

1968 / A.S-II
29/11/13

5062-CA
27.11.2013

UNIVERSITY OF THE PUNJAB

NOTIFICATION

It is hereby notified that the Syndicate at its meeting held on 12-10-2013 has approved the recommendations of the Academic Council made at its meeting dated 03-07-2013 regarding approval of the Revised Syllabi & Courses of Reading for 2-Years M.Sc. in Space Science under Annual System with effect from the Academic Session 2013-2015.

The Revised Syllabi & Courses of Reading for M.Sc. in Space Science is attached herewith, vide Annexure 'A'.

Admin. Block,
Quaid-i-Azam Campus,
Lahore.

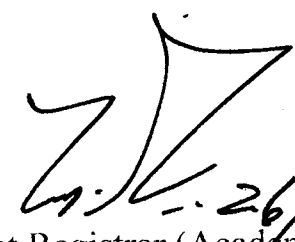
Sd/-
Prof. Dr. Khan Rass Masood
Registrar

No. D/ S702 /Acad.

Dated: 26-11- /2013.

Copy of the above is forwarded to the following for information and further necessary action: -

1. The Dean, Faculty of Science.
2. The Chairman, Department of Space Science.
3. Members of the Board of Studies.
- ✓ 4. Controller of Examinations.
5. Deputy Controller (Computer).
6. Secretary to the Vice-Chancellor.
7. P.S. to Registrar.
8. Assistant Syllabus.


26/11/2013
Assistant Registrar (Academic)
for Registrar

A
28-11-13
DCS
Ad 311
A/S
2-12-13
Mr Rizwan
2/12/13

M.Sc in Space Science*

Outline of Courses for M.Sc. (Space Science)

Part-I

Paper	Paper Title	Marks
Paper I	Mathematical Techniques and Quantum Mechanics	100
Paper II	Meteorology and Climatology	100
Paper III	Astronomy	100
Paper IV	Electronics	100
Paper V	Remote Sensing and Image Processing	100
Paper VI	Space Science Lab	50
Paper VII	Electronics Lab	50
Total (Part-I)		600

Part-II

Paper	Paper Title	Marks
Paper I	Astrophysics & Cosmology	100
Paper II	Electrodynamics and Space Plasma	100
Paper III	Telecommunication and Satellite Communication	100
Paper IV	Space Systems and their Applications	100
Paper V	Programming Language Lab	50

In addition to the above five compulsory papers, each candidate will have to opt anyone of the following specializations:

1. **Remote Sensing & GIS**

Paper VI	Geographic Information System (GIS)	100
Paper VII	Image Processing and GIS Lab	50

2. **Weather Forecasting & Climate Change**

Paper VIII	Weather Forecasting	75
Paper IX	Climate Change	75

3. **Astrophysical Techniques**

Paper X	Stellar Astrophysics	75
Paper XI	Galactic Astrophysics	75

4. **Thesis****

150

Total (Part-II)

600

* To be implemented w.e.f. the session 2013-2015

**The title of the thesis will be related to any field of Space Science.

Outline of Courses for M.Sc. (Space Science) Part-I

PAPER-I:	MATHEMATICAL TECHNIQUES AND QUANTUM MECHANICS
-----------------	--

Note: The candidate will have to attempt at least two questions from each section.

SECTION-I: MATHEMATICAL TECHNIQUES

Spherical and Cylindrical Co-ordinates, Co-ordinate Transformations, Functions of Complex Variables, Analytic Functions, Cauchy's Theorem, Cauchy's Integral Formula, Taylor and Laurent Series, Linear Differential Equations, Power Series Solution, Frobenius Method, Partial Differential Equations, Wave Equation, Laplace Equation, Heat Equation, Boundary Value Problems, Bessel and Legendre Functions, Calculus of Variation, Euler Lagrange Equation, Fourier Series, Fourier Transforms and Laplace Transforms.

SECTION-II: QUANTUM MECHANICS

Schrodinger Equation and its Applications, Potential Step, Potential Well and Potential Barrier Problems, Harmonic Oscillator, Hydrogen-Like Atoms, Uncertainty Principle, Expectation Values, Equation of Continuity, Angular Momentum, The Eigen Values and Eigen Functions of L^2 and L_z , Spin Angular Momentum, Pauli's Matrices, Total Angular Momentum, Magnetic Moment, Zeeman Effect, Time Independent Perturbation Theory for Non-Degenerate Case, First and Second Order Corrections to Eigen Values and Eigen Functions.

Books Recommended:

1. Butkov E., 1973, *Mathematical Physics*, Addison-Wesley Publishing Company.
2. Arfken G. 2001, *Mathematical Methods for Physicists*, 5th Edition, Academic Press.
3. Pipes L. A. and Harvill L. R. 1970, *Applied Mathematics for Engineers and Physicists*, McGraw Hill Book Company.
4. Potter M. C. and Goldberg J. 1991, *Mathematical Methods*, 2nd Edition, Prentice Hall
5. Gupta B. D. 1978, *Mathematical Physics*, Revised 2nd Edition, Vikas Publishing House, New Delhi.
6. Erwin Kreyszig & Don Ford, 2007, *Advanced Engineering Mathematics*, 6th Edition, John Wiley & Sons.
7. Eugene Merzbacher, 1970, *Quantum Mechanics*, 2nd Edition, John Wiley and Sons.
8. Powell J. L. and Crasemann B., (1990), *Quantum Mechanics*, 2nd Edition, Narosa Publishing House.
9. Linus Pauling and E. Bright Wilson E. B. 1994, *Introduction to Quantum Mechanics*, McGraw Hill Book Company.
10. P.C.W. Davies, 1984-87, Routledge & Kegan paul, *Quantum Mechanics*.
11. B. H. Bransden and C. J. Joachain, 1989, John Wiley & Sons, N.Y, *Introduction to Quantum Mechanics*.

