St. Albert's College (Autonomous)

PSP1CRT01 – FUNDAMENTALS OF ATMOSPHERIC AND SPACE SCIENCES

I. Course Instructor

Name	Sem, Programme & Batch	Email
Manesh Michael	Sem 1, M.Sc. Space Science & Technology ,2017-19	maneshmichael@gmail.com

II. Duration of Course:

No	Activity	Duration
1	Contact hours	83(Including assignments)
2	Assessment (CAE & ESE)	7
	Total	90
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	6

III. Course Objectives:

- To understand the fundamental concepts of Atmospheric and Space Sciences
- Interpretation of common atmospheric phenomena with the help of physics principles

IV. Course Delivery Plan

This course is a course requiring a lot of student centric learning processes. The teaching methods include lectures, discussions, ICT enabled methods, assignments etc.

Topics	Date(s)	Methodology
These are the topics to be covered in the modules		
Module 1		
Elementary concepts of atmospheric sciences: atmosphere and its composition, pressure and its variation with height, diurnal variation of surface pressure, Earth-Sun relationship, variation of temperature with height, diurnal variation of surface temperature, definition of wind, squall, gustiness, gale, Beaufort scale, land and sea breeze, katabatic and anabatic winds, Buys-Ballot's law, geostrophic wind, visibility, causes of poor visibility, haze, mist, fog, tropical	29-06-2017 To 24-07-2017	Lectures GD

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depression and storm, basic ideas of general circulation (without mathematical derivations). Remote sensing – basic principles. Sensors and systems: visible, infrared, water vapour and microwave sensors, sensor characteristics, sensor materials, passive and active sensors, scanning radiometers, spectral signatures.		
Module 2		
Laws of thermodynamics: Maxwell's equation, Gibbs' equation, free energy, atmospheric composition, equation of state for dry and moist air, adiabatic and isothermal processes, humidity parameters, thermodynamic laws, entropy, potential temperature, pseudo-adiabatic process, equivalent temperature, equivalent potential temperature, Claussius-Clapeyron equation, stability and instability.	25-07-2017 To 14-08-2017	GD Lectures
Module 3		
Thermal structure of the troposphere, stratosphere, mesosphere and ionosphere, D, E, F-1 and F2 regions, radio wave propagation, effect of earth's curvature, stratospheric circulation, stratospheric warming, quasi-biennial oscillation, ozone, temporal and spatial variations of ozone, Umkehr effect, ozone depletion and its impact.	16-08-2017 To 30-08-2017	GD, Lectures
Module 4		
sun and atmosphere, electromagnetic spectrum, attenuation, absorption, reflection, scattering, emissivity, black body, Planck's law, Stefan-Boltzmann law, Wien's displacement law. Radiative transfer, forward and inverse problems, optical depth, rotational, vibrational and mixed spectra, emissivity and polarization, Beer's law, thermal radiation, spectral windows.	11-09-2017 To 26-09-2017	GD, Lectures
Module 5		
Solar and planetary system - Kepler's laws, orbital elements. Satellite orbits and altitude: principles of satellite motion, satellite altitude and its control, types of orbits, polar and geostationary, earth and sun-synchronous, orbit optimization, viewing geometry, launch vehicles and space	27-09-2017 To 23-10-2017	GD, Lectures

V. Assignments and Seminars

Assignments

N.B: Both the assignments & presentation are individual assignments.

No	Topics	Activity	Submission Deadlines	
Assignment	Assignment on given topic	Preparation of assignment	Wednesday of 8th Week of Course	Submit the assignment before 11.59 pm
Seminar	PowerPoint presentation on given topic	PowerPoint Presentation for a presentation	Wednesday of 10th Week of Course	

		of 10 minutes duration

Note: Failure to upload the assignment to Google Classroom *on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.*

VI. Attendance (one component in class participation):

95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	**Not eligible for appearing for ESE**

VII. Required reading:

Text Books:

1. *An Introduction to Meteorology*, S. Petterssen
2. *Introduction to Theoretical Meteorology*, S. Hess
3. *Atmospheric Physics,* J. V. Iribrine and H. R. Cho
4. *Digital Image Processing*, R. C. Gonzales and R. E. Woods, 2nd Ed, Pearson India, 2002
5. *Lecture Notes on Satellite Meteorology*, Vol 1 and 2, SAC, Ahmedabad
6. *Fundamentals of Remote Sensing*, George Joseph, 2003
7. *Processing Remote Sensing Data*, M. C. Girgard and C. Girgard, Oxford-IBH, 1999
8. *Theory of Satellite Orbits in an Atmosphere,* King-Hele Desmond, Butterworths, 1964

Reference Books

1. *Elementary Meteorology*, S. Petterssen
2. *Atmospheric Science - An Introductory Survey*, J. M. Wallace and P. V. Hobbs
3. *Thermodynamics*, P. C. Rakshit
4. *Thermodynamics*, E. Fermi
5. *The Upper Atmosphere - the Meteorology and Physics*, R. A. Craig
6. *An Introduction to Atmospheric Dynamics*, A. A. Tsonis
7. *Satellite Meteorology*, S. Q. Kidder and T. H. Von der Haar, Academic Press, 1995
8. *Remote Sensing and Image Interpretation*, T. M. Lillesand and R. W. Kieffer, John Wiley, 2002
9. *Fundamentals of Space Systems,* V. L. Pisacane and R. C. Moore, Oxford University Press, 1994
10. *Quantitative Remote Sensing of Land Surfaces,* Shunlin Liang, Wiley Interscience, 2004
11. *Scale in Remote Sensing and GIS,* D. A. Quattrachi and M. F. Goodchild
12. *Uncertainty in Remote Sensing and GIS,* Ed: G. M. Foddy and P. M. Atkinson

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PSP1CRT02 – CLASSICAL MECHANICS

- Course Instructor

Name	Sem, Programme & Batch	Email
Stefy Thomas	Sem 1, MSc. Space Science , 2017-2019	stefythomas@gmail.com

- Duration of Course:

No	Activity	Duration
1	Contact hours	45(Including assignments)
2	Assessment (CAE & ESE)	4
	Total	49
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	1

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- Course Objectives:
  - How to use Newton's laws of motion to solve advanced problems involving the dynamic motion of classical mechanical systems.
  - How to use differential equations and other advanced mathematics in the solution of the problems considered in item 1.
  - How to use conservation of energy and linear and angular momentum to solve dynamics problems.
  - Lagrangian and Hamiltonian formulations of classical mechanics.

- Course Delivery Plan:

The teaching methods include lectures, discussions, assignments etc.

Stefy.
HoD in charge.

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Topics	Date(s)	Methodology
Module 1:		
Mathematical preliminaries, Newtonian mechanics of single and many-particle systems, conservation laws, work energy theorem, open systems with variable mass. Constraints, their classification, D'Alembert's principle, generalized coordinates.	29/06/2017 to 17/07/2017	Lecture with derivation.
Module 2:		
Lagrange's equations Gyroscopic forces and dissipative systems. Jacobi integral, gauge invariance, moments and Integrals of motion. Symmetries of space and time with conservation laws. Galilean transformation, impulsive forces. Rotating and translating frames. Inertial forces Terrestrial and astronomical applications of Coriolis force.	18/07/2017 to 29/07/2017	Lecture with derivation.
Module 3:		
Central force, definition and characteristics, two-body problem, closure and stability of circular orbits, general analysis of orbits, Kepler's laws and equation, artificial satellites, scattering, relationship between CM and Lab frames, Rutherford scattering.	01/08/2017 to 08/08/2017	Lecture with computational problems and derivation.
Module 4:		
Legendre transformation, Hamilton's equations, phase portraits of some simple systems. Principle of least action, Derivation of equations of motion, variation of end points, Hamilton's principal and characteristic functions, Hamilton-Jacobi equation.	09/08/2017 to 24/08/2017	Lecture with derivation.
Module 5:		

Canonical transformations, generating functions, properties, group property and examples. Infinitesimal generators, Poisson bracket, Poisson's theorems, angular momentum and PBs. Small oscillations, normal modes and coordinates. Case study of a coupled system of oscillators. Rigid bodies, Euler's and Chasel's theorems Moment of inertia, MI tensor and ellipsoid. Euler equation for rotating rigid body and its solutions and Eulerian angles. Symmetric top and introduction to classical scalar fields (optional).	25/08/2017 to 20/09/2017	Lectures with derivation.
Module 6:		
Classification of dynamical systems, conservative systems, integrable systems, non-linear perturbation, Hamiltonian chaos, dissipative systems, continuous systems, duffing oscillator, discrete systems, logistic map, fixed points, period doubling, limits cycles, chaotic attractors, Lyapunov characteristic exponent.	22/09/2017 to 06/10/2017	Lecture with derivation.
Module 7:		
Fluid dynamics: definition, Lagrangian and Eulerian systems, streamlines and trajectories, conservation equations of mass, momentum and energy, velocity potential, stream function, momentum equation, viscosity, stress tensors and their relation with strain function, Navier-Stokes' theorem.	09/10/2017 to 23/10/2017	Lecture with derivation.

- Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Group discussion & presentation on 'How Coriolis force affects life on Earth.	1 Week	Observational & Analytical Thinking	7th week

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- ## Assignments and Seminars

Assignments

The following Assignment needs to be submitted in writing format. assignments.

