



**TAMIL NADU STATE COUNCIL FOR  
HIGHER EDUCATION**  
CHENNAI 600 005

**Report of the Workshop on  
'Physics Education in the 21<sup>st</sup> Century'**

**October 2006**

## INTRODUCTION

Curriculum Development is a ceaseless process of searching for qualitative improvement in education in response to the changes taking place in the society. It is a total process in which different components such as formulation of a curriculum policy, curriculum research, curriculum planning, its implementation and then its evaluation play an important role.

The number of teachers playing an active role in designing the curriculum is obviously very small, although as its implementers they make a very vital contribution to the educational process. Teachers have to be an integral part of the curriculum development process and must include training in both the teaching methods and evaluation procedures.

Leaving teachers out of the design and development of curriculum change is most likely to result in little if any, real change in the scenario. Teacher involvement in curriculum development is desirable particularly because it can be a motivating factor for teachers in their profession, giving them a sense of ownership of the curriculum they have to transact.

To achieve this Tamil Nadu State Council for Higher Education has planned to organized a two day workshop in "Physics Education in the 21<sup>st</sup> Century". Besides the basic concepts of physics, the students of physics major should have a broader vision. They should be exposed to societal needs of physics and the importance of physics in the development of technology. Apart from this, communication and technical skill should be imparted to the students.

While framing the curriculum and syllabus, the teachers are expected to consider the employability of students after the course, possibility for higher education and to aim at the total development of personality of the student - the mind, the body and the intellect. There should be flexibility in the curriculum, so that students can select their subjects of choice in the domain of physics.

**TAMIL NADU STATE COUNCIL FOR HIGHER EDUCATION,  
CHENNAI 600 005**

**Workshop on “Physics Education in the 21<sup>st</sup> Century”**

**5<sup>th</sup> and 6<sup>th</sup> October 2006**

**PROGRAMME**

5-10-2006

- |                       |   |   |
|-----------------------|---|---|
| 10.00 a.m.            | - | Registration                                      |
| 10.30 a.m.            | - | Inauguration                                      |
| Inaugural Address     | : | Dr. A. Ramasamy,<br>Vice-Chairman,<br>TANSCHE     |
| Special Address       | : | Dr. S. Bhaskaran,<br>Member-Secretary,<br>TANSCHE |
| Resource Person       | : | Prof. S. Swaminatha Pillai                        |
| 11.30 a.m.            | - | Tea   |
| 11.45 a.m.            | - | Framing the Structure of the Curriculum           |
| 1.00 p.m.             | - | Lunch   |
| 2.00 p.m. – 5.00 p.m. | - | Generation of Model Syllabi in groups             |

6-10-2006

- |                         |   |   |
|-------------------------|---|---|
| 10.00 a.m. – 11.15 a.m. | - | Generation of Model Syllabi in groups           |
| 11.15 a.m. – 11.30 a.m. | - | Tea   |
| 11.30 a.m.              | - | Generation of Model Syllabi in groups           |
| 1.00 p.m.               | - | Lunch   |
| 2.00 – 4.00 p.m.        | - | Finalizing the Syllabi and Valediction          |
| Vote of Thanks          | - | Dr. S. Padmavathy,<br>Research Officer, TANSCHE |

# CURRICULUM DEVELOPMENT PROCESS

S. SWAMINATHA PILLAI

## COMPETENCIES TO BE DEVELOPED:

Knowing the form and function of a curriculum.  
Understanding the need for a curriculum.  
Following several steps in developing a curriculum.  
Evaluating a curriculum.  
Appreciating the role of curriculum in the social process of education.

## ABSTRACT:

*Curriculum is a contact document between the stakeholders of the educational process. It fulfils the need for directing, implementing and satisfying their role performance in the society. Being scientific in its approach a curriculum specifies all the required conditions for effective learning and teaching including testing, besides leading to continuous individual and social development. The philosophical foundations of an society is the basis for a curriculum; the practical and successful living is the result of well-developed curriculum. Economy of efforts, materials, manpower, time and money is achieved in the otherwise long, unwieldy and indirect process of education.*

## INTRODUCTION

The long and continuous social process of education is often offered in terms of specified periods. These periods are identified as stages of education viz., early childhood to university education. In each stage there may be several parallel forms or structures like general, special or professional education depending on the needs of the pursuers of education at that stage. To make them ready and interested in their direction of learning and teaching, it is required that both the teachers and the learners should have a clear idea about their plans and activities. This can be set by them if they are mature enough to draw the plan. Very often there arises a situation that quantitative expansion like population increase and transfer of persons like social mobility requiring some sort of uniformity or equality paving way for easy movement and comfort and confidence. Hence there is a need for a common source and plan to enable the younger generation to get the required education assuring a

sort of commonly recognized competencies at each stage of human development. This requirement is fulfilled by what is called curriculum.

## **WHAT IS A CURRICULUM?**

A curriculum seeks to answer questions like ‘What shall I teach or learn?’, ‘Why should I teach or learn?’, ‘How will I teach or learn?’, ‘What resources do I have at my disposal?’, and ‘How do I know if I have succeeded in my learning or teaching?’ Thus a curriculum is **a conceptual scheme** for joint implementation by teachers and learners in core, observed and appreciated by parents and users of the product/ learners in effect and valued and admired by other stakeholders as a result. It is in fact **a changing and living entity** in view of its need for continuous modification as demanded by the members of the society in view of the fast and dynamic changes around. It is obtained from **three sources** such as replacing the familiar environment of **family and friends to school and college**, moving from the **present scenario** to a predicted or even unpredicted **future situation** and making the implementers or beneficiaries **dependent or independent**, or balancing between **individuality and conformity**.

A curriculum is in fact **a programme of studies** or activities (curricular, co-curricular and extra curricular) and guidance. It can function as a scale of values providing a set of criteria. Arising from the **basic needs** and moving on to **social, cultural, individual and traditional needs**, the curriculum very often attempts to fulfil **the ideal needs also**, such as intellectual, moral, aesthetic and religious needs. Curriculum is frequently viewed as **a school/college/university function** for preserving and transmitting traditional cultures, for the transformation of culture, and primarily **for individual development** of the participants.

## **PRESSURES AND PRINCIPLES OF CURRICULUM DEVELOPMENT**

Curriculum is developed under **economic and social pressures**, caused by **knowledge explosion** and utilizing **research findings**. The principles of governing the development of a curriculum can be stated as follows:

*Curriculum should be **dynamic** enough to accommodate the changes in social environment; it should be specifically **goal-oriented** to move towards the accepted direction causing success; **scientific** method needs to be adopted in*

*developing a curriculum to make it reliable and successful; and curriculum has to be **evaluative** with a built-in mechanism of evaluation; and however it should be **comprehensive** enough to bring in clarity, brevity and surety in its success.*

Specifying the **objectives** in observable terms, describing a variety of alternative **learning experiences**, selecting the most appropriate **content** from the vast store of human knowledge, **organizing and integrating** the items into a homogeneous whole and providing for adequate and accurate measures of **evaluation** of the achievement of the state objectives so as to minimize, if not avoid, any loss or distortion of human development.

### **STAGES OF CURRICULUM DEVELOPMENT:**

There are several stages in the development of a curriculum. The following are the most identifiable and adoptable stages as practiced by the curriculum developers:

**PLANNING:** Observing the gaps, if any, between the educational achievements and the social development there should be a systematic attempt to identify the new needs of the society by adopting the techniques of need analysis. Considering the social forces, needs, goals and objectives, knowledge has to be treated for human development on the philosophical tenets of the society incorporating the learning process with the selection of proper instructional procedure decision is to be taken on the proposed curriculum.

**PREPARING:** Collecting the available data, identifying the relevant sources, organizing adequate and suitable manpower, debating several styles of learning and strategies of teaching, arranging for several materials useful to cull out specific content from, a curriculum developer has to be prepared for the process. Following a systemic approach the constituent subsystems need to be integrated to deal with the collected data yielding the relevant content to be selected, organized and assessment pattern to be specified.

**DESIGNING:** Levels, types and structure of educational institutions which are to adopt the proposed curriculum, precepts and practices of educational technology, humanistic approach, vocational possibilities and social

reconstruction contribute to the design of a curriculum. Even the concept of de-schooling or out-of-school or distance or on-line education will have a bearing process. The popular and prominent curriculum models of Tyler and Taba offer potentials of the curriculum development.

**DEVELOPMENT:** Curriculum development considers instructional development, learning materials and instructional media development besides strategies of teaching and techniques of testing. It is an integrated process taking into account all possible educational practices. Three different diagrammatic approaches are presented in the next section of this paper.

**IMPLEMENTATION:** The chief implementers of a curriculum are teachers and learners although other educational managers have assigned roles to play. Policy-makers, system managers, auxiliary manpower like technicians and other personnel and evaluators along with users like higher education system and employment organizations definitely play a secondary role in this regard.

**EVALUATION:** After implementing a curriculum it is essential to evaluate the same for its effectiveness, deficiencies and mishaps. There are several models of evaluation of a curriculum proposed by experts as in the case of Stufflebeam's model or CIPP model. In any case teacher evaluation of students followed by an analysis of the latter's performance, student evaluation of students followed by their experiences, materials evaluation of all concerned and evaluation of the testing techniques adopted and the examination pattern used form the basis for valid, reliable and acceptable evaluation of a curriculum.

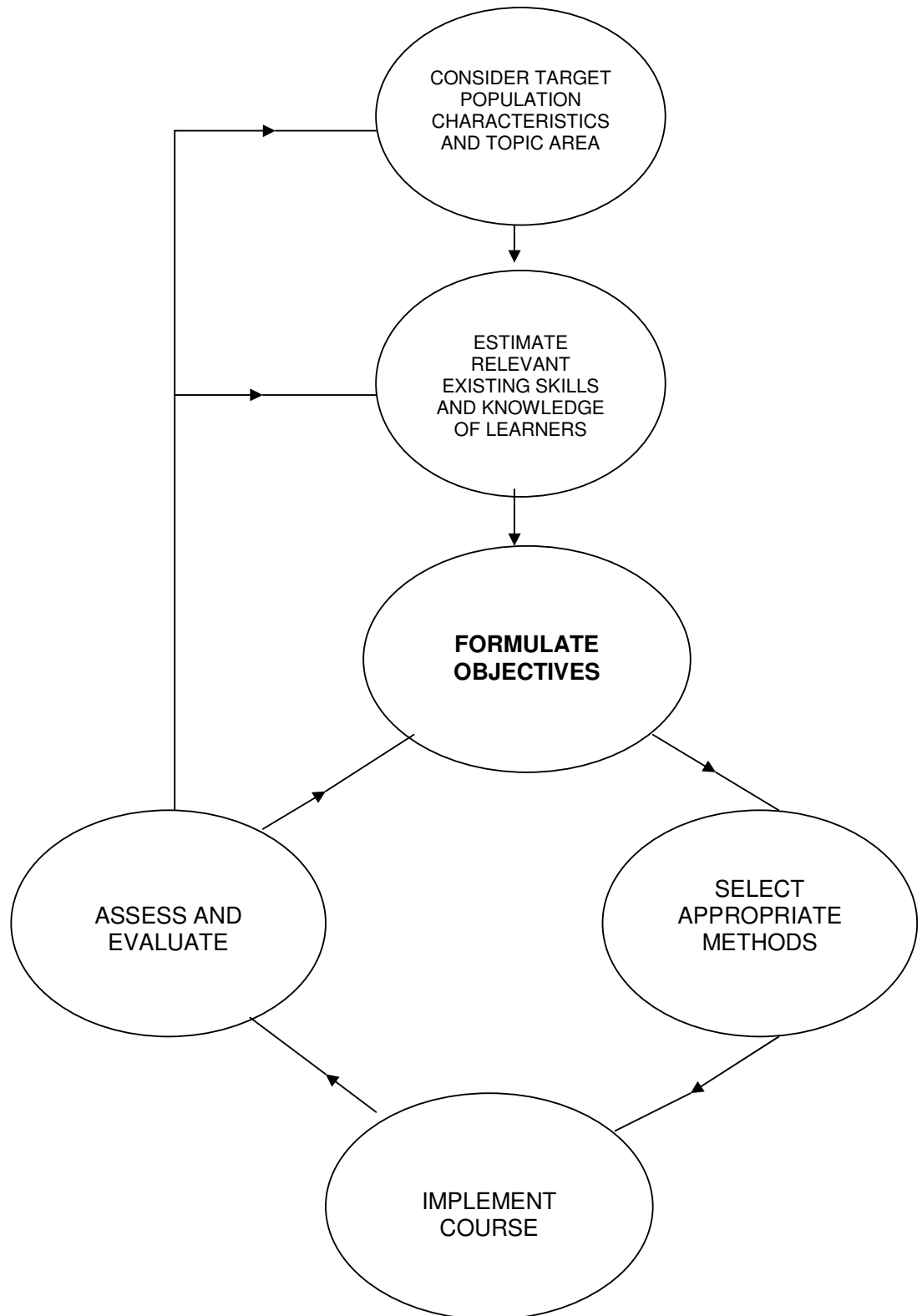
**REVIEW:** The after-effects of such evaluation will be the need and the mode of reviewing the developed and implemented curriculum periodically so as to make modifications in the relevant aspects of the curriculum. As per the present conditions the life of a curriculum is not even five years unlike in the past. Even annual review for making required changes in the curriculum makes it more dynamic, organizationally difficult though.