PAPER-II:	METEOROLOGY AND CLIMATOLOGY
------------------	------------------------------------

Note: The candidate will have to attempt at least two questions from each section.

SECTION-I: METEOROLOGY

Atmosphere: Origin, Composition, And Structure, Solar And Terrestrial Radiation, Heat And Temperature, Humidity, Saturation, And Stability, Forms Of Condensation And Precipitation, Air Pressure, The Wind, Atmospheric Circulation, Hydrostatic Equation And Its Applications, The Clausius-Clapeyron Equation, The Poisson's Equation, Air Masses, Fronts, Cyclones, And Anticyclones, Thunderstorms And Tornadoes, Tropical Storms And Hurricanes, Weather Analysis And Forecasting, Meteorological Satellites, Interpretation Of Weather Satellite Imagery, Weather Maps.

SECTION-II: CLIMATOLOGY

Introduction To Climatology, The Climate System: The Controls On Climate, Reconstruction of Past Climate, Causes Of Climate Change, Climate Changes In Geologic History, Human Influences On Climate And The Enhanced Greenhouse Effect, The Impacts Of Climate Change, Climate Classification, Modeling The Climate Change, Observations Of Climate, Satellite Clouds Climatologies,

Books Recommended:

1. *Bioclimatology and Natural Hazards Katar'ina St'relcov'a · Csaba M'aty'as · Axel Kleidon · Milan Lapin · František Matejka · Miroslav la'zenec · Jaroslav Škvarenina · J'an Hol'ecy* (Eds.) (2009)
2. Barrie Pittock, (2009), *Climate Change : the science, impacts and solutions*, 2nd Edn. Csiro Publishing
3. Andrews, D. G., (2000), *An Introduction to Atmospheric Physics*, 1st Edn. Cambridge University Press, Cambridge. 229 pp.
4. Tsonis, A. A, (2002), *An Introduction to Atmospheric Thermodynamics*. 1st Edn. Cambridge University Press, Cambridge. 171 pp.
5. Donald, A. C., (2000), *Meteorology Today*, Sixth Edn. Brooks/Cole, New York. 528 pp.
6. Houghton, J, (2002), *The Physics of Atmospheres*,. 1st Edn. Cambridge University Press, Cambridge. 320 pp.

PAPER-III:	ASTRONOMY
------------	-----------

Note: The candidate will have to attempt at least one questions from each section.

SECTION-I: SPECIAL RELATIVITY

Galileon Transformation, Lorentz Transformation, Consequences of Lorentz Transformation, Transformation Laws for Velocity and Acceleration, Minkowski Space, Four-Vectors, Intervals and Light Cone, Proper Time, Position 4-Vector, 4-Velocity and 4- Momentum, 4-Force and Equation of Motion, Motion under a Constant Force, Einstein's Mass-Energy Relationship and its Practical Examples, Motion of a Charged Particle in Transverse Electric and Magnetic Fields, Particles of Zero Rest Mass, Compton Effect, Emission of a Photon from an Excited Nucleus, Relativistic Optics, Doppler Effect, Aberration of Light, Tachyons.

SECTION-II: SPHERICAL ASTRONOMY

Spherical Trigonometry, The Earth, The Celestial Sphere, Horizontal and Equatorial Systems of Coordinates, Rising and Setting Times, The Ecliptic and Right Ascension, Perturbations of Coordinates, Positional Astronomy, Sidereal and Solar Times, Astronomical Time Systems, The Equation of Time, Motions of Celestial Bodies, Equation of Motion, Equation of the Orbit, Orbital Elements and Kepler's Laws, Position in the Orbit, Escape Velocity.

SECTION-III: SOLAR SYSTEM ASTRONOMY

Some Basic Concepts, Distances and Directions, The Visible Sky, Constellations, Angular Measurements, Parallax, The Earth-Moon System, Physical Properties of Earth and Moon. The Planets, Terrestrial Planets, Jovian Planets, Planetary Rings, Small Bodies in the Solar System (Asteroids and Comets, Meteors and Meteorites), Theories of Origin of Solar System, Physical Structure and Properties of the Sun, The Pressure and Temperature of Solar Interior, The Gravitational and Nuclear Energy.

Books Recommended:

1. Special Relativity by M. Saleem and M. Rafique, Ellis Horwood, London, Redwood Press Melksham, (1992).
2. Introduction to Einstein's Relativity by R. D'Inverno, Oxford University Press.
3. Introductory Special Relativity by W.V.G. Rosser, Taylor and Francis, (1991).
4. Relativity Theory – Concepts and Basic Principles, Amos Harpaz, Jones and Bartlett Publishers, Boston (1992).
5. The Special Theory of Relativity, Sriranjana Banerji and Asit Banerjee, Printice Hall of India (2002).
6. Foundation of Astrophysics by Barbra Ryden and B. M. Peterson, Addison-Wesley. (2010)
7. Universe by W. J. Kaufmann, W. H. Freeman and Company, New York. (1985).
8. Astronomy-The Cosmic Perspective by M. Zeilik and J. Gaustad, John Wiley & Sons. (1990).
9. Astronomy Today, McMillan, 5th edition, 2005.
10. Fundamental Astronomy, H. Karttunen et al., , Springer, 2000, 3rd Edition.
11. Introductory Astronomy & Astrophysics by M. Zeilik and S. A. Gregory, Saunders College Publishing, (1998), 4th Edition.

