOD OF UMMAYYADS
PERIOD OF ABBASIDS

UNIT NO.14: SOCIAL SYSTEM OF ISLAM

BASIC CONCEPTS OF SOCIAL SYSTEM OF ISLAM
ELEMENTS OF FAMILY
ETHICAL VALUES OF ISLAM

Recommended Books:

1. Hameed Ullah Muhammad, “Emergence of Islam” , IRI, islamabad
2. Hameed Ullah Muhammad, “Muslim Conduct of State”
3. Hameed Ullah Muhammad, ‘Introduction to Islam
5. Ahmad Hasan, “Principles of Islamic Jurisprudence” Islamic Research Institute, international Islamic University, Islamabad (1993)
Pakistan Studies (Compulsory)
(As Compulsory Subject for Degree Students)

Introduction/Objectives
The course has been designed as a compulsory subject for the students studying for Bachelor’s degree, general or professional. The course is of 2 credit hours carrying 100 marks (recommended). The teaching work is comprised of three dimensions: Historical Perspective (20%); Government and Politics (40%); and Contemporary Pakistan (40%). The course framework is issue-oriented. It has many dimensions, the historical and ideological background of Pakistan, the process of governance and national development as well as the issues arising in the modern, age and posing challenges to Pakistan. The course has been designed with a vision that Pakistan Studies should open a window to future.

Course Outline:

Historical Perspective
Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-e-Azam Muhammad 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
• 1999 onward

Contemporary Pakistan
Economic institutions and issues, Society and social structure, Ethnicity, Foreign policy of Pakistan and challenges, Futuristic outlook of Pakistan.

Recommended Books:
RECOMMENDATIONS/SUGGESTIONS

To cater the current/ future needs of the academic and research institutions for the socio-economic uplift of the country, the National Curriculum Revision Committee (NCRC) of the Higher Education Commission in Space Science put forward the following recommendations:

1. It is recommended that in under-graduate courses of natural / applied sciences, basic knowledge of Space Science may be incorporated to broaden the field of specialization.

2. Students should be encouraged to take basic courses in Space Science for their special applications in robotics and related micro-processor control applications.

3. Institutions should be equipped with Astronomical, Space & Earth observations and other related Space Science lab facilities for fulfilling the teaching and research requirements.

4. The information on current trends of research in Space Sciences should be disseminated to the public/private sector universities.

5. Public awareness/outreach programmes like Sky-watch/Star-gazing shows, World Space Week should be organized by utilizing existing facilities/planetaria and by arranging space days/weeks, seminars, quizzes etc.

6. University and school teachers should be trained on various software tools that are in-use in different fields of Space Sciences via providing them hands-on trainings.

7. The revised curricula would offer flexibility to universities/institutions. The committee recommended that universities should offer such courses from the list of electives to prepare graduates in such a way that they are accepted by other institutions for further studies and placement.

8. Fundamental topics in Space Sciences may be introduced at Matric and Intermediate levels (including Mada'ris).

9. Interaction / collaboration among universities and the relevant research & development (R&D) organizations like, SUPARCO, NESCOM, NESPAK, NCP, PTA, CAA, PIA, WAPDA, IWASRI, IIMI, EPA, SSOP, OGDCL, GSP, SOP, PAEC, Urban Unit, PCRWR etc. for workshops / seminars / lectures on current topics of Space Science.

10. National and international institutions / R&D organizations should be approached to share their technical resources (labs, data, instruments,
human expertise, etc), collaborative studies / projects / theses, as well as split study programs.

10. The committee recommends extending the existing MS Space Sciences program to “MS Leading to PhD”.

11. Committee also recommends the use of Space Science & Technology to address and resolve indigenous / regional, social and environmental issues.

12. The committee strongly recommends renaming the discipline from “Space Sciences” to “Space Science and Technology”. This has been proposed in the wake of the meaning and scope of technology which would open new avenues of applications for the students and enhance the scope of the subject in Pakistan and abroad.

13. To bring at par the knowledge-base in the field of Space Science and allied disciplines with the space faring nations, the committee strongly proposed to establish a National Centre of Excellence in Space Science.

15. The committee proposed to establish a society namely “Pakistan Space Science Society (PASSS)” to make associations among space scientists.