SACRED HEART COLLEGE (AUTONOMOUS)

Department of Physics

M.Sc. Physics

COURSE PLAN

Semester 1

2015 - 16

COURSE PLAN

PROGRAMME	MASTERS OF PHYSICS	SEMESTER	1
COURSE CODE AND TITLE	P1PHYT01: MATHEMATICAL METHODS IN PHYSICS – I	CREDIT	4
Theory HOURS/WEEK	4	HOURS/SEM	72
FACULTY NAME	Prof. ALEX SHINU SCARIA		

COURSE OBJECTIVES
To explain the concepts of different mathematical methods in physics
To apply to solve different physical Problems.
To categorize different types of matrices
To explain the concepts of differential equations to solve physical problems

SESSION	**TOPIC**	**LEARNING RESOURCES**	**REMARKS**
	MODULE I		
1 & 2	Integral forms of gradient, divergence and curl, Line, surface and volume integrals	Lect+ discussion	
3 & 4	Stoke's, Gauss's and Green's theorems	Lect+ discussion	
5 & 6	Potential theory - scalar, gravitational and centrifugal potentials	Lect	
7 & 8	Orthogonal curvilinear coordinates	Lect+ discussion	
9 & 10	gradient, divergence and curl in Cartesian	Lect + discussion	
11 & 12	gradient, divergence and curl in spherical and cylindrical co-ordinates	Lect	
13 & 14	Equation of continuity - Linear vector spaces	Lect	
15	Hermitian, unitary and projection operators with their properties	discussion	
16, 17	inner product space - Schmidt orthogonalization	Lect	
18	Hilbert space - Schwartz inequality	Lect+ Group Activity	
	MODULE II		
19	Direct sum and direct product of matrices	Lect	
20	diagonal matrices	Lect	
21	Matrix inversion (GaussJordan inversion method)	Group discussion	
22	orthoganal, unitary and Hermitian matrices, normal matrices	Lect	
23	Pauli spin matrices	Lect	

24	Cayley-Hamilton theorem	Group discussion	
25 & 26	Similarity transformation - unitary and orthogonal transformation	Lect	
27	Eigen values and eigenvectors	Group discussion	
28	Diagonalisation using normalized eigenvectors	Lect	
29 & 30	Solution of linear equation-Gauss elimination method	Lect + discussion	
31	Normal modes of vibrations.	Lect	
32 & 33	Elementary probability theory, Random variables	Lect +Group discussion	
34 & 35	Binomial, Poisson and Gaussian distributions	Lect + discussion	
36	central limit theorem.	Lect	
	MODULE III		
37 & 38	Definition of tensors, basic properties of tensors	Lect	
39	Covariant, contravariant and mixed tensors	Lect + discussion	
40	Levi-Civita tensor	Lect + discussion	
41 & 42	Metric tensor and its properties	Lect + discussion	
43 & 44	Tensor algebra	Lect + discussion	
45 & 46	Christoffel symbols and their transformation laws	Lect + discussion	
47	covariant differentiation	Lect + discussion	
48	geodesic equation	Lect.	
49 & 50	Riemann-Christoffel tensor	Lect	
51 & 52	Ricci tensor and Ricci scalar.	Lect	
MODULE IV			
53	Gamma and Beta functions	seminar + discussion	
54, 55 & 56	different forms of beta and gamma functions, evaluation of standard integrals	seminar + discussion	
57 & 58	Dirac delta function	seminar + discussion	
59 & 60	Kronecker Delta - properties and applications	seminar + discussion	
61 & 62	Bessel's differential equation – Bessel and Neumann functions	seminar + discussion	
63 & 64	Legendre differential equation - Associated Legendre functions	seminar + discussion	
65 & 66	Hermite differential equation	Lect + discussion	
67 & 68	Laguerre differential equation	Lect + discussion	
69 & 70	Associated Laguerre polynomials. (Generating function, recurrence relations, and orthogonality condition for all functions)	Lect + discussion	
71	Rodrigue's formula	Lect + discussion	
72	Problems	Group Activity	

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)
1	Before 1st Internal	Individual- Graded – 3 sets
2	Before 2nd Internal	Individual- Graded -3 sets

ASSIGNMENTS– Details & Guidelines – Will be notified prior to the announcement of the assignment – marks will be scaled to 5.