12. In Quest of the Universe by K. F. Kuhn and T. Koupelis, USA, Jones and Bartlett Publishers, (2001), 3rd Edition.
13. Astrophysical Concepts by Martin Harwit, Springer-Verlag, John Wiley & Sons, N.Y, (1998), 3rd Edition.
14. Cosmology – The Structure and Evolution of the Universe by G. Contopoulos and D. Kotsakis, Springer-Verlag, (1987), 2nd Edition.
15. Discovering the Universe by W. J. Kaufmann, W.H.Freeman and Company, New York (1997), 4th Edition.
16. Fundamental Astronomy by H. Karttunen et al.
17. W. M. Smart, Foundations of Astronomy, Longmans, Green and Company.
18. E. Roy and D. Clarke, Astronomy: Principles and Practice, Adam Higher Ltd., Bristol, 1977.
19. Michael Zeilik and John Gaustad, Astronomy: The Cosmic Perspective, Second Edition, John Wiley & Sons Inc. 1990.
20. H. Karttunen, P. Kroger, H. Oja, M. Poutanen, K. J. Donner, Fundamental Astronomy, Third Revised and Enlarged Edition, Springer, 2000.

PAPER-IV:	ELECTRONICS
------------------	--------------------

Note: The candidate will have to attempt at least two questions from each section.

SECTION-I ANALOGUE ELECTRONICS

Semiconductor materials, Semiconductor diode, diode characteristic curves, Zener diode construction, working and its applications, Introduction to Transistors, Transistor Construction PNP/NPN Transistors, Transistor Operation and Testing, Load Line & Operating Point, DC Bias Circuits for Transistor, CE, CB and CC Transistor Amplifiers, Classes of Amplification (class A, Class B, class C), FETs, Types of FETs, Load Line and Four Resistance Biasing of FETs, FET Amplifiers, Operational Amplifier, Ideal OP AMP, Differential Mode and Common Mode Operation, Operational Amplifier Parameters, Applications of OP AMP, Principle of Oscillation, RC, Hartley, Colpitts and Crystal Oscillators, Multivibrators, Astable, Mono-stable and Bi-Stable Multivibrators.

SECTION-II: DIGITAL ELECTRONICS

Number Systems and their inter-conversion, Floating-Point Number Systems, Alphanumeric Codes, Fundamental Concepts of Boolean Algebra, Basic Laws of Boolean Algebra, Logic Gates, De Morgan's Theorem, Derivation of a Boolean Expressions, NAND and NOR Gates and their logic, Map Method for Simplifying Expressions, Product-of-Sums Expressions, IC Logic Families, Data sheet interpretation, Latches and Flip-Flops, Clocks, Registers, Binary Counter, BCD Counters, Counter Design, State Diagrams and State Tables, Sequential Circuits, Shift Registers, Binary Half/Full Adders, Half/Full Subtractor, Multiplexers, Demultiplexers, Coders, Decoders, Code Conversion, Parity Generators/Checkers, Memory Concept, ROMs, PROMs, EPROMs, Special Memories, Microcomputer Memory, Programmable Logic Devices, PLDs, CPLDs, FPGAs, Programming Microcontroller/PLDs/CPLDs/FPGAs.

Books Recommended:

1. Louis Nashelsky, 1977, *Introduction to Digital Technology*, Prentice Hall.
2. M. Moris Mano, 2005, *Digital Logic and Computer Design*, Prentice Hall.
3. Hayes, 1998 *Computer Architecture and organizations*, McGraw-Hill.
4. T.c., Bartee, 1991, *Computer Architecture and Logic Design*, McGraw-Hill.
5. McClusky, 1986, *Logic Design*, Prentice Hall.
6. Millman and Taub, (1965), *Pulse, Digital and Switching Waveforms*, McGraw-Hill Kogakusha, Ltd. Tokyo..
7. T. L. Floyd, (1997), *Digital Fundamental* 6th Edition, Prentice Hall.
8. Millman and Halkias, (1972), *Integrated Electronics*, Mc Graw-Hill, Singapore,
9. J. D. Ryder, (1976), *Electronics circuit & System*, Prentice Hall Nc, New Jersey.
10. Floyd, *Digital Electronics*, Macmillan Publishing Company.
11. T. L. Floyd, (1997), *Digital Fundamental* 6th Edition, Prentice Hall.
12. T. Dankin 1990, *Basic Electronics*.

13. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, *The 8051 Microcontroller and Embedded Systems Using Assembly and C*, 2008
14. Clive Max Maxfield, 2004, *The Design Warrior's Guide to FPGAs, Devices, Tools and Flows*, Elsevier, USA.

PAPER V:	REMOTE SENSING AND IMAGE PROCESSING
-----------------	--

Note: The candidate will have to attempt at least two questions from each section.