No	Topics	Activity	Submission Deadlines	
Assignment	Assignment on 'Calculation of normal modes & normal coordinates of a simple harmonic oscillator'	Finding normal modes & coordinates of simple harmonic oscillators.	Monday of 5th Week of Course	Submit the assignment in written format preferably in A-4 size papers.

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

- ## Attendance (one component in class participation):

95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	Not eligible for appearing for ESE

- ## *Required reading:*

1. *Classical Mechanics, N. C. Rana and P. S. Joag, Tata McGraw Hill, 1991*
2. *Classical Mechanics, H. Goldstein, Addison Wesley, 2nd Ed, 1980*
3. *Calculus of Variations, M. Gel'fand and S. V. Fomin*
4. *Mathematical Methods of Classical Mechanics, V. I. Arnold, Springer-Verlag*
5. *New Foundations of Classical Mechanics, D. Hestenes, Kluwer Scientific*
6. *Classical Mechanics, Jose and Saletan, Cambridge University Press, 1999*
7. *Mechanics, F. Scheck, 3rd Ed, Springer-Verlag*
8. *Mechanics of Atom, Max Born, Fredrik Unger Publishing*

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PSP1CRT03 – QUANTUM MECHANICS

I. Course Instructor

Name	Sem, Programme & Batch	Email
Stefy Thomas	Sem 1, M.Sc. Space Science & Technology ,2017-19	stefythomas@gmail.com

II. Duration of Course:

No	Activity	Duration
1	Contact hours	83(Including assignments)
2	Assessment (CAE & ESE)	7
	Total	**90**
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	**10**

III. Course Objectives:

- Have a deep understanding of the mathematical foundations of quantum mechanics.
- Be able to solve the Schrödinger equation using various approximation methods.
- Have a basic understanding of relativistic effects in quantum mechanics.

IV. Course Delivery Plan

This course is a course requiring lot of student centric learning processes. The teaching methods include lectures, discussions, ICT enabled methods, assignments etc.

Topics	Date(s)	Methodology
Module 1		
Revision, inadequacy of classical concepts, wave-particle duality, thought experiments, uncertainty relations. Schrödinger equation, continuity equation, Ehrenfest's theorem, solutions of Schrödinger equation, admissible wave functions, stationary states. Simple one-dimensional problems, harmonic oscillator and its stationary states using	29-06-2017 To 24-07-2017	Class exercises Lectures GD

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Schrödinger equation, one-dimensional wells and barriers.		
Module 2		
Obtaining uncertainty relation of x and p from commutation relation, states with minimum uncertainty product. General formalism of wave mechanics, representation of states and dynamic variables, observables, self-adjoint operators, completeness of eigen functions, Dirac delta function, commutability and compatibility, bra and ket notation, matrix representation of an operator, change of basis, unitary transformations.	25-07-2017 To 14-08-2017	GD Lectures
Module 3		
Simple harmonic oscillator by operator method. Angular momentum in quantum mechanics, Pauli theory of spins, addition of angular momenta, computation of Clebsch-Gordan coefficients in simple cases. Central forces, hydrogen atom.	16-08-2017 To 30-08-2017	GD, Lectures
Module 4		
Evolution of system with time, constants of motion, Heisenberg, Schrödinger and interaction pictures. Time-independent perturbation theory, non-degenerate and degenerate cases, applications such as the Stark effect.	11-09-2017 To 26-09-2017	GD, Lectures
Module 5		
WKB Approximation, Variational method, helium atom, van der Waal's interaction.	27-09-2017 To 23-10-2017	GD, Lectures

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VI. Assignments and Seminars

Assignments

N.B: Both the assignments & presentations are individual assignments.

No	Topics	Activity	Submission Deadlines	
Assignment	Assignment on given topic	Preparation of assignment	Wednesday of 8th Week of Course	Submit the assignment before 11.59 pm

Seminar	PowerPoint presentation on given topic	PowerPoint Presentation for a presentation of 10 minutes duration	Wednesday of 10th Week of Course

Note: Failure to upload the assignment to Google Classroom *on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.*

VII. Attendance (one component in class participation):

95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	**Not eligible for appearing for ESE**

VIII. Required reading:

Text Books:

1. *Modern Quantum Mechanics* by J.J. Sakurai
2. *Quantum Mechanics*, G Aruldhas

Reference Books:

1. *Quantum Mechanics*, L. I. Schiff, McGraw Hill.
2. *Introduction to Quantum Mechanics*, L. Pauling and E. B. Wilson, McGraw Hill

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PSP1CRT04 – MATHEMATICAL AND STATISTICAL METHODS-1

I. Course Instructor

Name	Sem, Programme& Batch	Email
Subitha Sudheer M	Sem 1 Space science ,2017-19	subithasudheerm3491@gmail.com

II. Duration of Course:

No	Activity	Duration
1	Contact hours	56(Including assignments)
2	Assessment (CAE & ESE)	7
	Total	63
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	2

III. Course Objectives:

- To provide the students a sound academic on Mathematics and Statistics, it will help in their future.
- To help students develop a Statistical and mathematical approach to their practical problems.
- To help the students develop and refine the concept about statistics and mathematics...

IV. Course Delivery Plan

This course is a course requiring mathematical and problem solving skill. The teaching methods include lectures, problem based assignments .

Topics	Date(s)	Methodology
These are the topics to be covered in the modules		
Types of matrices, definition of Vector space, basic properties, properties for linear dependence and independence.	17/7/2017 18/7/2017	Class exercises Lectures

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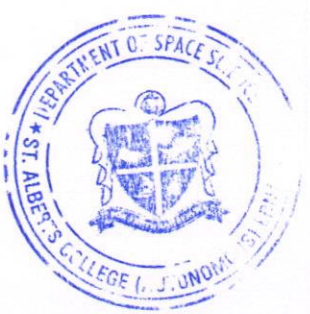
Definition and Methods for finding rank of a matrix.	19/7/2017	
Definition, properties and methods for testing consistency, methods for finding solutions.	20/7/201	
Definition , methods for finding eigen values and eigen vectors, definition of theorem.		
Various techniques for computation of inverse of matrices to find solutions of non-homogeneous equation.	7 21/7/2017 24/7/2017	
Eigen-values and Eigen-vectors of symmetric as well as non- symmetric matrices and their applications..	25/7/2017 26/7/2017 27/7/2017 28/7/2017 31/7/2017	
Complex analysis and special functions: differentiable and analytic functions, singularity, Taylor's series, Laurent series, calculus of residue, contour integration, Legendre polynomial, Hermite polynomial, Laguerre polynomial, introduction to Bessel functions.	1/8/2017 2/8/2017 3/8/2017 8/8/2017 9/8/2017 10/8/2017 11/8/2017 16/8/2017 17/8/2017 18/8/2017 21/8/2017	Class exercises Lectures
Definitions- Mean, Median, Mode, Harmonic mean, Geometric mean. Problems.	23/8/2017	Class exercises Lectures
Definitions – Range, Mean deviation, Standard deviation, Quartile deviation. Problems.	14/9/2017	
Definition, Types and methods for finding Correlation and Regression.	15/9/2017 18/9/2017 19/9/2017	
Probability, basic definitions, terms used, Addition and Multiplication theorem.	20/9/2017 22/9/2017	
Binomial, Poisson, Normal, Gamma , Student's t, Chi- square distributions- definitions and	25/9/2017	



problems.Basic steps in testing of hypothesis, Z- test, t-test , Chi- square test.	26/9/2017 27/9/2017 28/9/2017	
Definition, basic formulas, properties, problems of Laplace Transforms.	3/10/2017 4/10/2017 5/10/2017	Class exercises Lectures
Definition, basic formulas, properties, problems of Inverse Laplace Transforms.	6/10/2017 9/10/2017	
Solving differential equations using Laplace and Inverse Laplace transforms.	10/10/2017 11/10/2017	
Definition, basic formulas, properties, problems of Fourier Transforms	13/10/2017 16/10/2017	
Scalar and Vector point functions definitions and problems.Del, Gradient, Divergence and Curl definition and problems.Integration of vectors, Line Integral, Surface Integral and Volume integral problem,Divergence Theorem problems.Green's Theorem and Stoke's Theorem definition and problems	17/10/2017 19/10/2017 20/10/2017	Class exercises Lectures

V. Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Making problem from answers	1 week	Analytical thinking	4th Week

VI. Assignments and Seminars

Assignments

The following Assignment needs to be submitted and have to be present in class. Both the assignments & presentation are individual assignments.