SEMINARS will be given to each student (20 mins duration) – 5 marks ()

Basic Reference:

1) Mathematical Methods for Physicists, G.B. Arfken&H.J. Weber 4th Edition, Academic Press.
2) Mathematical Physics, P.K Chattopadhyay, New Age International (chapter 7)
3) Theory and problems of vector analysis, Murray R. Spiegel (Schaum's outline series)
4) Mathematical methods for Physics and Engineering, K.F. Riley, M.P Hobson, S. J. Bence, Cambridge University Press (Chapter 24)
5) Introduction to Mathematical Physics, Charlie Harper, PHI
6) Vector analysis and tensors, Schaum's outline series, M.R. Spiegel, Seymour Lipschutz, Dennis Spellman, McGraw Hill
7) Mathematical Physics, B.S. Rajput, Y. Prakash 9th Ed, PragatiPrakashan (Chapter 10)

8) Tensor Calculus: Theory and problems, A. N. Srivastava, Universities Press

Reference Books:

1. Mathematical Physics, B.D. Gupta, VikasPub.House, New Delhi
2. Advanced Engineering Mathematics, E. Kreyszig, 7th Ed., John Wiley
3. Introduction to mathematical methods in physics, G.Fletcher, Tata McGraw Hill
4. Advanced engineering mathematics, C.R. Wylie, & L C Barrett, Tata McGraw Hill
5. Advanced Mathematics for Engineering and Physics, L.A. Pipes & L.R. Harvill, Tata McGraw Hill
6. Mathematical Methods in Physics, J. Mathew & R.L. Walker, India Book House.
7. Mathematical Physics, H.K. Dass, S. Chand & Co. New Delhi.

COURSE PLAN

PROGRAMME	MSc PHYSICS	SEMESTER	1
COURSE CODE AND TITLE	P1PHYT02: Classical Mechanics	CREDIT	4
Theory HOURS/WEEK	4	HOURS/SEM	72
FACULTY NAME	GEORGEKUTTY JOSEPH		

COURSE OBJECTIVES
To summarize the concepts of Lagrangian and Hamiltonian formalism, canonical transformation, Poisson bracket
To apply to the problems related to classical mechanics
To explain the concepts of rigid body dynamics
To explain the concepts of principle of equivalence, Einstein`s field equations, nonlinear systems

SESSION	TOPIC	LEARNING RESOURCES	REMARKS
	MODULE I		
1 & 2	Review of Newtonian and Lagrangian formalism	Lect	
3 & 4	cyclic co-ordinates – conservation theorems and symmetry properties	Lect	
5 & 6	velocity dependent potentials and dissipation function	Lect	
7	Hamilton's equations of motion	Lect	
8 & 9	Least action principle – physical significance	Lect+ discussion	
10	Problems	Lect+ discussion	
11	Hamilton's principle	Lect	
12 & 13	calculus of variations	Lect	
14 & 15	examples	Lect + discussion	
16	Lagrange's equations from Hamilton's principle	Lect	
	MODULE II		
17	Stable and unstable equilibrium	Lect+ discussion	
18	two-coupled oscillators	Lect	
19 & 20	Lagrange's equations of motion for small oscillations – normal co-ordinates and normal modes	Lect+ discussion	
21	oscillations of linear tri-atomic molecules	Lect+ discussion	
22	Problems	Lect+ discussion	
23	Equations of canonical transformation	Lect	
24 & 25	examples of canonical transformation – harmonic oscillator	Lect	
26	Poisson brackets - properties	Lect	
27	equations of motion in Poisson bracket form – angular momentum Poisson brackets	Lect	

