MAR IVANIOS COLLEGE
(AUTONOMOUS)
THIRUVANANTHAPURAM

DEPARTMENT OF PHYSICS

Syllabus for
Master of Science in Physics

Academic Year (2018)

M.Sc PROGRAMME

Programme outcomes.

Through curriculum and assessment mechanisms defined by the program, graduate students will be able to attain :

PO 1: Basic knowledge that includes the understanding of recent developments

PO 2: Advanced knowledge of research principles and methods applicable to the field of work or learning

PO 3: Cognitive skills to demonstrate mastery of theoretical knowledge and to replicate critically on theory and its application

PO 4: Creative skills to investigate analyse and synthesise complex information, problems, concepts and theories.

PO 5: Technical skills to design, use and evaluate research and research methods

PO 6: Produce and defend an original significant contribution to knowledge;

PO 7: Demonstrate mastery of subject material

PO 8: Ability to work both independently and in a group.

PO 9: Qualify for PhD programmes

PO 10: Qualify for teaching at undergraduate and postgraduate level.

MASTERS PROGRAMME IN PHYSICS : M.Sc (PHYSICS)

Programme specific outcomes.

This course will be a prerequisite of PhD programme in any advanced area of theoretical , experimental or applied physics , as well as those choose teaching career in physics in colleges and Universities.

On completing MSc in Physics programme, students will attain :

PSO 1 : Knowledge and insight into physics on an advanced level

PSO 2 : Extended knowledge of advanced mathematical methods

PSO 3 : Skill in in research and methodology in different areas of Physics

PSO 4 : Knowledge in undertaking a major, individual, physics-related project and reporting the results in a full scientific report and oral and poster presentation

PSO 5 : Ability to work with analytical and numerical methods in Physics

PSO 6: Ability to evaluate and analyse scientific measurement data.

PSO 7 : Ability to develop critical comments on each experiment done in the original records including sources and estimates of errors and limitations in the experiments done

PSO 8 : Thorough knowledge and experimental skill in the special paper Electronics

1. GENERAL GUIDELINES

1.1 Theory papers

Books for study and the corresponding chapters are given for most of the theory papers in the syllabus to define the scope of the syllabus. For Continuous Assessment (CA) of theory papers at least one Viva Voce must be conducted for each paper. For assignments and seminars, current developments in the areas of the syllabus may be chosen for improving the general awareness of the student. In tutorial sessions problem solving in different topics of the syllabus maybe discussed.

1.2 Laboratory Course

Rough records may be properly maintained for each practical paper and should be produced during the End Semester Practical Examinations along with the Fair Record. Each student is encouraged to include critical comments on each experiment done in the original records including sources and estimates of errors, limitations in the experiments done and scope for improvements/additions in the experimental work. In performing Electronics Practical: Bread Board Practice is recommended in addition to soldering of electronic circuits. However for examination, only soldering procedure will be assessed and evaluated.

1.3 Special papers (Elective)

Depending on the expertise of faculty members and the facilities available in the College (with the approval of the University and Government as per rules) one of the five Specializations (Special paper Category) may be chosen by a student for the third and fourth semesters of the MSc programme. At present, for all specializations, the practical courses are common.

2 EVALUATION

Evaluation of each paper shall be done in two parts – Continuous Assessment [CA] and End Semester Assessment [ESA]

The distribution of marks for the above two shall be as follows:

Continuous Assessment [CA] : 25% of the total marks for each paper, and

End Semester Assessment [ESA] : 75% of the total marks for the paper.

All records of Continuous Assessment shall be kept in the Department and shall be made available for verification by any competent authority, if and when necessary.

2.1Continuous Assessment (CA)

The allocation of marks for each component under Continuous Evaluation shall be as given below:

Theory papers

1	Attendance	5 marks
2	Assignment	5 marks
3	Seminar	5 marks
4	Internal test(s)	10 marks
	Total	**25 marks**

Practical

1	Attendance	5 marks
2	Internal test(s)	10 marks
3	Record	10 marks
	Total	**25 marks**

There shall be no Continuous Assessment for the dissertation/project work.

2.2 Attendance

Attendance in all theory and practical classes is compulsory. Students have to secure a minimum of 80% attendance for each course within a semester to become eligible to register for each End Semester Examination. The attendance percentage will be calculated from the day of commencement of the semester to the last working day of that semester as specified in the semester schedule. Periodic evaluation of each student's attendance shall be done by the respective Class Teacher within each semester [i.e., at least twice within each semester].There will be no provision for condonation. Reappearance of course(s) will be distinctly indicated in the final mark/grade sheet.

2.3 **Allotment of marks**

The allotment of marks for attendance shall be as follows:

Less than 75%	0 mark
75%	1 mark
76 to 80%	2 marks
81 to 85%	3 marks
86 to 90%	4 marks
Above 90%	5 marks

2.4 Assignments:

Each student shall be required to do one assignment for each paper in each semester. The Class teacher shall explain to the students the expected quality of an assignment in terms of its structure, content, presentation etc. Valued assignments must be returned to the students.

2.5 Tests:

For each paper there shall be two internal tests during a semester. The tentative dates of the Internals shall be announced at the beginning of each semester. The first set of internal tests will be conducted by the respective departments, and the second will be conducted centrally as a model examination for three hours and will be based on the question paper pattern for the End Semester Examination. Marks for the internal tests shall be awarded on the basis of the marks scored for the better of the two tests for each paper. It is mandatory that all students must appear for both tests. There will be no provision for retest on the basis of absence in any one test. The scheme and question paper pattern for the test papers as well as for the End Semester Examination will be prepared by the respective Boards of Studies. Valued answer scripts must be made available to the students for perusal 10 working days from the date of the tests

2.6 Seminar

Each student shall present a seminar in each paper in each semester on a topic/area allotted. Seminar presentations shall be done in the respective classroom itself so as to benefit all the students. The interaction of the entire class is expected during the seminar presentations. Seminars shall be evaluated on the basis of the quality of the presentation, content, interaction etc. The evaluation shall be done by the concerned teacher of the faculty who handles the topic/paper. All the records of the continuous assessment must be kept in the department and be made available for verification by the concerned authorities, if necessary.

2.7 Project work and Project Evaluation

The project may be started during the second semester of the MSc programme.25 marks allotted for the project work is to be awarded on the basis of internal assessment carried out in the College for each student concerned. A rough record for the project work may be maintained by each student in order to help the examiners for evaluating the progress of the project. Each student is required to present the completed project along with experimental demonstration, if any, in the college before the final examinations of the fourth Semester. For the End Semester Assessment of the Project: 50 marks is allotted for Project report and 25 marks is allotted for Project based Viva Voce to be conducted along with General Viva Voce examination by the College**. *A minimum pass requirement of 40%***

marks for ESA for each theory and practical paper and an aggregate minimum of 50% marks for theory, project, and project based viva voce and comprehensive viva voce of PG degree is required.

Semester	Paper Code	Title of Paper	Contact hours per week			ESA duration (h)	Maximum Mark		
			L	T	P		CA	ESA	Total
I	APPY121	Classical Mechanics	6	1	…	3	25	75	100
	APPY122	Mathematical Physics	6	1	…	3	25	75	100
	APPY123	Basic Electronics	6	1	…	3	25	75	100
	APPY2PI	General Physics Practical	…	1	3	…	…	…	…
II	APPY2PII	Electronics & Computer Science Practical	…	1	4	…	…	…	…
		Total for Semester I (S1)	**18**	**5**	**7**	**…**	**75**	**225**	**300**
	APPY221	Modern Optics & Electromagnetic theory	6	1	…	3	25	75	100
	APPY222	Thermodynamics, Statistical Physics & Basic Quantum Mechanics	6	1	…	3	25	75	100
	APPY223	Computer Science & Numerical Techniques	6	1	…	3	25	75	100
	APPY2PI	General Physics Practical	…	1	3	6	25	75*	100
	APPY2PII	Electronics & Computer Science Practical	…	1	4	6	25	75*	100
		Total for Semester II (S2)	**18**	**5**	**7**	**…**	**125**	**375**	**500**
III	APPY321	Advanced Quantum Mechanics	6	1	…	3	25	75	100
	APPY322	Advanced Spectroscopy	6	1	…	3	25	75	100
	APPY323.1	Special Paper I							

		(Elective)							
	APPY323.1a	Advanced Electronics - I	6	1	…	3	25	75	100
	APPY323.1b	Advanced Nuclear Physics							
	APPY323.1c	Materials Science - I							
	APPY323.1d	Space Physics & Plasma Physics							
	APPY323.1e	Theoretical Physics - I							
	APPY4PIII	Advanced Physics Practical	…	1	4	…	…	…	…
	APPY4PIV	Advanced Electronics Practical	…	1	3	…	…	…	…
		Total for Semester III (S3)	**18**	**5**	**7**	**…**	**75**	**225**	**300**
IV	APPY421	Condensed Matter Physics	6	1	…	3	25	75	100
	APPY422	Nuclear & Particle Physics	6	1	…	3	25	75	100
	APPY423.1	Special Paper II							
	APPY423.1a	Advanced Astrophysics							
	APPY423.1b	Advanced Electronics - II	6	1	…	3	25	75	100
	APPY423.1c	Materials Science - II							
	APPY423.1d	Radiation Physics							
	APPY423.1e	Theoretical Physics - II							
	APPY4PIII	Advanced Physics Practical	…	1	3	6	25	75*	100
	APPY4PIV	Advanced Electronics Practical	…	…	4	6	25	75*	100
	APPY424	Project	…	…	…	…	25	75	100
	APPY425	General Viva Voce	…	…	…	…	…	100	100
		Total for Semester IV (S4)	**18**	**5**	**7**	**…**	**150**	**550**	**700**
		Grand Total	**72**	**20**	**28**	…	**425**	**1375**	**1800**

3. SCHEME OF TEACHING AND EVALUATION

4. PATTERN OF QUESTION PAPERS

4.1A Theory Papers

Each question Paper has three parts: Part A, Part B and Part C

Part A: Eight short answer questions covering the entire syllabus. *One of the questions from this section may be used to test the CURRENT AWARENESS (general knowledge) of the student in the areas of syllabus covered for this paper*. Each question carries 3 marks.

Par B: contains three compulsory questions with internal choice. Questions cover all the three Units in the syllabus. Each question carry 15 marks.

Part C: contains six problems covering the entire syllabus. The student need to answer any three. Each question carries five marks.

The question paper pattern for the theory papers is given separately.

4.1 B Practical

Each practical paper carries a total of 75 marks. 10 marks are allotted for practical records.