SECTION-I: REMOTE SENSING

Introduction to Remote Sensing, Principle of Remote Sensing: Ideal and Real Remote Sensing Model, Source: EMR, Interaction with Atmosphere: Scattering of EMR, Absorption of EMR, Transmission of EMR, Atmospheric Windows, Interaction with Earth: Absorption of EMR, Reflection of EMR, Spectral Signatures, Methods to obtain Spectral Signatures, Platforms and Sensors: Different Satellite Systems e.g. LANDSAT, SPOT, TERRA, IKONOS, QUICK BIRD etc, Classification of Sensors, Working Mechanism of Sensors e.g. Push broom, Wisk broom, Circular Scanner, MSS, TM, ETM+, CCD, Radiometers, Spectrometers etc, Satellite Image Characteristics: Modes of Images e.g. Multi-Spectral, Panchromatic, Hyper-spectral images Resolutions i.e. Spatial, Spectral, Temporal, Radiometric, Colour Models: Primary Colours, Secondary Colours RGB to HIS Conversion, Visual Image Interpretation: Band Combinations, Elements of Visual Interpretation.

SECTION-I: IMAGE PROCESSING

Image Statistics Multivariate Statistics Tools, i.e. Histogram, Scatter gram, Image Pre-Processing Image Rectification: Radiometric Correction, Geometric Correction, Image Enhancement: Spatial Enhancement e.g. convolution filtering, edge detection algorithms, Spectral Enhancement e.g. grey level transformations (histogram stretch, linear stretch), histogram equalization. Image Transformation: Indices, Band Ratios, Principle Component Analysis, Image Post-Processing: Image Classification (Segmentation), Supervised and Unsupervised Classification, Other Classification Techniques e.g. Hybrid Technique etc. Digital Change Detection, Change Detection Algorithms. Applications of Remote Sensing: Agriculture, Forestry, Glaciology, Geology, Hydrology and Urban Applications.

Books Recommended:

1. Thomas D.Rabenhorst and Paul D.McDermott, (1989), *Introduction to Remote Sensing*, Merrill Publishing Co.
2. Lillesand / Kiefer, John Wiley & Sons, (1987), *Remote Sensing and Image Interpretation*, 2nd Edition.
3. Floyd F. Sabins, W.H.Freeman, (1996), *Remote Sensing, Principles and Interpretation*, Electronic Publishing Centre.
4. *Principles of Remote Sensing* by Paul J. Curran, Longman Inc, (1985).
5. Gibson Paul.J, Routledge, (2000), *Introductory Remote Sensing: Principles and Concepts*,
6. Patel, Surindra Singh, (1992), *Principles of Remote Sensing*, 2nd Edition, Scientific Publishers.
7. Rees W.G, (2001), *Physical Principles of Remote Sensing*, 2nd Edition, Cambridge University Press.
8. C.P.Lo, (1986), *Applied Remote Sensing* Longman Scientific and Technical.
9. S.A. Drury, (1990), *A Guide to Remote Sensing*, Oxford University Press.
10. A.Mehrotra and R.K.Suri, (1994), *Remote Sensing for Environment and Forest Management*, Indus Publishing Co.N.Delhi.
11. P.J.Curran, G.M.Foody, K. Yakondratyer and Others. Taylor and Francis, (1990), *Remote Sensing of Soil and Vegetation in the USSR*.
12. J.R. Jensen, (1996), *Introductory Digital Image Processing – A Remote Sensing Perspective* Prentice Hall.

PAPER VI:	SPACE SCIENCE LAB
------------------	--------------------------

Note: The candidate will have to perform at least eight out of the following and similar experiments.

1. To determine the Critical Potential of neon gas by using Frank-Hertz tube.
2. To determine the Plank's Constant with the help of a Photo Cell.
3. Study the characteristics of Geiger Muller Tube and determine its operating voltage.

4. To determine the direction of Quibla from any place.
5. To determine the Absorption Coefficient of β particles.
6. To find the dielectric constant of some dielectric material.
7. To determine the velocity of light in free space.
8. To study the Sunspots, Rotation of the Sun and Measurement of the Radius of the Sun.
9. Study of Noise Pollution

PAPER-VII:

ELECTRONICS LAB

Note: The candidate will have to perform at least eight out of the following and similar experiments.

1. Design a Single Stage CE. Amplifier and Study its Gain, Input Impedance, Output Impedance and Frequency Response.
2. Design and Construct an RC Oscillator and Measure its Frequency.
3. Design and Construct OP AMP Inverting and Non-Inverting Amplifier Circuits.
4. Astronomical Observations.
5. Construct (Using Discrete Components) OR, AND, NOT and EX-OR Gates.
6. Construct OR, AND, NOT, EX-OR Using NAND Logic.
7. Design & Construct Half Adder and Full Adder Using Discrete Components and ICs.
8. Design & Construct Half Sub tractor and Full Sub tractor Using Discrete Components and ICs.
9. Construct and Test the Following Flip-Flops, RS, Clocked RS, D, T, JK, JK Master Slave & RS Master Slave (Using NAND Logic).
10. Design and Construct Binary Ripple Count Up and Count Down Counters.
11. Design and Construct Synchronous Fixed Modulus Counters and Synchronous Variable Modulus Counters.
12. Design and Construct Serial Input Shift Register, Parallel Input Shift Register, Shift Right/Shift Left Register.
13. Design and Construct Different Code Converters (Gray to Binary & Binary to Gray)
14. Design a Transistor Astable Multivibrator and Logic Gate Astable Multivibrator and Study the Effect of Varying Component Values.
15. Design a Transistor Monostable Multivibrator and Study the Effect of Varying Component Values.
16. Programming Microcontrollers
17. Programming PLDs and CPLDs
18. Programming FPGAs