28	invariance under canonical transformations – Lagrange brackets	Lect	
29	Problems	Lect+ discussion	
30	Hamilton-Jacobi equation for Hamilton's principal function	Lect	
31	harmonic oscillator problem	Lect + discussion	
32 & 33	Hamilton - Jacobi equation for Hamilton's characteristic function	Lect	
34	action angle variables in systems of one degree of freedom	Lect	
35	Hamilton-Jacobi equation as the short wavelength limit of Schroedinger equation	Lect	
36	problems	Lect + discussion	
MODULE III			
37	Reduction to the equivalent one body problem	Lect + discussion	
38 & 39	equations of motion and first integrals	Lect + discussion	
40 & 41	equivalent one-dimensional problem and classification of orbits	Lect + discussion	
42	differential equation for the orbits	Lect + discussion	
43	virial theorem	Lect + discussion	
44	Kepler problem	Lect + discussion	
45	Problems	Lect + discussion	
46	Angular momentum - kinetic energy	Lect + discussion	
47 & 48	inertia tensor - principal axes	Lect.	
49	Euler's angles	Lect	
50	infinitesimal rotations	Lect	
51	rate of change of a vector - Coriolis force	Lect	

52 & 53	Euler's equations of motion of a symmetric top	Lect	
54 & 55	heavy symmetric top with one point fixed	Lect + discussion	
56	problems	Lect + discussion	
MODULE IV			
57	Principle of equivalence - principle of general covariance	PPT+SEMINAR+class activity	
58 & 59	motion of a mass point in a gravitational field – the Newtonian approximation – time dilation	PPT+SEMINAR+class activity	
60 & 61	rates of clocks in a gravitational field - shift in the spectral lines	PPT+SEMINAR+class activity	
62 & 63	energy- momentum tensor- Einstein's field equations	PPT+SEMINAR+class activity	
64	Poisson approximation - problems	PPT+SEMINAR+class activity	
65	Linear and non-linear systems	PPT+SEMINAR+class activity	
66	integration of linear equation: Quadrature method	PPT+SEMINAR+class activity	
67	the pendulum equation	PPT+SEMINAR+class activity	
68 & 69	phase plane analysis of dynamical systems – phase curve of simple harmonic oscillator and damped oscillator.	PPT+SEMINAR+class activity	
70	phase portrait of the pendulum - bifurcation	PPT+SEMINAR+class activity	
71	logistic map – attractors - universality of chaos	PPT+SEMINAR+class activity	
72	Lyapunov exponent - fractals - fractal dimensions -Problems	PPT+SEMINAR+class activity	

INDIVIDUAL ASSIGNMENTS/SEMINAR – Details & Guidelines

	Date of completion	Topic of Assignment & Nature of assignment (Individual/Group – Written/Presentation – Graded or Non-graded etc)
1	Before 1st Internal	Individual- Graded – 3 sets
2	Before 2nd Internal	Individual- Graded -3 sets

ASSIGNMENTS– Details & Guidelines – Will be notified prior to the announcement of the assignment – marks will be scaled to 5.

SEMINARS will be given to each student (20 mins duration) – 5 marks ()

Basic Reference:

1. Classical Mechanics, H. Goldstein, C.P. Poole & J.L. Safko, Pearson, 3rd Ed.
2. Classical Mechanics, S.L. Gupta, V. Kumar & H.V. Sharma, PragatiPrakashan, 2007
3. Classical Mechanics, J.C. Upadhyaya, Himalaya, 2010
4. Classical Mechanics, G. Aruldhas, Prentice Hall 2009
5. Relativistic Mechanics, SatyaPrakash, Pragathiprakashan Pub
6. Deterministic Chaos, N Kumar, University Press

Reference Books:

1. Classical Mechanics, N.C. Rana and P.S. Joag, Tata McGraw Hill
2. Introduction to Classical Mechanics, R.G. Takwale and P.S. Puranik, TMGH.
3. Langrangian and Hamiltonian Mechanics, M.G. Calkin, World Scientific Pub.Co Ltd
4. Introduction to General Relativity, R. Adler, M. Bazin, M. Schiffer, TMGH.
5. An introduction to general relativity, S. K. Bose, Wiley Eastern.
6. The Theory of Relativity, R.K. Pathria, Dover Pub. Inc. NY,2003
7. Chaos in Classical and Quantum Mechanics, M.C.Gutzwiller, Springer, 1990.
8. Classical Mechanics, G. Aruldhas, Prentice Hall 2009
9. Chaotic Dynamics, G.L.Baker&J.P.Gollub, Cambridge Uni. Press, 1996
10. Mathematical Methods for Physicists, G.B. Arfken&H.J. Weber 4th Edition

COURSE PLAN

PROGRAMME	MASTER OF SCIENCE (PHYSICS)	SEMESTER	1
COURSE CODE AND TITLE	P1PHYT03: ELECTRODYNAMICS	CREDIT	4
HOURS/WEEK	4	HOURS/SEM	72
FACULTY NAME	MATHEW GEORGE		

COURSE OBJECTIVES
To outline the concepts of electrodynamics.
To apply Maxwell's Equations in various situations
To apply the concepts of relativity in various cases
To apply the concepts of waveguides.