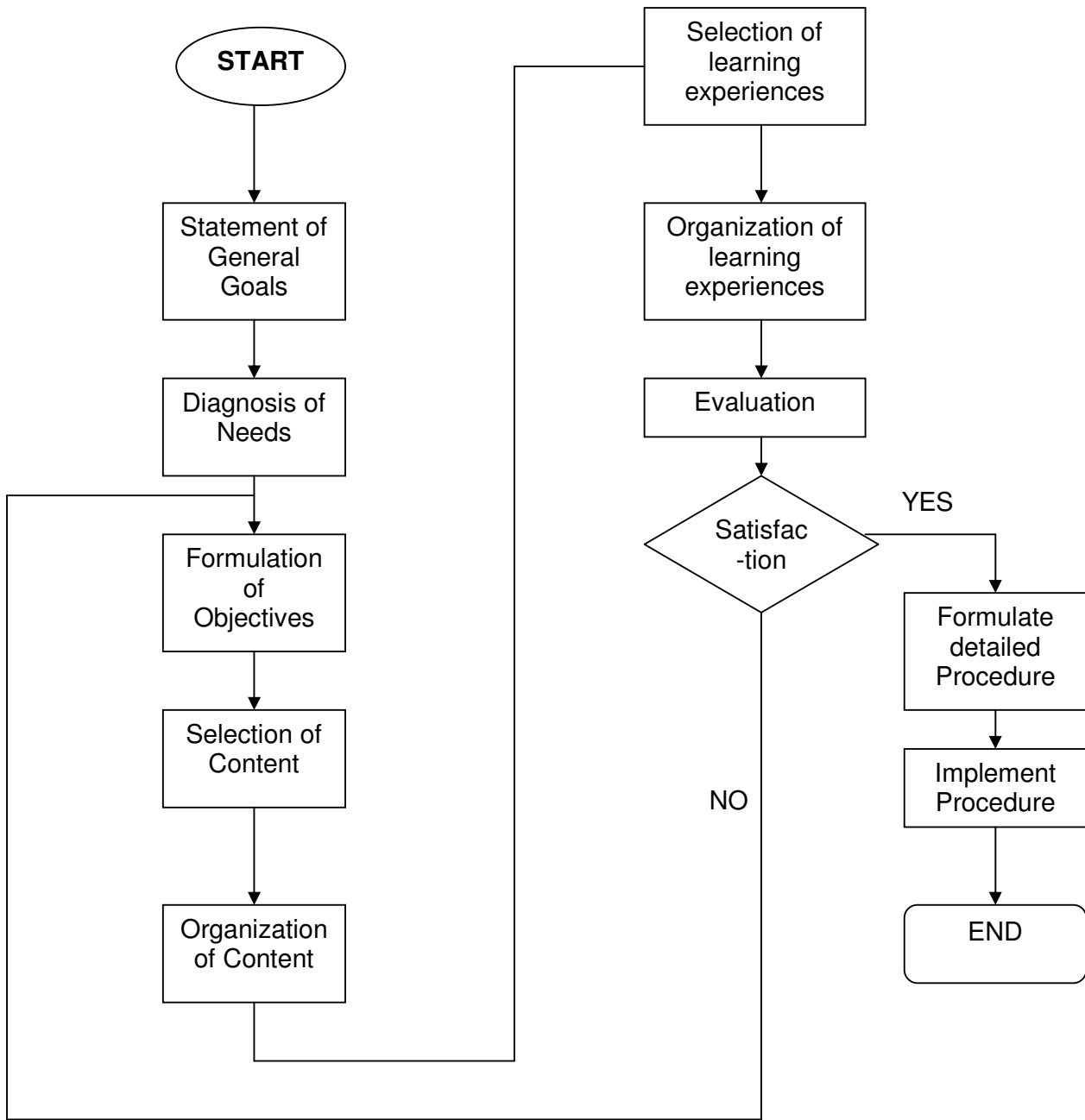
**IMPROVEMENT:** In order to improve a curriculum the process should have a re-look including restart from the scratch. Tinkering with a curriculum makes

it lopsided and takes its life away. Total revision is always a must. In view of the fast changes in the social milieu and of the human knowledge and experience the concept of rolling curriculum will yield better results. Anyway every five, or better, three years or period of duration of a course offered there is a need Curriculum improvement or revision or even reconstruction.

# CURRICULUM DEVELOPMENT MODELS:

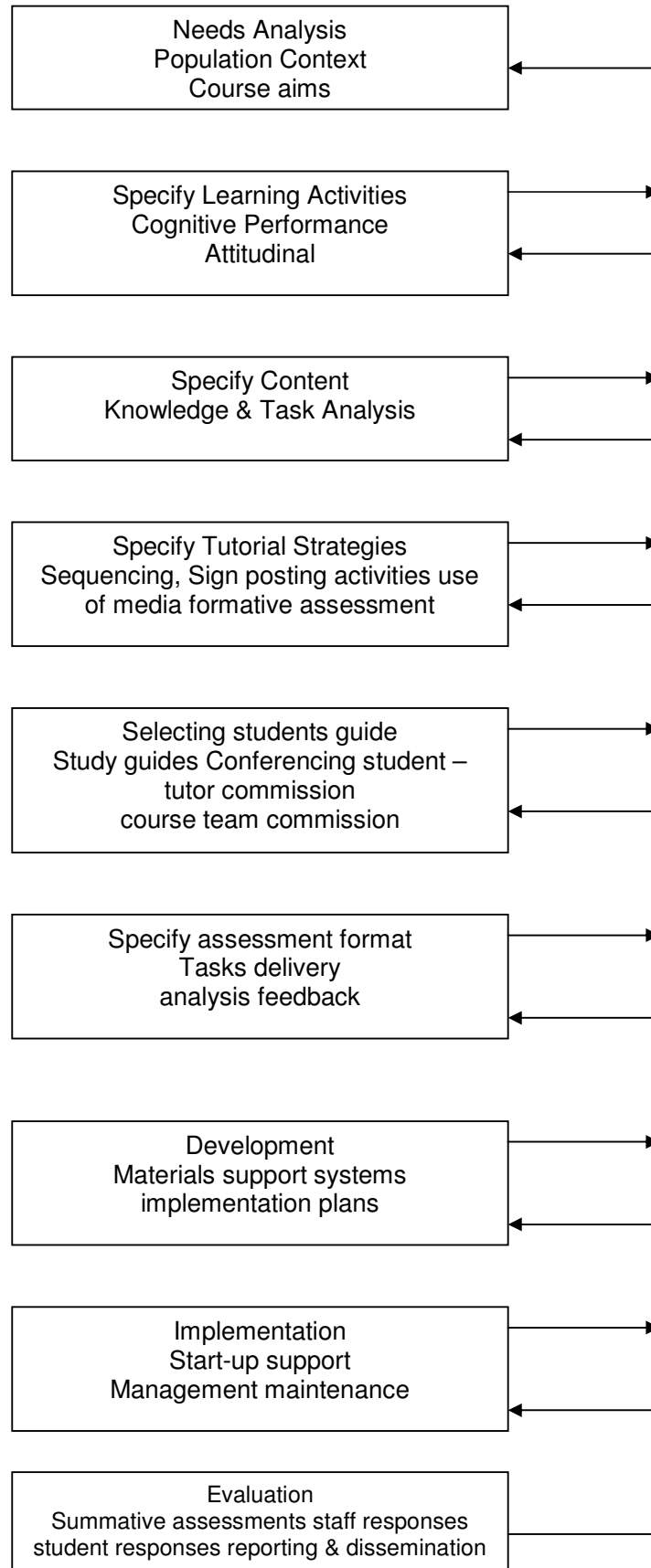
## 1. A SIMPLIFIED SYSTEMS APPROACH





**FLOWCHART REPRESENTATION OF TABA-TYLER CURRICULUM DEVELOPMENT MODEL**

### 3. THE COURSE DESIGN PROCESS



## **CURRICULUM & SYLLABUS STRUCTURE:**

### Structure of Curriculum

1. Introduction
2. Scope
3. Aims & Goals
4. Courses of Studies
  - Paper I
  - Paper II
  - Paper III
5. Methodology
6. Materials
7. Media
8. Evaluation
9. Outcome

### **Structure of Syllabus**

1. Linkage
2. Objectives
  - General
  - Specific (Competences)
3. Structured Content
4. Materials
5. Methods & Media
6. Testing

F.N.:-

Objectives

Competencies

Achieve Objectives

Demonstrate Competences

Able to -----

Can do / does -----

'Learning outcome'

'Performance descriptors'

skills

indicators

## **CURRICULUM CHANGES:**

National aspirations and needs, cultural change, social change caused by technological development, economic changes, political variations and changes in values, the value system in vogue, philosophical, sociological and psychological approaches tend to make changes in the curriculum. The National Framework for School Curriculum 2000 has now been revised as the National Framework for School Curriculum 2005. This is an example of curriculum change due to one or more of the above contexts affecting the same.

## **CONCLUSION:**

As an MOU between the participants in the curriculum process, any curriculum is subjected to a variety of pressures, forces and changes. The vital factor involved is the societal need arising then and there in any modern set-up. Speed on the one hand and economy on the other hand provide the essential impetus to the periodical development of different curricula of different stages of education. From a one-month programme to even a five-year programme several curricula need to be developed to supply the specifically needed manpower meeting the demands of a nation.

## **References**

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Tyler, Robert (1986) Curriculum Development Process  
(not available) (1990) The Course Design

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**B.Sc. Degree Curriculum - Courses of Study and Scheme of Examination**

Year	Semester	Core Paper	Subject	Instruction Hours	Max. Marks	
I	I		Language-1 – Paper-1	6	100	
			Language-2 – Paper-1	6	100	
		Paper – 1 (P <sub>1</sub> )	Properties of Matter and Acoustics	5	100	
		Paper – 2 (P <sub>2</sub> )	Mechanics	5	100	
			Practical – I	2	--	
		Allied – 1 (Paper-I)	Mathematics-I	6	100	
	II			Language-1 – Paper-2	6	100
				Language-2 – Paper-2	6	100
		Paper – 3 (P <sub>3</sub> )	Thermodynamics and Statistical Methods	5	100	
		Paper – 4 (P <sub>4</sub> )	Optics and Spectroscopy	5	100	
		Paper – 5 (Pr-1)	Practical – 1 (Exam)	2	100	
		Allied-1 (Paper –2)	Mathematics – II	6	100	
II	III		Language-1 – Paper-3	6	100	
			Language-2 – Paper-3	6	100	
		Paper-6 (P <sub>6</sub> )	Electricity and Magnetism	5	100	
		Paper-7 (P <sub>7</sub> )	Mathematical Methods in Physics	5	100	
			Practical - II			
		Allied-II (Paper-I)	Chemistry (Theory) – I	4	75	
	Practical		2	--		
	IV			Language-1 – Paper-4	6	100
				Language-2 – Paper-4	6	100
		Paper-8 (P <sub>8</sub> )	Analog Electronics	5	100	
		Paper-9 (P <sub>9</sub> )	Numerical Methods and Computer Programming in C	5	100	
		Paper-10 (P <sub>10</sub> )	Practical-II (Exam)	2	100	
		Allied-II	Chemistry (Theory) – II	4	75	
			Practical	2	50	

III	IV	Paper-11 (P <sub>11</sub> )	Quantum Mechanics & Relativity	6	100
		Paper-12	Atomic and Nuclear Physics	6	100
			Practical-III	3	--
			Practical-IV	3	--
		Optional/ Elective (Paper-1)		5	100
		Paper-13 (P <sub>13</sub> )	Radiation Physics Environmental Science	5 2	100 100
	VI	Paper-14 (P <sub>15</sub> )	Digital Electronics	6	100
		Paper-15 (P <sub>15</sub> )	Solid State Physics	6	100
		Paper-16 (PR-3)	Practical-III (Exam)	3	100
		Paper-17 (PR-4)	Practical-IV (Exam)	3	100
		Paper-18 (P <sub>18</sub> )	Communication Electronics	6	100
		Optional/ Elective (Paper-2)		6	100
				180	3300

## **PROPOSED MODEL CURRICULUM**

Prepared in the workshop organized at Chennai on the 5<sup>th</sup> and 6<sup>th</sup> October 2006 and discussed in the meeting of the Tamil Nadu State Council for Higher Education on 27<sup>th</sup> June 2007

Recommended to the Universities in Tamilnadu offering B.Sc. Physics Degree programmes and all Autonomous Colleges for consideration in their Academic Bodies and consequent implementation from the next academic year.

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## INTRODUCTION

We are pleased to present the model curriculum for B.Sc., Physics and Allied papers applicable to other branches of science.

After detailed discussion, the curriculum is designed as follows:

1. Core Subjects :  
Theory : 14 papers  
Practicals : 4 papers
2. Elective Subjects : 2 papers  
Practicals : --
3. Allied Subjects :  
Theory : 2 papers  
Practical : 1 paper

### Scope:

The study of B.Sc., Physics enables the student to pursue Higher Education like M.Sc., Physics, M.Sc., Electronics, MCA, M.Sc., Computer Science, M.Sc., (I.T.), and other professional courses. The sound knowledge developed through this curriculum enrich the students for their future carrier.

### Aims & Goals:

The recent developments in physical sciences has been included in the enriched syllabus to meet the present day needs of academic and research institutions and industries.

### Blue Print of Question Pattern:

Unit	Type of Questions			Total
	Section – A MC/Definitions	Section – B (SA)	Section – C (LA)	
1.	<u>marks</u> MC – 2 x 1 = 2 Definition - 1 x 2 = 2/4	<u>either/or type marks</u> 1 x 4 = 4	<u>either/or type marks</u> 1 x 12 = 12	20
2.	" 4	1 x 4 = 4	1 x 12 = 12	20
3.	" 4	1 x 4 = 4	1 x 12 = 12	20
4.	" 4	1 x 4 = 4	1 x 12 = 12	20
5.	" 4	1 x 4 = 4	1 x 12 = 12	20
	Total 20	Total 20	Total 60	100

Section A :            All questions carry equal marks

(20 marks)

i) Sec-A contains two objective type questions [multiple choice (mc)] from each unit carrying one mark each. ( $10 \times 1 = 10$ ).

ii) Physical laws and definitions – one question from each unit carrying 2 marks each. ( $5 \times 2 = 10$ )

Total: 20 marks

Section B:            All questions carry equal marks

(20 marks)

One question from each unit "either or type" including at least two problems, each carrying 4 marks. ( $5 \times 4 = 20$ )

Section C:            All questions carry equal marks

(60 marks)

One question from each unit "either or type" including at least 2 problems each carrying 12 marks. ( $5 \times 12 = 60$ )

**PROPOSED MODEL SYLLABI FOR CORE PAPERS**

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Ms. Gigie Verghese,  
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Tmt. K. Girija,  
S.G.Lecturer,  
Department of Physics,  
Government Arts College (Women),  
Salem - 636 008.