APPY2PII : Electronics and Computer Science: Unit A-Electronics practical (4h, 45 marks)

Unit B- Computer Science (2h,20 marks)

APPY4PIII: Advanced Physics has two parts: Physics Experiment (5h, 45 marks)

Data Analysis of given scientific data (1 h, 20 marks)

APPY4PIV: Advanced Electronics has two parts: (i) Electronics practical (4h, 45 marks)

(ii) Microprocessor Practical (2h, 20 marks)

APPY424 Project: Internal Evaluation for project is 25 marks

For University Examinations: 50 marks for Project Dissertation/report evaluation and 25 marks for Project based Viva Voce

APPY425 General Viva Voce: For General Viva Voce covering the entire MSc Syllabus,

End Semester Examinations: 100 marks

(Question Paper pattern given separately)

QUESTION PAPER PATTERN

MSc Degree Examination
Branch II PHYSICS
APPYxyz………………………… ………………
Duration: 3 hours Maximum marks: 75
Instructions to question paper setter
1. Each question paper has three parts - Part A, Part B and d Part C
2. Part A contains eight short answer questions spanning the entire syllabus, of which the candidate has to answer any *five* question carries *three* marks.
3. Part B contains *three* compulsory questions with internal choice. Each question shall be drawn from each unit of the syllabus. Each question carries 15 marks
4. Part C contains six problems spanning the entire syllabus. The candidate has to answer any *three*. Each question carries *five* marks
PART A
(Answer any five question. Each question carries three marks)
I (a)………………………………………………………………………………………...
(b)………………………………………………………………………………………….
(c)………………………………………………………………………………………….
(d)………………………………………………………………………………………….
(e)………………………………………………………………………………………….
(f)………………………………………………………………………………………….
(g)…………………………………………………………………………………………
(h)………………………………………………………………………………………….
(5 x 3 = 15 marks)
PART B
II A (a)…………………………………………………………………………………….
(b)………………………………………………………………………………………….
OR
II B (a)……………………………………………………………………………………..
(b)………………………………………………………………………………………….
(15 marks)

III A(a)…………………………………………………………………………………………..
(b)……………………………………………………………………………………………
OR
III B (a)……………………………………………………………………………………
(b)……………………………………………………………………………………………
(15 marks)
IV A (a)……………………………………………………………………………………
(b)…………………………………………………………………………………………
OR
IV B (a)……………………………………………………………………………………
(b) …………………………………………..(15 marks)
Part C
(Answer any three questions. Each question carries five marks)
V (a)……………………………………………………………………………………….
(b)……………………………………………………………………………………………
(c)……………………………………………………………………………………………
(d)…………………………………………………………………………………………
(e)……………………………………………………………………………………………
(f)……………………………………………………………………………………………
(3 x 5= 15 marks)

5. DETAILED SYLLABUS

APPY121 CLASSICAL MECHANICS **(6L, 1T)**	
Total Teaching Hours for Semester:108	**No of Lecture Hours/Week:6**
Max Marks:75	
Course Outcomes	
On completing the course the student will be able to **CO1**: **u**nderstand the Lagrangian mechanics	

CO2: understands two body central force problems

CO3: understands the theory of small oscillations,Hamiltonian mechanics and Hamilton-Jacobi equation,idea of rigid body dynamics

CO4: understands the four vector formulation of the special theory of relativity

CO5: understands the graphical representation of four vector space called the Minkowski diagram

CO6: understands the four vector form of energy and momentum

CO7: understands the covariant formulation of Lagrangian and Hamiltonian

CO8: apply the principles in (i) motion of a charged particle (ii) free particles etc.

CO9: achieve mathematical foundations of the basics of general theory of relativity

CO10: understand the applications of Einstein's field equation like the precession of planet mercury, gravitational lensing etc.

CO11: get a basic knowledge of non-linear dynamics

CO12: understands applications of non-liner dynamics like Chaos, Solitons, fractals etc.

Unit-1	**Teaching Hours:36**

Lagrangian mechanics (12 hours)

Mechanics of a particle and system of particles- constraints-D'Alembert's principle and Lagrange's equations-simple applications of Lagrangian formulation-Hamilton's principle-techniques of calculus of variations-derivation of Lagrange's equations from Hamilton's principle-conservation theorems and symmetry properties *(Chapters 1 and 2 of Goldstein)*

Two body central force problem (14 hours)

Reduction to one body problem-equations of motion-equivalent one dimensional problem-differential equation for the orbit in the case of integrable power law potentials-Kepler's problem-inverse square law of force-scattering in central force field- Virial theorem-transformation of the scattering problem to laboratory coordinates (Chapter 3 of Goldstein)

Theory of small oscillations (10 hours)

Equilibrium and potential energy-theory of small oscillations-normal modes with examples-longitudinal vibrations- longitudinal vibrations of carbon dioxide molecule (Chapter 9 of Aruldas)

Unit-2	**Teaching Hours:36**

Hamiltonian mechanics (12 hours)

Generalized momentum and cyclic coordinates-conservation theorems-Hamilton's equations-examples in Hamiltonian dynamics-canonical transformations-generating functions-Poisson brackets-Liouville's theorem *(Chapters 3, 6 and 7 of Upadhyaya)*

Hamilton-Jacobi equations (10 hours)

Hamilton-Jacobi equation-harmonic oscillator as an example-separation of variables in Hamilton-Jacobi equation-action angle variables-Kepler's problem *(Chapter 10 of Goldstein)*

Rigid body dynamics (14 hours)

Generalized coordinates of rigid body-Euler's angles-infinitesimal rotations as vectors angular momentum and inertia tensor-Euler's equations of motion of a rigid body force free motion of symmetrical top-motion of heavy symmetrical top *(Chapter 10 of Upadhyaya)*

Unit-3	**Teaching Hours:36**

Special Theory of relativity (8 Hours)

Proper time and Four-vectors, Minkowski's Geometry of space-time, Lorentz transformation in four dimensional space, Covariant four dimensional formulation, Force and energy, equations in relativistic mechanics, Lagrangian formulation of relativistic mechanics, Covariant Lagrangian formulation, Relativistic energy –momentum tensor for a fluid,*(Books of H Goldstein & K. D. Krori)*

General Theory of relativity (12 Hours)

Non-Uniform relative motion-Principle of general relativity, Principle of equivalence, Some applications of the principle of equivalence (a) Equality of inertial mass and gravitational mass (b) gravitational red shift, Curved geometry and metric tensor, Covariant differentiation – parallel displacement, Riemannian geometry –curvature tensor, Bianchi identities, Tidal force – geodesic deviation, Einstein's field equation, Weak field approximation (a) motion of test particle in a weak gravitational field (b) Poisson's equation form Einstein's law, Line elements for objects with spherical symmetry, Schwarzschild solution, Experimental test (a) Advance of perihelion of mercury (b) bending of light,*(Book of K. D. Krori)*

Introduction to non-linear dynamics (10 hours)

Linear and nonlinear systems, Integration of second order non-linear differential equation, Pendulum equation, Phase plane analysis of dynamical systems, linear stability analysis

Limit cycles, *(Book of G. Aruldhas)*

Chaos, Fractals and Solitons (6 Hours)

Introduction to chaos, Logistic map, Bifurcation, Lyapunov Exponent, Routes to chaos, Elementary ideas of fractal and fractal dimension, Introduction to solitons, *(Books of G. Aruldhas and Drazin)*

Books for study

1. **H.Goldstein, C.Pooleabd S.Safko, *Classical Mechanics*,3rd Edn, Pearson Education Inc (2008 Print)**
2. **J.C.Upadyaya, *Classical Mechanics*, Revised Edn, Himalaya Publishing Company (2005)**
3. **G.Aruldhas, *Classical Mechanics*, Prentice Hall of India Pvt Ltd (2008 Print)**
4. **K.D.Krori, *Fundamentals of Special and General Relativity*, PHI Learning Pvt Ltd (2010)**
5. **S.K. Srivastava, *General Relativity and Cosmology, PHI* learning Pvt Ltd (2008)**
6. **P.G Drazin and R.S Johnson, *Solitons –An Introduction*, Cambridge University Press (1989)**
7. N.C.Rana and B.S.Joag, Classical Mechanics, Tata Mc Graw Hill (1991)
8. V.B.Bhatia, Classical Mechanics with introduction to nonlinear oscillations and chaos, Narosa Publishing House (1997)
9. M.Tabor, Chaos and Integrability in Nonlinear Dynamics, John Wiley& Sons (1989)
10. R.K.Pathria, The Theory of Relativity, Second Edition ,Dover Publications (2003)

APPY122 MATHEMATICAL PHYSICS

(6L, 1T)

Total Teaching Hours for Semester:108	**No of Lecture Hours/Week:6**
Max Marks:75	
Course Outcomes	

The course includes chapters on Vector analysis and matrices, Complex analysis, Fourier series and applications, Probability, Differential equations, Special functions, Tensor analysis and Group theory.

On completing the course the student will be able to

CO1. understand orthogonal curvilinear coordinates, gradiant, divergence, curl and Laplacian operators are studied

CO2. understand the Probability, discrete and continuous probability distributions, error analysis and least square fitting etc. are discussed

CO3. understand Partial differential equations, solutions of homogeneous and non homogeneous equations, singular points etc. are studied

CO4. familiarize special functions, namely, Bessel functions of first, second and third kind, Legendre, Hermite, Lagurerre, Chebyshev and hypergeometric functions, their properties and recurrence relations is made

CO5. understand the Tensors, different types of tensors, tensor calculus and kinematics of Riemann space are discussed

CO6. apply group theory in crystallography and molecular symmetry

Unit-1	**Teaching Hours:36**

Vector analysis and matrices (8 hours)

Review of vector analysis-vector calculus operators-orthogonal curvilinear coordinates – Gradient, divergence, curl, Laplacian in cylindrical\ and spherical polar coordinates-orthogonal and unitary matrices-Hermitian matrices-diagonalization of matrices-normal matrices *(Chapter 1 ,2, and 3 of Arfken and Weber)*

Complex analysis (8 hours)

Cauchy-Riemann conditions-Cauchy's integral theorem and formula-singularities and mapping-calculus of residues-dispersion relations *(Chapter 6 and 7 of Arfken and Weber)*

Fourier series and applications (8 hours)

General principles of Fourier series-advantages and applications-Gibbs phenomenon-Discrete Fourier Transform-Fast Fourier transform *(Chapter 14 of Arfken and Weber)*

Probability (12 hours)