No of Sessions	**Topic**	**Method**	**Remarks**
	Unit-1 Electrostatic fields in matter and Electrodynamics		
4	Review of Electrostatics and Magnetostatics,	lecture/discussion	
1	Time varying fields and Maxwell's equations,	lecture/discussion	
1	Potential formulations, Gauge transformations, boundary conditions,	lecture/discussion	
1	wave equations and their solutions,	lecture/discussion	
1	Poynting theorem,	lecture/discussion	
2	Maxwell's stress tensor.	lecture/discussion	
1	Maxwell's equations in phasor notation. Plane waves in conducting and non-conducting medium,	lecture/discussion	
3	Polarization,	lecture/discussion	
2	Reflection and transmission (Normal and Oblique incidence),	lecture/discussion	
2	Dispersion in Dielectrics, Superposition of waves, Group velocity.	lecture/discussion	
	Unit-2 Relativistic Electrodynamics		

2	Structure of space time:	lecture/discussion	
2	Four vectors, Proper time and proper velocity,	lecture/discussion	
1	Relativistic dynamics - Minkowiski force,	lecture/discussion	
2	Magnetism as a relativistic phenomenon,	lecture/discussion	
2	Lorentz transformation of electromagnetic field,	lecture/discussion	
3	electromagnetic field tensor,	lecture/discussion	
3	electrodynamics in tensor notation,	lecture/discussion	
3	Potential formulation of relativistic electrodynamics.	lecture/discussion	
	Unit-3 EM Radiation		
2	Retarded potentials,	lecture/discussion	
2	Jefimenkos equations,	lecture/discussion	
3	Point charges, Lienard-Wiechert potential,	lecture/discussion	
2	Fields of a moving point charge,	lecture/discussion	
3	Electric dipole radiation,	lecture/discussion	
2	Magnetic dipole radiation,	lecture/discussion	
2	Power radiated by point charge in motion.	lecture/discussion	
2	Radiation reaction,	lecture/discussion	
2	Physical basis of radiation reaction.	lecture/discussion	
	Unit-4 Antenna, Wave Guides and Transmission Lines		
1	Radiation resistance of a short dipole,	lecture/discussion	
2	Radiation from quarter wave monopole or half wave dipole.	lecture/discussion	
3	Antenna parameters.	lecture/discussion	
2	Waves between parallel conducting plane TE, TM and TEM waves,	lecture/discussion	
2	TE and TM waves in Rectangular wave guides,	lecture/discussion	
1	Impossibility of TEM waves in rectangular wave guides.	lecture/discussion	
3	Transmission Lines-Principles-Characteristic impedance,	lecture/discussion	

2	standing waves-quarter and half wavelength lines	lecture/discussion	
Total 72 Sessions			

Assignments/seminars: In addition to lectures students will have to submit assignments given, to strengthen their mastery in the subject. There will also be one seminar, to be given by the students.

References: 1. Introduction to Electrodynamics, Griffiths

2. Electromagnetic Waves and Radiating Systems, Balmain and Jordan.

3. Other books specified in the syllabus.

COURSE PLAN

PROGRAMME	MSC PHYSICS	SEMESTER	1
COURSE CODE AND TITLE	P1PHYT04- ELECTRONICS	CREDIT	3
Theory HOURS/WEEK	3	HOURS/SEM	54
FACULTY NAME	Dr. Sumod SG		

COURSE OBJECTIVES
To describe the theoretical aspects of OP-amps
To apply the OP-amp circuits for various Amplifiers
To design the op-amp compensating netwroks
To evaluate problems of Op-amps