No	Topics	Activity	Submission Deadlines

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Assignment	Assignment on given topic	Preparation of assignment	Monday of 6th Week of Course	Submit the assignment before 10.00 am.
Seminar	presentation of given topic	Presentation for a presentation of 10 minutes duration	Wednesday of 7th Week of Course	Present seminar in roll number order

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

VII. Attendance (one component in class participation):

95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	**Not eligible for appearing for ESE**

VIII. Required reading:

1. *Theory of Differential Equations*, Andrew Russell Forsyth, Dover
2. *Partial Differential Equations in Physics*, Arnold Sommerfield, Academic Press
3. *A Book of Splines*, Arthur Sard and Sol Weintrub, John Wiley
4. *Vector Calculus*, Peter Bexandall an Hans Liebeck, Clarendon
5. *Vector Space and Matrices*, Robert M. Thrall and Leonard Tornhein, John Wiley
6. *Theory of Matrices*, F. R. Gantmacher, Chelsea
7. *Principle of Random Walk*, Franks Spitzer, Van Nostrand
8. *Mathematics of Statistics*, Kenney and Keeping, Van Nostrand
9. *Fundamentals of Mathematical Statistics*, C. Gupta, and V K Kapoor, S. Chand Publication
10. *Mathematical Statistics*, J N Kapoor and H C Saxena, S. Chand Publication
11. *Fourier Series*, Georgi P. Tolstov and Richard A. Silverman, Prentice-Hall
12. *Survey of Applicable Mathematics*, Karel Rektory, Ilifee Books
13. *Methods of Mathematical Physics*, Vol I & II, R. Courant and D. Hilbert, Wiley Eastern
14. *Advanced Engineering Mathematics* , Erwin Kreyszig, Wiley Eastern
15. *Applied Mathematics for Engineers and Physicists*, Pipes and Harvill, McGraw Hill
16. *Analysis of Variance and Regression*, Ruth M. Mickey, Olive Jean Dunn, Virginia A. Clark, Wiley Interscience
17. *Vector Analysis and Introduction to Tensor Analysis*, Murray R Spiegel, Schaum Publishing

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18. *Theory and Problems of Statistics*, Murray R Spiegel, Schaum Outline Series, McGraw Hill
19. *Theory and Problems of Matrices*, Frank Ayres, Jr, Schaum Publishing
20. *Theory and Problems of Probability*, S. Lipschutz, Schaum Outline Series, McGraw Hill
21. *Theory and Problems of Fourier Analysis with Application to Boundary Value Problems*, Murray R. Spiegel, Schaum Outline Series, McGraw Hill
22. *The Fourier Transform and its Applications*, Ronald N. Bracewell, McGraw Hill

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PSP1CRT05– NUMERICAL METHODS & COMPUTER PROGRAMMING

- Course Instructor

Name	Sem, Programme & Batch	Email
Manesh Michael	Sem 1, MSc. Space Science , 2017-2019	maneshmichael@gmail.com

- Duration of Course:

No	Activity	Duration
1	Contact hours	54(Including assignments)
2	Assessment (CAE & ESE)	2
	Total	56
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	0

- Course Objectives:
  - Apply Numerical analysis which has enormous application in the field of Science and some fields of Engineering.
  - Familiar with finite precision computation.
  - Familiar with numerical solutions of nonlinear equations in a single variable.
  - Familiar with calculation and interpretation of errors in numerical method.
  - Familiar with programming with numerical packages like FORTRAN

- Course Delivery Plan:

The teaching methods include lectures, discussions, assignments etc.

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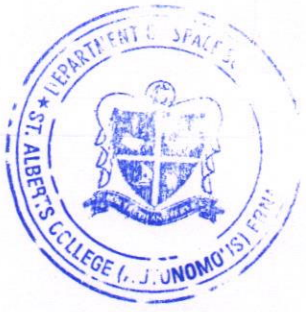
Topics	Date(s)	Methodology
Module 1:		
Finding roots of Algebraic and Transcendental Equations by Bisection, Regula Falsi and Newton – Raphson's methods, Finite difference schemes, Interpolation: Newton's Forward and Backward Difference, Sterling's interpolation, Lagrange's Interpolation and Extrapolation.	29-06-2017 To 24-07-2017	Lectures with derivation and computational problems
Module 2:		
Numerical Integration: Trapezoidal rule, Simpson's 1/3 and 3/8 rule. Gaussian quadrature. Numerical solutions of Simultaneous Algebraic Equations. Generation of random number, Monte-Carlo technique.	25-07-2017 To 14-08-2017	Lectures with computational problems.
Module 3:		
FORTRAN fundamentals: integer constant, floating point constant. Variables, arithmetic operator, relational operator, FORTRAN arithmetic and expression, input/output and format statements, declaration and initialization. Branching and looping, Arithmetic IF, Logical IF, Unconditional GO TO, Computed GO TO, DO statement. Nesting of DO Loops, Dimension Statement, arrays, multidimensional arrays. Functions, sub-programs and subroutines. Basics of file handling and data manipulation.	16-08-2017 To 30-08-2017	Lectures Lectures with example programs.
Module 4:		
Concept of finite element method, solution of ordinary differential equation. Euler method Taylor series and Runge Kutta method. Solution of partial differential equations, elliptic equations.	11-09-2017 To 26-09-2017	Lectures with computational problems.
Module 5:		



Approximation of function by cubic spline. Harmonic analysis, spectral analysis, use of filters.	27-09-2017 To 23-10-2017	Lectures with computational problems.

- Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Find out about 'The different ways to generate random number and present it.	1 Week	Analytical Thinking	Third week.

- Assignments and Seminars

Assignments

The following Assignment needs to be submitted in writing format.

No	Topics	Activity	Submission Deadlines	
Assignment	Assignment on 'Computation of different problems using Euler, Taylor and Runge-Kutta methods'.	Finding the solution of the problems by applying the formula.	Wednesday of 8th Week of Course	Submit the assignment in written format preferably in A-4 size papers.

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

- Attendance (one component in class participation):

95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	Not eligible for appearing for ESE

- Required reading:

Text Books:

1. *Introductory Methods of Numerical Analysis*, S. S. Shastry, Prentice Hall India
2. *Computer-Oriented Numerical Methods*, V. Rajaraman, Prentice Hall India
3. *Fortran 77 Elemetst of Programming Style,* Willam M Fuori, Stephen Gaughran, Louis Gioia and Michael Fuori, CBS Publishers

Reference Books

1. *Numerical Methods for Scientific and Engineering Computation*, M. K. Jain, S. P. K
2. Iyenger and R. K. Jain, Wiley Eastern
3. *Numerical Analysis and Algorithms*, Pradip Neogy, Tata McGraw Hill
4. *New Methods for Solving Elliptical Equations*, I. N. Vekua, North Holland and John Wiley
5. *Numerical Methods in Engineering*, Salvadori and Baron, Prentice Hall India
6. *Numerical Analysis,* Kaiser Kunz, McGraw Hill
7. *Numerical Analysis*, F.B. Hilderbrand, Tata McGraw Hill
8. *Finite Difference and Differential Equations*, Murray R. Spiegel, Schaum Outline Series,
9. McGraw Hill
10. *Numerical Analysis*, Francis Scheid, Schaum Outline Series, McGraw Hill

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PSP2CRT01- FUNDAMENTALS OF EARTH SCIENCE AND REMOTE SENSING

I. Course Instructor

Name	Sem 2, Programme & Batch	Email
Manesh Michael	Sem 2, M.Sc. Space Science & Technology ,2017-19	maneshmichael@gmail.com

II. Duration of Course:

No	Activity	Duration
1	Contact hours	83(Including assignments)
2	Assessment (CAE & ESE)	7
	Total	**90**
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	**10**

III. Course Objectives:

- Have a deep understanding of the theoretical foundations of electromagnetic phenomena,
- Be able to solve the Maxwell equations for simple configurations

IV. Course Delivery Plan

This course is a course requiring a lot of student centric learning processes. The teaching methods include lectures, discussions, ICT enabled methods, assignments etc.

Topics	Date(s)	Methodology
Module 1		

Stefy.
HOD in charge

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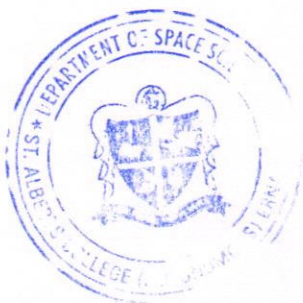
Earth as a planet of the solar system: its origin and internal structure, physical and chemical characteristics of the internal zones, crustal types, Archaean shields and Cratons, heat flow and temperature gradient. Types of rocks, major constituent minerals and their (chemical) composition, stability of minerals, climatic belts, effect of climate on processes of weathering and erosion, sediment cycle, radioactive minerals and dating methods, paleoclimate, quaternary ice age, factors affecting sea level, sea level changes, with reference to India. Geomagnetism,magneto-stratigraphy, palaeomagnetism, convection current, geodynamics, continental drift, sea floor spreading, plate tectonics, drift of the Indian subcontinent; belts of compressional and tensional stresses, seismicity and volcanism, subduction zone, Benioff zone and island arcs, polar wandering, permanence of continents and ocean basins.Internal structure, constitution and magnetism of planetary bodies.	13-11-2017 To 15-12-2017	Lectures
Module 2		
Satellite data processing: satellite data acquisition, satellite communications, data collection platforms, earth station, image processing, geometric and radiometric corrections, image navigation, registration, image enhancement techniques, noise removal methods, histogram methods, density slicing, image classification. Applications of remote sensing in earth resources management, agriculture, forestry, water resources and disaster mitigation.	18-12-2017 To 29-01-2018	Lectures
Module 3		



Remote sensing:Radars – principle, atmospheric applications, radar equation, range, resolution, anomalous propagation, radar cross-section, Z-R relationships, Doppler radar, interpretation of Doppler radar data, polarimetry. Soundings – principle, sodar, lidar, wind profiler, radio-acoustic sounding systems, MST radar,radiosondes, GPS sondes.Practicals – hands-on experience with sodar, lidar, WP-RASS.	30-01-2018 To 08-03-2018	Lectures

V. Assignments and Seminars

Assignments

N.B: Both the assignments & presentations are individual assignments.