Definitions and simple properties of probability-random variables-Chebychevs inequality and moment generating function-discrete and continuous probability distributions-binomial distributions-Poisson distributions-Gauss Normal distribution error analysis duf and least square fitting-chi-square and student 't' distributions*(Chapter 19 of Arfken and Weber)*

Unit-2	**Teaching Hours:36**

Differential equations (16 hours)

Partial differential equations-first order equations-separation of variables-singular points-series solutions and Frobenius method-non homogeneous partial differential equations-Green's functions-Laplace transforms and inverse Laplace transforms applications to solution of simple differential equations *(Chapter 9 of Arfken and Weber)*

Special functions (20 hours)

Bessel functions of the first kind-orthogonality-Neumann functions-Henkel functions modified Bessel functions-spherical Bessel functions-Legendre functions-generating function-recurrence relations and orthogonalility-associated Legendre function spherical harmonics-Hermite functions-Laguerre functions-Chebychevs polynomials hyper-geometric functions *(Chapter 11, 12, 13 of Arfken and Weber)*

Unit-3	**Teaching Hours:36**

Tensor analysis (18 hours)

Notations and conventions in tensor analysis-Einstein's summation convention covariant and contra variant and mixed tensors-algebraic operations in tensors symmetric and skew symmetric tensors-tensor calculus- Christoffel symbols-kinematics in Riemann space-Riemann—Christoffel tensor.*(Chapter 49 in Dass and Verma, Chapter 2 of Joshi)*

Group theory (18 hours)

Definitions of a group-elementary properties-sub groups-homomorphism and isomorphism of groups-representation of groups-reducible and irreducible representations-simple applications in crystallography and molecular symmetry-Lie groups-SU (2) groups and their representations *(Chapter 1, 3, and 7 of Joshi and Chapter 4 of Bagchi et al)*

Books for study

1. **1 G.B.Arfken and H.J.Weber, *Mathematical methods for Physicists*, 6thEdition, Elsevier (2005).**
2. **H.K.Dass and R.Verma, *Mathematical Physics, S Chand & Co Pvt. Ltd* (1997)**
3. **A.W.Joshi,*Matrices and Tensors in Physics*,3rdEdition,New Age International Pub (1995)**
4. **A.W.Joshi, *Elements of Group Theory for Physicists*, Fourth Edition, New Age International Pub (1997).**
5. **S.C.Bagchi,S. Madan,A, Sitaram,V.B Tewari A *first course in representation theory and linear Lie groups*, Universities Press (India) Pvt Ltd (2000).**

6. Harry Lass, Vector and Tensor Analysis, McGraw Hill Pub (1950)
7. M.L.Jain,Vector Spaces and Matrices in Physics, Alpha Science International (2001)
8. W.W .Bell,Special Functions for Scientists and Engineers, Dover Publications (2004)
9. W.K. Tung, Group theory in Physics, World Scientific Pub Co (1999)
10. C. Harper, Introduction to Mathemaical Physics, Prentice Hall (1986)
11. A.K.Ghatak, I.C. Goyalamd S.T.Chua, Mathematical Physics, Macmillan India (1985)

APPY123 BASIC ELECTRONICS (6L, 1T)	
Total Teaching Hours for Semester:108	**No of Lecture Hours/Week:6**
Max Marks:75	
Course Outcomes	

On completing the course the student will be able to

CO1: understand the basic design of electronic circuits.

CO2: familiarize the different solid state devices.

CO3: get a thorough knowledge about the Arithmetic, data processing and sequential digital circuits.

CO4: understand the differences between Step Index and Graded index fibers, single mode and multimode fibers

CO5:understand the advantages of fiber optic communication system

CO6: understand the sources and detectors used for fibre optic communication.

CO7: get a thorough knowledge about the analog and digital instrumentation for measurements.

Unit-1	**Teaching Hours:36**

Electronic circuits (24 hours)

Frequency response of an amplifier circuits-power and voltage gain-impedance matching-Bode plots-Miller effects-rise time bandwidth relations-frequency analysis of BJT and FET amplifier stages Active filters-first order and second order Butterworth transfer function-first order and second order active filters-low pass, high pass and band pass filters-comparators-OP Amp as a voltage comparator-zero crossing detectors-Schmitt trigger-voltage regulators-square, triangular and saw tooth wave form generators-Weinberg oscillator monostable and astable multivibrator circuits using IC 555 timer-Phase Locked Loop circuits (PLL)

Microwave solid state devices (12 hours)

Tunnel diode-varactor diode-IMPATT diode-Gunn diode-applications of semiconductor microwave devices

Unit-2	**Teaching Hours:36**

Digital electronics

Arithmetic and data processing digital circuits (16 hours)

Binary adder and subtracter-arithmetic logic unit-binary multiplication and division – **Karnaugh map and simplification-** multiplexers-de-multiplexers-BCD to decimal counters encoders-**Digital comparators** - parity generators and checkers-programmable logic arrays

Sequential digital circuits (20 hours)

Flip flops-clocked SR flip flops-JK flip flops-different types of registers-shift registers and applications-asynchronous and synchronous electronic counters-decade counters-digital clock-applications of electronic counters.

Unit-3	**Teaching Hours:36**

Optoelectronics (20 hours)

Optical fibre as a wave guide-mode theory of circular wave guide-wave guide equations-modes in step index fibres-propagation of modes in single mode fibres signal distortion in optical fibres-sources of attenuation and signal distortion-optical sources-LED’s and Laser diodes-photo detectors-semiconductor and fibre amplifiers (Chapters 2,3,6 and 11 of Keiser)

Electronic Instrumentation (16 hours)

Electronic measurements and instruments-comparison between analog and digital instruments-performance and dynamic characteristics-ideas of errors and measurement standards-voltmeters-ammeters-ohmmeters-multimeters-balance bridge voltmeters-components of a CRO-dual beam and dual trace CRO-digital storage CRO classification of transducers-active and passive transducers-force and displacement transducers-strain gauges-temperature measurements-thermistors-thermocouples-flow measurements

Books for study

1. **A. Malvino and D.J.Bates, *Electronics Prinicples*,7thEdition,Tata McGraw Hill(2007)**
2. **R.A. Gayakwad, *Operational Amplifiers and Linear integrated Circuits*, Prentice**

Hall of India (2000)

3. **M.S. Tyagi, *Introduction to semiconductor materials and devices*, Wiley India (2005)**
4. **B.G. Streetman,S.K.Banerjee, *Solid state electronic devices*. Pearson Inc (2010)**
5. **D.P. Leach, A.P. Malvino, and G.Saha ,*Digital principles and applications*, Tata Mc Graw Hill (2011)**
6. **G. Keiser, *Optical Fibre Communication*,3rdedition,McGraw Pub (2000)**
7. **Lal Kishore, *Electronic measurements and Instrumentation*, Dorling Kindersley (India) Pvt Ltd(2010)**
8. J. Millman,C,Halkias and C.D.Parikh, Integrated Electronics, Tata Mc GrawHill (2010)
9. T.F. Bogart Jr,J.S. Beasley and G. Reid, Electronic devices and circuits, Sixth Edition, Pearson Inc (2004)
10. Thomas. L. Floyd, Digital Fundementals,10thedition,Dorling Kindersley (India) Pvt Ltd (2011)
11. Joachion Piprek, Semiconductor Optoelectronic Devices, Academic Press (2003)
12. W.D.Cooper, A,O,Helfrik and H.Albert, Electronic Instrumentation and measurement Techniques, PHI (1997).
13. Charles K. Kao, Optical Fiber Systems: Technology, Design, and Applications.

APPY221 MODERN OPTICS AND ELECTROMAGNETIC THEORY

(6L, 1T)

Total Teaching Hours for Semester:108	**No of Lecture Hours/Week:6**
Max Marks:75	
Course Outcomes	

On completing the course the student will be able to

CO1: understand optical phenomena such as polarisation, birefringence, interference and diffraction in terms of the wave model

CO2: apply wave optics and diffraction theory to a range of problems

CO3: apply the principles of non-linear optics to materials used in optics and photonics

CO4: attain a deep understanding of the theoretical foundations of electromagnetic phenomena

CO5: understand the role of the wave equation and appreciate the universal nature of wave motion in a range of physical systems

CO6: analyze electromagnetic wave propagation and attenuation in various medium and propagation through boundaries between media

CO7: understand Maxwell's Equations for time-harmonic fields and the boundary conditions across media boundaries

CO8: understand a working knowledge of relativistic electrodynamics

CO9: understand Radio wave propagation in earth's ionosphere and expression for maximum usable frequency.

CO10: understand the distribution of electromagnetic fields within transmission line geometries

CO11: **u**se Smith chart to design transmission lines; find reflection coefficient for a given impedance and conversely, find impedance for a given reflection coefficient.

CO12: understand the difference between TE and TM waves, theory of wave guides and antennas

Unit-1	**Teaching Hours:36**

Selections from modern optics (24 hours)

Multiple beam interference-Fabry-Perot interferometer-theory of multilayer films, antireflection films and high reflectance films -Fresnel-Kirchhoff integral theorem and formula-Fraunhofer and Fresnel diffraction patterns and theory-applications of Fourier transforms to diffraction-acoustic -optic modulation-basic ideas of Raman-Nath diffraction and Bragg diffraction-holography as wave front reconstruction propagation of light in crystals-optical activity and Faraday rotation*(Chapters 4 to 6 of Fowles and Chapters17 and 18 of Ghatak and Thayagarajan)*

Non-linear optics (12 hours)

Physical origin of non-linear polarization-electromagnetic wave propagation in nonlinear media-optical second harmonic generation-ideas of parametric amplification electro-optic modulation of laser beams-electro-optic amplitude and phase modulation-LiNbO3 crystals as phase modulators *(Chapters 8 and 9 of Yariv)*

Unit-2	**Teaching Hours:36**

Electromagnetic waves (12 hours)

Electromagnetic wave equations-electromagnetic waves in non-conducting media plane waves in vacuum-energy and momentum of electromagnetic waves-propagation through linear media-reflection and transmission at normal and oblique incidence electromagnetic waves in conductors-modified wave equations and plane waves in conducting media-reflection and transmission at a conducting interface*(Chapter 9 of Griffiths)*

Relativistic electrodynamics (12 hours)

Magnetism as a relativistic phenomenon-transformation of the field-electric field of a uniformly moving point charge-electrodynamics in tensor notation-electromagnetic field tensor-potential formulation of relativistic electrodynamics *(Chapter 12 of Griffiths)*

Radio wave propagation through earth's atmosphere (12 hours)