Books Recommended:

1. Louis Nashelsky, 1977, *Introduction to Digital Technology*, Printice Hall.
2. M. Moris Mano, 2002, *Digital Logic and Computer Design*, Printice Hall.
3. Hayes, 1998, *Computer Architecture and Organization*, McGraw-Hill.
4. T.c., Bartee, 1991, *Computer Architecture and Logic Design*, McGraw-Hill.
5. McClusky 1986, *Logic Design*, Printice Hall.
6. *Pulse, Digital and Switching Waveforms* by Millman and Taub, McGraw-Hill Kogakusha, Ltd. Tokyo, (1965).
7. T. L. Floyd, (1997), *Digital Fundamental*, 6th Edition, Prentice Hall.
8. Millman and Halkias, (1972), *Integrated Electronics*, Mc Graw-Hill, Singapore.
9. J. D. Ryder, (1976), *Electronics circuit & System*, Prentice Hall Nc, New Jersey.
10. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinlay, 2008, *The 8051 Microcontroller and Embedded Systems Using Assembly and C*.
7. Clive Max Maxfield, 2004, *The design Warrior's guide to FPGAs, Devices, tools and flows*, Elsevier, USA.

Outline of Courses for M.Sc. (Space Science) Part-II

PAPER-I:	Astrophysics & Cosmology
-----------------	-------------------------------------

Note: The candidate will have to attempt at least two questions from each section.

SECTION-I: ASTROPHYSICS

Interaction of Electromagnetic Radiation with Matter, Radiation Mechanisms, Stellar Spectra, H-R Diagram, Binary Stars and Stellar Masses, Visual Binaries, Astrometric Binaries, Spectroscopic Binaries, Interstellar Medium and Star Birth, Stellar Structure, Physical Conditions, Stellar Energy Sources, Stellar Models, Stellar Evolution, Pre-Main-Sequence and Main Sequence Phase, Giant Phase, Final Stages of Evolution, Classification of Variable Stars, Pulsating and Eruptive Variables, Compact Stars, White Dwarfs, Neutron Stars and Black Holes.

SECTION-II: Cosmology

Introduction, Fundamental Observations, Cosmological Principle, Olbers Paradox, Hubble's Law, The Contents of the Universe, Cosmic Microwave Background Radiation, Gravitation and Expansion of the Universe in Newtonian Cosmology, Equivalence Principle, Relativistic Cosmology, Metrics of Space-Time, Proper Distance, Cosmic Dynamics, The Friedmann Equation, The Fluid and Acceleration Equations, Equation of State, The Cosmological Constant, History of the Universe, The Consensus Model, The Accelerating Universe, The Early Universe, The Very Early Universe.

Books Recommended:

1. Martin Harwit, (1998), *Astrophysical Concepts*, 3rd Edition, Springer-Verlag, John Wiley & Sons, N.Y.
2. Andrew Fraknoi et al., (2004), *Voyages Through the Universe*, 3rd Edition, Thomson Books/Cole.
3. Springer-Verlag, Martin Harwit, 1998, *Astrophysical Concepts*, John Wiley & Sons, N.Y., 3rd Ed.
4. W. J. Kaufmann, 1985, *Universe* H. Freeman and Company, New York.
5. M. Zeilik and J. Gaustad, 1990, *Astronomy - The Cosmic Perspective*, John Wiley & Sons.
6. M. Zeilik and S. A. Gregory, 1998, *Introductory Astronomy & Astrophysics*, 4th Ed, Saunders College Publishing.
7. G. Contopoulos and D. Kotsakis, 1987, *Cosmology - The Structure and Evolution of the Universe*, 2nd Edition, Springer-Verlag.
8. W. J. Kaufmann, 1997, *Discovering the Universe*, 4th Ed, W.H. Freeman and Company, New York.
9. Barbara Ryden, 2003, *Introduction to Cosmology*, Addison-Wesley
10. Barbara Ryden, 2010, *Foundations of astrophysics*, Addison-Wesley
11. J. M. Pasachoff, 1989, *Contemporary Astronomy*, 4th Ed, Saunders College Publishing.

PAPER-II:	ELECTRODYNAMICS AND SPACE PLASMA
------------------	---

Note: The candidate will have to attempt at least two questions from each section.

SECTION-I: ELECTRODYNAMICS

Electrostatics, Dielectric Materials, Electric Polarization, Charge and Current Density, Electric Potential, Magnetic Induction, Vector Potential and its Applications, Gauss's Law, Ampere's Law and Faraday's Law of Magnetic Induction, Four-Dimensional Operator (\square), The Conservation of Electric Charge, Maxwell's Equations, Characteristics of Electromagnetic Waves, Covariant form of Maxwell's Equations, Wave Equations in terms of Electromagnetic Potential and their Solutions, Plane Electromagnetic Waves in Free Space and their Solutions, Propagation of Electromagnetic Waves in Conducting and Non-Conducting Media, Modes of Propagation, Poynting Theorem, Plane Wave Between Two Parallel Conducting Plates, TE-Mode, TM-Mode, TEM-Mode, Laser Light, Light in Cavities, Einstein Theory of Light-Matter Interaction, Laser Applications.