No	Topics	Activity	Submission Deadlines	
Assignment	Assignment on given topic	Preparation of assignment	Wednesday of 5th Week of Course	Submit the assignment before 11.59 pm
Seminar	PowerPoint presentation on given topic	PowerPoint Presentation for a presentation of 10 minutes duration	Wednesday of 8th Week of Course	

Note: Failure to upload the assignment to Google Classroom *on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.*

VI. Attendance (one component in class participation):

95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	**Not eligible for appearing for ESE**

VII. Required reading:

Textbooks

Module 1

Text Books

1. *Earthquakes*, Bolt B.A., W. H. Freeman and Company, New York.
2. *Manual of Geology (Vol. I and II)*, Dana J.D., Akashdeep Publishing House.
3. *A text book of general & engineering Geology*, Arora D.S., Mohindra Capital Publishers.

Reference Books

1.*Planet Earth- Cosmology, geology and the evolution of life and environment*, A.
2.Emilianic,Cambridge University Press.
3.*Encyclopedic Dictionary of Applied Geophysics*, Sheriff R.E., Society of exploration geophysics, USA.
4.*Isostasy and Flexure of lithosphere*, Watts A.B., Cambridge University Press.

Modules 2, 3**Text Books**

1. *Digital Image Processing*, R. C. Gonzales and R. E. Woods, 2nd Ed, Pearson India, 2002
2. *Lecture Notes on Satellite Meteorology*, Vol 1 and 2, SAC, Ahmedabad
3. *Remote Sensing and Image Interpretation*, T. M. Lillesand and R. W. Kieffer, John Wiley, 2002
4. *Fundamentals of Remote Sensing*, George Joseph, 2003
5. *Quantitative Remote Sensing of Land Surfaces,* Shunlin Liang, Wiley Interscience, 2004
6. *Theory of Satellite Orbits in an Atmosphere,* King-Hele Desmond, Butterworths, 1964
7. *Radar metereology, Dr. M. S. Raghavan, Academic Press*

Reference Books

1. *Satellite Meteorology*, S. Q. Kidder and T. H. Von der Haar, Academic Press, 1995

Page PAGE *
MERGEFORMAT 2

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2. *Fundamentals of Space Systems,* V. L. Pisacane and R. C. Moore, Oxford University Press, 1994

3. *Processing Remote Sensing Data*, M. C. Girgard and C. Girgard, Oxford-IBH, 1999

4. *Scale in Remote Sensing and GIS,* D. A. Quattrachi and M. F. Goodchild

5. *Uncertainty in Remote Sensing and GIS,* Ed: G. M. Foddy and P. M. Atkinson

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MERGEFORMAT 2

St. Albert's College (Autonomous)

PSP2CRT02- STATISTICAL MECHANICS

I. Course Instructor

Name	Sem 2, Programme & Batch	Email
Manesh Michael	Sem 2, M.Sc. Space Science & Technology ,2017-19	manesh michael@gmail.com

II. Duration of Course:

No	Activity	Duration
1	Contact hours	83(Including assignments)
2	Assessment (CAE & ESE)	7
	Total	**90**
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	**10**

III. Course Objectives:

- Have a deep understanding of the theoretical foundations of electromagnetic phenomena,
- Be able to solve the Maxwell equations for simple configurations

IV. Course Delivery Plan

This course is a course requiring a lot of student centric learning processes. The teaching methods include lectures, discussions, ICT enabled methods, assignments etc.

Topics	Date(s)	Methodology
Module 1		
Elementary probability theory: preliminary concepts, random walk problem, binomial distribution, mean values, standard deviation, various moments, Gaussian distribution, Poisson distribution, mean values, probability density, probability for continuous variables (brief).Laws of thermodynamics and their consequences (brief).	13/11/17 To 27/11/17	Lectures

HOD in charge

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Problem of kinetic theory: phase space, Gibbsian ensemble, Liouville's theorem and its consequences, Boltzmann equation.		
Module 2		
Statistical description of system of particles: state of a system, microstates, ensembles, basic postulates, behaviour of density of states, density of state for ideal gas in classical limit, thermal and mechanical interactions, quasi-static process. Statistical thermodynamics: irreversibility and attainment of equilibrium, reversible and irreversible processes, thermal interaction between macroscopic systems, approach to thermal equilibrium, dependence of d.o.s. on external parameters, statistical calculation of thermodynamic variables.	28-11-2017 To 12-12-2017	Lectures
Module 3		
Classical statistical mechanics: microcanonical ensembles and their equivalence, canonical and grand canonical ensembles, partition functions, thermodynamic variables in terms of partition function and grand partition function, ideal gas, Gibbs paradox, validity of classical approximation, equipartition theorem, MB gas velocity and speed distribution, chemical potential, free energy and connection with thermodynamic variables, 1st and 2nd order phase transition, phase equilibria.	13-12-2017 To 10-01-2018	Lectures
Module 4		
Formulation of quantum statistics: density matrix, ensembles in quantum statistical mechanics, simple application of density matrix. Theory of simple gases: Maxwell, Boltzmann, Bose-Einstein, Fermi-Dirac gases, statistics of occupation numbers, evaluation of partition functions, ideal gases in the classical limit.	11-01-2018 To 29-01-2018	Lectures
Module 5		

Page PAGE *
MERGEFORMAT 2

Ideal Bose system: thermodynamic behavior of an ideal Bosegas,Bose-Einstein condensation. Thermodynamics of black body radiation: Stefan-Boltzmann law,Wien's displacement law, specific heat of solids (Einstein and Debye methods).	30-01-2018 To 08-03-2018	Lectures

V. Assignments and Seminars

Assignments

N.B: Both the assignments & presentations are individual assignments.

No	Topics	Activity	Submission Deadlines	
Assignment	Assignment on given topic	Preparation of assignment	Wednesday of 5th Week of Course	Submit the assignment before 11.59 pm
Seminar	PowerPoint presentation on given topic	PowerPoint Presentation for a presentation of 10 minutes duration	Wednesday of 8th Week of Course	

Note: Failure to upload the assignment to Google Classroom *on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.*

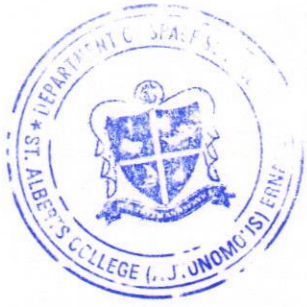
VI. Attendance (one component in class participation):

95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	**Not eligible for appearing for ESE**

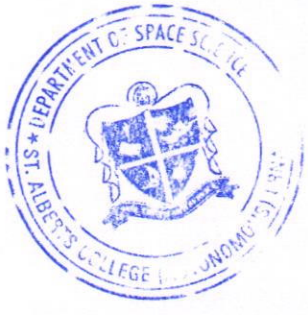
VII. Required reading:

Textbooks

1.*Statistical Mechanics, R.K Pathria, Pergamon press.*



2.Statistical Mechanics, K Huang 2nd Ed John Wiley.
3.Fundamentals of Statistical Mechanics, B. B. Laud, New Age



St. Albert's College (Autonomous)

PSP2CRT05 : ADVANCED COMPUTER PROGRAMMING

I. Course Instructor:

Name	Sem, Programme & Batch	Email
Stefy Thomas	Sem 2, M.Sc. Space Science & Technology ,2017-19	stefythomas@gmail.com

II. Duration of Course:

No	Activity	Duration
1	Contact hours	49(Including assignments)
2	Assessment (CAE & ESE)	5
	Total	**54**
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	**3**

III. Course Objectives:

- Apply and develop object oriented code.
- Develop software for a variety of architectures (e.g. Windows, UNIX, and Linux).
- Choose an appropriate computer language (e.g. Python, MATLAB, IDL) for a given project.

IV. Course Delivery Plan:

The teaching methods include lectures, discussions, ICT enabled methods, assignments etc.

Topics	Date(s)	Methodology
Module 2		
Introduction to MATLAB	13-11-2017 To 15-12-2017	Class exercises Demonstrations using PC Practical Sessions
Module 3		
IDL	18-12-2017 To 29-01-2018	Class exercises Demonstrations using PC Practical Sessions

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VI. Assignments and Seminars

N.B: Both the assignments & presentation are individual assignments.

No	Topics	Activity	Submission Deadlines	
Assignment	Assignment on given topic	Preparation of assignment	Wednesday of 8th Week of Course	Submit the assignment before 11.59 pm
Seminar	PowerPoint presentation on given topic	PowerPoint Presentation for a presentation of 10 minutes duration	Wednesday of 10th Week of Course	

Note: Failure to upload the assignment to Google Classroom *on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.*

VII. Attendance (one component in class participation):

95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	**Not eligible for appearing for ESE**

VIII. Required reading:

1. Getting Started with MATLAB 7 – A quick introduction for Scientists and Engineers, Rudraprathab, Oxford University Press.

IX. 2.An Introduction to Programming with IDL: Interactive Data Language, Kenneth P. Bowman

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St. Albert's College (Autonomous)

PSP1CRT05 – ADVANCED COMPUTER PROGRAMMING

I. Course Instructor

Name	Sem, Programme& Batch	Email
Subitha Sudheer M	Sem 2 Space science ,2017-19	subithasudheerm3491@gmai .com

II. Duration of Course:

No	Activity	Duration
1	Contact hours	45(Including assignments)
2	Assessment (CAE & ESE)	7
	Total	**52**
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	**2**

III. Course Objectives:

- To provide the students a sound academic on programming, it will help in their future.
- To help students develop a programming approach to their practical problems.
- To help the students develop and refine the concept about various programming langauges.