Radio wave propagation in free space-radio wave propagation through earth's troposphere-radio horizon-ideas of ground and surface waves-radio wave propagation in earth's ionosphere-maximum usable frequency and virtual height calculations classification of different radio wave bands *(Chapter 15 of Roody and Coolen)*

Unit-3	**Teaching Hours:36**

Transmission Line parameter and equations, Input impedance, Standing wave ratio and Power, The Smith Chart, Applications of transmission lines, (Books of M. N. O. Sadik and B. S. Nair**)**

Wave Guides (12 Hours)

Rectangular waveguides, Transverse Magnetic (TM) Modes, Transverse Electric (TE) Modes,Power transmission, Attenuation factor,*(Books of M. N. O. Sadik and B. S. Nair***)**

Antennas (12 Hours)

Radiation from Hertzian dipole antenna, half wave dipole antenna, Quarter wave monopole antenna, Antenna characteristics, Antenna arrays, Effective area and Friis equations, *(Book of M. N. O. Sadik)*

(Topics for assignments-Photonic Band gap, EM band gap and Meta-materials)

Books for study

1. **G.R.Fowles,, Introduction to Modern Optics, Second Edition, over Publications (1989)**
2. **A.Yariv, Introduction to Optical electronics, Holt, Reinhart and Winston (1976)**

3. **A.Ghatak and K.Thyagarajan, Optical Electronics, Cambridge University Press (1998)**
4. **D.Roody and J.Coolen, Electronic Communications, Fourth Edition, Dorling Kindersley (India) Pvt Ltd (2008)**
5. **D.J.Griffiths, Introduction to Electrodynamics, PHI Learning India Pvt. Ltd (2007)**
6. **M.N.O.Sadiku, Elements of Electromagnetics, Oxford University Press (2007)**
7. J.R.Meyer-Arendt, Introduction to Classical and Modern Optics, Prentice Hall Intl (1995)
8. J.C.Palais,Fiber optic communications, Fifth Edition, Pearson Education Inc.(2005)
9. E.C.Jordan and K.G.Balmain, Electromagnetic waves and radiating systems, Second Edition,Pearson Education (2002)
10. D.K.Cheng,Field and Wave electromagnetics, Second Edition, Addison Wesley (1999)
11. L. Ganesan and S.S. Sreejamole, Transmission lines and waveguides, Second Edition, Tata Mc GrawHill (2010).

AUPY222 THERMODYNAMICS, STATISTICAL PHYSICS AND BASIC QUANTUM MECHANICS

(6L, 1T)

Total Teaching Hours for Semester:108	**No of Lecture Hours/Week:6**
Max Marks:75	
Course Outcomes	

The course include chapters on Thermodynamic relations and consequences, Phase transitions, Foundations of classical statistical physics, Quantum statistics, Foundations of quantum mechanics, paradoxes in quantum mechanics and Exactly solvable problems in quantum mechanics.

On completing the course the student will be able to

CO1: understand thermodynamic functions and the relations between them, thermodynamic potentials, phase transitions and Ising model are discussed

CO2: get a clear picture of the three ensembles and Gibb's paradox

CO3: get knowledge on the three statistics, namely, the MB, BE and FD statistics and the distribution laws and their applications is made

CO4: understand the basic postulates of quantum mechanics and topics like uncertainty principle, paradoxes alpha particle emission, hydrogen atom problems etc. are discussed

Unit-1	**Teaching Hours:36**

Thermodynamic relations and consequences (20 hours)

Thermodyanamic functions and Maxwells's equations- Clausius-Clapeyron equations-Properties of thermodynamic potentials-Gibbs-Helmholtz relation thermodynamic equilibrium-Nernst –heat theorem and its consequences-Gibb's phase rule-chemical potential-vapour pressure relation and chemical constants *(Chapter 2 of Satyaprakash)*

Phase transitions (16 hours)

Triple point- Van der Waals equation equation and phase transitions-first and second order phase transitions-Ehrenfest's equations-Ising model-Yang and Lee theory of phase transitions-London theory of phase transitions *(Chapter 12 of Satyparakash)*

Unit-2	**Teaching Hours:36**

Foundations of classical statistical physics (16 hours)

Phase space-ensembles-Lioville's theorem-statistical equilibrium-microcanonical ensemble-partition functions and thermodynamic quantities-Gibb's paradox-Maxwell-Boltzmann distribution laws-grand canonical ensemble *(Chapter 6 and 7 of Satyparakash)*

Quantum statistics **(20 hours)**

Quantum statistics of classical particles-density matrix in microcaonical, canonical and grand canonical ensembles-Bose Einstein statistics and Bose Einstein distribution law-Maxwell Boltzmann statistics and Maxwell Boltzmann distribution law—Fermi Dirac statistics and Fermi Dirac distribution law-comparison of three types of statistics, applications of quantum statistics-Planck radiation laws-Bose Einstein gas and Bose Einstein condensation—Fermi Dirac gas-electron gas in metals-thermionic emission ,statistical theory of white dwarfs.*(Chapter 8 of Satyaprakash)*

Unit-3	**Teaching Hours:36**

Foundations of quantum mechanics (12 hours)

Basic postulates if quantum mechanics-Hilberts space-observables-Hermitian operators-general statistical interpretation-Uncertainty principle-minimum uncertainty wave packetenergy time uncertainty principle-Dirac notation-Matrix representation of state vectors and operators-change of representations-eigenvalue problem in matrix mechanics-energy and momentum representations-unitary transformations involving time-Schrodinger, Heisenberg and interaction pictures. *(Chapter 3 of Griffiths, Chapters 2 and 10 of Agarwal and Hariprakash)*

Paradoxes in quantum mechanics (8 hours)

Examples of paradoxes in physics-paradoxes in quantum mechanics-The Stern Gerlach experiment and the measurement process-EPR paradox-Bell's theorem and inequality-Schrodinger cat-quantum zero paradox *(Chapter 10 of Devanarayanan and Chapter 12 of Griffiths)*

Exactly solvable problems in quantum mechanics (16 hours)

one dimensional eigenvalue problems-square well potential-potential barrier-alpha particle emission-Bloch waves in periodic potential-linear harmonic oscillator problem using wave mechanics and operator methods-free particle wave functions and solutions-three dimensional Eigen value problems-particle moving in spherical symmetric potential-rigid rotator-hydrogen atom problem-three dimensional potential well-Deuteron *(Chapters 4 and 5 of Aruldhas)*

Books for study

1. **Satyaprakash, Statistical Mechanics, Kedarnath Ram Nath Publishers, Meerut and Delhi (2009)**
2. **B.K.Agarwal and Hari Prakash, Quantum Mechanics, Prentice Hall of India (2002)**
3. **S. Devanarayanan, Quantum Mechanics, Sci Tech Publications (India) Pvt Ltd (2005)**
4. **D.J.Griffiths, Introduction to Quantum Mechanics, Second Edition, Pearson Education Inc (2005)**
5. **G.Aruldas, Quantum Mechanics, 2nd Edition, PHI learning Pvt Ltd (2009).**
6. R.K.Srivastava and J.Asok, Statistical Mechanics, Wiley Easter Ltd (2005)
7. S.K. Sinha, Statstical Mechancis-Theory and Applications, Tata Mc Graw Hill
8. P.M.Mathews and K.Venkitesan, A Text Book of Quantum Mechanics, Tata Mc Graw Hill (2010)
9. A.Ghatak and S.Lokanathan, Quantum Mechanics Theory and Applications, Kluewer Academic publishers (2004).
10. V.K.Thankappan,Quantum Mechanics, Second Edition, New Age International Pvt.

Ltd(2003)

AUPY223 COMPUTER SCIENCE AND NUMERICAL TECHNIQUES (6L, 1T)	
Total Teaching Hours for Semester:108	**No of Lecture Hours/Week:6**
Max Marks:75	
Course Outcomes	
On completing the course the student will be able to **CO1** get the basic knowledge of hardware, software and memory systems **CO2** understand the basic ideas of Python programming **CO3** understand the fundamentals of microprocessors **CO4** apply computer programming in C++ language **CO5** understand the theory and problems of Gauss elimination method, finite differences, interpolation, numerical differentiation, numerical integration, numerical solutions to ordinary and partial differential equations and solutions to Poisson and Laplace equations.	

Unit-1	**Teaching Hours:36**
Foundations of computer science (12 hours) Introduction to computers-computer architecture-memory and storage-I/O devices computer languages-operating systems-data communications and computer networks databases-Internet basics-multimedia *(Chapter 1 and 3-15 of ITL Education solutions)* **Introduction to Python Programming (12 hours)** Python programming basics –strings-numbers and operators-variables-functions-Classes and objects-organizing programs-files and directories-other features of Python language *(Chapter 1 to 9 of Peter Norton et al)* **Introduction to microprocessors (12 hours)** Evolution of microprocessors-microcontrollers and digital signal processors-Intel8085 8 bit microprocessor-pin description-functional description-8085 instruction format-addressing modes of 8085-interrupts of 8085-memory interfacing-8085machine cycles and Bus timings-Assembly language programming of 8085 *(Chapter 1 of Udayakumar and Umasankar and Chapter 3 and 4 of Abhishek Yadav)*	

Unit-2	**Teaching Hours:36**
Programming with C++ (36 hours) Features of C++-basic structure of C++ programs-header files-in and out functions compilation and execution-data types-constants and variables global variables operators and Expressions of C++-flow control-conditional statements-iterative statements-switch statements-conditional operators as an alternative to IF-nested loops-break statements Ext functions-structured data types-arrays-storage classes-multidimensional arrays-sorting of strings-functions-built in and user defined-accessing function and passing arguments to functions-calling functions with arrays-scope rule for functions and variables structures in C++-classes and objects –definition-class declaration-class function definitions-creating objects-use of pointers in the place of arrays-file handling in C++-basic file operations-serial and sequential files-reading and writing on to disks. *(Relevant Chapters from both Ravichandran and Somasekhara)*	
Unit-3	**Teaching Hours:36**
Numerical Techniques (36 hrs.) Solution of simultaneous linear algebraic equations-Gauss elimination method-Gauss Jordan method-inverse of a matrix using Gauss elimination method-Finite differences forward and backward differences-central differences-difference of a polynomial error propagation in difference table-Interpolation with equal intervals-Gregory Newton forward and backward formula-error in polynomial interpolation-central difference interpolation formula-Gauss's forward and backward formula-Stirling's formula-Lagrange interpolation formula-numerical differentiation-numerical integration using general quadrature formula-Trapezoidal rile-Simpsons 1/3 and 1/8rules-numerical solutions to ordinary differential equations-Euler and modified Euler methods-RangaKutta methods-numerical solution to partial differential equations solutions to Poisson and Laplace equations *(Chapters 4,5,6,7,8,9,11 and 12 of Vedamurty and Iyengar)*	
Books for study	
1. **ITL Education Solutions Ltd, *Introduction to Computer Science,* Second Edition, Dorling Kindersley (India) Pvt Ltd (2011)** 2. **V.N. Vedamurty and N.Iyengar, *Numerical Methods,* Vikas Publishing Pvt. Ltd (1998)** 3. **K. Udayakumar, and B.S. Umasankar, *The 8085 microprocessor,* Dorling**	