SESSION	TOPIC	LEARNING RESOURCES	REMARKS
	MODULE I		
1	Introduction Differential amplifier – Inverting amplifier – Non-inverting amplifier -	Lect	
2	Block diagram representations – Voltage series feedback:	Lect	
3	Negative feedback –	Lect	
4	closed loop voltage gain – Difference input voltage ideally zero	Lect	
5	– Input and output resistance with feedback –	Lect	
6	Bandwidth with feedback – Total output offset voltage with feedback –.	Lect	
7	Voltage follower. Voltage shunt feedback amplifier:	Lect	

8	Closed loop voltage gain – inverting input terminal and virtual ground -	Lect	
9	input and output resistance with feedback – Bandwidth with feedback -	Lect	
10	Total output offset voltage with feedback –	Lect	
11	Current to voltage converter-	Lect+ Group Activity	
12	Inverter. Differential amplifier with one op-amp	Lect	
13	Differential amplifier two op-amps	Lect	
MODULE II			
14	Input offset voltage –Input bias current –	Lect	
15	input offset current –	Lect	
16	Problems	Lect	
15	Total output offset voltage- Thermal drift –	Lect	
17	Effect of variation in power supply voltage on offset voltage –	Lect	
18	Change in input offset voltage and input offset current with time - Noise –	Lect	
19	Common mode configuration and CMRR.	Lect	
20	DC and AC amplifiers	Lect	
21	– AC amplifier with single supply voltage	Lect	
22	– Peaking amplifier – Summing	Lect	
23	Scaling, averaging amplifiers –	Lect	
24	Instrumentation amplifier using transducer bridge –	Lect	
25	Differential input and differential output amplifier –	Lect	
26	Low voltage DC and AC voltmeter -	Lect	
27	Voltage to current converter with grounded load –	Lect	

28	Current to voltage converter –	Lect	
29	Very high input impedance circuit –	PPT+SEMINAR+class activity	
30	Integrator	PPT+SEMINAR+class activity	
31	Differntiator	PPT+SEMINAR+class activity	
	MODULE III		
32	Frequency response –	Group Activity	
33	Compensating networks –	PPT+SEMINAR+class activity	
34	Frequency response of internally compensated and non compensated op-amps –	PPT+SEMINAR+class activity	
35	High frequency op-amp equivalent circuit –	PPT+SEMINAR+class activity	
36	Open loop gain as a function of frequency	PPT+SEMINAR+class activity	
37	– Closed loop frequency response – Circuit stability - slew rate..	Lect.	
38	Active filters –	Lect	
39	First order LPBWF	Lect	
40	second order low pass Butterworth filter	Lect	
41	- First order HPBWF	Lect	
42	and second order high pass Butterworth filter-	PPT+SEMINAR+class activity	
43	wide band pass filter	PPT+SEMINAR+class activity	
44	narrow band pass filter - wide and	PPT+SEMINAR+class activity	
45	narrow band reject filter- All pass filter –	Group Activity	

46	Oscillators: Phase shift and Wien-bridge oscillators –	PPT+SEMINAR+class activity	
47	square, triangular and	PPT+SEMINAR+class activity	
48	sawtooth wave generators- Voltage controlled oscillator	PPT+SEMINAR+class activity	
49	Problems	PPT+SEMINAR+class activity	
50	Basic comparator- Zero crossing detector- Schmitt Trigger –	Lect.	
51	Comparator characteristics- Limitations of op-amp as comparators-	Lect	
52	Peak detector– Sample and Hold circuit	Lect	
53	Problems	Lect	
54	Revision	Lect	

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1	Before 1st Internal	Individual- Graded – 3 sets
2	Before 2nd Internal	Individual- Graded -3 sets

ASSIGNMENTS– Details & Guidelines – Will be notified prior to the announcement of the assignment – marks will be scaled to 5.

SEMINARS will be given to each student (20 mins duration) – 5 marks (,)

Basic Reference:

1. Op-amps and linear integrated circuits R.A. Gayakwad 4th Edn. PHI.

Reference Books:

1. Electronic Devices (Electron Flow Version), 9/E Thomas L. Floyd, Pearson

2. Fundamentals of Electronic Devices and Circuits 5th Ed. David A. Bell, Cambridge.

3. Linear Integrated Circuits and Op Amps, S Bali, TMH