IV. Course Delivery Plan

This course is a course requiring mathematical and problem solving skill. The teaching methods include lectures, problem based assignments .

Topics	Session No & Date(s)	Methodology and Duration
These are the topics to be covered in the modules		
Fundamentals of C: data type, integers, float, double, character constant and	14/11/17 15/11/17 16/11/17 17/11/17	Class exercises Lectures

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variable, array and array declaration, expression statement, symbolic constant, arithmetic operator, relational operator, assigned operator, library function, data input and output, unformatted input /output statement, entering data input, writing data output, control statement, while statement, IF statement, IF ELSE statement, Switch statement, structures, arrays and pointers, pointer arrays, linked lists, stacks, queues, regression and trace. Error handling. Introduction to C-graphics	20/11/17 21/11/17 28/11/17	
Introduction to MATLAB: data type, Operators, input /output statement, writing data output, control statement,	4/12/2017 5/12/2017 to 1/3/2018	Class exercises Lectures
IDL (with emphasis on file manipulation, data handling and graphic utilities)	4/1/18 to 9/2/18	Class exercises Lectures

V. Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Who will be the best debugger?	3 hours	Logical thinking	1 hour in 4th week 1 hour in 8 th week 1 hour in 15 th week

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VI. Assignments and Seminars

Assignments

The following Assignment needs to be submitted and have to be present in class. Both the assignments & presentation are individual assignments.

No	Topics	Activity	Submission Deadlines	
Assignment	Assignment on given topic	Preparation of assignment	Monday of 6th Week of Course	Submit the assignment before 10.00 am.
Seminar	presentation of given topic	Presentation for a presentation of 10 minutes duration	Wednesday of 7th Week of Course	Present seminar in roll number order

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

VII. Attendance (one component in class participation):

95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	**Not eligible for appearing for ESE**

VIII. Required reading:

1. Getting Started with MATLAB 7 – A quick introduction for Scientists and Engineers, Rudraprathab, Oxford University Press.
2. An Introduction to Programming with IDL: Interactive Data Language, Kenneth P. Bowman .
3. Programming with C, Byron S. Gottfried, Tata McGraw Hill.
4. Mastering "C", Bolon, BPB Publication .
5. The "C" Programming Language, Brian W. Kernighan and Dennis M. Ritchie, Prentice Hall India .
6. C Programming for Unix, John J. Valley, Prentice Hall India .

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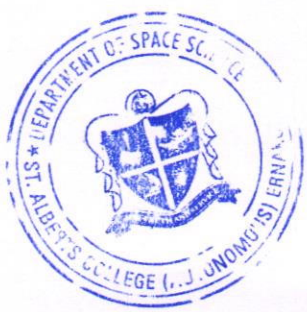
7. Theory and Problems of Programming with C, Byron S. Gottfried, Schaum Outline Series International.



St. Albert's College (Autonomous)

PSP3SCRT01-ATMOSPHERIC DYNAMICS

- Course Instructor

Name	Sem 3, Programme & Batch	Email
Johnson Zachariah	Sem 3, MSc. Space Science , 2017-2019	johnsonmekkat@gmail.com

- Duration of Course:

No	Activity	Duration
1	Contact hours	25(Including assignments)
2	Assessment (CAE & ESE)	2
	Total	27
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	0

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- Course Objectives:
  - A broad knowledge of fundamental physical laws applying to the world at scales ranging from the nuclear to the cosmological.
  - Comprehend, apply, and analyze the most important scientific models governing modern astrophysics and be familiar with the astronomical objects studied by astronomers.

- Course Delivery Plan:

- This course is a course requiring a lot of student centric learning processes. The teaching methods include lectures, discussions, assignments etc.

Topics	Date(s)	Methodology
Module 1:		

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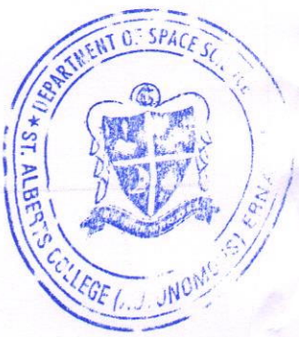
Basic equations:inertial and non-inertial frame, pressure gradient force, gravitational force, viscous force,equation of motion in rotating coordinates, equation of motion in tangential local coordinate system, spherical coordinate system, isobaric coordinate system, scale analysis of the equation of the motion, thermodynamic energy equation and equation of continuity, vertical velocity.	04/06/18 To 19/06/18	Lectures
Module 2 Classification of flow: natural coordinate system and the horizontal momentum equation in natural coordinates, inertial flow, Eulerian flow, cyclostrophic flow, geostrophic flow, gradient flow. Trajectory and streamline, Blaton's equation, geopotential, thermal wind, cold and warm air advection, hodograph, barotropic and baroclinic atmosphere.	20-06-2018 To 09-07-2018	Lectures
Module 3 Circulation and vorticity: Kelvin's circulation theorem, Bjerknes' circulation theorem, Stoke's theorem, divergence and outflow, absolute and relative vorticity, solenoidal vector, sea and land breeze.	10-07-2018 To 26-07-2018	Lectures
Module 4 Vorticity and divergence equations: vorticity equation, cartesian and isobaric coordinates, divergence and vorticity in natural coordinates, conservation of absolute vorticity, potential vorticity, scale analysis of vorticity equation, dynamics of lee side trough, geostrophic vorticity and divergence, divergence equation, balance equation, stream function and velocity potential, Helmoltz theorem, geostrophic, quasi-geostrophic approximation.	10-07-2018 To 26-07-2018	Lectures



Module 5		
Perturbation theory and atmospheric waves: phase velocity and group velocity, dispersion, acoustic waves, inertial waves, Rossby waves, concept of instability.	14-08-2018 To 07-09-2018	Lectures
Module 6		
Atmospheric boundary layer and turbulence: viscous flow and turbulent flow, Navier-Stokes' theorem, general properties of boundary layer and classification, Reynold's number, Froud number, Rossby number, Richardson number, Boussinesq approximation.	10-09-2018 To 24-09-2018	Lectures

- Assignments and Seminars

Assignments

The following Assignment needs to be submitted in writing format. assignments.

No	Topics	Activity	Submission Deadlines	
Assignment	Assignment on the given topic	Write by referring from books and website	Monday of 8th Week of Course	Submit the assignment in written format preferably in A-4 size papers.

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

- Attendance (one component in class participation):

95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	Not eligible for appearing for ESE

- Required reading:

Books:

Text Books

1. *Dynamic and Physical Meteorology*, S. L. Haltiner and F. L. Martin
2. *Introduction to Theoretical Meteorology*, S. Hess
3. *Introduction to Dynamic Meteorology*, J. R. Holton, (1st, 2nd and 3rd Editions)
4. *Atmospheric Boundary Layer*, W.M.O. Technical Notes

Reference Books

1. *Atmospheric Science – An Introductory Survey,* J. M. Wallace and P. V. Hobbs
2. *Numerical Analysis and Prediction*, P. D. Thomson
3. *W. M. O. Compendium of Meteorology: Dynamic Meteorology*, AkselWiin-Nielsen
4. *The Physics of Atmosphere*, John Houghton

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St. Albert's College (Autonomous)

PSP3CRT02 – CLIMATOLOGY-TROPICAL & GLOBAL

- Course Instructor

Name	Sem, Programme & Batch	Email
Stefy Thomas	Sem 3, MSc. Space Science , 2017-2019	stefythomas@gmail.com

- Duration of Course:

No	Activity	Duration
1	Contact hours	90(Including assignments)
2	Assessment (CAE & ESE)	2
	Total	92
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	0

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- Course Objectives:
  - Critically analyse the interactions between the atmosphere and the surface (topography, vegetation, built structures), and apply this understanding in an environmental decision-making context.
  - Apply an understanding of synoptic processes and the ability to interpret a range of graphical and visual data to the explanation of weather events and forecasting.
  - Analyse and interpret the relationships between large-scale ocean-atmosphere processes and regional-local climates, using simple statistical techniques.
  - Synthesise their understanding of climate processes at a range of scales to explain and critique the applications of climate modelling in research and policy contexts.

- Course Delivery Plan:

The teaching methods include lectures, discussions, assignments etc.