Kindersley (India) Pvt Ltd (2008)

4. **Peter Norton et al., *Beginning Python*, Wiley Publishing (2005)**
5. **AbishekYadav, *Microprocessor 8085 8086*, University Science Press, New Delhi(2008)**
6. **D. Ravichandran, *Programming in C++*, Tata Mc Graw Hill (2011)**
7. **M.T. Somasekhara, *Programming in C++*, PHI Pvt. Publishing (2005)**
8. V.Rajaraman, Fundamentals of Computers, 5^{th} Edition, PHI(2010)
9. R.S.Gaonkar, Microprocessor-Architecture, Programming and Applications with8085,
10. S.S.Sastry, Introductory method of Numerical analysis, 5^{th}edition,PHI.
11. P.Ghosh, Numerical Methodswith computer programs in C++, PHI learning Pvt. Ltd
12. Bjorne Stroustrup,The C++ Programming Language, 4thEdition, Addison Wesley
13. B Ram, Computer Fundamentals

AUPY321 ADVANCED QUANTUM MECHANICS

(6 L, 1 T)

Total Teaching Hours for Semester:108	**No of Lecture Hours/Week:6**
Max Marks:75	
Course Outcomes	

On completing the course the student will be able to

CO1: acquaint on time-independent and time-dependent perturbation theory.

CO2: familiarize the phenomenon of Stark effect in the ground state and in the first excited state of hydrogen atom

CO3: understand the Variational and WKB methods in quantum mechanics

CO4: get knowledge on the principles of Symmetries, translations in space and time, parity and time reversal, rotations and angular momentum,

CO5: understand the basics of angular momentum in operators and commutation relations

CO6: understand the Quantum theory of Scattering and Born approximation

CO7: understand the systems of Identical particles, atoms, exchange forces, periodic systems, Hartree-Fock and Thomas-Fermi approximations,

CO8: understand the founding principles of relativistic quantum mechanics;

CO9: achieve working knowledge of Klein Gordon equations and Dirac matrices
use operators to filter spin and positive/negative energy solutions;

CO10: understand the modern field-theoretic description of negative energy states;

CO11: solve relativistic one-body problems for spin-0 and ½ particles; relativistic corrections of Hydrogen atom spectrum-spin orbit correction

CO12: understand the elementary ideas of Quantum Field Theory

Unit-1	**Teaching Hours:36**

Time independent perturbation theory (14hours)

Non degenerate energy levels-first order and second order correction to energy and wave function - first order correction to energy of anharmonic oscillator-ground state of He atom - Stark effect in hydrogen atom on the ground state – quadratic Stark effect- polarizability of H atom - degenerate levels - Stark effect in the first excited state of hydrogen atom- energies and Eigen states

Variation method (10 hours)

The variational principle-Rayleigh Ritz method-variation method and excited states-ground state of Helium - Hydrogen molecule ion - H atom using the trial function $e^{-\alpha r}$ – one dimensional harmonic oscillator using Gaussian trial function

Time dependent perturbation theory (12 hours)

First order perturbation - harmonic perturbation-Fermi's Golden rule, dipole approximation, absorption and emission of radiation-Einstein's A and B coefficients, Laporte selection rule-selection rule for electric dipole transitions of linear harmonic oscillator

Unit-2	**Teaching Hours:36**

Symmetry and conservation laws (8 hours)

Symmetry transformations-space translation and conservation of angular momentum-time translation and conservation of energy-rotation in space and conservation of angular momentum-space inversion-time reversal.

Angular momentum (10 hours)

Angular momentum in operators and commutation relations-Eigen values and Eigen functions of L_2 and L_z –general angular momentum-Eigen values of J_2 and J_z-angular momentum matrices-spin angular momentum –spin vectors for a spin ½ system-addition of angular momentum-Clebiz-Jordon coefficients

Quantum theory of scattering (12 hours)

Scattering cross section and scattering amplitude-partial wave analysis and scattering by a central potential-scattering by attractive square well potential-scattering length-expression for phase shifts-Born approximation-scattering by Coulomb potential-Laboratory and center of mass coordinate transformations

WKB method (6 hours)

Connection formula –barrier potential-penetration-alpha particle emission-bound states in a potential well.

Unit-3	**Teaching Hours:36**

System of identical particles (14 hours)

Identical particles-Pauli's exclusion principle-inclusion of spin-spin function for a two electron system-Helium atom-central field approximation-Thomas Fermi model of an atom-Hartree and Hartree-Fock equations.

Relativistic quantum mechanics (18 hours)

Klein-Gordon equations and its relevance-particle in a Coulomb's field-Dirac's relativistic theory-Dirac's equation for a free particle-Dirac matrices-covariant form of Dirac's equations-probability density-plane wave solutions-negative energy starts-spin in Dirac's theory-magnetic moment of an electron-relativistic corrections of Hydrogen atom spectrum-spin orbit correction-Lamb shift

Quantum Field Theory (Elementary Ideas only)-(**4hours)**

Books for study

1. **G. Aruldhas, Quantum Mechanics, Second Edition, PHI learning Pvt. Ltd (2009)**
2. S. Devanarayanan, Quantum Mechanics, Sci Tech Publications (India) Pvt. Ltd (2005)

3. D. J. Griffiths, Introduction to Quantum Mechanics, Second Edition, Pearson Education Inc (2005)
4. P.M. Mathews and K.Venkitesan, A Text Book of Quantum Mechanics, Tata McGraw Hill (2010)
5. A. Ghatak and S.Lokanathan, Quantum Mechanics Theory and Applications, Kluwer Academic Publishers (2004).
6. V. K. Thankappan, Quantum Mechanics, Second Edition, New Age International Pvt Ltd (2003)
7. J. J. Sakurai, Advanced Quantum Mechanics, Pearson Education Inc. (2009)
8. L.H. Ryder, Quantum Field Theory Second Edition, Cambridge University Press (1996)
9. Steven Weinberg, Quantum Theory of Fields (in Three Volumes), Cambridge University Press (2002)

AUPY322 ADVANCED SPECTROSCOPY **(6l, 1T)**	
Total Teaching Hours for Semester:108	**No of Lecture Hours/Week:6**
Max Marks:75	
Course Outcomes	

On completing the course the student will be able to

CO1: understand the general tools of experimental spectroscopy
CO2: achieve a deep knowledge of the molecular symmetry

CO3: get thorough knowledge about the different spectroscopic techniques like IR,Raman,UV, NMR,ESR, Mossbaur , Photoelectron and Photo acoustic spectroscopy.

Unit-1	**Teaching Hours:36**

General tools of experimental spectroscopy (14 hours)

General components of absorption measurements-dispersing elements-prisms-grating and interferometers-tools in different regions of the electromagnetic spectrum-atomic absorption spectroscopy-inductively coupled plasma emission spectroscopy-recording spectrophotometers for IR-visible and UV regions *(Chapter 3 of Hollas)*

Molecular symmetry (10 hours)

Symmetry operators-symmetry elements-algebra of symmetry operations multiplication tools-matrix representation of symmetry operators-molecular point groups-reducible and irreducible representations-great orthogonally theorem character tables for point groups-symmetry species of point groups-IR and Raman activity *(Chapter 5 of G. Aruldhas)*

Molecular rotational spectroscopy (12 hours)

Classification of molecules-rotational spectra of diatomic molecules-isotope effect and intensity of rotational lines-non rigid rotator-linear polyatomic molecules-symmetric and asymmetric top molecules-microwave spectrometer-analysis of rotational spectra. *(Chapter 6 of G. Aruldhas)*

Unit-2	**Teaching Hours:36**

IR spectroscopy (12 hours)

Vibrational spectra of diatomic molecules-characteristic IR spectra-vibrations of polyatomic molecules-anharmonicity-Fermi resonance-hydrogen bonding-normal modes of vibration in a crystal-interpretation of vibrational spectra-Fourier transform IR spectroscopy *(Chapter 7 of G. Aruldhas)*

Raman spectroscopy (12 hours)

Theory of Raman scattering-rotational and vibrational Raman spectra-Raman spectrometer-structure determination using Raman and IR spectroscopy-nonlinear Raman effects-Hyper Raman effect-stimulated Raman scattering –coherent anti-stokes Raman scattering *(Chapter 8 and 15 of G. Aruldhas)*

Electronic spectra of molecules (12 hours)

Vibrational coarse structure and analysis of bound systems-Deslanders table-Frank Condon principle-vibrational electronic spectra-rotational fine structure-Fortran parabola-electronic angular momentum in diatomic molecules *(Chapter 9 of G. Aruldhas)*

Unit-3	**Teaching Hours:36**

NMR Spectroscopy (8 hours)

Magnetic Properties of Nuclei, Resonance Condition, NMR instrumentation, Chemical Shift and factors affecting chemical shift, Fine structure (spin –spin coupling),Relaxation processes (Line shapes),NMR imaging ,Interpretation of NMR spectra,*(Books G Aruldhas & Mool*

Chand Gupta)

ESR Spectroscopy (6 hours)

Principle of ESR,ESR Spectrometer, Hyperfine structure, ESR spectrum of (a) Hydrogen atom (b) One electros system coupled to nucleus of spin I =1 (c) Unpaired electron coupling with two equivalent nuclei of spin I = ½ .,ESR spectra of free radicals, Applications of ESR spectroscopy,*(Book of G Aruldhas)*

Mossbauer Spectroscopy (6 hours)

Recoilless emission and absorption, Mossbauer spectrometer, Experimental technique, Isomer shift, Quadrupole interaction, hyperfine interaction, *(Book of G Aruldhas)*

Photoelectron and photo-acoustic spectroscopy (16h)

Photoelectron spectroscopy, Experimental methods, Photoelectron spectra and their interpretation, Auger electron and X-ray fluorescence spectroscopy, Photo acoustic effect (basic theory), Experimental arrangements, Applications *(Book of J. M. Hollas)*

Books for study

1. **J.M. Hollas, *Modern Spectroscopy, Fourth* Edition, John Wiley &Sons (2004)**
2. **G. Aruldas, *Molecular Structure and Spectroscopy*, PHI learning Pvt. Ltd (2007)**
3. **Suresh Chandra, *Molecular Spectroscopy*, Narosa Publishing Co (2009)**
4. C.N. Banwell and E.M.Mc Cash, Fundamentals of Molecular Spectroscopy, Fourth Edn,TataMcGrawHill (1995).
5. D.N.Satyanarayana,Vibrational spectroscopy-Theory and applications, New Age International Pvt Ltd (2004)
6. J.L.McHale, Molecular Spectroscopy, Pearson education Inc. (2008).
7. Kazuo Nakamoto, Infrared and Raman Spectra of Inorganic and Coordination Compounds, Part A and Part B, Two Volume Set, 6th Edition, Publisher .Wiley

SYLLABUS FOR SPECIAL PAPER (SPECIAL PAPER I-ELECTIVE)

APPY323.1a ADVANCED ELECTRONICS -I (6L, 1T)	
Total Teaching Hours for Semester:108	**No of Lecture Hours/Week:6**
Max Marks:75	
Course Outcomes	

The course includes chapters on Analog radio frequency communication, Microwave radio communication, Pulse modulation, Digital communications, Optical fibre communications, Mobile cellular communications and digital signal processing.