SECTION-II: SPACE PLASMA

Concepts of Plasma and Temperature, Debye Shielding, The Plasma Parameter and Applications, Electrical Neutrality in a Plasma, Motion in Electric and Magnetic Fields, Motion of Charged Particles in Gravitational Field, Magnetic Mirrors, Motion in Time Varying Electric & Magnetic Fields, Adiabatic Invariants, First and Second Adiabatic Invariants, Introduction to Plasma as Fluid, Plasma and Ordinary Electromagnetics, Classical Treatment of Magnetic Materials and Dielectrics, The Fluid Equation of Motion, Complete Set of Fluid Equations, Plasma Approximation, Representation of Waves, Group Velocity, Plasma Oscillations, Electron Plasma Waves, Sound Waves, Ion Acoustic Waves, Ion and Electron Waves, Electrostatic Electron Oscillations and Ion Acoustic Waves Perpendicular to Magnetic Field B, The Lower Hybrid Frequency, Electromagnetic Waves Perpendicular to B_0 , Electromagnetic Waves Parallel to B_0 , Cut-off and Resonance, Hydromagnetic Waves, Magneto Sonic Waves, Alfvén Waves, The CMA Diagram, Diffusion and Resistivity, Solar Activity and Magnetosphere.

Books Recommended:

1. Fawwaz.J.Ulaby, (1997), *Fundamentals of Applied Electromagnetic*, Prentice Hall.
2. John. Reitz, Fredeick J.Milford, (1990), *Foundations of Electromagnetic Theory*, 6th Reprint, Narosa Publishing House, New Delhi.
3. Edward.E.Jorden & Keith Balmaiv, (1991), *Electromagnetic Waves and Radiating System*, Prentice Hall of India, 2nd Edition.
4. Paul Lorrain and Dal Carson, 1986, *Electromagnetic Fields and Waves*, CBS Publishers and Distributors, Delhi.
5. Peter W.Milonni and Joseph H. Eberly, (1991), *Lasers*, John Wiley and Sons
6. K. D. Parsad, (1996), *Antenna and Wave propagation*, 3rd Edition, Tech India Publications,.
7. J.D.Jackson, V.R.Damodaran, (1999), *Classical Electrodynamics* 3rd Edition for Wiley Eastern Ltd,.
8. F. F. Chen., 2001, *Introduction to plasma physics* (McGraw-Hill).
9. R.J.Goldston, PH Rutherford, (1995), *Introduction to plasma physics*, Institute of Physics Publishing, Bristol and Philadelphia Publishing Ltd,

PAPER-III:	TELECOMMUNICATIONS AND SATELLITE COMMUNICATIONS
-------------------	--

Note: The candidate will have to attempt at least two questions from each section.

SECTION-I: TELECOMMUNICATIONS

Basics of Electronic Communications, Signal Encoding and Modulation Techniques: Manchester, differential Manchester, RZ, NRZ, AMI, AM, FM, PM, Multiplexing Techniques: TDM, FDM, WDM, Spread Spectrum Techniques: FHSS, DSSS, CDMA, Optical Fiber Communications: optical laws, optical fibre cables, power budgeting, light sources and detectors and their characteristics, Cellular Systems: Principles, organization, frequency reuse, capacity issues, cellular operation, Mobile radio propagation effects, Introduction to Data Communications: Codes of transmission, Networks, topologies, modes of communications, modems, Transmission Media: copper, coaxial, optical, satellite, Antenna Theory, Basics of Radar Systems.

SECTION-II: SATELLITE COMMUNICATIONS

Principles of Satellite Communication, Electromagnetic Spectrum, Satellite Orbits: Foundation, Equation of Satellite Orbit, Satellite Path in Space, The Two-Body Problem, Classical Orbital Elements, The Geostationary Orbit, Change of Longitudes, Orbital Perturbations, Geometry of Geostationary Orbit, Communication Satellite Sub-Systems: AOCS, TT&C, Power Sub-System, Communication Sub-System, Satellite Antennae, Satellite Link Design (Basic transmission theory, RF Links, Optimisation of RF Links, System Noise Temperature, Noise Figure, G/T Ratio, Down/Uplink Design and Complete Link Budget), Interactions of Microwaves with Atmosphere, Attenuation Modeling, Earth Station Parameters, Multiple Access Techniques: FDMA, TDMA, CDMA, Special Purpose Communication Satellite Overview (DBS, INMARSAT, VSAT, SARSAT and LEO Satellites).

Books Recommended:

1. Timothy Pratt, (1986), *Satellite Communication* John Wiley & Sons,.

2. Frenzal, (1999), *Communication Electronics* 3rd Edition, Mc Graw-Hill.
3. Dr.D.C.Agarwal 1991, *Satellite Communication*, Khanna.
4. Brain Ackroyd, 1990, *World Satellite Communication* CRC press..
5. Dennis Roddy, (1991), *Electronic Communication* 3rd Edition, Prentice Hall of India,.
6. John Marul , *Satellite Communication*.
7. J.D.Ryder, (1976). *Electronic Circuits and System*, Prentice Hall,
8. Umesh Sinha, S.M.T.Sumitra Handa, (1992), *Antenna and Wave Propagation* 2nd Edition.
9. Zeimer Rodger, 2006, *Principles of Communication*, Wiley India Pvt.
- 10 Maral Gerard, (1993), *Satellite Communication* 4th Edition, John Wiley & Sons,.