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Topics	Date(s)	Methodology
Module 1:		
Climatology: basics, definition of climate, physical factors of climate. Earth-sun relationship, ecliptic and equatorial plane, rotation and evolution of the earth. Climatic controls, elementary ideas about general circulation of the atmosphere. Physical climatology: solar radiation, terrestrial radiation, heat, energy and water balance, evaporation and evapotranspiration. Climatic classification: methods of Koppen, Thornthwaite and Penman. Micrometeorology: influence of ground surface on the microclimate. Factors affecting soil temperature, vertical profile of temperature, humidity and wind in the lowest layer.	04/06/18 To 09/07/18	Lecture
Module 2:		
Indian climatology: pressure, wind, temperature and rainfall distribution during the four seasons. Winter: western disturbances, fog, thunderstorm, hail, cold waves, subtropical jet stream, north-east monsoon, interaction of low and high latitude disturbances, easterly waves. Pre-monsoon: cyclonic storms, tracks, and frequencies, western disturbances, fog, dust-storms, thunderstorms, nor'westers, heat waves, pre-monsoon thunderstorms, dust-raising winds, equatorial troughs. Monsoon: onset and advance of monsoon, activity of monsoon, rainfall, break monsoon, strong and weak monsoon, monsoon trough. Off-shore vortices and trough, low level jet, Mascarene high. Floods and draughts, tropical easterly jet stream.	10-07-2018 To 13-08-2018	Lectures

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Westerly disturbances and their influence on monsoonal circulation, withdrawal of monsoon. Post monsoon: cyclonic storm- tracks, frequency, northeast monsoon circulation and rainfall. Tropical Meteorology: Hadley cell, trade winds, equatorial trough, monsoon areas of the world, monsoon over Asia, Australia and Africa. Tropical convection, tropical precipitation and its spatial and temporal variation. ITCZ, easterly waves, El-nino, southern oscillation, monsoons, convective systems, tropical cyclones, Gray's parameter, CISK, waves in equatorial atmosphere		
Module 3:		Lectures
Surface temperature, pressure, wind, cloudiness and rainfall distribution and variation with latitude in January and July. Upper air climatology during winter and summer. Climate of the continents: Asia, Africa, Australia, Europe, North America and South America, Arctic and Antarctic. Climatic change scenario and impact.	14-08-2018 To 30-08-2018	
Module 4:		Lectures
Cloud morphology, atmospheric aerosols. Cloud condensation nuclei. Warm cloud microphysics, cold cloud microphysics. Shallow layer clouds, cumulus clouds, thunderstorms, meso-scale convective systems. Weather modification experiments.	31-08-2018 To 24-09-2018	

- Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Unravelling the Overcast	1 Week	Observational	

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- Assignments and Seminars

Assignments and Seminar

The following Assignment and seminar needs to be submitted in writing format.

No	Topics	Activity	Submission Deadlines
Assignment	Assignment on 'Climate Change Scenario and Impact'.	Make a brief study about climate change and its impact.	Submit the assignment in written format preferably in A-4 size papers.
Seminar	Climate of the Continents.	Each continent is divided among students and they were asked to present it.	Make the seminar presentation on the allotted topic in the given time.

Note: Failure to submit the assignment & seminar on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

- Attendance (one component in class participation):

95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	Not eligible for appearing for ESE

- Required reading:

Text Books

1. *Monsoons*: P. K. Das, NBT
2. *Southwest Monsoon (IMD Met Monograph)*: Y. P. Rao
3. *World Survey of Climate*, Vol I to XV, Ed: Landsberg
4. *Physical Climatology,* W. D. Sellers
5. *An Introduction to Climate*, G. T. Trewartha
6. *Tropical Meteorology,* Herbert Riehl
7. *Tropical Meteorology*, Vol I and II, G. C. Asnani
8. *Climate of South Asia,* G.B. Pant and Rupa Kumar
9. *Cloud Physics*, R. R. Rogers
10. *The Physics of Clouds*, B. J. Mason

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PSP3CRT03 – SYNOPTIC METEOROLOGY AND SATELLITE METEOROLOGY

- Course Instructor

Name	Sem, Programme & Batch	Email
Stefy Thomas	Sem 3, MSc. Space Science , 2017-2019	stefythomas@gmail.com

- Duration of Course:

No	Activity	Duration
		90(Including assignments)
1	Contact hours	2
2	Assessment (CAE & ESE)	92
	Total	0
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	

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- Course Objectives:
  - Skills for interpreting and applying atmospheric observations.
  - Knowledge of the atmosphere and its evolution.
  - Mastery of the fundamental principles governing the atmosphere and the characteristic atmospheric processes across spatial and temporal scales.

- Course Delivery Plan:

The teaching methods include lectures, discussions, assignments etc.

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HOD in charge

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Topics	Date(s)	Methodology
Module 1:		
Introduction to synoptic meteorology, scales of weather systems, network of observatories, synoptic observations, surface. Upper air and special observations, satellite, radar data etc., representation and analysis of fields of meteorological elements. Extra-tropical meteorology: air masses, characteristics, prediction and modification. Fronts and frontolysis, slope and fronts, Margule's formula, Structure of fronts and polar-front theory. Cyclones and anti-cyclones, frontal and baroclinic models. Structure and development theories, jet stream and tropopause, long waves, cut-off lows and highs, blocking highs, Jet stream: polar front jet, sub-tropical jet, tropical easterly jet, polar night jet, characteristic features of various jet streams, Theories of formation, weather development, cloud and clear air turbulence (CAT)	04/06/18 To 13/08/18	Lecture
Module 2		
Principles of satellite image interpretation: identifying cloud types and patterns in satellite images, comparison of visible, infrared, water vapour and microwave imagery, monitoring development of weather phenomena and tracking movement of weather systems. Monsoons: large-scale circulation, onset and advance of south-west monsoon, monsoon trough, active, weak and break monsoon conditions. Monsoon depressions, tropical easterly jet, north-east monsoon. Mesoscale systems: MCCs, orographic systems, dust storms. Extra-tropical systems: sub-tropical and polar jets. Long and short waves, clod and warm fronts.	14-08-2018 To 07-09-2018	Lectures

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Cyclogenesis, types of extra-tropical cyclones, western disturbances. Tropical disturbances: inter-tropical convergence zone, easterly waves. tropical cyclones, formation, structure, intensification, movement, recurvature. Tropical cyclones, formation, structure, intensification, movement, recurvature. Upper air troughs/ridges, fronts, western disturbances, fog, in satellite images		
Module 3:		
Quantitative product derivation from satellite data: rainfall, sea surface temperature. Outgoing longwave radiation, cloud motion winds, vertical temperature profiles. Microwave retrievals: scatterometer. TRMM satellite. Global Precipitation Mission. Global Precipitation Climatology Project. D'vorak's technique for tropical cyclone intensity estimation,local severe storms, SST analysis.	10-09-2018 To 24-09-2018	Lectures

- ## Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Knowing the monsoon	1 Week	Analytical	07/09/18

- ## Assignments and Seminars

Assignments

The following Assignment and seminar needs to be submitted in writing format.

No	Topics	Activity	Submission Deadlines	
Assignment	Assignment on 'The basics of	Understood the basics of microwave	Monday of 8th Week of Course	Submit the assignment in written format

	microwave retrievals'.	retrievals and write about it.		preferably in A-4 size papers.

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

- Attendance (one component in class participation):

95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	Not eligible for appearing for ESE

- Required reading:

Books
Module 1
Text Books
1. *Atmospheric Circulation Systems*: E. Palmen and Newton
2. *Monsoons*: P. K. Das, NBT
3. *Southwest Monsoon (IMD Met Monograph)*: Y. P. Rao
4. *World Survey of Climate*, Vol I to XV, Ed: Landsberg
5. *Physical Climatology,* W. D. Sellers
6. *An Introduction to Climate*, G. T. Trewartha
7. *Tropical Meteorology,* Herbert Riehl
8. *Tropical Meteorology*, Vol I and II, G. C. Asnani
9. *Tropical Climatology*, Nieuwolt
10. *Climate of South Asia,* G.B. Pant and Rupa Kumar

Reference Books
1. *Monsoons (WMO lectures)*, P. K. Das
2. *World Climatology*, John G. Lockwood
3. *Climate of the Continents,* W. C. Kendrew
4. *Foundation of Climatology*, E. T. Stringer
5. *Weather Forecasting*, A. A. Ramsastry

Modules 2 and 3
Text Books
1. *Lecture Notes on Satellite Meteorology*, Vol 1 and 2, SAC, Ahmedabad
2. *Satellite Meteorology*, S. Q. Kidder and T. H. Von der Haar, Academic Press, 1995

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3. *satellite meteorology, Dr. R. R Kelkar, academic Press*

Reference Books

1. *Images in Weather Forecasting,* M. J. Bader, G. S. Forbes, J. R. Grant, R. B. E. Lilly and A. J. Waters, Cambridge University Press, 1995
2. *Quantitative Meteorological Data from Satellites*, WMO Technical Note No. 166

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MERGEFORMAT 5

St. Albert's College (Autonomous)

PSP3CRT04 – ASTRONOMY AND ASTROPHYSICS

- Course Instructor

Name	Sem, Programme & Batch	Email
Karthika P P	Sem 3, MSc. Space Science , 2017-2019	karthikapp@gmail.com

- Duration of Course:

No	Activity	Duration
1	Contact hours	65(Including assignments)
2	Assessment (CAE & ESE)	2
	Total	67
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	0

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- Course Objectives:
  - A broad knowledge of fundamental physical laws applying to the world at scales ranging from the nuclear to the cosmological.
  - Comprehend, apply, and analyze the most important scientific models governing modern astrophysics and be familiar with the astronomical objects studied by astronomers.

- Course Delivery Plan:

- This course is a course requiring a lot of student centric learning processes. The teaching methods include lectures, discussions, assignments etc.