On completing the course the student will be able to

CO1. familiarize the Principles, techniques and applications of AM and FM in radio and microwave frequency ranges are studied

CO2. familiarize the Principles, techniques and applications of pulse modulation (PM) and frequency and time division multiplexing are studied

CO3. Get knowledge about optical communication systems and the principles of wavelength and code division multiplexing is obtained

CO4. Understand the description of cellular telephone network and digital cellular telephone systems is done

CO5. Understand the classification of signals and systems is discussed

CO6. familiarize the Fourier and z-transforms, their properties and a large number of applications are studied

CO7. familiarize the concept of digital filters, namely, finite impulse response (FIR) and infinite impulse response (IIR) filters are obtained.

Unit-1	**Teaching Hours:36**

Analog radio frequency communications (16 hours)

Different types of analog continuous wave modulation-analog baseband signal transmission-signal distortions and equalization-linear continuous wave modulation schemes-amplitude modulation-DSB and SSB schemes-frequency conversion-angle modulation-spectra of angle modulated signals-power and bandwidth of FM signals generation and demodulation of FM signals-commercial radio broadcasting techniques-AM and FM radio broadcasting and reception*(Chapter 5 of Sam Shanmugam)*

Microwave radio communications (10 hours)

Advantages and disadvantages of microwave radio communications-digital and analog systems-frequency and amplitude modulation techniques-FM microwave radio system-FM microwave repeaters-FM microwave radio stations-line of sight path characteristics *(Chapter 24 of Tomasi)*

Pulse modulation (10 hours)

Different types of pulse modulation-pulse amplitude modulation (PAM)-PA spectrum-pulse code modulation (PCM)-sampling and quantization of analog signals quantization error-signal to noise ratio-differential PCM_delta modulation-other pulse modulation schemes-applications of pulse modulation *(Chapter 13 of Kennedy and Davis and Chapter 11 Roody and Coolen)*

Unit-2	**Teaching Hours:36**

Digital communications (16 hours)

Basics of information theory-ideas of digital codes –noise in information carrying channel-Digital carrier modulation -binary ASK, PSK and FSK schemes-bandwidth and power requirements-synchronization methods-ideas of error control coding and error corrections-digital transmission of analog signals-transmission using PCM –frequency and time division multiplexing (TDM) –TDM in PCM telephone system. *(Chapter 13 &14 of Kennedy and Davis, and 10 of Sam Shanmugam and Chapter12 of Roody and Coolen)*

Optical fiber communications (20 hours)

Overview of the optical communication system and its components-optical communication receiver and its equivalent circuit-direct and coherent detection systems- digital modulation and demodulation schemes for coherent optical communication receivers-heterodyne and homodyne detection – principles of wavelength division and code division multiplexing in optical communication- optical solitons-soliton based optical communication systems. *(Chapters 1,7-10 of Keiser and Chapters 1,3,6-10 of Agrawal)*

Unit-3	**Teaching Hours:36**

Mobile cellular communications (12 hours)

Mobile telephone services-cellular telephone-frequency reuse-cell splitting sectoring, segmentation and dualisation-cellular system topology-roaming and handoffs-cellular telephone network components and call processing-first and second generation cellular telephone services-digital cellular telephone system-global system for mobile communication-personal satellite communication system*(Chapters 19 and 20 of Tomasi)*

Digital Signal processing (24 hours)

Basics of signals and systems (6 hours)

Classification of signals-amplitude and phase spectra-classification of system-simple manipulations of discrete time signals-representation of systems-analog to digital conversion of signals. *(Chapter 1 of Salivahananetal)*

Fourier analysis of signals and systems (12 hours)

Trigonometric Fourier series-exponential form-Parseval's identity-power spectrum of a period function-Fourier transform-properties of Fourier transform-Fourier transform of important signals-Fourier transform of power and energy signals-Discrete time Fourier transform - Fast Fourier transform (FFT)*(Chapter 2 of Salivahanan et al)*

Z-transforms (8 hours)

Definition of z- transform-properties of z-transform-evaluation of the inverse z-transform *(Chapter 4 of Salivahanan et al)*

Digital Filters (10 hours)

Magnitude and phase response of Digital filters- Finite Impulse Response (FIR) digital filters-frequency response of linear phase FIR filters-design techniques of FIR filters-ideas of Infinite Impulse Response filters. *(Chapter 7 of Salivahanan et al)*

Books for study

1. **K.Sam Shanmugam, Digital and Analog communication systems, John Wiley& Sons (2006)**
2. **W.Tomasi, Electronic communication systems: Fundamentals through advanced ,Dorling Kinderley (India) Pvt Ltd (2009)**
3. **G.Kenndy and B.Davis, Electronic communication systems, Fourth Edition, Tata McGraw Hill (2003)**
4. **G.Keiser, *Optical Fibre Communication*, 3rd Edition, McGraw Pub (2000)**
5. **G.P.Agrawal,Fibre optic communication systems, John Wiley& Sons (1993)**
6. **S. Salivahanan and G. Ganapriya, Digital Signal Processing, Tata Mc Graw Hill (2011)**
7. H.Taub,D,Schilling and G.Saha,Principle of Communication systems,3rdEdition,TataMc Graw Hill (2008)

8. W.C.Y.Lee,Mobile Communications-design, Fundamentals, Second Edition, John Wiley & Sons (1993)
9. J.S.Chitode, Digital Communications, Technical Publications Pune (2008)
10. J.M.Senior,Optical Fibre Communications-Principles and Practice, Second Edition, Pearson Education (2006).
11. J.J.Carr, Microwave and Wireless communications Technology, Butterworth-Heinemann (1996)

APPY421 CONDENSED MATTER PHYSICS

(6L, 1T)

Total Teaching Hours for Semester:108	**No of Lecture Hours/Week:6**
Max Marks:75	
Course Outcomes	

The course gives an introduction to condensed matter physics including crystalline materials, theoretical models on the electronic, electrical, magnetic ,dielectric and thermo dynamical properties of matter, introduction to, nano science -technology. Students will be able to understand how different kinds of matter are described mathematically and how material properties can be predicted based on microscopic structure .They will be able to understand how different kinds of matter are described mathematically and how material properties can be predicted based on microscopic structure. Students will become comfortable with the language of condensed matter, specialized terms and key theories, thus enabling them to read and understand research papers and produce their own paper on a relevant topic.

Upon successful completion of this course it is intended that a student will be able to:

CO 1: recognize introductory crystal structures, crystal lattice and imperfections in crystals.

CO 2: understand the elastic properties of solids and the physics of phonons;

CO 3: use models to calculate dispersion relations for acoustical and optical phonons.

CO 4: understand the free electron gas, sketch the free electron band structure and to describe the occupation of the electronic states.

CO 5: derive a quantitative equation of the electronic contribution to the heat capacity;

CO 6: understand the electronic band structure of metals and be able to apply the relevant theory to simple metals;

CO 7: understand the mechanism for electrical conductance in metals;

CO 8: understand the basic materials and properties of semiconductors ,electronic structure, charge carrier statistics, and transport properties in semiconductors

CO 9: understand the fundamentals of polarizable solids, Peizo, Pyro and ferroelectricity,

CO 10: get knowledge on magnetic materials and their atomic theory of magnetism

CO 11: understand the phenomenon of superconductivity: key experiments, some attempts to explain superconductivity, the BCS model

CO 12: demonstrate the length scales concepts, nanostructures and nanotechnology.

CO 13: identify the principles of processing, manufacturing and characterization of nanomaterials and nanostructures.

CO 14: apply the electronic microscopy and scanning probe microscopy techniques to characterize the nanomaterials and nanostructures.

