Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon

'A' Grade
NAAC Re-Accredited
(4th Cycle)

SYLLABUS
for
F. Y. B. Sc.(PHYSICS)
(Semester I & II)
For
Affiliated Colleges

Asper theNational Education Policy 2020 (NEP2020)

(With Effect from -June 2024)

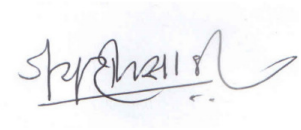
Acknowledgement

The Board of Studies in Physics of KavayitriBahinabai Chaudhari North Maharashtra University, Jalgaon acknowledges the contributions from all members in restructuring the curriculum for Four Year Undergraduate (FYUG)programme in Physics at F. Y. B. Sc level. The abundant support and recommendations from the sub-groups for designing different courses has shaped this curriculum to its present shape.

I congratulate the committee for their wholehearted participation for preparing the syllabi for F.Y.B.Sc. (Physics) as per NEP2020 with relevant guidelines of BoS (Physics).

We thank all for their generous support and cooperation to make this venture a success.

For the Board of Studies in Physics,



Prof. Jaydeep V. Sali

(Chairman, BoS Physics)

Foreword

The New Education Policy 2020 (NEP2020) is a paradigm shift from the conventional system we practice even today. Giving students the entire freedom to choose what to learn, how to learn, where to learn and when to learn, will enable a personalized education that suits his/her own personality.

The Board of Studies (BoS) in Physics recognizes that curriculum, course content and assessment of academic achievement play complementary roles in shaping education. The BoS is of the view that assessment should support and encourage broad instructional goals such as basic knowledge of the discipline of Physics including phenomenology, theories and techniques, concepts, and general principles. This should also support the ability to ask questions and to obtain solutions to questions by use of qualitative and quantitative reasoning and by experimental investigation. With this in mind, through this curriculum, we aim to provide a firm foundation in every aspect of Physics and to explain a broad spectrum of modern trends in physics and to develop experimental, computational and mathematics skills of the students.

It is imperative that in the spirit of the NEP, several academic matters must change. The most important among these will be the pedagogy that will be adopted in the Teaching-Learning experience to enroll, engage, and involve and inspire the students.Along with conventional teaching methods, activity-based pedagogies are seen to be extremely effective in achieving the Program Educational Objectives. The BoS has attempted to consider both the spirit of the NEP and the existing system and framed the syllabus within the curriculum options.

The syllabus restructuring committees for F. Y. B. Sc. (Physics), were constituted for various courses comprising Hon'ble BoS Chairman,Members BoS, eminent faculty members of Physics from various colleges of the university.These committees drafted syllabi, as per the NEP2020 for four-Year UG Program. Hon'ble BoS Chairman has paid attention to every detail through repeated discussions and hours of deliberations (Online/Offline).

In the syllabus framing workshop held on 30/09/2023, the participant had lively discussions on various topics, some of ideas were acknowledgedand the draft has been unanimously accepted by the BoS.We are sure this draft will help the students to understand thefour-year multidisciplinary degree programme with multiple entry and exit option with effect from academic year 2024-25.

Board of Studies, Physics, KBCNMU.

Introduction

The NEP is based on Outcome Based Education, where the Graduate Attributes and employment opportunities are first kept in mind to reverse-design the Programs, Courses and Supplementary activities to attain the graduate attributes and learning outcomes.The NCrF provides for earning and accumulation of credits through education, skill development and experiential learning including relevant experience and professional levels acquired on outcome-based assessment approach (rather than learning hours alone). However, for earning and accumulation of credits, assessment of student corresponding to a particular NCrF level is a mandatory requirement. The level descriptors define the level of knowledge, skills, competencies and learning outcomes for each Credit level under NCrF.

The learning outcomes-based curriculum framework for a degree in B.Sc.(Honours) Physics is intended to provide a comprehensive foundation to the subject and help students to develop the ability to successfully continue with further studies and research in the subject while they are equipped with required skills at various stages. The framework is designed to equip students with valuable cognitive abilities and skills so that they are successful in meeting diverse needs of professional careers in a developing and knowledge-based society. The curriculum framework takes into account the need to maintain globally competitive standards of achievement in terms of the knowledge and skills in Physics,as well develop scientific orientation, spirit of handling complexities, which foster rational and critical thinking in the students.