PAPER-IV:	SPACE SYSTEMS AND THEIR APPLICATIONS
------------------	---

Aerospace Systems Overview, System Elements and Components, System Program and Operational Organization, Space Segment, Post-Launch Requirements, Satellite Composition, Critical Structural Phases, Mission and Satellite Control Activities, Satellite Orbits: Foundation, Equation of Satellite Orbit, Satellite Path in Space, The Two-Body Problem, Classical Orbital Elements, The Geostationary Orbit, Change of Longitudes, Orbital Perturbations, Solar Radiation Pressure, Atmospheric Drag, Types of Orbits, Geometry of Geostationary Orbit, Basics of Communications, Launch of Geostationary Satellite (ELV, Space Shuttle) and concept of Launch Window, The Non-Spherical Earth, Eclipse Geometry, Sun Interference. Launch Vehicles, Rocket Propulsion, Chemical Propulsion, Solid Propellants, Multi Stage Rocket, Injection into Final Orbit, Launch Vehicles for Commercial Satellites, Attitude Control, Propulsion Subsystem, System Reliability, Estimation of Mass, Telemetry Interface Functions, Telecommand Interface Functions, Tracking Interface Functions, Satellite Applications: Communications (Civil and Defence), Navigation (Transit, Navstar GPS), Surveillance (Civil and Military), Meteorology, DMSP, METEOR, FENGYUN, METEOSAT AND GMS. Earth Resources /Imaging Satellite, BADAR I & II, PAKSAT I & II, TERRA, METEOR, and Advanced Satellites, Recent Developments in Space Systems. Search and Rescue: COSPAS-SARSAT, National Missile Defence Program (NMD), Anti-Satellite Weapon System etc.

Books Recommended:

1. J.T.Garner and M.Jones. Ellis Harwood, N.Y, (1990), *Satellite Operations*
2. W.L.Pritchard, H.G.Suyderhoud and R.A.Nelson,2005, *Satellite Communication System Engineering*, Pearson education.
3. Mortin. R.Davidoff, K2UBC, 1984, *The Satellite Experimenter's Hand Book*, American radio Relay League..
4. James R. Wertz 1980, *Space Attitude Determination and Control*,. Published by D.Reidel Publishing Company.
5. Iyn Ddutton, David de Garis, Richard Winterton, and Richard Harding, 1990, *Military Space*, Brassey,s.
6. Maxwell Pergamon, *Brassy's Air Power, Air Craft, Weapon Systems, and Technology Series* Vol. 10 Publishing Cor. John Wiley & Sons.
7. Timodthy Pratt, Charles W. Bostian, (1986), *Satellite Communication* John Wiley and Sons, N.Y,
8. Emanuel Fthenakis,1984, *Manual of Satellite Communications*, McGraw-Hill Co.
9. M.Richharia, 1995,*Satellite Communication Systems* McGraw Hill.

PAPER-V:	PROGRAMING LANGUAGE LAB
-----------------	--------------------------------

Introduction, Software Categories/ history of C/ IDE, Starting to 'C', Expressions and Operators, Decisions, Repetition Structures, Loops and Operators, Switch Statement, Functions, Arrays, Pointers, Strings and Arrays, Pointers and Arrays (Advance), String Manipulation Functions, File Handling, Structures, Bit Manipulation, Review Lecture, Pre-processor Directives and Macros, Dynamic Memory Allocation using C++, Structured Programming, Classes and Objects, Memory Allocation in C++, Friend functions, Reference Data Type, Operator Overloading, Arrays of Objects, Streams, Stream Manipulation, Overloading Insertion and Extraction Operators, User Defined Manipulators, Copy Constructor, Classes and Objects (Advance), Template Functions, Class Templates, Programming Exercise, Practical Examples.

Books Recommended:

1. Detail Detail, 2005, *C++ How to Program*, Pearson Education.
2. Kernighan Brian, 1988, *C Program Lanuage*, 2nd edition, Prentice Hall,

PAPER-VI:	GEOGRAPHIC INFORMATION SYSTEM (GIS)
------------------	--

Introduction to GIS: Definition, Components of GIS, Working. Data Types: Spatial and Non-Spatial Data, Data Models: *Spatial*, Raster, Vector (Topology and spatial relationship) and *Attributes* Data models e.g. relational data model, Network Model, Object oriented model etc. Projections and Coordinate Systems, Data Input: Digitizing, scanning etc. Spatial Analysis: Overlay analysis, Spatial Queering, Neighbourhood analysis, Network analysis, Data visualization: Map Components, Software Customization, Internet GIS, and Data Quality.

Land Information System: Land information, Location of land Registration and Cadastre in LIS, Relation Land Registration and Cadastre, General Role of land registration and cadastre, Land Tenure Systems, Land Registration process, Boundaries, Fiscal cadastre, Multipurpose Cadastre, Institutional arrangement and technical matters, Procedures for introducing a land administration system.

Photogrammetry: Introduction, Optics for Photogrammetry, Principle of Photogrammetry, Aerial cameras, Films for Aerial Photography, Photographic measurement and refinement, Vertical photographs, Stereoscopic viewing, Stereoscopic parallax, Elementary methods of polarimetric mapping with vertical photographs, Photomaps and mosaics, Tilted photographs, Stereoscopic plotting instruments, Ortho photography, Aero triangulation, Ground control for aerial Photogrammetry, Project planning, Photographic interpretation.

Urban Planning: Introduction to urban planning and management, Planning Concepts, International Scenario on Urban Issues, Managing our urban future, Planning Process, Development Plans System, Decision Support, GIS, and Urban Planning, Planning System in Pakistan, Various sectors identification in urban planning, Urban Networks, Indicators, Land Ownership in Urban Planning, Utility Information System, Enterprise GIS in Urban Planning and Management.