Mr. C. James,  
Senior Scale Lecturer in Physics,  
Scott Christian College,  
Nagercoil – 629 003.

Mr. K.S. Joseph Wilson,  
Selection Grade Lecturer,  
Department of Physics,  
Arul Anandar College,  
Karumathur – 625 514.

Dr. G. Kumar Sathian,  
HOD of Physics,  
Madras Christian College,  
Tambaram,  
Chennai – 600 059.

Dr.(Tmt.) M. Kuppayee,  
Reader in Physics,  
Sri Sarada College for Women,  
Fairlands,  
Salem – 636 016.

Dr. V. Manivannan,  
Reader in Physics,  
Presidency College,  
Triplicane,  
Chennai- 600 005.

Dr. Tmt. N. Manju,  
Lecturer (SG),  
Department of Physics,  
Meenakshi College for Women,  
Arcot Road,  
Kodambakkam,  
Chennai – 600 024.

Dr. Mercy Rajasekar,  
HOD of Physics,  
The Women's Christian College,  
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Nungambakkam,  
Chennai – 600 006.

Dr. M.G. Mohammed Kamil,  
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Chennai - 600 014.

Mrs. R. Nivedita Devi,  
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Women,  
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Udumalpet - 642 126.

Dr. K. Perumal,  
HOD of Physics,  
Sri Ramakrishna Mission Vidyalaya  
College of Arts and Science,  
Coimbatore – 641 020.

Tmt. P. Prabha,  
SG Lecturer,  
Department of Physics,  
Kunthavai Nachiyar Government  
Arts College (Women),  
Thanjavur 613 007.

Mrs. P.G. Rajakulamani,  
SG Lecturer in Physics &  
HOD of Physics,  
Sri Meenakshi Government College  
(Women),  
Madurai 625 002.

Dr. A. Ramanand,  
HOD of Physics,  
Loyola College,  
Nungambakkam,  
Chennai – 600 034.

Prof. S. Ramasubramanian,  
HOD of Physics,  
Rajah Serfoji Government College,  
Thanjavur 613 005.

Dr. Mrs. Rani Christu Dhas,  
HOD incharge,  
Department of Physics,  
The Ethiraj College for Women,  
Victoria Crescent Buildings,  
Ethiraj Salai, Chennai – 600 105.

Dr. R. Sambathu,  
HOD of Physics,  
P.S.G. College of Arts and Science,  
Civil Aerodrome (Post),  
Coimbatore – 641 014.

Dr. A. Subbarayan,  
Reader & Head,  
Department of Physics,  
Kongu Nadu Arts and Science College,  
Gnanambigai Mills (Post),  
Coimbatore 641 029.

Dr. A. Subramanyam,  
HOD of Physics,  
Pachaiyappa's College,  
Chennai - 600 030.

Thiru. R.S. Sundararajan,  
Senior Lecturer in Physics,  
Government College (Men),  
Kumbakonam – 612 001.

Dr.(Mrs.) G. Vasanthi,  
Reader in Physics,  
Lady Doak College,  
Madurai – 625 002.

Mr. R. Velusamy,  
Lecturer (SG) in Physics,  
Ayya Nadar Janaki Ammal College,  
Sivakasi – 626 124.

Mrs. R. Vijayalakshmi,  
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## LIST OF PROPOSED CORE SUBJECTS

1. PROPERTIES OF MATTER AND ACOUSTICS
2. MECHANICS
3. THERMODYNAMICS AND STATISTICAL METHODS
4. OPTICS AND SPECTROSCOPY
5. PRACTICAL – I
6. ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM
7. MATHEMATICAL METHODS IN PHYSICS
8. ANALOG ELECTRONICS
9. NUMERICAL METHODS AND COMPUTER PROGRAMMING
10. PRACTICAL – II
11. QUANTUM MECHANICS AND RELATIVITY
12. ATOMIC AND NUCLEAR PHYSICS
13. RADIATION AND REACTOR PHYSICS
14. DIGITAL ELECTRONICS
15. SOLID STATE PHYSICS
16. PRACTICAL – III
17. PRACTICAL – IV
18. COMMUNICATION ELECTRONICS

## **PROPERTIES OF MATTER AND ACOUSTICS**

Linkage:

- ✧ This should be the first subject for Physics graduates. It gives full details about natural properties of material bodies. Experiments based on this will create

Books for Reference:

1. C.J.Smith - General Properties of Matter, Orient & Longman
2. Resnick and Halliday - Physics, Volume - I.
3. Brijlal & Subramanyam - Waves and Oscillations.

Books for teaching in Tamil:

1. சுந்தரவேலுசாமி - பொருட்பண்பியல், மோகன் பதிப்பகம், சென்னை-5.
2. சுந்தரவேலுசாமி - ஒலியியல், பிரியா பப்ளிகேஷன்ஸ், கரூர்
3. மணிவண்ணன் - பொருட்பண்பியலும் ஒலியியலும்.

## MECHANICS

### Linkage:

- ✧ Force is the fundamental concept of all sciences. Mechanics is mainly to do with bodies acted upon by forces. Hence, students of Physics must have a clear knowledge of mechanics so as to enable them to understand the other branches of Physics.

### Objectives:

- ✧ To understand the physical laws and concepts of static and Dynamic bodies.

### Unit I            STATICS

Centre of Gravity: Center of Gravity of a solid hemisphere, hollow hemisphere, tetrahedron and solid cone - Friction: Laws of friction - Coefficient of friction - Static and dynamic friction - Equilibrium of a body on a rough inclined plane - Application of friction: friction clutch. (15 hrs)

### Unit II           PROJECTILE, IMPULSE AND IMPACT

Projectile - Path of a projectile - Range on an inclined plane - Impulse - Impact - Impulsive force - Laws of impact - Impact of a smooth sphere on a horizontal plane - Direct and Oblique impact - Loss of Kinetic energy - Motion of two interacting bodies - Reduced mass. (15 hrs)

### Unit III          DYNAMICS OF RIGID BODIES

Moment of Inertia - Angular Momentum - Torque - Conservation of linear and angular momentum - Kinetic energy of rotating body - Theory of Compound Pendulum - determination of  $g$  and  $k$  - Centre of Mass - Velocity and acceleration of centre of mass - M.I. of a diatomic molecule. (15 hrs)

### Unit IV          HYDROSTATICS AND HYDRODYNAMICS

Centre of Pressure - Centre of Pressure of a rectangular lamina and triangular lamina - Atmosphere Pressure - Variation of atmospheric pressure with altitude height of homogeneous atmosphere - Equation of Continuity - Energy of liquid in motion - Euler's equation - Bernoulli's theorem - Pitot tube - Venturimeter. (12 hrs)

### Unit V           CLASSICAL MECHANICS

Mechanics of a system of particles - Constraints - Generalised co-ordinates - Principle of virtual work - D'Alembert's principle - Lagrange's equation from D'Alembert's principle - Applications: Atwood's machine and simple pendulum.

Hamiltonian function - Hamilton's equation - Physical significance of Hamiltonian function. (18 hrs)

Books for study:

1. Narayanamoorthy - Mechanics Part I and II, National Publishing Company.
2. D.S. Mathur - Mechanics II Edition, S.Chand and Co, – 2001.
3. R. Murugesan - Mechanics and Mathematical Methods, S.Chand and Co, - 2002.

Books for Reference:

1. P.K.Chakrabarthy - Mechanics and General Properties of Matter, Books and Allied (p) Ltd., 2001.
2. D.Halliday, R.Resnick and J.Walker - Fundamentals of Physics, 6th edition, Wiley, Newyork 2001.

## THERMODYNAMICS AND STATISTICAL METHODS

Linkage:

- ✧ A thorough knowledge of thermodynamics and statistical methods would create an awareness regarding the heat engines so far developed, starting from steam engine to diesel engines. It will also stimulate efforts towards research and development further. Besides, it has varied applications in chemistry, mathematics and allied subjects. More especially students can acquire and face confidently towards problems that are complex and endless chances.

Objectives:

- ✧ To understand the concept of heat and temperature, influence of heat and thermodynamical applications on bodies.

### Unit I THERMODYNAMICS - I

Thermodynamic system - Zeroth Law of Thermodynamics - First law of Thermodynamics - Reversible and irreversible process - Second law of thermodynamics - Carnot's Reversible engine - Carnot's theorem - Working and derivation for its efficiency - absolute (or work) scale of temperature - Internal combustion engines - Otto and Diesel engines - Clapyron latent Heat equation - Applications. (15 hrs)

### Unit II THERMODYNAMICS - II

Concept of Entropy - Change in entropy during reversible and irreversible processes - Entropy and II law of thermodynamics - Third law of thermodynamics - Temperature - entropy diagrams - Entropy of a perfect gas - Zero point energy - Negative temperature - Maxwell's Thermodynamical relations - Derivation of relations - Tds equations - Application of Maxwell's relations for a perfect gas, a gas obeying van der waals equation -  $cp-cv=R$ , Clapeyron's latent Heat Equations. (15 hrs)

### Unit III LOW TEMPERATURE PHYSICS

Joule - Thomson Effect - Porous Plug experiment - Liquefaction of Hydrogen - Solidification of Hydrogen - Liquefaction of Helium - Kammerling Onne's Method - Helium I and Helium II - Production of Low temperatures - Adiabatic demagnetization - Its theory - Conversion of magnetic temperature of Kelvin temperature - Helium Vapour pressure thermometer - Super conductivity - Refrigerator. (12 hrs)

### Unit IV KINETIC THEORY OF GASES AND GENERAL PRINCIPLES OF STATISTICAL METHODS

Degrees of freedom - Maxwell's Law of equipartition of energy - Maxwell's law of distribution of velocity - Theory and experimental verification - Mean free path - Transport Phenomena - Viscosity of gases ( $\eta$ ) - Thermal conductivity of gases ( $K$ ) - Relation between  $K$  and  $\eta$ . (15 hrs)

Phase Space - Ensembles - Micro states and Macro states - Definition of probability, Relation between entropy and probability. [Qualitative Analysis only].

## Unit V STATISTICAL THERMODYNAMICS

Maxwell - Boltzmann distribution law - Maxwell - Boltzmann distribution law in terms of temperature - M.B. distribution and ideal gas - Quantum statistics - Fermi - Dirac distribution law - Electron gas - Bose - Einstein distribution law - Photon Gas - Comparison of three statistics. (18 hrs)

### Books for Study:

1. Brijlal and Subramanyam - Heat and Thermodynamics, S.Chand & Co, New Delhi – 2002.
2. R.Murugesan and Kiruthiga Sivaprasath - Thermal Physics, S.Chand & Co, New Delhi – 2002.
3. Satya Prakash and J.P.Agrawal - Statistical Mechanics, Kedar Nath Ram Nath & Co, Meerut – 2001.

### Books for Reference:

1. D.S.Mathur - Heat and Thermodynamics, Sultan Chand & Sons, New Delhi.
2. J.B.Rajam - Heat and Thermodynamics, S.Chand & Co, New Delhi.
3. Gupta and Kumar - Elements of Statistical Mechanics, Pragati Prakashan Publishers, Meerut.

## OPTICS AND SPECTROSCOPY

Linkage:

- ✧ An optical instrument is an essential component of any scientific investigation. Spectroscopy is the eye of a scientist through which he looks into the microscopic world. A basic knowledge of the principles which govern optics is essential for any science graduate.

Objectives:

- ✧ To understand the optical behaviour and wave nature of light. To study the spectroscopic analysis of light.

### Unit I GEOMETRICAL OPTICS

Spherical aberration in lenses - Reducing Spherical aberration - Coma - Aplanatic lens - Oil immersion objective - Astigmatism - Curvature - Distortion - Dispersion - Angular and Chromatic dispersion - Combination of prisms to produce (i) dispersion without deviation and (ii) deviation without dispersion - Achromatism in lenses - Achromatic combination of lenses (i) in contact and (ii) Separated by a distance.

Eye Pieces - Ramsden's and Huygen's eye pieces. (15 hrs)

### Unit II INTERFERENCE OF LIGHT

Fresnel's Biprism - Colour of thin films - Interference in thin films due to reflected and transmitted light - Fringes due to wedge shaped films - Newton's rings - Refractive index of a liquid.

Michelson's Interferometer and its applications. (15 hrs)

### Unit III DIFFRACTION OF LIGHT

Fresnel's diffraction - Diffraction at a straight edge - Rectilinear propagation of light - Zone plate - Construction and action - Comparison with convex lens - Fraunhofer diffraction - Diffraction at a single slit, double slit, N slits - Diffraction grating - Dispersive power of a grating - Resolving power of a grating. (15 hrs)

### Unit IV POLARISATION OF LIGHT

Double Refraction - Huygen's explanation in uniaxial crystals - Production and detection of plane, Circularly and elliptically polarized light - Optical activity - Fresnel's explanation - Laurent's half shade polarimeter. (15 hrs)

### Unit V SPECTROSCOPY

X-ray spectra - continuous and Characteristic Spectra - Mosley's law - Applications - Molecular spectra - Spectra of diatomic molecules - Pure rotational spectra - Vibration - Rotation spectra - Selection rules - Raman effect - Experimental study - Raman effect in solids and gases - Explanation of Raman effect - Application of Raman effect in molecular spectra. (15 hrs)

Books for Study:

1. Brijlal and Subramanian - Text book of Optics, S.Chand & Co, - 2002.
2. R.Murugesan - Modern Physics (Unit V), S.Chand & Co, - 2002.
3. S.L. Kakani & Bhandari – Optics – Sultan Chand & Sons – 2002.