Topics	Date(s)	Methodology
Module 1		

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Overview of the universe: Qualitative description of interesting astro objects (from planets to large scale structure), length, mass and time scales, physical conditions in different objects, evolution of structures in the universe, red shift. Radiation in different bands, astronomical jargon, astronomical measurements in different bands, current sensitivities and resolution available. Gravity: Newtonian gravity and basic potential theory, simple orbits, Kepler's laws, precession, flat rotation curve of galaxies and implications for dark matter, virial theorem and simple applications, role of gravity in different astrophysical systems. Radiative processes: overview of radiation theory and Larmor formula, different radiative processes, Thomson and Compton scattering, Bremsstrahlung, synchrotron (detailed derivations are not expected), radiative equilibrium, Planck spectrum and properties, line widths and transition rates in QT of radiation, contribution of radiative processes in different wavebands and astrophysical systems (qualitative description), distribution function for photons and its moments, elementary notion of radiation transport through a slab, concept of opacities. Gas dynamics: equations of fluid dynamics, equation of state in different regimes (including degenerate systems), models for different systems in equilibrium, application to white dwarfs and neutron stars, simple fluid flows including supersonic flow, example of SN explosions and its different phases.	04/06/18 To 19/06/18	Lectures with derivation.
Module 2:		

Basic equations of stellar structure Stellar energy sources Qualitative description of numerical solutions for stars of different mass, homologous stellar models. Stellar evolution, evolution in the HR-Diagram.	20-06-2018 To 09-07-2018	Lecture
Module 3:		
Galactic physics: Milky Way galaxy, spiral and elliptical galaxies. Galaxies as self-gravitating systems. Spiral structure, super-massive black holes, active galactic nuclei.	10-07-2018 To 26-07-2018	Lecture
Module 4:		
Principles of relativity: overview of special relativity, space-time diagrams, Lorentz metric, light cones. Electrodynamics in 4-dimensional language, introduction to general relativity, equivalence principle, gravitation as a manifestation of the curvature of space-time. Geometrical framework of general relativity: curved spaces, tensor algebra, metric, affine connection, covariant derivatives. Physics in curved space-time, curvature - Riemann tensor, Bianchi identities, action principle. Einstein's field equations. Energy momentum tensors, energy momentum tensor for a perfect fluid, connection with Newton's theory. Solutions to Einstein's equations and their properties: spherical symmetry, derivation of the Schwarzschild solution. Test particle orbits for massive and mass less particles, the three classical tests of general relativity. Black holes, event horizon, one-way membranes, gravitational waves.	27-07-2018 To 07-09-2018	Lectures with derivation.
Module 5		
Cosmological models: cosmological principle, Robertson-Walker metric. Cosmological red shift, Hubble's law, observable quantities. Luminosity and angular diameter distances, dynamics of Friedmann-Robertson-Walker models.	10-09-2018 To 24-09-2018	Lectures with derivation.

Solutions of Einstein's equations for closed, open and flat universes. Physical cosmology and the early universe: thermal history of the universe, temperature red shift relation. Distribution functions in the early universe, relativistic and non-relativistic limits, decoupling of neutrinos and the relic neutrino background. Nucleosynthesis, decoupling of matter and radiation. Cosmic microwave background radiation, inflation, origin and growth of density perturbations.		

- Assignments and Seminars

Assignments

The following Assignment needs to be submitted in writing format. assignments.

No	Topics	Activity	Submission Deadlines	
Assignment	Assignment on 'Different types of galaxies'	Write by referring from books and website	Monday of 8th Week of Course	Submit the assignment in written format preferably in A-4 size papers.

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

- Attendance (one component in class participation):

95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	Not eligible for appearing for ESE

- Required reading:

1. *Modern Astrophyiscs*, B. W. Carroll and D. A. Ostlie, Addison -Wesley

2. *The Physics of Astrophysics*, Vol. I and II, F. Shu, University Science Books

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3. *The Physical Universe*, F. Shu, University Science Books

4. *Theoretical Astrophysics*, Vol. I, II and III, T. Padmanabhan, Cambridge University Press

5. *The Physics of Fluids and Plasmas*, Arnab Rai Choudhuri, Cambridge University Press

6. *Astrophysical Concepts*, M. Harwitt, Springer-Verlag

7. *Galactic Astronomy*, J. Binney and M. Merrifeld, Princeton University Press

8. *Galactic Dynamics*, J. Binney and S. Tremaine, Princeton University Press

9. *Quasars and Active Galactic Nuclei*, A. K. Kembhavi and J. V. Narlikar,

10. *An Introduction to Active Galactic Nucleii*, B. M. Peterson

Modules 4 and 5

1. *General Relativity and Cosmology*, J. V. Narlikar, Macmillan India

2. *Introduction to Cosmology*, J. V. Narlikar, Cambridge University Press

3. *Structure Formation in the Universe*, T. Padmanabhan, Cambridge University Press

4. *Classical Theory of Fields*, Vol. 2, L. D. Landau and E. M. Lifshitz

5. *First Course in General Relativity*, B. F. Schutz, Cambridge University Press

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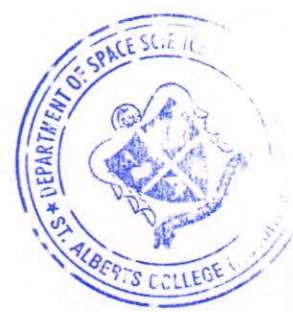
MERGEFORMAT 4



St. Albert's College (Autonomous)

PSP3CRT05 – ATMOSPHERIC CHEMISTRY & ATMOSPHERIC ELECTRICITY.

- Course Instructor

Name	Sem, Programme & Batch	Email
Karthika P P	Sem 3, MSc. Space Science , 2017-2019	karthikapp@gmail.com

- Duration of Course:

No	Activity	Duration
1	Contact hours	36(Including assignments)
2	Assessment (CAE & ESE)	2
	Total	38
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	0

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- Course Objectives:
  - Predict fate of molecules and radicals under typical atmospheric conditions.
  - Explain basic principles of greenhouse effect and compute global warming potentials.
  - Qualitatively explain and quantitatively compute trends in photolysis rate constants with altitude, season, and time of day for molecules whose photochemistry is known.

- Course Delivery Plan:

- This course is a course requiring a lot of student centric learning processes. The teaching methods include lectures, discussions, assignments etc.

Topics	Date(s)	Methodology
Module 1:		
Evolution of the earth's atmosphere. Primitive atmosphere.	04/06/2018 to 26/07/2018	Lectures Lectures

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Prebiotic atmosphere and origins of life, rise of oxygen and ozone, oxygen and carbon budgets, other atmospheric constituents. Half-life, residence time and renewal time of chemicals in the atmosphere. Spatial and temporal scales of variability. Present chemical composition of the atmosphere. Units for chemical abundance, composition of air close to the earth's surface, change in the atmospheric composition with height. Sources, transformations, transport, sinks of chemicals in the atmosphere. Transformations by homogeneous transformation. Transformations by other processes, transport and distribution of chemicals, sinks of chemicals. Tropospheric chemical cycles: carbon cycle, nitrogen cycle, sulphur cycle. Air pollution: sources of anthropogenic pollutants, some atmospheric effects of air pollution. Stratospheric chemistry: unperturbed stratospheric ozone, anthropogenic perturbations to stratospheric ozone. Stratospheric aerosols, sulphur in the stratosphere.	
Module 2	
Ions and electrical conductivity, fair weather electricity, electrical currents in the atmosphere.Electrical structure of storms, cloud electrification, laboratory experiments. Lightning discharges, lightning electric fields, lightning location systems. Upward lightning and sprites, global electric circuit. Nitrogen fixation.	27-07-2018 To 24-09-2018

- Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Find out about the sources of air pollution in your locality.	1 Week	Observational	Monday of 8th Week of Course

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ST. ALBERT'S COLLEGE (AUTONOMOUS) ERNAKULAM

- Assignments and Seminars

Assignments

The following Assignment needs to be submitted in writing format. assignments.

No	Topics	Activity	Submission Deadlines	
Assignment	Assignment on 'Stratospheric Aerosols'	Write by referring from books and website	Monday of 12th Week of Course	Submit the assignment in written format preferably in A-4 size papers.

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

- Attendance (one component in class participation):

95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	Not eligible for appearing for ESE

- Required reading:

1. *Introduction to Atmospheric Chemistry*, P. V. Hobbs

2. Chemistry of the Upper and Lower Atmosphere, Barbara J. Finlayson-Pitts, Jr. and James N. Pitts

3. *Chemistry of Atmospheres*, Richard P. Wayne.

4. *Atmospheric Chemistry and Physics: From Air Pollution to Climate Change*, John H. Seinfeld and Spyros N. Pandis

5. *Basic Physical Chemistry for Atmospheric Sciences*, P.V. Hobbs

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St. Albert's College (Autonomous)

PSP4CRT01– SPACE PLASMA

- Course Instructor

Name	Sem, Programme & Batch	Email
Stefy Thomas	Sem 4, MSc. Space Science , 2017-2019	stefythomas@gmail.com

- Duration of Course:

No	Activity	Duration
1	Contact hours	65(Including assignments)
2	Assessment (CAE & ESE)	2
	Total	67
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	0

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- Course Objectives:
  - Calculate fundamental properties of a plasma given appropriate information.
  - Apply basic electromagnetism to derive the kinetic theory of plasmas.
  - Use kinetic theory to explain the motions of charged particles in the ionosphere and near- Earth space.