ProgrammeCredit Framework under Three/Four-Years UG Programme with Multiple Entry and Multiple Exit options:

The minimum and maximum credit structure for different levels under the Three/Four -year UG Programme with multiple entry and multiple exit options are as given below:

FYUG Credit Structure

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
4.5	UG Certificate	40	44	2	1
5.0	UG Diploma	80	88	4	2
5.5	Three Year Bachelor's Degree	120	132	6	3
6.0	Bachelor's Degree-Honours Or Bachelor's Degree-Honours with Research	160	176	8	4

Distribution of Credits across Four Years Degree Programmes

In general, for the four years' bachelor's degree programme, the distribution of credits will be as follows:

a) Major (Core) Subject comprising Mandatory and Elective Courses:

- **i)** Minimum 50% of total credits corresponding to Three/Four - year UG Degree- Mandatory Courses offered in all Four years;
- **ii)** Major Specific IKS (2-credit)
- **iii)** Elective courses of Major will be offered in the third and/or final year.
- **iv)** Vocational Skill Courses, Internship/ Apprenticeship, Field Projects, Research Projects connected to Major

b) Minor Subject: 18-20 Credits

- **i)** The Minor subjects may be from the different disciplines of the same faculty of DSC Major (Core) or they can be from different faculty altogether.
- **ii)** The credits of Minor subjects shall be completed in the first three years of UG Programme.

c) Generic/ Open Elective Courses (OE): 10-12 credits

- **i)** It is to be offered in I and/or II year
- **ii)** Faculty-wise baskets of OE is to be prepared by University.
- **iii)** OE is to be chosen compulsorily from faculty other than that of the Major.

d) Vocational and Skill Enhancement Courses (VSEC): 14-16 credits

- **i)** Vocational Skill Courses (VSC): 8-10 credits, including Hands on Training corresponding to the Major and/or Minor Subject:
- **ii)** Skill Enhancement Courses (SEC) : 06 credits

e) Ability Enhancement Courses (AEC), Indian Knowledge System (IKS) and Value Education Courses (VEC): 14 Credits

- **i)** AEC: 08 credits
- **ii)** IKS (Generic): 2 Credits
- **iii)** VEC: 04 Credits

f) Field Projects/ Internship/ Apprenticeship/ Community Engagement and Service corresponding to the Major (Core) Subject, Co-curricular Courses (CC) and Research Project

- **i)** Internship/Apprenticeship corresponding to the Major (Core) Subject: 8 Credits
- **ii)** Field Projects/Community Engagement and Service corresponding to the Major (Core) Subject: minimum 4-6 credits.
- **iii)** Co-curricular Courses (CC): 8 credits

iv) Research Projects: 12 credits.

Aims and Objectives of FYUG program in Physics

- Motivate and inspire the students to create deep interest in Physics.
- Develop broad and balanced knowledge and understanding of physical concepts, principles and theories of Physics.
- Learn, design and perform experiments in the laboratory to demonstrate the concepts, principles and theories learned in the classrooms.
- Develop observational skills, confidence in using scientific equipment and relate the knowledge of scientific concepts to quantitative and physical measurement.
- Develop the ability to apply the knowledge acquired in the classroom and laboratories to specific problems in theoretical and experimental Physics.
- Emphasize the discipline of Physics to be the most important branch of science for pursuing the interdisciplinary and multidisciplinary higher education and/or research in interdisciplinary and multidisciplinary areas.
- Underline the importance of Physics as the most important discipline for sustaining the existing industries and establishing new ones to create job opportunities at all levels of employment.

Programme Specific Outcome

On successful completion of this program, students will have the ability to;

- Acquire knowledge and understanding of fundamental concepts, principles and theories.
- Develop a systemic understanding of core physical concepts, principles and theories along with their applications
- Develop proficiency in the analysis of complex physical problems and the use of appropriate techniques to solve them
- Acquire the skills to take measurements in a physics laboratory and analyze the measurements to draw valid conclusions.
- Acquire the skills to communicate effectively by oral, written, computing and graphical means
- Develop the computational skills for control, data acquisition and data analysis in experimental investigations.
- Use computers effectively to solve problems through numerical methods and simulations and to analyze the data through available software.