Books for Reference:

1. Narayanamoorthy and others – NPC – (Old) – Optics.
2. Jenkins & White – Optics.
3. V. Gosagan – Optics.

## PRACTICAL – I (Pr-I)

(Any Sixteen – Giving equal weightage to all subjects)

1. Uniform bending – Pin and microscope
2. Uniform bending – Optic lever
3. Non-Uniform bending – Pin and microscope
4. Non-Uniform bending – Optic lever
5.  $q$ ,  $n$ ,  $\sigma$  - Searle's method
6. Torsion pendulum – determination of 'n' and M.I.
7. Compound pendulum
8. Oscillation of a cantilever
9. Comparison of Viscosities
10. Sonometer – frequency of tuning fork and verification of the laws of transverse vibrations of strings.
11. Melde's string – two modes.
12. Thermal conductivity – Lee's method
13. Thermal conductivity – Forbe's method
14. Thermal conductivity of rubber
15. Static torsion method – Rigidity modules
16. Surface tension – Capillary rise
17. Viscosity – Searle's method
18. Sonometer – relative density of a solid and liquid
19. Refractive index – Solid and hollow prism – spectrometer
20. Dispersive power of a prism – Spectrometer
21. Diameter of a wire and thickness of Insulation – Air wedge method.
22. Refractive Index – Newton's ring.
23. Spectrometer – i-d curve.
24. Spectrometer – grating – Normal incidence.
25. Spectrometer – grating – minimum deviation.
26. Hartmann's – Interpolation formula.

## **ELECTRICITY, MAGNETISM AND ELECTROMAGNETISM**

### Linkages:

- ✧ The domain of electricity and magnetism extends over the whole of nature.
- ✧ The concepts taught through the course can be applied to several fields of relevance e.g. Optics, material science, biophysics, atomic physics, nuclear physics etc.
- ✧ Theoretical and practical skills developed can be extended to industrial applications.

### Objectives:

- ✧ To study the electrical behaviour of charges and magnetic effects of current.

### Unit I           ELESTROSTATICS

Electrostatic Field - Coulomb's Law - Divergence and Curl of Electrostatic field - Gauss law and Applications - Electrostatic potential - Poisson's and Laplace's Equations - Equipotential lines and surfaces conductors - Basic principles - Electric fields at the surface of the conductor - Screening of electric field by a conductor.

(12 hrs)

### Unit II           CHEMICAL EFFECTS OF ELECTRIC CURRENT AND THERMO ELECTRICITY

Electrical conductivity of an electrolyte - Faraday's laws of electrolysis - Determination of specific conductivity of electrolyte (Kohlrausch bridge) - Gibbs Helmholtz equation for the emf of a reversible cell - Seebeck, peltier and Thomson effect - Laws of thermoelectric circuits - Measurement of Thomson and Peltier coefficient - Thermoelectric diagram - Applications of thermoelectric effect. (15 hrs)

### Unit III          MAGNETIC EFFECTS OF CURRENT

Biot and Savart's law - Magnetic field intensity due to a solenoid carrying current - Effect of iron core in a solenoid - Holmholtz Galvanometer - Theory of moving coil Ballistic Galvanometer - Damping correction - Uses of BG.

Magnetic induction - Magnetisation - Relation between B,H and M - Magnetic Susceptibility - BH Curve - energy loss due to hysteresis - Importance of hysteresive curve - Magnetic circuit - Magnetic circuit of an electromagnet - Magnetic shielding.

(15 hrs)

### Unit IV          A.C, D.C. CIRCUITS AND THEIR ANALYSIS

Kirchoff's current and Voltage laws, superposition theorem, Theveniu's and Norton's theorem - Wheatstone's network - Carey Foster's bridge - Charging of a Capacitor through L and R - Discharging of a capacitor through L and R LCR – Series and parallel resonance circuits - Condition for discharge to be Oscillatory - Q factor - Waltless current - Skin effect - Choke Coil - Distribution of 3 phase a.c. - Star and delta connection.

## Unit V        MAXWELLS EQUATION AND ELECTROMAGNETIC WAVES

Maxwells Equation - Maxwell Equation and Magnetic charge, Maxwell Equation inside matter, boundary conditions.

Electromagnetic waves - Wave equation in one dimension - sinusoidal (linear combination and sinusoidal waves). (18 hrs)

### Books for study

1. D. Chattopadhyay and P.C. Rakshit – Electricity and Magnetism – New Central Book Agency (P) Ltd. – 6<sup>th</sup> Edition – 2005.
2. R. Murugesan, - Electricity and Magnetism, 8th Edn, S.Chand & Co, New Delhi – 2006.
3. Brijlal and Subramanian, Electricity and Magnetism, 6th Edn., Ratan & Prakash, Agra.
4. K.K. Tewary – Electricity and Magnetism – S.Chand & Co, Revised Edition – 2007.

### Books for Reference:

1. Sengal D.L., Chopra K.L, Sengal N.K – Electricity and Magnetism – Sultan Chand & Sons, New Delhi – 2007.
2. N. Narayanamurthy & N. Nagarathinam – NPC – Chennai.
3. David J. Griffiths, - Introduction to Electrodynamics, 2nd Edition, Prentice Hall of India Pvt. Ltd, New Delhi – 1997.

## MATHEMATICAL METHODS IN PHYSICS

### Linkage:

- ✧ Vector Analysis is needed for the understanding and developing of Electromagnetic theory.
- ✧ Matrix Analysis needed for the understanding the Quantum Mechanics. Eigen values and Eigen vectors concepts are widely applied in various branches of Physics like quantum mechanics and solid state physics.
- ✧ Functions of Complex variables occur frequently in all branches of physics.
- ✧ Group theory is made use of in Spectroscopy, Quantum mechanics, Solid state physics and Nuclear physics.
- ✧ Fourier techniques are essential for the Analysis of all Linear systems in Physics.

### Objectives: To enable the students

- ✧ To learn the various Mathematical techniques
- ✧ To apply these techniques to physical problems
- ✧ To appreciate the close connection of mathematics with physics and
- ✧ To prepare themselves for pursuing higher study in physics.

### Unit I VECTOR ANALYSIS

Introduction - The Cartesian System of base vectors - The Derivative of a vector - The concept of a gradient - Integration of vector functions - Gauss Divergence theorem - The Stoke's theorem - Some useful relations involving vectors. (15 hrs)

### Unit II MATRIX ANALYSIS

Notation - Matrix Operations - Properties of arbitrary matrices - Special square matrices - Solution of a system of linear equations - The eigen problem. (12 hrs)

### Unit III FUNCTIONS OF COMPLEX VARIABLES

Complex variables and representations - Algebraic operations - Euler's formula - De' Moivre's theorem - Analytic functions - Derivatives of  $f(z)$  and analyticity - Harmonic functions - Contour integrals - Cauchy's integral theorem - Cauchy's integral formula. (18 hrs)

### Unit IV GROUP THEORY

Group Postulates - The multiplication table conjugate elements and classes - Subgroup - Direct product of groups - Isomorphism and Homomorphism - Permutation groups - Distinct group of a given order. (15 hrs)

### Unit V FOURIER SERIES AND TRANSFORMS

Fourier theorem - The Fourier cosine and Sine series - Change of interval - Fourier integral - Complex fourier transform - Cosine and Sine transform - The transform of derivatives.

### Books for Study:

1. Charlie Harper - Introduction to Mathematical Physics, Prentice - Hall of India Private Limited (1987) New Delhi.

2. Suresh Chandra – A Text Book of Mathematical Physics – Second Edition – Narosha Publishing House Pvt. Ltd, Chennai - 2006.
3. Joshi A.W. Elements of Group theory for Physicists, New Age international Publishers, Fourth Edition (1997), New Delhi. Unit IV - Chapter I.
4. Mathematics for B.Sc., - S.Chand & Co, - 2005.

Books for Reference:

1. Spiegel M.R. - Theory and Problem of Advanced Calculus, Schaum's outline series, McGraw-Hill Book Co (1974) London.
2. Joshi, A.W. - Matrices and Tensors in Physics - Wiley Eastern Ltd. (1995) New Delhi.
3. Spiegel, M.R. - Theory and Problems of Complex Variables - Schaum Outline Series, McGraw - Hill Book Co.(1981) London.
4. Cotton F.A. Chemical Applications of Group theory, John Wiley & Sons (1963), New Delhi.

## ANALOG ELECTRONICS

Linkage:

- ✧ The knowledge of semiconductors and its theory are very essential for understanding electronic circuits.

Objectives:

- ✧ To enable the students to learn the basic principles of semi conductors and its applications.

### Unit I SEMICONDUCTOR DIODES AND HYBRID PARAMETERS

Semiconductor diode - Crystal diode - Rectifiers - Half and full - Wave rectifiers - Bridge rectifier - Efficiency - Ripple factor - Filter circuits - Zener diode - Crystal diode versus vacuum diode - Hybrid parameters - Determination of  $h$  parameters - Transistor circuit performance in  $h$  parameters - Experimental determination of  $h$  parameters - Limitations of  $h$  parameters. (15 hrs)

### Unit II TRANSISTORS AND TRANSISTOR BIASING

Transistor action - CB, CE & CC modes - Comparison - Amplifier in CE arrangement - Load line analysis - Cut-off and saturation - Power rating - Application of CB amplifier - Faithful amplification - Transistor biasing - Various methods of transistor biasing: base resistor, feedback resistor, voltage divider methods - Instantaneous current and voltage wave forms. (15 hrs)

### Unit III AMPLIFIERS SINGLE STAGE MULTISTAGE

Single stage amplifier - Graphical demonstration - Practical circuit - Phase reversal - DC & AC equivalent circuits - Load line analysis - Voltage gain - Classification of amplifiers - Input impedance of an amplifier - Multistage transistor amplifier - RC, transformer, direct coupled amplifiers - Comparison of different types of amplifiers - Difference between transistor and tube amplifier. (15 hrs)

### Unit IV AUDIO AMPLIFIERS

Transistor audio power amplifier - Difference between voltage and power amplifiers - Performance quantities of power amplifiers - Classification of power amplifiers - Expression for collector efficiency - Class A amplifier - Push-Pull amplifier - Heat sink - Symmetry amplifier - Feedback principle - Negative feedback - Current gain with negative feedback - Emitter follower - DC analysis - Voltage gain - Input & Output impedance - Applications - Darlington amplifier - OP AMP: IC OP AMP biasing - Voltage follower - Non-inverting & Inverting amplifiers - Summing circuits - Instrumentation amplifier - Voltage level detector - Schmidt trigger circuits. (15 hrs)

### Unit V SINUSOIDAL OSCILLATORS, REGULATED POWER SUPPLY AND OP AMPS

Types of oscillations - Undamped oscillations - Colpitt's Hartley, Phase-shift, Wien bridge & crystal oscillators - Transistor crystal oscillator - Power supply: DC power supply - Regulated power supply - Voltage regulator - Various types of voltage regulators - Zener diode regulator - Transistor series voltage regulators - Transistor

shunt voltage regulator - Glow-tube voltage regulator - OP AMP signal generators:  
Phase-shift, Colpitts', Hartley, Wein Bridge, Square wave and triangular wave -  
Frequency stabilizers. (15 hrs)

Books for Study:

1. V.K.Mehta, Principles of Electronics, S.Chand & Co Ltd., 2004.  
(ISBN:81-219-1723-9)
2. D.A.BELL, Electronic Devices and Circuits (4th Ed.), Prentice-Hall of India,  
1999 (ISBN: 81-203-2358-0).
3. Salivaganan - Text Book of "Applied Electronics" – 2004.

Books for Reference:

1. B.L. Theraja – Basic Electronics – S. Chand & Co, - 2003.
2. Malvino & Leach – Transistor Approximations – International Publication –  
2000.
3. A. Gayakwad – OP-Amps and Linear Integrated Circuits – 4th Edition –  
Prentice Hall of India Pvt. Ltd. – New Delhi – 2001.
4. BOGART – UBS – Electronic Devices and Circuits – 2005.

## NUMERICAL METHODS AND COMPUTER PROGRAMMING

Linkage:

- ✧ This paper aims at imparting mathematical knowledge and computer programming skill to the learners of physics.

Objectives:

- ✧ To develop a knowledge of Computer Programming.

Unit I

Solution of Numerical, algebraic transcendental and differential equations - Bisection method - Method of successive approximation - Regula Falsi method - Newton-Raphson method - Euler's method - Hunge Kutta method (II & IV order) - Numerical Integration - Trapezoidal rule - Simpson's rule 1/3 and 3/8 rule - Practical applications. (15 hrs)

Unit II

First differences - Difference table - Blackboard properties of the operator - Linear interpolation - Newton's forward interpolation formula - Interpolation with unequal intervals - Langrange's interpolation formula (No derivation) Hermite's - Bessel's interpolating polynomials. (15 hrs)

Unit III

Structure of C, fundamentals of C - Character set - Identifiers and Keywords - Datatypes - Constants - Variables - Declarations - Expressions - Arithmetic, Relational, Logical, assignment, Increment and decrement - Conditional, bitwise, Special operators - Arithmetic operators - Precedence of Arithmetic operators. (15 hrs)

Unit IV

Preliminaries: Data input and output - Functions - Control statements - While, do..while, for nested loops - if...else, switch, break, continue and goto statements.