Unit-1	**Teaching Hours:36**

Crystal physics (10 hours)

Lattice points and space lattice-basis and crystal structure-unit cells and lattice Parameters-symmetry elements in crystals –space groups-Bravais lattice-density and lattice constant relation-crystal directions. Planes and Miller indices-reciprocal lattice allotropy and polymorphism in crystals-imperfections in crystals *(Chapter 4 of S.O Pillai)*

Lattice vibrations and thermal properties (10 hours)

Dynamics of identical atoms in crystal lattice- dynamics of linear chain-experimental measurement of dispersion relation-anharmonicity and thermal expansion-specific heat of solids-classical model-Einstein's model-Debye model-thermal conductivity of solids-role of electrons and phonons-thermal resistance of solids. *(Chapters 7 and 9 of M.A. Wahab)*

Free electron and band theory (16 hours)

Electrons moving in one dimensional potential well-Fermi-Dirac statistics-effect of temperature on Fermi distribution-electronic specific heat-electrical conductivity of metals-Wiedmann- Franz- Lorentz law-electrical resistivity of metals-Hall effect-energy bands in solids-Kronig-Penny model-construction of Brillouin zones-nearly free electron model-conductors, semiconductors and insulators-elementary ideas of Fermi surfaces *(Chapters 10,11 and 12 of Wahab)*

Unit-2	**Teaching Hours:36**

Semiconductors (12 hours)

Free carrier concentration in semiconductors-mobility of charge carriers-temperature effects electrical conductivity of semiconductors-Hall effect in semiconductors semiconductor junction properties *(Chapter 13 of M.A. Wahab)*

Dielectric and magnetic properties of materials (24 hours)

Dipole moment-polarization-local electric field in an atom-dielectric constant and its measurement-polarizability-classical theory-Peizo, Pyro and Ferro electric properties of Crystals-Ferroelectric domains-classification of magnetic materials-atomic theory of magnetism-Langevin’s theory-paramagnetism and quantum theory-Weiss molecular exchange field-ferromagnetic domains-anti ferromagnetism-Ferrites *(Chapter 14 and 16 of M.A. Wahab)*

Unit-3	**Teaching Hours:36**

Semiconductors (12 hours)

Free carrier concentration in semiconductors-mobility of charge carriers-temperature effects electrical conductivity of semiconductors-Hall effect in semiconductors semiconductor junction properties *(Chapter 13 of M.A. Wahab)*

Dielectric and magnetic properties of materials (24 hours)

Dipole moment-polarization-local electric field in an atom-dielectric constant and its measurement-polarizability-classical theory-Peizo, Pyro and Ferro electric properties of Crystals-Ferroelectric domains-classification of magnetic materials-atomic theory of magnetism-Langevin’s theory-paramagnetism and quantum theory-Weiss molecular exchange field-ferromagnetic domains-anti ferromagnetism-Ferrites *(Chapter 14 and 16 of M.A. Wahab)*

Unit III

Superconductivity (20 hours)

Experimental attributes to superconductivity-critical temperature, critical current and critical Magnetic field of superconductors-effects of magnetic field on superconductors-Type I and II Superconductors-intermediate and vortex states-thermal conductivity, specific heat and energy gap in superconductors-microwave and IR properties-coherence length-Theories of superconductivity-London equations-Ginzberg-Landau theory-BCS theory-AC and DC Josephson effects in superconductors- Examples and properties of High Temperature superconductors *(Chapter 13 of R.J .Singh)*

Introduction to Nanoscience and technology (16 hours)

Scope of Nanoscience and technology-Nano material preparation techniques-Lithographic and Non-lithographic techniques-sputtering-chemical vapor deposition-pulsed laser deposition molecular beam epitaxy-sol-gel technique-characterization of nano materials scanning probe microscopy-atomic force microscopy-SEM and TEM techniques carbon nano structures-elements of nano electronics.*(Chapters 1,7, and 8 of Chattopadhya)*

Books for study

1. **S.O.Pillai, *Solid State Physics*, Third Edn New Age International Pvt. Ltd (1999)**
2. **M.A.Wahab, *Solid State Physics*, Narosa Publishing House (1999)**
3. **R.J. Singh, Solid State Physics, Dorling Kindersley (India) Pvt. Ltd (2012)**
4. **K.K.Chattopahyay, A.N.Banerjee, Introduction to Nano Science and Nano Technology, Prentice Hall of India (2009)**
5. N.W. Ashcroft and N.D. Merwin, Solid State Physics, Cenage Learning India (2001)
6. Charles. C. Kittel, Introduction to Solid State Physics, Wiley Student Edition (2007)
7. M. Ali Omar, Elementary Solid State Physics, Pearson Education Inc (1999)
8. P.Phillips, Advanced Solid State Physics, Second Edn, Cambridge University Press (2012)
9. Thomas Varghese & K.M. Balakrishna, Nanoscience & Nanotechnology (Atlanta Publishers)

APPY422 NUCLEAR AND PARTICLE PHYSICS

(6L, 1T)

Total Teaching Hours for Semester:108	**No of Lecture Hours/Week:6**
Max Marks:75	
Course Outcomes	

On completing the course the student will be able to

CO1: attain a deep understanding of the Nuclear forces

CO2: understand the fundamental interactions

CO3: understand the importance of models in describing the properties of nuclei

CO4: achieve a deep understanding of the Nuclear Reactions

CO5: understand nuclear phenomena such as Nuclear Fission and Fusion.

CO6: understand how various types of nuclear radiation detectors and accelerators work and understand differences between them

CO7: understand the quark model and modern classification of elementary particles

CO8: make quantitative estimates for nuclear phenomena

CO9: attain basic understanding of the Standard Model employed in particle physics

Unit-1	**Teaching Hours:36**

Nuclear forces (10 hours)

Deuteron-neutron –proton scattering and proton-proton scattering at low energies-non central forces-nuclear exchange force-meson theory of nuclear forces *(Chapter 8 of Tayal)*

Nuclear models (12 hours)

Detailed studies on liquid drop, shell and collective models of the nuclei. *(Chapter 9 of Tayal)*

Nuclear reactions (14 hours)

Conservation laws-energetic nuclear reactions-Q value equation-partial wave analysisof nuclear reaction cross section- compound nuclear hypothesis-resonance reactions-Brot-Wigner one level formula-optical model-theory of stripping reactions. *(Chapter 10 of Tayal)*

Unit-2	**Teaching Hours:36**

Nuclear fission (20 hours)

Mechanism of nuclear fission-calculation of critical energy based on liquid drop model-fission products and energy release-fission chain reactions-neutron cycle and four factor formula-general features and classification of nuclear fission reactors *(Chapter 7 of Verma et al)*

Nuclear fusion (16 hours)

Nuclear fusion in stellar interiors-proton-proton reactions-carbon-nitrogen cycle thermonuclear reactions in the laboratory-conditions for the construction of nuclear fusion reactor-critical ignition temperature-Lawson criterion-plasma confinement infusion- principles of pinch, magnetic and inertial confinements *(Chapter 7 of Verma et al)*

Unit-3	**Teaching Hours:36**

Nuclear detectors and particle accelerators (20 hours)

Gas filled detectors-ionization chamber and proportional counters-GM counter scintillation detectors-semiconductor detectors-Cerenkov detector-bubble chamber *(Chapter 6 of Verma et.al)*

Particle accelerators-electrostatic accelerators-cyclotron accelerators-synchrotrons linear accelerators-colliding beam accelerators *(Chapter 15 of Krane)*

Elementary particle physics (16 hours)

Elementary particle interactions-symmetries and conservation laws-quark model of elementary particles-colored quarks and gluons-ideas of charm, beauty and truth-quark dynamics-ideas of grand unified theories of fundamental forces *(Chapter 18 of Krane)*

Books for study

1. **D.C.Tayal, *Nuclear Physics*, 5th Edition, Himalaya Publishing Co (2008)**
2. **J.Verma, R.C.Bhandari, D.R.S.Somayajulu, *Fundamentals of Nuclear Physics*, CBS Publishers and Distributors (2005)**
3. **K.S.Krane, Introductory *Nuclear Physics*, Wiley India Pvt Ltd (1988)**
4. S.B. Patel, Nuclear Physics-An Introduction, New Age International Pvt Ltd (1996).
5. B.R. Marhu, Nuclear and Particle Physics- an Introduction, Second Edition, Wiley (2012)
6. S.N. Ghoshal, Nuclear Physics, S,Chand Ltd (1997)

10. M.P.Khanna, Introduction to Particle Physics, PHI (2011)
11. J. Freidberg, Plasma Physics and Fusion Energy, Cambridge University Press (2007)
12. FF. Chen, Introduction to Plasma Physics, Springer, London (2002).

SPECIAL PAPER SYLLABUS: SPECIAL PAPER –II ELECTIVE

APPY423.1b ADVANCED ELECTRONICS-II

(6L, 1T)

Total Teaching Hours for Semester:108	**No of Lecture Hours/Week:6**
Max Marks:75	
Course Outcomes	

On completing the course the student will be able to

CO1: understand the architecture and the programming of Intel 8086 microprocessor

CO2: understand the microprocessor interfacing devices like 8251-A, USART 8257, DMA controller 8259, Interrupt controller 8279, keyboard/ display interface, A/D and D/A converter etc.

CO3: understand the basics of artificial intelligent systems

CO4: get a general knowledge of the search processes in AI problems,Blind search processes like - Depth first search, Breadth first search etc.Informed search processes or Heuristic search

CO5: understands the various Knowledge representation schemes

CO6: get the basic idea about symbolic programming languages like LISP and PROLOG

CO7: understands the basics of Fuzzy network and Neural networks

CO8: understands the working of TV, Radar and Satellite communications systems

Unit-1	**Teaching Hours:36**

Microprocessor 8086: Introduction and Programming (18 hours)

Internal architecture of 8086-pin configuration of 8086-memory organization of 8086-addressing modes of 8086-minimum and maximum mode configurations-instructions set of 8086-data movement instructions-arithmetic and logic instructions programming of 8086-flow charts and programming steps *(Chapter 2, 3, 4 of Sunil Mathur)*

Microprocessor interfacing devices and advanced microprocessors (12 hours)

Programmed I/O –direct memory access-micro controllers-8251A USART-8257DMA controller-8259A programmable interrupt controller-8279 programmable keyboard/display interface-analog to digital and digital to analog converters advancedmicroprocessors-80186/80188 high integration 16-bit microprocessors-80386 and 80386 processors-RISC processors.*(Chapter 6 and 7 of Abishek Yadav)*

Elements of embedded systems (6hours)

Example of an embedded system-processor chips for embedded applications-a simple micro controller using embedded systems-embedded processor families (Chapter 10 of Hamacher et al)

Unit-2	**Teaching Hours:36**

Introduction to artificial intelligence and expert systems (20 hours)

Overview of artificial intelligence (AI)-knowledge representation in AI-problem solving in AI-search methods-predicate and propositional logic-Formal symbolic logic-LISP and PROLOG basics-network representations of knowledge-natural language study in AI-Fuzzy sets and Fuzzy logic- Expert systems-rule based expert systems-nonproduction system architectures-examples of expert systems.*(Chapters 1,2,4,5,7,9,12 & 15 of Patterson; Chapter 1-5 and 8 of Rich and Knight)*

Advanced artificial intelligence systems (16 hours)

Introduction to robotics-artificial intelligence machines-language based and knowledge based machines-Fuzzy expert systems-fuzzy quantifiers-fuzzy inference-fuzzy rule based systems-engineering applications of fuzzy logic-applications in power plants, data mining and image processing and control instrumentation-basic concepts of Artificial neural networks-neural network architectures-learning methods-neural network systems-ADALINE and MADALINE networks –neural network application domains.*(Chapter 21 of Rich and Knight, Chapter 16 of Janakiramanet-al, Chapters 1 and 7 of Rajashekaran and Pai,, Chapter 8 of Sivanandan et al)*

Unit-3	**Teaching Hours:36**

Television (14 hours)