Global Positioning System (GPS): U. S. Department of Defence Satellite Navigation System, GPS Positioning Services Specified In The Federal Radio navigation Plan, GPS Satellite Signals, GPS Data, Position and Time from GPS, GPS Error Sources, Geometric Dilution of Precision (GDOP), Differential GPS (DGPS) Techniques

Books Recommended:

1. Ray Harris, Routledge & Kegan Paul, (1987), *Satellite Remote Sensing*
2. Thomas D.Rabenherst and Paul, (1989). *Applied Cartography, Introduction to Remote Sensing*, McDermott, Merrill Publishing Co,
3. S.A.Drury, 1990, *A Guide to Remote Sensing* Oxford University Press,.
4. A.Mehrotra and R.K.Suri, (1994), *Remote Sensing for Environment and Forest Management* Indus Publishing Co.N.Delhi.
5. P.J.Curran, G.M.Foody, K.Yakondratyter and Others. Taylor and Francis, (1990), *Remote Sensing of Soil and Vegetation in the USSR*
6. Lillesand / Kiefer, (2000). *Remote Sensing and Image Interpretation* John Wiley & Sons, N.Y,
7. C.P.Lo, Longman Scientific and Technical, (1986) *Applied Remote Sensing*.
8. David J.Lindgren, 1985, *Landuse Planning and Remote Sensing*, Nijhoff.
9. Jeffery Star, John Easter, 1990, *Geographical Information System - An Introductionp*, Prentice Hall..
10. J.R. Jensen, (1996), *Introductory Digital Image Processing - A Remote Sensing Perspective* Prentice Hall.

PAPER-VII:	IMAGE PROCESSING AND GIS LAB
-------------------	-------------------------------------

Note: The candidates will have to perform at least twelve out of the following and similar experiments.

1. To study following functions: import export, layer stack, image mosaic, and image subset
2. To study different band combinations (colour composites), and perform visual image interpretation
3. To compute uni-variate and multi-variate image statistics
4. To perform image radiometric rectification
5. To perform image geometric rectification using different methods
6. To perform spatial enhancement using convolution filtering
7. To perform spectral enhancement and study gray level transformation
8. To perform resolution merging and study RGB to HIS conversion
9. To study band ratios
10. To study indices
11. To study FFT function
12. To perform supervised classification
13. To perform unsupervised classification

14. To interpret a satellite image and identify different vegetation types.
15. To interpret a satellite image and classify a vegetation type on the bases of its health.
16. To develop the GIS database of irrigation for a particular area.
17. To analyse the satellite image to estimate crop yield production.
18. To map and monitor forests using GPS and satellite images.
19. To study the mapping parameters (co-ordinate system, projection, datum) used in Pakistan
20. To study and develop the topographical map of certain area GPS, aerial photos, GT sheets, satellite images.
21. To study the techniques of stereo image processing for developing DTM.
22. To study the visual and machine interpretation of Radar
23. To perform digitization and add attribute data in different thematic layers
24. To study and visualize different projection, datum and coordinate systems
25. To study spatial relational database (join & relate)
26. To study inter-conversion of vector and raster data
27. To perform data querying in GIS environment
28. To geo-reference and rectify data using GIS software
29. To develop and study personal geo data base in ArcGIS environment
30. Use of topology rules to fix digitizing anomalies

Books Recommended:

1. *Introduction to Remote Sensing* by Thomas D.Rabenhorst and Paul D.McDermott, Merrill Publishing Co, (1989).
2. Lillesand / Kiefer, (1987), *Remote Sensing and Image Interpretation* 2nd Edition, John Wiley & Sons,.
3. Floyd F. Sabins, (1996), *Remote Sensing, Principles and Interpretation* W.H.Freeman Electronic Publishing Centre,
4. Paul J. Curran, Longman Inc, (1985), *Principles of Remote Sensing*.
5. *Introductory Remote Sensing: Principles and Concepts* by Gibson Paul.J, Routledge, (2000).
6. *Principles of Remote Sensing* by Patel, Surindra Singh, Scientific Publishers, (1992), 2nd Edition.
7. *Physical Principles of Remote Sensing* by Rees W.G, Cambridge University Press, (2001), 2nd Edition.
8. *Satellite Remote Sensing* by Ray Harris, Routledge & Kegan Paul, (1987).
9. Thomas D.Rabenherst and Paul, (1989), *Applied Cartography, Introduction to Remote Sensing*, D.McDermott, Merrill Publishing Co,
10. S.A.Drury, (1990), *A Guide to Remote Sensing* Oxford University Press,
11. A.Mehrotra and R.K.Suri, (1994), *Remote Sensing for Environment and Forest Management* Indus Publishing Co.N.Delhi,
12. P.J.Curran, G.M.Foody, K.Yakondratyer and Others. Taylor and Francis, (1990), *Remote Sensing of Soil and Vegetation in the USSR*.
13. J.R. Jensen, (1996), *Introductory Digital Image Processing – A Remote Sensing Perspective* Prentice Hall,
14. Lillesand / Kiefer, 2000, *Remote Sensing and Image Interpretation* by John Wiley & Sons, N.Y.,.
15. C.P.Lo, 1986, *Applied Remote Sensing* Longman Scientific and Technical.
16. David J.Lindgren, 1985, *Landuse Planning and Remote Sensing*, Nijhoff.
17. Jeffery Star, John Easter, 1990, *Geographical Information System – An Introduction*, Prentice Hall.