BOS (PHYSICS)-Faculty of Science & Technology
KavayitriBahinabai Chaudhari North Maharashtra University, Jalgaon

Curriculum Framework for Multidisciplinary Four- yearUndergraduate Programme as per NEP2020 for Affiliated Colleges, w.e.f. June-2024

Class: F. Y. B. Sc. Subject: Physics

Semester-wiseCourseStructure,CourseCode/TitleandCreditdistribution

B. Sc (Honors/Research) – First Year, SEMESTER–I,Level– 4.5

Course	Course Type	Course Code	CourseTitle	Credits	TeachingHours/ Week			Marks(Total100)			
					T	P	Total	Internal (CA)		External (UA)	
								T	P	T	P
DSC-1	DSC	PH-111	Basic Mechanics	2	2	--	2	20	--	30	--
DSC-2	DSC	PH-112	Electrostatics and Electricity	2	2	--	2	20	--	30	--
DSC-3	DSC	PH-113	Laboratory-I	2	--	4	4	--	20	--	30
MIN-1	MIN	PH-114	Understanding Home Electric Supply	2	2	--	2	20	--	30	--
MIN-2	MIN	PH-115	Lab on PH-114	2	--	4	4	--	20	--	30
OE-1	OE	PH-116	Energy	2	2	--	2	20	--	30	--
SEC-1	SEC	PH-117	Physics Laboratory Skill	2	2	--	2	20	--	30	--
B. Sc (Honors/Research) – First Year, SEMESTER– II,Level– 4.5											
DSC-4	DSC	PH-121	Magnetism & Electromagnetism	2	2	--	2	20	--	30	--
DSC-5	DSC	PH-122	Ancient Indian Astronomy	2	2	--	2	20	--	30	--
DSC-6	DSC	PH-123	Laboratory-II	2	--	4	4	--	20	--	30
MIN-3	MIN	PH-124	Understanding Solar, Thermal & Photovoltaic System	2	2	--	2	20	--	30	--
MIN-4	MIN	PH-125	Lab on PH-124	2	--	4	4	--	20	--	30
OE-2	OE	PH-126	Materials in Today's World	2	2	--	2	20	--	30	--
SEC-2	SEC	PH-127	Computational Physics	2	2	--	2	20	--	30	--
SEC-3	SEC	PH-128	Lab on PH-127	2	--	4	4	--	20	--	30

- **One credit means:** One hour of theory or Two hours of laboratory work for a duration of a semester (13-15 weeks) resulting in the award of one credit.
- **DSC:** Discipline Specific Core Course, **DSE:** Discipline Specific Elective, **T:** Theory Course, **P:** Practical course, **CA:** College Assessment; **UA:** University Assessment.
- **Passing standards: 40% marks in UA and CA separately**.

Semester – I

Detailed Syllabus

for

F. Y. B. Sc., Physics

Course Code: PH-111

Course Title: Basic Mechanics

Course Code: PH-111	**Course Category: Core Course (DSC)**
Course Title: Basic Mechanics	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA): 20 Marks	**University Assessment (UA): 30 Marks**
Course Objectives: • Gain the fundamental knowledge of mechanics • Develop skills to predict the effect of force and motion of bodies.	
Course Outcomes:On completion of the course students will be able to • Understand the physical significance of scalar and vectors • Understand laws of motion and their application to various dynamical situations. • Apply the concept ofconservation of energy, momentum, angular momentum and apply them to basic problems.	

Course Content:

Unit 1: Vectors **(04 L, 08 M)**

Vectors and scalars, adding vectors, components of vectors, adding vectors by components, multiplying vectors: Scalar product and vector product.

Unit 2:Work and Kinetic Energy **(08 L, 06 M)**

Kinetic energy, work and kinetic energy, work done by: the gravitational force (a constant force), a spring force (a variable force), a general variable force

Unit 3: Dynamics: single and multiple bodies **(08 L, 06 M)**

Center of mass, linear momentum of system of particles, conservation of linear momentum, collision in one dimension: elastic and inelastic, collision in two dimensions.

Unit 4:Rotational Dynamics **(10 L, 10 M)**

Rotational variables: Angular position, Angular Displacement, Angular Velocity, Angular Acceleration; relation between linear and angular variable, Kinetic energy of rotation, Torque.

Physics of rolling motion: Rolling as combination of translation and rotation, forces and kinetic energy of rolling, angular Momentum, Expression for Angular momentum of rotating rigid body, Conservation of Angular Momentum.