Television broadcasting fundamentals-scanning, blanking and synchronizing pulses video bandwidth-video signal characteristics-TV broadcasting channels-TV camera tubes-monochrome TV transmission and reception-color camera tube-color TV system-advanced TV systems-satellite TV techniques-cable TV system-Digital color TV system *(Chapter 1 to 5 of Veera Lakshmi and Srivel)*

Radar (12 hours)

Basic principles of radar-Radar equation-M T I, Pulse and Doppler Radars-Radar signal analysis-ideas of Radar transmitters and receivers-hyperbolic systems for navigation-LORAN and DECCA systems. *(Relevant chapters of Skolni, Chapter 4 of Nagaraja)*

Satellite communications (10 hours)

Satellite orbits-Geosynchronous satellites-antenna look angles-satellite classifications spacing and frequency allocations-satellite antenna radiation patterns-satellite system link models – satellite system parameters and link equations *(Chapter 25 of Tomasi)*

Books for study

1. Sunil Mathur, *Microprocessor 8086-Architecture, Programming and Interfacing*, PHI learning Pvt Ltd (2011)
2. AbishekYadav, *Microprocessor 8085 8086*, University Science Press, New Delhi (2008)
3. Carl Hamacher, Z.G. Vranesic,S.G. Zaky, *Computer organization*,5thEdition,McGrawHill Education (2002)
4. V.S. Janakiraman, K.Sarukesi and P. Gopalakrishnan, *Foundations of Artificial Intelligence and Expert systems*, Macmillan Publishers India Ltd. (2011).
5. E. Rich and K. Knight, *Artificial Intelligence,* Second Edition, Tata McGraw Hill Pub

Co (2006),

6. D.W.Patterson, Introduction to *Artificial Intelligence and Expert Systems*, Prentice Hall of India Pvt. Ltd (2001)
7. S. Rajasekharan and G.A. Vijalekshmi Pai, *Neural Networks Fuzzy logic and Genetic algorithms*, PHI learning PVt Ltd (2010).
8. S.N. Sivanandan, S. Sumathi and S.N. Deepa, *Introduction to Fuzzy logic using MATLAB*, Springer (2007).\
9. A. Veera Lakshmi and R.Srivel, *Television and Radio Engineering*, Ann Books Pvt Ltd (2010)
10. Skolini.M.I, *Introduction to Radar systems*, Third edition, Tata Mc Graw Hill (2001)
11. Nagaraja, *Elements of Electronic navigation*, Second Edition, Tata Mc Graw Hill (2006).

APPY2PI GENERAL PHYSICS PRACTICALS **(Total of 10 experiments to be done from Section A and B)**	
Total Teaching Hours for Semester:108	**No of Lecture Hours/Week:6**
Max Marks:75	
Course Outcomes	

Section A

(At *least 5 experiments to be done in this section*)

1. Determination of elastic constants by Cornu's method (elliptical and hyperbolic fringes)
2. Analysis of absorption spectra of liquids using spectrometer
3. Study of ultrasonic waves in liquids
4. Determination of e/k using Ge and Si transistors

5 Anderson Bridge –determination of self and mutual inductance

6. Michelson Interferometer experiments
7. Identification of Fraunhofer lines in solar spectra
8. Verification of Richardson's equation using diode valve
9. LED experiments (a) wavelength determination (b) I-V characteristics (c) output Power variations with applied voltage etc.

10. Thermal diffusivity of brass
Section B
(At *least 2 experiments to be done from this section*)
1. BH curve-anchor ring 2. Study of photoelectric effect and determination of Planck's constant 3. Determination of Stefan's constant 4. Experiments using Laser: (a) Laser beam characteristics (b) Diffraction grating (c) Diffraction at different types of slits and apertures (d) refractive index of liquids (e) particle size determination 5. Young's modulus of different materials using strain gauge 6. Determination of magnetic force in a current carrying conductor 7. Optical fibre characteristics 8. Cauchy's constants of liquids and liquid mixtures using hollow prism and spectrometer 9. Surface tension of a liquid using Jaeger's method 10 Experiments using Phoenix Kit (a) Capacitor charging/discharging experiments (b) Dielectric constant of glass

APPY2PII ELECTRONICS AND COMPUTER SCIENCE PRACTICAL	
Total Teaching Hours for Semester:108	**No of Lecture Hours/Week:6**
Max Marks:75	
Course Outcomes	
Unit-1 Electronics Experiments	**Teaching Hours:36**
(A total of 10 experiments to be done)	
Section A	
(*At least 5 experiments to be done*)	
1. Single stage CE amplifier –Design and study of frequency response 2. Study of RC Phase shift oscillator circuits using Transistors 3. Construction and study of Astable multivibrator and VCO circuits using Transistors 4. Study of OP Amp circuits (a) summing amplifier (b) difference amplifier (c) zero cross	

detector etc.

5. OP Amp as an integrator and differentiator

6. Characteristics of JFET and MOSFET

7. Characteristics of SCR

8. Design and study of negative feedback amplifier circuits

9. Study of Clipping and Clamping circuits

10. UJT Characteristics and UJT relaxation Oscillator

Section B

(A*t least 3 experiments to be done*)

1. Emitter follower and source follower circuits

2. Weinberg oscillator using OP Amp

3. SR and JK Flip Flops -construction using Logic Gates and study of truth tables

4. Study of the frequency response of a tuned amplifier

5. Study of power amplifier circuits

6. Frequency multiplier using PLL

7 Study of Schmitt trigger circuits

8. Construction and study of a cascade amplifier circuit using transistors.

9. Simple electronics experiments using Phoenix and Python based Kits.

Unit-2 Computer Programming	**Teaching Hours:36**

(A minimum of 8 experiments to be done, programs should be written in C++ language)

1. Least square fitting

2. First derivative of tabulated function by difference table

3. Numerical integration (Trapezoidal rule and Simson method)

4. Solution of algebraic and transcendental equations using Newton-Ralphson method

5. Solution of algebraic equations using bisection method

6. Numerical interpolation using Newton and Lagrangian methods

7. Monte Carlo simulation

8. Evaluation of Bessel and Legendre functions

9. Matrix addition, multiplication, trace, transpose and inverse

10. Fourier series analysis

11. Study of motion of projectile in a central force field

12. Study of Planetary motion and Kepler's laws

APPY4PIII ADVANCED PHYSICS PRACTICAL **(A total of 10 experiments to be done)**	
Total Teaching Hours for Semester:108	**No of Lecture Hours/Week:6**
Max Marks:75	
Course Outcomes	

(A total of 10 experiments to be done)	
Unit-1 Physics experiments	**Teaching Hours:36**
Section A	
(At *least 5 experiments to be done*)	
1. e/m of an electron-Thompson's method 2. Charge of an electron-Millikan's method 3. Determination of Fermi energy of Copper 4. Study of variation of resistance of a semiconductor with temperature and determination of Band gap 5. Magnetic Susceptibility of a liquid using Quincke's method 6. Ferromagnetic studies using Guoy's method 7. Hall effect in a semiconductor 8. Rydberg constant determination using grating, spectrometer and discharge tubes. 9. Thermo-emf of bulk samples like Al, Cu. Brass etc.	
Section B	
(At least two experiments to be done)	
1. Electrical characteristics of a solar cell 2. Studies using visible spectrophotometer 3. Refractive index of liquids and liquid mixtures using Abbe's refractometer 4. Optical activity studies using Polarimeters 5. Determination of temperature characteristics of a Flame (a) Candle flame using digital photography and image analysis	

(b) Sodium flame in comparison with incandescent lamp using a spectrometer 6. LDR and photodiode characteristics 7. Simple experiments using GM counter 8. Determination of dielectric constant of materials 9. Experimental determination of Avogadro's number using an electrochemical cell 10 Study of arc spectra and hydrogen spectra using an imager (CCD) and Photoelectric/electronic recorder.	
Unit-2 Data Analysis	**Teaching Hours:36**
(***Five experiments to be done***)	
1. Analysis of the given band spectrum 2. Analysis of given rotation-vibration spectrum 3. Interpretation vibration spectra of simple molecules using Raman and IR spectra 4. Dissociation energy of diatomic molecules 5. Analysis of powder XRD data 6. Study of stellar spectral classification from low dispersion stellar spectra 7. Study of HR diagram of stars 8. Radioactive material counting statistics 9. Interpretation of UV- visible spectra of materials 10. Weather and astronomy related image processing	

APPY4PIV ADVANCED ELECTRONICS PRACTICAL	
Total Teaching Hours for Semester:108	**No of Lecture Hours/Week:6**
Max Marks:75	
Course Outcomes	
Unit-1 Electronics	**Teaching Hours:36**
(***A total of seven experiments to be done***)	
Section A	
(at least 5 experiments to be done)	

1. Study of active filters using OP amps (a) low pass (b) high pass (c) band pass for both first order and second order-gain/ roll off determination

2. Wave form generation using OP amp circuits :(a) astable and monostable multivibrators (b) square, triangular and saw-tooth wave generation

3. IC 555 timer experiments (a) monsostable and astable multivibrators(b) VCO

4. D/A convertor circuits using OP Amp 741

5. Differential amplifier circuits using transistors

6. Design of series pass voltage regulators using (a) transistors with load and line regulation (b) OP Amp

Section B Electronics

(At least 2 experiments to be done)

1 Study of IF tuned amplifier and Amplitude modulation (generation and detection) using transistor, diode etc.

2. Frequency modulator and detector circuits.

3. Pulse modulation circuits using 555 timer (a) PAM (b) PWM

4. Digital modulation circuits (a) BFSK generation using 555 timer (b) BFSK detector using 555 timer and PLL (c) BPSK generation

5. Shift register and ring counter circuits using flip flops

6. Miscellaneous transistor applications (a) automatic night light with LDR
(b) Invertor circuit (transistors as a switch) (c) time delay circuit using SCR

7. BCD to decimal decoder and seven segment display using IC

8 Design of Electronic counters (up and down counters)

Unit-2 Microprocessor Based Experiments	**Teaching Hours:36**

(Five *experiments to be done*)

1. 8085 /8086 program to find out largest from a group of 8bit/16 bit numbers
2. Square wave generation using 8255A interface using 8085/8086
3. 8086 program for block additions
4. Interfacing LED display board with 8085/8086
5. 8086 program to convert binary to ASII and ASII to BCD
6. 8086 program to arrange a given data in ascending and descending order
7. 8086-simple traffic light controller

8. 8086 program for binary to BCD conversion and vice versa

9. Program of Fibonacci series using 8086