Programme:

1. Area/Volume of circle, square, rectangle sphere and hemisphere.
2. Conversion of centigrade of Fahrenheit and vice-versa.
3. Addition, Subtraction, multiplication of the given numbers.
4. Finding the largest and smallest of three integer quantities.
5. Solving quadratic equations. (15 hrs)

Unit V FUNCTIONS

Functions - Forms of C functions - Return Values and their types - Calling a function - Category of functions Handling of non-integer functions - Nesting of functions - Recursion.

Programming:

1. Finding the factorial of the given number.
2. Upper case to lower/lower to upper case conversion.
3. Arranging a series of numbers into ascending / descending order.

4. Numerical integration by Trapezoidal/ simpson's rule.
5. Determination of the roots of an algebraic equation by Newton-Raphson method. (15 hrs)

Books for Study:

1. Sastry S.S. - Introductory methods of Numerical Methods, Prentice Hall Ltd.
2. Venkat Raman M.K., Numerical Methods in Science and Engineering, National Publishing Company; Chennai.
3. Singaravelu A, - Numerical Methods - Meenakshi Agency, Chennai.
4. E.Balagurusamy - Programming in C, Tata Mcgraw Hill
5. Venugopal K.R. and Sudeep R.P. - Programming with C, Tata McGraw Hill.
6. P. Kandasamy & Others – Numerical Methods – S.Chand & Co, - 2007.

Books for Reference:

1. Byron S. Gottfried - Programming with C, Schaum outline series.
2. E.Balaguruswamy - Programming in ANCI C, Tata McGraw Hill.

## PRACTICAL – II

(Any 10 in non-computer and 6 in computer experiments)

1. Thermo-emf – Potentiometer
2. Comparison of low resistances – Potentiometer
3. Sonometer – AC frequency
4. Field along the axis of a coil – Deflection magnetometer
5. Tan – C position – Deflection magnetometer
6. Calibration of high range – voltmeter
7. Calibration of ammeter
8. Carry-Foster Bridge – Temperature Coefficient.
9. Impedance and power factor – LR Circuit
10. LCR – Series resonance circuit
11. LCR – Parallel resonance circuit.
12. Figure of merit – Voltage, current and charge sensitiveness – Spot galvanometer/ B.G.
13. E.C.E of copper – Copper voltameter
14. Probable error – C programming
15. Matrix addition, multiplication – C programming
16. Arranging numbers in ascending and descending order – C programming
17. Roots of a polynomial – C programming
18. Conversion of Celsius to Fahrenheit / Fahrenheit to Celsius – C programming
19. Biggest/ smallest number of an array – C programming
20. Factorial of a number – C programming
21. Generating Fibonacci series – C programming
22. Evaluation of series – C programming
23. Newton – Raphson method – C programming
24. Simpson's/ Trapezoidal method – C programming
25. Runge-Kutta method – C programming

## QUANTUM MECHANICS AND RELATIVITY

Linkage:

- ✧ To understand the quantum concepts of particles and its behaviour.

Objectives:

- ✧ To understand the nature of particles from macro to micro states. Also to know about the relationship between space and time; mass and energy.

### Unit I ORIGIN OF WAVE MECHANICS

Failure of Classical Mechanics - Dual nature of matter - De-Broglie's theory - Davisson and Germer Experiment - G.P. Thomson's experiment - Uncertainty principle - Illustration of Heisenberg's uncertainty principle - Heisenberg's Electron microscope - Advantages over ordinary optical Microscope - Applications. (16 hrs)

### Unit II FORMALISM OF WAVE MECHANICS

Postulates of Quantum Mechanics - Equation of Motion of Matter waves (i) Time - Independent Schrodinger equation - (ii) Schrodinger equation for a free particle - (iii) Time dependent Schrodinger's wave equation - Physical interpretation of the wave function - Normalised and Orthogonal wave functions - Solution of the Schrodinger's equation - Expectation values of dynamical quantities - Probability current density - Particle flux, Ehrenfest's theorem - Eigen value and Eigen function. (20 hrs)

### Unit III APPLICATIONS OF SCHROEDINGER'S EQUATIONS

Solution of Schrodinger's equation for a particle in a box - Linear harmonic oscillator - One dimensional square well potential - Step potential - Rigid rotator.

### OPERATORS

Operator formalism in quantum mechanics - Dynamical variables as operators - Hamiltonian operator - Commutation relation between position and momentum - Commutation rules for the components of orbital angular momentum - Ladder operators. (20 hrs)

### Unit IV TIME INDEPENDENT PERTURBATION THEORY

First order Time independent perturbation theory - The perturbed Harmonic Oscillator - Zeeman effect (without electron spin) - First order Stark Effect in Hydrogen Atom - Helium Atom. (16 hrs)

### Unit V RELATIVITY

Michelson - Morley Experiment - Galilean transformation and Newtonian Relativity - Inadequacy of Galilean Transformation - Fundamental Postulates of Special theory of Relativity - Lorentz transformation equation - Length contraction and Time dilation - Experimental evidences - Law of addition of Velocities - Variation of Mass with velocity - Equivalence of Mass and Energy. (18 hrs)

#### Books for Study

1. Murugesan R. - Modern Physics, S.Chand & Co, 1995, 5th Edition.
2. Sathya Prakash and C.K.Singh - Quantum Mechanics.
3. Agarwal and K.K.Chopra – Quantum Mechanics – Krishna Prakasham Media (p) Ltd – 1999.

#### Books for Reference

1. G.Arul dass - Quantum Mechanics, Prentice Hall of India, Pvt. 2004, 3rd Printing.
2. Y.R.Waghmare - Introductory Quantum Mechanics, S.Chand & Co.
3. V. Devanathan – Quantum Mechanics – Narosha Publishing House – 2004.
4. Mathews and Venkatesan – Quantum Mechanics.

## ATOMIC AND NUCLEAR PHYSICS

Linkage:

- ✧ The study of this paper will lead to the knowledge of atomic and nuclear forces and sub atomic particles.

Objectives:

- ✧ To understand the atomic and nuclear structures.

### Unit I ATOMIC STRUCTURE AND PHOTO ELECTRIC EFFECT

Vector atom model - Pauli's exclusion principle - explanation of periodic table - Various quantum numbers - Angular momentum and magnetic moment. Coupling schemes - LS and JJ coupling - Special quantisation - Bohr magnetron - Stern and Gerlach experiments.

Laws of photo electric emission - Einstein photo electric equation - Experiment and verification of photo electric equation - Photo electric cells - Photo emissive cells - Photo voltaic cell - Photo conductive cell - Photo multiplier. (18 hrs)

### Unit II IONISATION POTENTIAL AND SPLITTING OF ENERGY LEVEL

Excitation and Ionization potential - Davis and Goucher's method - Spectral terms and notations - Selection rules - Intensity rule and interval rule - Fine structure of sodium D lines - alkali spectra - Fine structure of alkali spectra - Spectrum of Helium, Zeeman effect - Larmor's theorem - Debyes explanation of normal Zeeman effect; Anamalous, Zeeman effect - Theoretical explanation - Lande's 'g' factor and explanation of splitting of D1 and D2 lines of sodium, Pascheu-Back effect - Stark effect. (18 hrs)

### Unit III RADIO ACTIVITY AND PARTICLE ACCELERATORS

Natural radio activity - Law of disintegration - half-life and mean life period - Units of radio activity - Transient and secular equilibrium - Radio carbon dating - Age of earth - Alpha rays - Characteristics - Geiger-Nuttal law -  $\alpha$  ray spectra - Garnow's theory of  $\alpha$  decay (qualitative study) - Beta rays - Characteristics - Beta ray spectra - Neutrino hypothesis - Violation of parity conservation - Experimental verification with  $CO^{60}$  gamma rays and internal conversion - Nuclear isomerism - G.M. Counter - Scintillation counter - Photo multiplier tube - Linear accelerator - Cyclotron - synchrocyclotron. (20 hrs)

### Unit IV NUCLEAR REACTIONS

Conservation laws - Nuclear reaction - Kine matrices - Q value - Threshold energy - Nuclear reaction - Cross section - Artificial radio activity - Radio isotopes and its uses - Classification of neutrons - Nuclear fission - Chain reaction - Four factor formula - Critical mass and size nuclear reactor - Breeder reactor - Transuranic elements - Nuclear fusion - Thermo nuclear reactions - Sources of Stellar energy. (18 hrs)

## Unit V ELEMENTRAY PARTICLES

Classification of elementary particles - Fundamental interaction - Elementary particle quantum numbers - Isospin and strangeness - Conservation laws and symmetry - Basic ideas about quark - Quark model. (16 hrs)

### Books for Study:

1. Tayal, D.C.2000 - Nuclear Physics, Edition, Himalaya Publishing House, Mumbai - 400 004.
2. R. Murugesan (2002) - Modern Physics, Tenth edition S.Chand and Co. New Delhi - 110 005.
3. Irving Kaplan (1962) Nuclear Physics, Second Edition, Oxford & IBH Publish & Co, New Delhi - 110 001.
4. H.S.Mani, G.K. Mehta, Introduction to Modern Physics Affiliated East-West Pvt. Ltd., New Delhi 1990.
5. Sehgal and Chopra - Modern Physics, Sultan Chand Publication.
6. J.B. Rajam - Atomic Physics
7. N. Subramaniam and Brijlal - Atomic Nuclear Physics, S.Chand & Co, 5th Edition, 2000.

### Books for Reference:

1. A.B. Gupta and Dipak Ghosh - Atomic Physics, Books and Allied Publishers.
2. Roy and Nigam, - Nuclear Physics (1967) First edition, Wiley Eastern, Limited, New Delhi - 110 001.

## **RADIATION AND REACTOR PHYSICS**

Linkage:

- ✧ To enable the student to gain practical knowledge and application ideas leading to research. It will also provide one with the job opportunity as Radiologists and Reactor Designer.

Objectives:

- ✧ To know about the radiation and its applications.

### **RADIATION PHYSICS**

#### Unit I

Biological effects of radiation - Structure of the cell - Radiation effects on cells - Biological effects - Lethal dose - Radiation sickness - Stochastic and non stochastic effect. Radiation units and operational limits - Activity - Exposure - Dose - Dose Equivalent - Dose rate - Operational limits - Dose equivalent limit.

Interaction of charged particles with matter - Heavy charged particles - Electrons - Absorption of gamma rays by matter - Photoelectric effect - Compton scattering and pair production - Detectors of radiation - Solid state counter - G.M. counter - Nuclear emulsion plates - Scintillation counter. (18 hrs)

#### Unit II

Industrial and Analytical applications - Tracing, Gauging, Material modification, Sterilization - Food preservation and other applications. Radiation protection and safety - Area monitoring - Gun monitoring - Mini Rad Survey meter - Radiation survey meter - Personal monitoring - Film badge dosimeter - Pocket dosimeter - Control of radiation hazards - Distance and time shielding - Shielding thickness calculations. (15 hrs)

#### Unit III

Diagnostic imaging and application to Radiation therapy - Radio isotopes used for Brach therapy - Digital Radiography - Digital X-ray detectors, digital subtraction angiography - Computed tomography - Nuclear medicine - Properties of radioactive pharmaceuticals - Nuclear medicine imaging - Positron emission Tomography. (12 hrs)

### **REACTOR PHYSICS**

#### Unit IV

Criticality of an infinite homogenous reactor - Buckling - Criticality of rectangular parallelepiped, Sphere and infinite cylinder - Infinite reactor with no delayed neutrons - The reactivity equation - The prompt critical condition - Changes in reactivity - Temperature coefficients - Fission poisoning. (15 hrs)

#### Unit V

Control Rod - Fuel management - Natural reactors - Thermal reactors - Intermediate reactors - Fast reactors - Breeding - The Thorium converter - Light water

reactors - Heavy water reactors - Heat generation and removal - Radiation shielding - and reactor safeguards - Evolution of reactors - Indian reactors. (15 hrs)

Books for Study:

1. Baldev Raj and B.Venkataraman, (2004), Practical Radiography - Narosa Publishing House.
2. William R. Herndee, Geoffrey S. Ibbott and Eric G. Hendee, Radiation Therapy Physics, 3rd Edition, John Wiley & sons. INC., Publication.
3. John R. Lamarsh, (1992), Introduction to nuclear Reactor Theory, 2nd edition, Addison Wesley Publishing Co.
4. Paul F.Zweifel, (1973), Reactor Physics, McGraw Hill Book Company, India.

Books for Reference:

1. R.S.Khandpur, (2003) Hand book of Biomedical Instrumentation, 2nd Edition, Tata McGraw - Hill Publishing Co.
2. Meridith, (1992), Radiation Physics, 3rd Edition, Varghese Publishing House, New Delhi.
3. Richard Stephenson, (1974), Introduction to Nuclear Engineering, McGraw Hill Book Company, New York.
4. Suresh Gard, Feroz Ahmed and L.S.Kothari, McGraw Hill Book Company, London.

# DIGITAL ELECTRONICS

Linkage:

- ✧ The concept of digital principles are applied to microprocessor and computers.

Objectives:

- ✧ To develop the knowledge in combinational logic and sequential logic and their applications.

## Unit I DIGITAL FUNDAMENTALS

Codes and Number Systems - Decimal, Binary, Octal and Hexadecimal number systems - Inter conversions - 8421 BCD code - Other 4 bit BCD codes - Excess 3 code - Gray code - Binary to Gray & Gray to Binary conversions - ASCII code.

Basic LOGIC Gates - AND, OR, NOT, NAND, EX-OR, EX-NOR functions - their Truth tables. De Morgan's theorem - Associative law, Commutative law - Distributive law - NAND & NOR as Universal gates. (15 hrs)

## Unit II COMBINATIONAL LOGIC

Binary Arithmetic Circuits - Half Adder - Full Adder - Parallel Binary Adder - 8421 BCD Adder - Half Subtractor - Parallel Binary Subtractor.