- Course Delivery Plan

This course is a course requiring a lot of student centric learning processes. The teaching methods include lectures, discussions, assignments etc.

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Topics	Date(s)	Methodology
Module 1:		
Plasma waves and instabilities. Electromagnetic waves parallel to the external magnetic field.	04/06/18 To 19/06/18	Lectures with derivation.
Module 2:		
Oscillations in acoustic wave radiation from plasma, plasma state, fluid picture, hydromagnetic waves and pulsations. Geomagnetic pulsations, VLF and whistler phenomena.	20-06-2018 To 09-07-2018	Lectures with derivation.
Module 3:		
Ionospheric storms – causative mechanisms. Neutral wind – Ionosphere coupling, EXB drift, TIDs. Models like IRI and FLIP. Geomagnetic and magnetic coordinates. Poles, measurement of geomagnetic field components. Micro-pulsation indices Variations of geomagnetic field, quiet and disturbed variations. Geomagnetic storms, equatorial and auroral phenomena.	10-07-2018 To 26-07-2018	Lectures.
Module 4:		
Detection of radio wave propagation in the ionosphere. Ionosondes, whistlers, electric field measurements. Magnetic field of earth. Types of magnetometers like proton precession, fluxgate and rubidium vapour magnetometers. All-sky camera and photometers for aurora, Particle detectors for cosmic rays GPS – working and application.	10-07-2018 To 26-07-2018	Lectures with presentations.
Module 5		
Solar wind: observational evidence for the solar atmosphere, model of solar winds, interaction in the interplanetary medium and with the planets. Magnetosphere: interaction of solar wind with the geomagnetic field and formation of the	14-08-2018 To 07-09-2018	Lectures with presentation

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magnetospheric tail, storm and sub-storm phenomena. Van Allen radiation belts, trajectory of charged particles and invariants of motion, energy and momentum spectra of trapped radiations, sources and sinks of trapped radiation.		
Module 6		
Cosmic rays: solar and galactic cosmic rays, phenomenology and interpretation. Dynamo theory, earth and planetary magnetic fields, comparative planetary magnetosphere, stellar magnetic fields, pulsar's magnetic field	10-09-2018 To 17-09-2018	Lectures with presentations.
Module 7		
Balloon, rocket and satellite based systems for measurements of particles, fields and bodies in the interplanetary space interacting with plasmas like solar wind and cosmic rays.	18/09/18 To 24/09/18	Lectures with presentations.

- Innovative Learning Programmes

Name of Programme	Duration	Type	Proposed Time
Write a review by analysing the articles 'on the effects of solar wind on geomagnetic field'.	2 Weeks	Critical Thinking	Thursday of 5th Week of Course

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- Assignments and Seminars

- Assignments

The following Assignment needs to be submitted in writing format. assignments.

No	Topics	Activity	Submission Deadlines

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Assignment	Assignment on 'Applications of GPS'	Prepare a write up on 'Applications of GPS'	Monday of 7th Week of Course	Submit the assignment in written format preferably in A-4 size papers.

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

- Attendance (one component in class participation):

95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	Not eligible for appearing for ESE

- Required reading:

Text Books

1. *An Introduction to Ionosphere and Magnetosphere*, J. A. Raticliffe
2. *Solar System Astrophysics,* J. C. Brandft and P. W. Hodge
3. *Introduction to Experimental Physics*, W. B. Fretter
4. *Physics of Geomagnetic Phenomena*, Vol. I and II, S. Matsushita and W. H. Campbell, Academic Press
5. *Introduction to Ionospheric Physics,* H. Risbeth and H. Garriot, Academic Press

Reference Books

1. *Plasma Diagnostic Techniques*, R. H. Huddlestone and S. L. Leonard
2. *High Vacuum Techniques*, J. Yarwood
3. *Plasma Diagnostics*, Vol. I, O. Anciello and D. L. Flamn
4. *The Earth's Ionosphere: Plasma Physics and Electrodynamics,* Michael C. Kelley, Academic Press
5. *Ionospheric Techniques and Phenomena*, A. Giraud and M. Petit, D. Reidel Publishers

DEPARTMENT OF SPACE SCIENCE
ST. ALBERT'S COLLEGE (AUTONOMOUS)

St. Albert's College (Autonomous)

~~SPS01~~-PSP4CRT01~~-~~ SPACE DYNAMICS

- **Course Instructor**

Name	Sem, Programme & Batch	Email
Karthika P P	Sem 4, MSc. Space Science , 2017-2019	karthikapp@alberts.edu.in

- **Duration of Course:**

No	Activity	Duration
1	Contact hours	45(Including assignments)
2	Assessment (CAE & ESE)	2
	Total	**47**
	Remedial Sessions/Peer Tutoring/Tutorials (need based & Optional)	**0**

- **Course Objectives:**
  - Understand the basics of Orbital Mechanics
  - Full understanding of conic sections and fundamental orbit equations of motion
  - Understanding of the fundamentals of spacecraft attitude dynamics

- **Course Delivery Plan**

This course is a course requiring a lot of student centric learning processes. The teaching methods include lectures, discussions, assignments etc.

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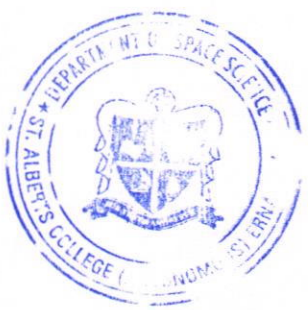
Topics	Session No & Date(s)	Methodology and Duration
Module 1:		
Gas and dust particles, dynamics of inter-planetary particles.	16/01/19	Lectures
Radiation pressure, zodiacal light, brightness and polarization, temperature variations.	17/01/19 18/01/19	Lectures with derivation.
Cometary structures, comets and asteroids.	21/01/19	Lectures
Physical processes in the head of the comet, dust tails and grains, origin of comets, origin of solar system.	22/01/19	Lectures
Module 2:		
Photographic, photoelectric, spectroscopic, interferometric and polarimetric techniques.	23/01/19 24/01/19 25/01/19	Lectures.
The study of phenomena like corona, zodiacal light and bodies in the solar system such as planets, asteroids, comets and meteors.	28/01/19 29/01/19 30/01/19 31/01/19	Lectures
Module 3:		
Characteristics of propellants, standard atmosphere.	8/02/19 11/02/19	Lectures
Principal aerodynamic forces, coordinate systems, general equations of motion.	13/02/19 14/02/19	Lectures
Vertical lift-off dynamics under wind and mal-alignment of thrust.	15/02/19 18/02/19 19/02/19	Lectures
Multi-staging, 2-d motion of a launch vehicle up to a specified height.	25/02/19 26/02/19	Lectures
Computation of launch vehicle motion, polar and geostationary orbit dynamics.	27/02/19	Lectures

- **Assignments and Seminars**

Assignments



The following Assignment needs to be submitted in writing format. assignments.

No	Topics	Activity	Submission Deadlines	
Assignment	Assignment on 'Polar and Geostationary Satellites & their orbits'	Prepare a write up on 'Polar and Geostationary Satellites & their orbits'	Submit on 1/03/19	Submit the assignment in written format preferably in A-4 size papers.

Note: Failure to submit the assignment on the date mentioned will result in 0 marks for the assignment. Requests for extension of dates for submission not entertained.

- **Attendance (one component in class participation):**

95-100%	5
90-95%	4
85-90%	3
80-85%	2
75-80%	1
<75	**Not eligible for appearing for ESE**

- **Required reading:**

Modules 1, 2

1. *Electrodynamics*, Griffith
2. *Solar System Astrophysics,* J. C. Brandt and P. W. Hodge
3. *Introduction to Experimental Physics*, W. B. Fretter.

Reference Books

1. *The Magnetic Field of the Earth*, Roland T. Merrill, Michael W. McElhinny, Phillip L. Mcfadden, Academic Press
2. *Physics of Geomagnetic Phenomena,* Vol. I and II, S. Matsushita. and W. H. Campbell, Academic Press
3. *Earth's Magnetospheric Process,* Ed. B. M. McCormac, D. Reidel Publishers
4. *Physics of the Magnetosphere*, Eds. R. L. Corovillano, J. T. McCaulley and H. Radosky, D. Reidel Publishers
5. *Solar System Plasma Physics*, Vol. I, II and III, Eds. C. F. Kennel, L. J. Lanzenrutti and E. N. Parker
6. *Dynamics of the Geomagnetically Trapped Radiation (Physics and Chemistry in Space*, Vol II)
7. *Solar Terrestrial Physics*, Ed. E. R. Dyer, D. Reidel Publishers

Module 3

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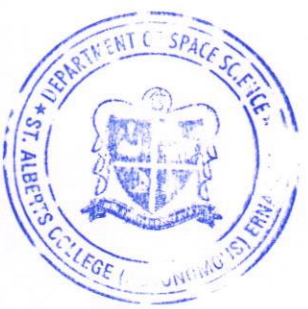
Text Books

1. *Introduction to Celestial Mechanics*, S. W. McCusky, Addison-Wesley
2. *Fundamentals of Astrodynamics*, R. R. Bates et al, Dover

Reference Books

1. *Orbital Mechanics*, Ed. Vladimir A, Chobotov, AIAA Edn Series
2. *Orbital Motion*, A. E. Roy, Adam Hinglar Ltd
3. *Rocket Motion*, DASS issue