Boolean Algebra - Boolean theorems - Simplification of Boolean functions - Algebraic simplification - Sum of Products & Product of Sums - AND-OR logic = NAND-NAND net work - OR - AND logic = NOR-NOR network - Karnaugh mapping of Two, Three, Four variables - K map simplifications - Don't care conditions - SOP & POS simplifications. (15 hrs)

## Unit III SEQUENTIAL LOGIC

FLIP-FLOP - R-S Flip-Flop - Clocked R-S Flip-Flop-D Flip-Flop J-K Flip-Flop - Triggering of Flip-Flop - Master Slave Flip-Flop.

REGISTERS & COUNTERS - Registers - Shift Registers - Shift Right, Shift Left Registers - Counters - Ring counter - Johnson's ring counter - asynchronous (Ripple) Counter - Different moduli Counters - up counter - down counter - Synchronous Counter - Different moduli Counters - Timing Sequence. (15 hrs)

## Unit IV D/A and A/D CONVERTERS

Introduction - Variable resistor network - Binary ladder - D/A Converter - D/A accuracy and resolution - A/D converter - Simultaneous conversion - Counter method - Successive approximation - Dual slope A/D converters - A/D accuracy and resolution. (15 hrs)

## Unit V MEMORY CIRCUITS AND SYSTEMS

Programming bipolar PROMS - AIM Technique - Floating gate (FAMOS) - MOS static RAM cell - MOS dynamic RAM cell - Refreshing circuits - Charged Coupled devices - Basic CCD operations - Two phase CCD - Magnetic bubble

memory - Auxiliary memory storage - Magnetic disk, floppy disk and Winchester hard disk - CD - Laser R/W systems - Flash Memory (memory stick). (15 hrs)

Books for Study:

1. Millman and Halkias, (1972), Integrated Electronics, International Ed., McGraw Book Co., New Delhi.
2. Malvino and Leach, (2000), Digital Principles and Application, 4th Ed., Tata McGraw Hill, New Delhi.
3. Anokh Singh and A.K. Chhabra, Fundamentals (2005), Fundamentals of Digital Electronics and Microprocessors, 2nd Revised and Enlarged Ed., S.Chand and Co Ltd, New Delhi.
4. A. Subramanyam – Applied Electronics - NPC – 2005,

Books for Reference:

1. Virendra Kumar – Digital Technology Principle and Practice – New Age International Pvt. Ltd. – 2005.
2. FLOYD – UBS – 2005 – Digital Fundamentals.
3. Samuel.C.Lee – Digital Circuits and Logic Design – Prentice Hall of India pvt. Ltd – 2005.

## SOLID STATE PHYSICS

### Linkages:

- ✧ This paper leads to the study of subjects such as materials science, nano science, etc.

### Objectives:

- ✧ To learn about the structure and properties of solids and their relationship.

### Unit I CRYSTAL STRUCTURE

Crystalline solids - Lattice - Types - Crystal systems - Lattice parameters - Crystal planes - Miller Indices - Simple cubic structures, hcp - X-ray diffraction - Defects in solids. (15 hrs)

### Unit II CRYSTAL BINDING

Inter-atomic forces - Cohesive energy - Ionic bonding - Modelling energy - Covalent bonding - Metallic bonding - Molecular solids. (15 hrs)

### Unit III THERMAL PROPERTIES

Lattice vibrations - 1-d monatomic chain - Acoustic and optic modes - diatomic chain - Density of states - Specific heat of solids - Limitations of Einsteins' theory and Debye's theory - Thermal expansion - Thermal conductivity. (15 hrs)

### Unit IV ELECTRICAL PROPERTIES

Free electron theory of metals - Drude - Lorenz model - Wiedemann - Franz law - Nearly-Free electron theory - Band formation - Classification as insulators, Semi-conducting, metals - Fermi surface - de Hall - Van Alphen effect - Hall effect. (15 hrs)

### Unit V MAGNETIC PROPERTIES

Introduction - Magnetic quantities - Diamagnetism - Classical theory - Paramagnetism - Langerim Theory - Wein theory - Curie Models - Ferromagnetism - Molecular field theory - Domain's Hystereism. (15 hrs)

### Books for Study:

1. Murugesan – Modern Physics – S.Chand & Co, - 2005.
2. P.K. Palanisamy – Solid State Physics.
3. Kakani, S.L. & Hem Rajani. C. – A Text Book of Solid State Physics – Sultan & Sons – 2006.

### Books for Reference:

1. M.A. Wahab – Solid State Physics – 2nd edition – 2005 – Narosa Publishing House Pvt. Ltd., Chennai.

## PRACTICAL – III

(Any Sixteen – Experiments)

1. Determination of L – Anderson's Bridge
2. Determination of L – Maxwell's Bridge
3. Boltzmann's constant – transistor
4. Band gap of a semiconductor using diode
5. Hysteresis – B.H.curve
6. i-i' curve – Stoke's formula
7. Cauchy's constants – Prism and grating
8. Small angle prism - Spectrometer
9. Biprism - Spectrometer
10. Biprism – optic bench
11. Young's modulus – Cornu method
12. Dielectric constant – LCR bridge
13. Comparison of low and high resistances using spot galvanometer/ BG
14. G.M. counter characterization
15. Internal resistance of a cell – Potentiometer
16. Comparison of mutual inductance – spot galvanometer/ B.G.
17. Absolute determination of mutual inductance – spot galvanometer/ B.G.
18. Comparison of capacitance – spot galvanometer/ B.G.
19. Absolute determination of capacitance – spot galvanometer/ B.G.
20. High resistance leakage – spot galvanometer/ B.G.
21. Conversion of galvanometer to voltmeter/ ammeter.
22. Determination of L – Releigh's bridge.

## PRACTICAL – IV

(Any Sixteen – Experiments)

1. CE transistor characteristics
2. Zener diode – characteristics – voltage regulator
3. Bridge rectifier
4. Dual power supply (IC)
5. Single stage amplifier and double stage amplifier
6. Hartley oscillator – Transistor/ Op. amp
7. Colpitt's oscillator – Transistor/ Op. amp
8. Phase shift oscillator – Transistor/ Op. amp
9. Astable multivibrator using transistor
10. Logic gates using discrete components
11. Verification of De Morgan's theorem
12. Adder, subtractor, differentiator and integrator using Op. amp.
13. JK flip flop
14. 4 bit binary counter
15. FET characteristics
16. A stable Multivibrator using 555 Timer
17. Wien bridge oscillator/ Op. Amp.
18. UJT characteristics
19. Adder and subtractor – Op. amp
20. Inverting amplifier – Op. amp
21. Non-inverting amplifier – Op. amp
22. Regulated power supply using IC
23. Four bit up/down counter
24. Mono stable multi vibrator using 741 for frequency divider (by 2/ by 3)
25. NAND and NOR using universal IC
26. UJT relaxation oscillator

## COMMUNICATION ELECTRONICS

Linkage:

- ✧ This paper provides one area of the major applications of electronics in day-to-day life as well as advancement of technology.

Objective:

- ✧ To develop a knowledge in learning communication through electronic devices.

Unit I

Modulation: Introduction - Amplitude modulation (Theory and Mathematical Analysis) - Power in an AM wave - Vector representation - Block diagram of an AM transmitter - Collector modulation - Double side band modulator - Single Side Band Suppressed Carrier (SSB/SC) - Vestigial Side Band system (VSB).

Frequency Modulation (Theory and Mathematical Analysis) - Frequency Spectrum of FM - Vector Representation - Narrow Band FM - Wide Band FM - Varactor diode FM Modulator - Transistor Reactance FM Modulator.

Phase Modulation (Theory and Mathematical Analysis) - Vector Representation - Armstrong Phase Modulator - Pulse Width Modulation (PWM) - Theory and Pulse Position Modulation. (15 hrs)

Unit II

Demodulation and Noise: AM Detectors - Practical Diode AM Detector - VSB Demodulator - Synchronous Detector - Phase - Locked Loop (PLL) - FM Discriminator Foster - Seeky FM Discriminator - Ratio Detector Demodulation of PM.

Noise in Communication System: Noise in AM System - Noise in FM System - Noise in Phase Modulated System - Noise in Pulse Modulated System. (15 hrs)

Unit III DIGITAL COMMUNICATION

Introduction to Digital Communication System - Amplitude Shift Keying (ASK) - Band width and Spectrum frequency of ASK - Binary ASK Modulator - Coherent ASK Detector - Non Coherent ASK Detector - Frequency Shift Keying (FSK) - Bandwidth of binary FSK - Detection of FSK using PLL - Phase Shift Keying (PSK) Generation of Binary PSK Wave - Detection of Differential Phase Shift Keying (DPSK) - DPSK Transmitter Generator - DPSK Demodulator - Advantage and Disadvantage of Digital Communication. (15 hrs)

Unit IV

Broad band and Satellite Communication: Time Division Multiplexing (TDM) - Frequency Division Multiplexing (FDM) - Computer Communication - Microwave Service Digital Network (ISDN) - Broadband ISDN (BISDN) - Local Area Network (LAN) Bus Topology - Star Topology - Ring Topology - Hybrid Topology - Private Branch Exchange (PBX) - MODEMS.

Communication Satellite Systems: Basic Components of Satellite Communication System - Telemetry, Tracking and Command System (Block Diagram) - Satellite Links - Uplink and Down Link - Commonly Used Frequency in Satellite Communication - Multiple Access - Error Detection. (15 hrs)

#### Unit V FIBRE OPTIC COMMUNICATION

Introduction - Basic Fibre Optic System - Advantage of Fibre Optic System - Propagation of Light through Fibre - Numerical Aperture - Losses and Distortion in Optical Fibres - Basic Fibre Optical Communication and Links.

Special Applications: Video Link (Fibre Optic) - Satellite Link - Computer Link Community Antenna Television (CATV) - Switched Star CATV. (15 hrs)

#### Books for Study:

1. SK. Venkatraman - Digital Communications, S.Chand.
2. Arokh Sing and A.K.Chhabra - Principles of Communication Engineering - S.Chand.
3. Subir Kumar Sarkar - Optical Fibres and Fibre Optic Communication Systems - S.Chand.
4. DC Agarwal - Fibre Optic Communication - S.Chand.
5. BL. Theraja - Basic Electronics - S.Chand.

#### Books for Reference:

1. George Kennedy - Electronic Communication Systems - Mac Graw Hill International 3 ed.
2. Roddy and Coolen - Communication Electronics - PHI
3. B.P.Lathi - Communication System - Wiley Eastern.
4. K. Samshanmugam, John Wiley – Digital and Analog Communication system.
5. Robert M. Gagliardi – Satellite Communication – CBS Publication.

**PROPOSED MODEL SYLLABI FOR OPTIONAL PAPERS**

**List of Participants who prepared the proposed model syllabi for Optional papers**

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**LIST OF PROPOSED OPTIONAL SUBJECTS**  
(Any Two papers: One in V Semester and Another in VI Semester)

1. NON-DESTRUCTIVE TESTING
2. BIO-MEDICAL INSTRUMENTATION
3. PROGRAMMING IN 'C'
4. OPTOELECTRONICS
5. PHOTOGRAPHY
6. LASER PHYSICS AND FIBRE OPTICS
7. MICRO PROCESSORS AND MICRO COMPUTERS
8. BIOPHYSICS
9. PROGRAMMING IN C++
10. ENERGY PHYSICS

## **NON-DESTRUCTIVE TESTING**

Linkage:

- ✧ Non-Destructive testing is an engineering application oriented subject principles of magnetism, electro-magnetism electricity and ultrasonic are applied.

### **Unit I VISUAL EXAMINATION AND LIQUID PENETRANT TESTING**

Basic principle - The eye - unaided visual inspection - Optical Aids used for visual inspection - Applications - Liquid penetrant testing - Physical principles procedure - Penetrant testing materials - Testing methods - Application and limitation.

### **Unit II MAGNETIC PARTICLE TESTING AND EDDY CURRENT TESTING**

Principle of MPT - Magnetizing techniques - Procedure - Equipment - Limitations - Eddy current testing principles - Instrumentation Techniques - Applications - Limitations.

### **Unit III RADIOGRAPHY**

Basic Principle - X-ray source - Production gamma ray sources - Properties of X-rays and gamma rays - Attenuation in specimen effect of Radiation on film - Radiographic imaging - Inspection techniques - Applications limitations - Safety in industrial radiography - Neutron radiography.

### **Unit IV ULTRASONIC TESTING**

Basic properties of sound beam - Ultrasonic transducers - Inspection methods - Techniques for normal beam inspection - Techniques for angle beam inspection - Flaw characteristic techniques, detection equipment - Modes of display - Immersion testing - Applications - Advantages - Limitations.

### **Unit V AUTOMATION AND ROBOTS IN NDT AND QUALITY CONTROL**

Manipulator arm operation - Control system memory - Application of Robots - Quality control - Probability - Statistical methods - Taguchi concepts - Standards - Indian National standard - International standards for NDT.

Books for study:

1. Baldev Raj, Jayakumar & Thavasi muthu - Practical Non-Destructive Testing for Units I, II, III & IV.
2. Baldev Raj, Subramanian & Jayakumar - Non-Destructive testing of welds for unit V, Narosa Publishing House.

## **BIO-MEDICAL INSTRUMENTATION**

### **Unit I            TRANSDUCERS**

Transducers & transduction principles - Active principles - Piezoelectric effect - Thermoelectric effect - Photoelectric effect - Passive transducers - Passive transducers using inductive, Capacitive, active circuits elements - Transducers for biomedical applications.

### **Unit II            BIOELECTRIC POTENTIALS AND ELECTRODES**

Sources of bioelectric potentials - Resting and acting potentials - Propagation of action potentials - Bioelectric potentials - The Electrocardiogram (ECG) - The Electroencephalogram (EEG) - The Electromyogram (EMG) - Electrodes - Electrode theory - Biopotential electrodes - Biochemical transducers.

### **Unit III          CARDIOVASCULAR MEASUREMENTS**

Blood Pressure - Characteristics of blood flow-heart sounds - Electrocardiography - ECG amplifiers - electrodes & leads - ECG recorder principles - Measurement of blood flow and cardiac output - Measurement of heart sound - Pacemakers - Pacemaker systems - Pacing modes and Pulse generators - Power sources of electromagnetic interference.

### **Unit IV          RESPIRATORY SYSTEM**

Tests & Instrumentation for the mechanics of breathing - Lung volumes & capacities - Measurement of gaseous exchanges & diffusion - Ventilator & respirator - Measurement of systemic body temperature - Thermography - Skin temperature measurements.

### **Unit V            ULTRASONIC IMAGING**

Ultrasonic imaging - Ultrasonic diagnosis - Ultrasonic transducers - Echoencephalography - Ophthalmic scans - Ultrasonic imaging - Neuronal firing measurements - electromyographic measurements - Biomedical application - Computer analysis of the Electrocardiogram - Computerized axial tomography (CAT) scanners.

Books for study:

1. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer - Biomedical Instrumentation & Measurements - Second Edition (Pearson Education).

## **PROGRAMMING IN 'C'**

Linkage:

- ✧ Linked with numeric methods in solving problems
- ✧ Language of choice for the most of the scientific applications
- ✧ Simplified version of PERL language, hence helpful for research works.

### **Unit I           CONSTANTS, VARIABLES AND DATA TYPE**

Basic structure of C Program - Executing a C program - Character set - C tokens - Key words and identifiers - Constants, variables - Data types - Declaration of variables - Assigning value to variables - Defining symbolic constants - Mathematical function.

### **Unit II           OPERATORS AND EXPRESSIONS**

Arithmetic operators - Relational operators - Logical operators - Assignment operators - Increment and Decrement operators - Conditional operators - Bitwise operators - Special operator - Arithmetic expressions - Evaluation of expressions - Precedence of operators.

#### **MANAGING INPUT AND OUTPUT OPERATIONS**

Reading a character - Writing a character - Formatted input - Formatted output.

### **Unit III         DECISION MAKING AND BRANCHING**

Decision making with 'if' statement - Simple if - if-else - Nested if-else - the else-if ladder - Switch and goto statement.

#### **DECISION MAKING AND LOOPING**

While statement - do statement - for statement - jumps in loops.

#### **ARRAYS**

One dimensional arrays - Declaration and initialization of one dimensional arrays - Two dimensional arrays - Simple program.

### **Unit IV         HANDLING OF CHARACTER ARRAYS AND STRINGS**

Declaring and initializing string variables - Reading strings from terminal - Writing strings to screen - String Handling function.

#### **USER DEFINED FUNCTION**

Need for user defined function - A Multifunction program - Elements of user - Defined function - Definition of function - Function declaration - Category of functions - Recursion.

### **Unit V           STRUCTURE**

Defining a structure - Declaring a structure variable - Accessing a structure member - Structure initialization - Arrays of structure - Arrays within structure - Structure within structure.

## POINTERS

Declaring and initializing pointer variable - Accessing the address of a variable  
- Pointer expressions.

## FILE MANAGEMENT IN C

Defining and opening a file - Closing a file - Input / Output operation in file -  
Error handling during input / Output operations.

Books for Study:

1. E. Balagurusamy - Programming in ANSI C

Books for Reference:

1. Henry Milliar & Huberz Roopu - The spirit of C
2. Byron Gottfried, Schaur Series - Programming with C

# OPTOELECTRONICS

Linkage:

- ✧ Optoelectronics is an application oriented fast developing subject which make use of principles of electronics, optics and communication systems.

## Unit I LIGHT SOURCES AND DETECTORS

Introduction - LED - The processes involved in LEDs - Structures of LED - LED materials - Output characteristics of LED - Fibre - LED coupling - Modulation Bandwidth of LED - Spectral emission of LEDs. LASER: Laser Operation - Semiconductor laser diode - Spatial Emission pattern of Laser - Current Vs output power characteristics of Laser - White LED - Organic LEDs - OLED structure and operations - Photo detectors - Characteristics of Photo-detectors - Photo emissive photo detectors - Photo conductive devices - Photo-Voltaic devices - Prejunction photodetector - PIN photo-diode Avalanche photo-diode (APQ) - Photo transistor - Bit - Error rate.

## Unit II OPTICAL FIBRES

What are optical fibres? - Importance of optical fibres - Propagation of light waves in an optical fibre - Basic structure of an optical fibre and propagation of light wave through it - Acceptance angle and acceptance core of a fibre - Numerical aperture (general) - Numerical aperture of a graded index fibre - Modes of propagation - Meridional and Skew rays - Numbering modes and cut-off parameters eg. fibres - Single mode propagation - Comparison of step and graded index fibres - Application of fibres - Fibres classification - Stepped index fibre - Stepped - Index monomode fibre - Disadvantage of monomode fibre - Graded index multimode fibre - Plastic fibres.

## Unit III FIBRE FABRICATION, FIBRE LOSSES AND DISPERSION

Fibre fabrication - External CVD - Axial Vapour Deposition (AVD) - Internal Chemical Vapour Deposition (IVCD) - Characteristics of all these methods - Fibre drawing and coating - Double - Crucible method - Attenuation in optic fibres - Material loss - Absorption loss - Leaky modes - Bending losses radiation induced losses - Inherent defect losses - Inverse square law losses - Transmission losses - Temperature dependence of fibre losses - Core and cladding losses - Dispersion in optical fibres - Inter-modal dispersion - Mixing of modes - Material chromatic dispersion - Wave guide dispersion - Dispersion power penalty - Total dispersion delay - Maximum transmission rate.

## Unit IV OPTICAL COUPLERS - SPLICING AND MEASUREMENT ON OPTIC FIBRES

Types of optical couplers - Biconically tapered direction coupler - Beam splitting directional couplers - T Couplers - Calculations on couplers - Splicing - Mechanical Splicing - Steps involved in splicing procedures - Loss comparison - Losses in splices and connectors Measurement of numerical aperture and its related terms - OTDR - Working of OTDR - Applications of OTDR - Fibre loss measurement by OTDR - Limitations - Advantages.

## Unit V MODULATION AND DETECTION

Introduction - LED analog modulation - Digital modulation - Laser modulation (Analog and Digital) - Formats of modulation - Pulse code modulation (PCM) - Merits and demerits of PCM. Intensity modulation (IM) - External optical modulators - Electro optic modulator - Acousto optical modulator - Demodulation methods - Direct detection methods - Heterodyne detection receiver.

### Books for Study:

1. Subir Kumar Sarkar - Optical fibres and fibre optic communication systems Fourth revised edition, S.Chand & Company Ltd.
2. M. Mukunda Rao - Optical Communication, (For Unit V).

### Books for Reference:

1. Wilson and Hawkes - Optoelectronics, Prentice Hall of India, New Delhi.
2. Battacharya P. - Semiconductor Opto Electronics, PHI, New Delhi.
3. Ajoy Ghatak and K. Thyagarajan - Introduction to Fibre Optics.

## PHOTOGRAPHY

Linkage:

✧ Geometrical Optics, Analog Electronics, Digital Electronics, Opto Electronics

### Unit I BASICS OF OPTICS

Image formation using pin hole and lenses - U.V. formula - lens types, lens defects, close up and wide angle, telephoto and zoom lenses - nature of images - Depth of Focussing, f-number - lighting - Contrast - exposure - Illumination and use of flash light.

### Unit II IMAGE RECORDING DEVICES

Parts of a Camera - Camera types - Viewfinders and Shutters - SLR and automatic camera - Video Camera - Digital Camera.

### Unit III MATERIALS AND PROCESSING

Film - Characteristics, Speed of film - Printing paper types - Developing of film and papers, contact printing, printing using enlarger, techniques of colour printing - Reversal developing.

### Unit IV MODERN TECHNIQUES

Image recording using video camera - Editing mixing - Recording using digital camera - Transfer to computer - Use of Photo shop - Printing images on paper.

### Unit V SPECIAL EFFECTS

Working in layers - Using marks - Retouching with Photoshop - applying filters - Colour inversions - Pixilation - Preparation of Identity Cards and visiting cards - Creation of Season's greetings.

Books for Study:

1. S.Thiagarajan, - Practical Photography, Ennes Publications, 3rd Edn. Madurai.
2. Teach Yourself Digital Photography in 14 days - Carla Rose, Hayden Books, Techmedia, New Delhi.

Books for Reference:

1. Fundamentals of Photography - C.B.Neblette, Van Nostrand Reinhold Co.
2. Adobe Photoshop 6 Studio - Prentice Hall of India Pvt. Ltd.
3. O.P.Sharma - Photography, Hind Pocket Books, New Delhi.

## LASER PHYSICS AND FIBRE OPTICS

Linkage:

- ✧ This application oriented paper provides the subject linkage with the core paper, optics and spectroscopy. Also it develops the students confidence going for higher education.

### Unit I LASER PHYSICS

Basic principles of laser - Einstein Coefficients - Condition for light amplification - Population inversion - Threshold condition - Line shape function - Optical resonators (Qualitative only) - Three level & four level systems.

### Unit II TYPES OF LASERS AND OUTPUT MODULATION METHODS

Ruby Laser - Nd - YaG Laser - He-Ne Laser, CO<sub>2</sub> Laser - Dye Laser - Semi Conductor Laser - Q Switching & mode locking (qualitative) - Experimental methods.

### Unit III APPLICATION OF LASER

Application of Laser in industry - Cutting - Welding - Drilling - Surface hardening - Medical applications - Laser as diagnostic & therapeutic tool - Holography - Theory of recording & reconstruction - Applications of holography - Holographic interferometry in non destructive testing, Acoustic holography and Holographic microscopy - Lasers in compact disc players.

### Unit IV OPTIC FIBRES

Basic structure of an Optic fibre - Acceptance angle - Numerical aperture - Propagation of light through an optical fibre - Theory of modes formation - Classification of fibres - Step index & graded index fibres - Comparison of the two types - Single mode & multimode fibres - Losses in fibres - Dispersion in fibres - Fabrication of fibres.

### Unit V FIBRE OPTIC COMMUNICATION

Optical communication - Advantages - Light sources - Modulation methods - Photo detectors - Optical couplers - Splicing - Communication systems (Block diagram) - Repeaters - Fibre cables - Measurements of numerical aperture & optical time domain reflectometers.

Books for Study:

1. K.Thyagarajan, A.K.Ghatak - Lazer theory and applications, Cambridge university press.
2. Avadhanulu M.N., - An introduction to Lasers, theory & applications, S.Chand & Co, New Delhi 2001.
3. Subir Kumar Sarkar - Optical fibres & Fibre optic communication systems, S.Chand & Co., New Delhi, 2001.
4. R.K.Gaur & S.L. Gupta (eighth edition) - Engineering Physics, Dhanpat rai publications, New Delhi.
5. P.K. Palanisamy - Physics for Engineering, Scitech Publications private Ltd.

Books for Reference:

1. Ajoy Ghatak & K. Thygarajan, - Introduction to Fibre Optics, Cambridge University Press.
2. P.K. Palanisamy - Solid State Physics, Scitech Publication (India) Private Ltd.

## MICRO PROCESSORS AND MICRO COMPUTERS

Linkage:

- ✧ Digital Principles and Applications.

### Unit I MICRO COMPUTER ORGANIZATION AND ARCHITECTURE

Micro processor Architecture and Micro computer systems - Memory - I/O Devices - Examples of a Micro computer systems - 8085 Micro processor 8085.

### Unit II INTERFACING INPUT/OUTPUT DEVICES

Basic interfacing concepts - Memory Mapped INPUT/OUTPUT - Introduction to 8085 Assembly Language Programming - The 8085 Programming Model - Instruction Classification and Data format - How to write - Assemble and Execute a simple programs.

### Unit III INTRODUCTION TO 8085 INSTRUCTIONS

Data Transfer (copy) Operators - Arithmetic Operations - Log operations Branch operations - Writing Assembly Language Programs - Debugging a Programme - Programming Techniques Looping, Counting and Indexing - Additional Data Transfer and 16-bit Arithmetic instructions - Arithmetic operations - Related Memory - Logic operations - Rotate and compare - Dynamic debugging.

### Unit IV COUNTERS AND TIME DELAYS

Counter and Time Delays - Hexadecimal counter - Zero to Nine (Modulo Ten) Counter - Generating Pulse waveforms Stack and Subroutines - Stack - Subroutine - Conditional call and Return instructions - Advanced Subroutine concepts.

### Unit V

Code Conversion, BCD Arithmetic and 16 bit Data operations BCD to Bineray; Binary to BCD Conversion - BCD Addition - BCD subtraction - Introduction to Advanced Instructions and Application - Multiplication - Subtraction with carry.

Books for Study:

1. Ramesh S. Gaokar - Microprocessor Architecture Programming and Applications with the 8085, 4th edition 2000.

Books for Reference:

1. Aditya P. Mathur, - Introduction to Microprocessors - III Edition.
2. Lance A. Leventhal - Introduction to Microprocessors: Software, Hardware, Programming.

## BIOPHYSICS

Linkage:

- ✧ Optics, Spectroscopy, Crystallography, Chemistry, Medicine, Properties of Matter, Thermal Physics, Sound and Physiology.

Unit I

Chromatography: Separation Techniques - Electrophoresis - Physico-Chemical Techniques to study Biomolecules - Spectroscopy - Ultraviolet/Visible spectroscopy - Circular Dichroism (CD) - Optical Rotatory Dispersion (ORD) - Fluorescence Spectroscopy - Infrared Spectroscopy - Raman Spectroscopy - ESR.

Unit II

Light Microscopy - Different types of Microscopy - Electron Microscopy - X-ray Crystallography.

Unit III

NMR Spectroscopy - Principle - Theory and Experiment - NMR Parameters - Nuclear Over Hauser effect - NMR applications in chemistry, Bio-Chemistry and Biophysics - NMR in medicine - Molecular modelling - Optimising the model.

Unit IV

Macromolecular structure - Nuclear Acid structure - Protein structure - Energy pathways in Biology - Photo synthesis - Energy conversion pathways - Membrane Transport.

Unit V

Biomechanics - Striated muscles - Mechanical properties of muscles - Biomechanics of the Cardiovascular system - Neuro biophysics - the nervous system - Physics of membrane potentials - Sensory mechanisms - The Eye - Physical aspects of hearing - Signal transduction - Origin and Evolution of life.

Book for Study:

1. Vasantha Pattabhi and N.Gautham - Biophysics, Reprint 2004, Narasa Publishing House, 35-36 Greams Road, Thousand Lights, Chennai - 600 006.

Books for Reference:

1. P.Narayanan - Introductory Biophysics, (1999) New Age Publishing Company, Mumbai, India.
2. W.Hoppe, W.Lohman, H.Markl and H.Zeigler - Biophysics, (Edn. 1983) Springer - Verlag, New York, USA.

## **PROGRAMMING IN C++**

Linkage:

- ✧ It is linked with numerical methods to solve problems.
- ✧ C++ is the language of choice for most of the scientific applications.
- ✧ It is helpful for research purpose specifically in the field of Bio-informatics.

### **Unit I PRINCIPLE OF OBJECT ORIENTED PROGRAMMING**

Procedure oriented and object oriented programming - Principles of object oriented programming - Basic concepts of OOP - Applications of OOP - Structure of C++ program.

Tokens, Keywords - Identifiers and Constants - Basic data types - User defined data types - Derived data types - Symbolic constants - Declaration of variables - Dynamic initialization of variables - Operators in C++ - Scope resolution operator - Manipulators.

### **Unit II**

Expressions and their types - Special assignment expressions - Implicit conversions - Control structures.

Function in C++ - The main function - Function prototyping - Inline functions - Default arguments - Constant arguments - Function overloading - Math library functions.

### **Unit III**

Classes and Objects: Specifying a class - Defining a member function - Making an outside function inline - Nesting of member functions - Private member functions - Arrays with in a class - Friend functions - Static member functions - Arrays of objects - Objects as function arguments.

### **Unit IV**

Constructors and Destructors: Constructors - Parameterized constructors - Copy constructor - Dynamic constructor - Destructors.

Inheritance: Single inheritance - Multiple inheritance - Multilevel inheritance - Hierarchical inheritance - Hybrid inheritance.

### **Unit V POLYMORPHISM**

Operator overloading - Overloading unary and binary operators - Virtual functions.

Working with files: Classes for file stream operations - Opening and closing a file - Text file operations - Error handling during file operations.

Book for Study:

1. E. Balagurusamy - Object Oriented Programming with C++

Books for Reference:

1. Bjarne Stroustrup - The C++ Programming Language
2. Grady Booch - Object Oriented Analysis and Design

## ENERGY PHYSICS

Linkage:

- ✧ Environmental Studies, Thermal Physics, Electricity, Electronics, Solid State Physics, Organic Chemistry.

### Unit I AN INTRODUCTION TO ENERGY SOURCES

Energy consumption as a measure of prosperity - World Energy Future - Energy Sources and their availability - Commercial or conventional energy sources - Non-conventional sources - Renewable energy sources.

#### SOLAR RADIATION AND ITS MEASUREMENT

Introduction - Solar constant - Solar radiation at the Earth's surface - Solar radiation geometry - Solar radiation measurements - Solar radiation data.

### Unit II SOLAR ENERGY COLLECTION AND STORAGE

Introduction - Physical Principles of the conversion of solar radiation into heat - Flat plate collectors - Concentrating collectors - Focussing type - Advantages and disadvantages of concentrating collectors over flat plate collectors.

Solar energy storage - Solar energy storage systems - Solar pond.

### Unit III APPLICATIONS OF SOLAR ENERGY

Introduction - Solar water heating - Space heating - Passive and active heating systems - Solar thermal electric conversion - Solar electric power generation - Solar photo voltaic - Solar cell principles - A basic photo voltaic system for power generation - Solar cell connecting arrangements - Battery storage - Applications of photo voltaic systems - Advantages and disadvantages of photo voltaic conversion - Agriculture and industrial process heat - Solar distillation - Solar pumping - Solar furnace - Solar cooking - Design principles and constructional details of box type solar cooker - Solar green house - Advantages of solar green house.

### Unit IV WIND ENERGY

Introduction - The nature of the wind - Basic components of a WECS - (Wind Energy Conversion Systems) - Advantages and disadvantages of WECS.

#### ENERGY FROM BIOMASS

Introduction - Photosynthesis - Biogas generation - An aerobic digestion.

### Unit V GEOTHERMAL ENERGY

Introduction - Estimation of Geo thermal power - Nature of Geothermal fields - Geothermal sources - Advantages and disadvantages of geothermal energy - Applications of Geothermal energy.

#### ENERGY FROM OCEAN

Introduction - OTEC - Energy from tides - Basic principles of tidal power - Site requirements - Storages, advantages and limitations of tidal power generation - Ocean

waves - Wave energy - Small scale hydro electric systems - Advantages and disadvantages of wave energy conversion.

Books for Study:

1. G.D.Rai - Non-Conventional Sources of Energy, (IV Edn) Unit I: Ch:1&2, Unit II: Ch:3&4, Unit III: Ch:5, Unit IV: Ch:6&7, Unit V:Ch:8&9.

Books for Reference:

1. G.D.Rai, - Solar Energy Utilization
2. Sukatme - Solar Energy
3. H.C.Jain - Non-Conventional Sources of Energy
4. M.P.Agarwal - Solar Energy
5. Janet Ramage - Energy, A guide book.

## **PROPOSED MODEL SYLLABI FOR ALLIED PAPERS**

## **List of Participants who prepared the proposed model syllabi for Allied papers**

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## LIST OF PROPOSED ALLIED SUBJECTS

1. ALLIED PHYSICS PAPER - I
2. ALLIED PHYSICS PAPER - II
3. ALLIED PHYSICS PRACTICALS

## ALLIED PHYSICS PAPER – I

Linkage:

- ✧ To understand the basic physical laws of moving bodies translational and rotational and to understand the laws of motion of liquids and properties of solids. To understand the concept of heat and its influences and to know the wave concept of light.

Objective:

- ✧ To provide the basic knowledge of physical laws and principles to the students of other branches of science.

### Unit I MECHANICS

Definition of force – Unit – Dimension – Like parallel forces – Unlike parallel forces – Resultant – Equilibrant – Condition for equilibrium when number of forces acting on a plane – Moment – Couple (Torque) – Parallelogram – Law of forces – Triangle law of forces – Lami's theorem – Centre of Gravity.

Projectile – Motion in horizontal plane – Maximum height – Time of flight – Range – Maximum Range – The path of the projectile is a parabola – Projectile in an inclined plane – Range and Time of flight in a horizontal plane – Circular motion – Angular velocity – Angular acceleration – Normal acceleration – Centrifugal force – Banking of curves.

### Unit II FLUID MECHANICS

Surface Tension – Explanation – Surface energy – Definition of S.T. – Units – Dimensions – Excess of pressure across a spherical surface – Excess of pressure inside a spherical drop and liquid bubble – Angle of contact – Capillary rise – Experimental determination of surface tension of water by capillary tube – Viscosity – Introduction – Viscous Force – Coefficient of Viscosity - Units and Dimensions – Experimental determination of coefficient of Viscosity using Burette – Lubricants – Bernoulli's theorem – Statement – Explanation – Application – Venturimeter.

### Unit III PROPERTIES OF MATTER AND SOUND

Properties of matter Elasticity – Young's Modulus – Rigidity modulus – Bulk modulus – Poisson's ratio – Definition – Bending of beams – Expression for bending moment – Determination of Young's modulus – Uniform and non-uniform bending – I-section of girders – Torsion of a cylinder – Expression for torque per unit twist – Work done in twisting the wire – Torsional oscillations of a body (qualitative) – Determination of rigidity modulus of the wire by torsion pendulum.

Sound Simple harmonic motion – Superposition of two SHM – Interference of sound waves – Beats – Doppler effect – Medical applications – Ultrasonics – Properties – Piezoelectric effect – Piezoelectric method of producing Ultrasonics – Applications.

### Unit IV HEAT AND THERMODYNAMICS

Specific heat of solids – Dulong Petit law – Variation of specific heat with temperature – Newton's law of cooling – Specific heat of liquids – Coefficient of

Thermal Conductivity – Lee's Disc method – Black body – Black body radiation – Planck's radiation law – Rayleigh Jean's law – Wein's displacement – Stefan's law – Zeroth, I, II and III law of thermodynamics – P-V diagram – Carnot's engine – Efficiency – Entropy – Reversible and irreversible processes.

#### Unit V OPTICS

Coherence – Condition for interference – Young's double slit experiment – Interference due to transmitted light – Air Wedge – Newton's Rings – Application of thin film interference (qualitative) – Antireflection coating – Dielectric mirrors and interference filters – Fresnel's diffraction – Distinction between diffraction and interference – Diffraction at a single slit – Transmission Grating – Polarization of Electromagnetic wave – Polarization of linearly polarized light – Polarizer and analyser – Explanation of double refraction – Optical activity – Specific rotation – Laurentz half shade polarimeter – Application of polarized glasses.

#### Books for Study and Reference:

1. D.S. Mathur, Mechanics, S.Chand & Co, 2002.
2. Brijlal and Subramanyam, Properties of Matter, S.Chand & Co, 2004.
3. R.L. Saihgal, A Text book of Sound, S.Chand & Co, 1990.
4. Brijlal and Subramanyam, Heat and Thermodynamics, S.Chand & Co, 2004.
5. S.L. Kakani and Bhandari, Optics, S.Chand & Co, 2000.

## ALLIED PHYSICS PAPER – II

Linkage:

- ✧ To understand the behaviour of electric charges under different conditions and its influence in motion. To understand the basic concept of Nuclear energy. To understand the relative concept of space and time and mass and energy. To acquire the knowledge of application of physics and computer.

### Unit I CURRENT ELECTRICITY

Ohm's law – Law of resistances in series and parallel – Specific resistance – Capacitors – Capacitors in series and in parallel – Kirchhoff's laws – Wheatstone's network – Condition for balance (no derivation) – Carey-Foster's Bridge – Measurement of Specific resistance – Potentiometer – Measurement of resistance – Determination of temperature coefficient of resistance – Calibration of Voltmeter and Ammeter.

### Unit II ELECTROMAGNETISM

Electromagnetic Induction – Faraday's laws – Lenz law – Self Inductance – Mutual Inductance – Coefficient of Coupling – A.C. Circuits – Mean value – RMS value – Peak value – LCR in series – Sharpness of resonance – Transformer theory (qualitative) – Chokes – Audio Frequency choke – Radio Frequency choke – Uses.

### Unit III ATOMIC AND NUCLEAR PHYSICS

Atomic excitation - Ionization potential – Frank and Hertz Method – Nucleus – Nuclear properties – Mass defect – Binding energy – Radio isotopes – Uses of radio isotopes – Nuclear fusion and Nuclear fission – Atomic Bomb – Hydrogen bomb – X-Rays – Properties and uses in industrial and Medical fields.

### Unit IV RELATIVITY AND PHOTOELECTRICITY

Newton's laws and their limitations – Inertial frames – Galilean transformation and invariance – Michelson and Morley experiment – Postulates of special theory of Relativity – Lorentz transformation – Einstein mass energy equivalence – Photo electric emission – Work function of a material – Einstein photo electric equation – Experimental verification of Einstein's equation by Millikan's experiment.

### Unit V SEMICONDUCT AND DIGITAL ELECTRONICS

Semiconductors – pn junction diode – Bridge rectifier – Zener diode – Regulated Power Supply – Transistor – CE configuration only – Hartley Oscillator (qualitative).

Number systems – Decimal – Binary – Octal and Hexadecimal systems – Double Dadd method – Binary addition, subtraction, multiplication and division – Conversion of one system of numbers into another system – Logic gates – OR, AND, NOT, XOR, NAND and NOR gates – Truth tables – NAND and NOR as Universal gates – Arithmetic processing units – Half adder, full adder, Half subtractor and full subtractor – Laws and theorems of Boolean Algebra – De Morgan's theorems.

**Books for Study and Reference:**

1. R. Murugesan – Electricity and Magnetism, S.Chand & Co, 2001.
2. R. Murugesan – Modern Physics, S.Chand & Co, 1998.
3. B.L. Theraja – Basic Electronics, S.Chand & Co, 2003.

## ALLIED PHYSICS PRACTICALS

### Any Sixteen Only (For Two Semesters)

1. Young's Modulus – Uniform Bending (Optic lever)
2. Young's Modulus – Non-Uniform Bending (Pin & Microscope)
3. Torsion Pendulum – Rigidity Modulus
4. Surface Tension of a liquid by Capillary Rise method.
5. Coefficient of Viscosity by Poiseuille's method.
6. Coefficient of Thermal Conductivity – Lee's Disc method.
7. Newton's law of cooling.
8. Carey-Foster's Bridge – Determination of specific resistance.
9. Potentiometer – Comparison of resistances.
10. Potentiometer – Calibration of Voltmeter.
11. Potentiometer – Calibration of low range ammeter.
12. Newton's Rings – Radius of Curvature of the lens.
13. Thickness of a thin wire by Air-Wedge.
14. Grating – Normal incidence method.
15. LCR – Series Resonance Circuit.
16. Junction and Zener diode – V-I characteristics.
17. Construction of Regulated power supply using Zener diode.
18. Transistor characteristics – Common Emitter Configuration.
19. Logic gates – OR, AND, NOT (Using discrete components).
20. Logic gates – NAND, NOR (Using discrete components).
21. Transistor – Hartley Oscillator.