Reference Books:

1) Principles of Physics by Resnick, Halliday & Walker, Wiley
2) Concepts of Physics by H. C. Verma, Bharati Bhawan publishers and distributers, New Delhi, India.
3) Mechanics by v.1: Charles Kittel, Berkeley Physics course, Tata McGraw-Hill.
4) Physics in Daily Life by Jo Hermans, EDP Sciences
5) University Physics by FW Sears, MW Zemansky and HD Young, Addison-Wesley
6) Elements of properties of matter by D.S. Mathur, Shamlal Charitable trust New Delhi.
7) Engineering Mechanics by Basudeb Bhattacharya, Oxford University Press

Course Code: PH-112

Course Title: Electrostatics and Electricity

Course Code: PH-112	**Course Category:Core Course (DSC)**
Course Title: Electrostatics and Electricity	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA) Marks: 20 Marks	**University Assessment (UA): 30 Marks**

Course Objectives:

- To impart knowledge of basic concepts in Electricity and Electrostatics.
- To understand the basic properties of electric charge.
- To understand the basic properties of electric field lines.

Course Outcomes:

- Students should recognize when Gauss' Law is the appropriate way to solve a problem.
- Students should be able to describe electric field for simple charge distributions in uniform and non-uniform situations.
- Student should be able to understand the concept of electric field lines and use their understanding to predict the electric field lines about a point charge or a configuration of point charges.

Course Content:

Unit 1: Vector Analysis **(05 L, 06 M)**

Gradient of a scalar, Divergence of a vector, Curl of a vector and their physical significance, Vector integration, Line, Surface and Volume integrals of vector field, Gauss divergence theorem and Stoke's theorem (Statement only)

Unit 2: Electrostatics **(09 L, 08 M)**

Electric charge, Coulomb's law, Coulomb's law in vector form, Principle of superposition: Force calculation of three and N charges, Distribution of charges (continuous and discrete), Concept of charge density (Linear, surface and volume), Electric (Electrostatic) field, Electric field intensity, Electric lines of force, Electric flux, Electric field due to a system of point charges by principle of superposition, Electric field due to system of three and N charges, Electric potential, Electric potential as line integral of vector field, Electric potential due to a point charge. Problems based on these topics.

Unit 3: Gauss law and Electric dipole **(06 L, 06 M)**

Gauss law (Statement and Proof), Applications of Gauss law – Electric field due to uniformly charged spherical shell, infinite line of charge, plane charged sheet, charged conductor and point charge, Electric dipole, Electric dipole moment, Electric potential due to an electric dipole. Problems based on these topics.

Unit 4: Current Electricity **(10 L, 10 M)**

Electric current and current density, Kirchoff's laws, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem, Electric power, Joule's law. Problems based on these topics.

Reference Books:

1. Vector Analysis by Dipak Chatterjee, Prentice-Hall of India Pvt. Ltd.
2. Mathematical Physics by B.S. Rajput, Pragati Prakashan
3. Electricity and magnetism by Edward Purcell, McGraw Hill Education
4. Introduction to electrodynamics by David Griffith, Pearson Prentice Hall
5. A textbook of electrical technology vol. 1 by B.L. Theraja and A.K. Theraja, S. Chand publication.
6. Electricity and Magnetism by D. C. Tayal, Himalaya Publishing house.
7. Electricity and Magnetism by Edward M. Purcell, McGraw-Hill Education.
8. Electricity and Magnetism by J.H. Fewkes& J. Yarwood. Vol. I, Oxford Univ. Press.
9. Electricity, Magnetism and Electromagnetic Theory by S. Mahajan and Choudhury, Tata McGraw Hill.

Course Code: PH-113

Course Title: Laboratory-I

Course Code: PH-113	**Course Category:Core Course (DSC)**
Course Title: Laboratory-I	**Type: Practical**
Total Contact Hours: 60 (4/week)	**Course Credits: 02**
College Assessment (CA) Marks: 20 Marks	**University Assessment (UA): 30 Marks**
Course Objectives • To learn concepts in mechanics through experiments • Understand different ways to measure a single physical quantity	
Course Outcomes:On successful completion of this course students will be able to: • Understand the concepts of errors and their estimation. • Judge pros and cons in different ways to measure a single physical parameter	

List of Experiment:

1) Calculation of errors from given data.
2) Measurements of length (or diameter) using vernier caliper, screw gauge and travelling microscope and find out the most probable answer with error in it.
3) Determine the acceleration due to gravity 'g' of an object falling freely using Kinematic equation
4) To determine 'g' by Bar Pendulum.
5) To determine 'g' by Kater's Pendulum.
6) To determine 'g' and velocity for a freely falling body using Digital Timing Technique
7) To determine the restoring force per unit extension of a spiral spring by statisticaland dynamical methods and also determines the mass of the spring.
8) To study the Motion of a Spring and calculate (a) Spring Constant (b)Value of 'g'
9) To determine the Moment of Inertia of a Disc.
10) To determine the Moment of Inertia of a Flywheel.
11) To study the AC and DC, analog and digital, Voltmeter and Ammeter.
12) Use of analog/ digital Multimeter to measure resistance, voltage and current: Understanding resolution, range, uncertainty
13) Verification of Kirchhoff's laws.
14) Verification of Thevenin's theorem.

- Any eight experiments are to be performed. New experiments can be added to this list with permission from BOS (Physics)

Reference Books:

1) Advanced Practical Physics for students by B.L. Flint and H.T. Worsnop, Asia Publishing House.
2) Practical Physics by R. K. Shukla, Anchal Srivastava, New Age International.
3) Advance Practical Physics by S. P. Singh, Pragati Prakashan.
4) Practical Physics: Gupta and Kumar, Pragati Prakashan Meerut
5) University Practical Physics by D. C. Tayal, Himalaya Publishing House.
6) Advance Practical Physics by S. P. Singh, Pragati.
7) Practical Physics by Gupta and Kumar, Pragati Prakashan Meerut
8) University Practical Physics by D. C. Tayal, Himalaya Publishing House

Course Code: PH-114

Course Title: Understanding Home ElectricSupply

Course Code: PH-114	**Course Category:Minor Course (MIN)**
Course Title: Understanding Home Electric Supply	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA) Marks: 20 Marks	**University Assessment (UA): 30 Marks**
Course Objectives: • **To understand generation and transmission of electric energy to utility.** • **To understand different components involved in a typical home electric supply.** • **To understand a typical home electric supply plan, billing system and safety tips.**	
Course Outcomes: On completion of the course students will be able to • Explain home electric supply from generation to utility. • Understand different components of such a system and significance of their specifications. • Create a typical home electric supply plan for some common loads.	

Course Content:

Unit 1: Generation and Transmission of Electricity (10 L, 10 M)

Generation: Concept of power and energy, Concept of AC and DC electricity, use of DC and AC electricity, unit of measuring electric energy, Generation of AC electricity, different types of power generation methods: thermal, hydel, nuclear, DC power generation from solar plants, DC to AC conversion

Transmission: Why AC power is used for transmission, Single phase, triple phase. Need of high voltage transmission, different steps from power plant to utility, step up and step-down transformers, nature of power supply available at utility.

Unit2: Components in Home Electric Supply (8 L, 8 M)

Need, types, specifications and symbol of different components: Wires, switches, MCB, distribution boxes, sockets, holders, electric meter, regulators, fuses, etc

Concept of phase, neutral and earthing, importance of earthing, meaning of proper earthing, how it is tested, results of improper earthing, methods of good earthing.

Unit3: A typical house electric plan and safety tips (8 L, 8 M)

Single Phase Wiring diagram for a typical house: how supply from electric distribution company is distributed to different equipment, inclusion of inverter in home-electric supply.

Few typical examples of home electric plan with common electric loads.

Possible hazards in handling ac electricity, safety tools, precautions to be taken.

Unit4: Electric meters, billing system, conservation tips (4 L, 4 M)

Introduction to ac electric meters, meaning of a 'unit', concept of 'electric load', how to estimate monthly electric energy utilization, understanding billing system and corresponding rules and regulations, simple energy conservation tips.

Reference Books:

1) Electric Power Generation, Transmission and Distribution, by S.N. SINGH, Prentice Hall India Learning Private Limited
2) Home Electrical Wiring: A Complete Guide to Home Electrical Wiring Explained by a Licensed Electrical Contractor by David W Rongey
3) A Guide to the Home Electric System: Residential Handbook of Electric Service (Home Guide Series) Kindle Edition by Paul Wonning, Mossy Feet Books
4) Tech-Design Residential Wiring Module Guide by Lab-Volt Systems, Inc.

Course Code: PH-115

Course Code: PH-115	**Course Category:Minor Course (MIN)**
Course Title: Laboratory on PH-114 (Understanding Home Electric Supply)	**Type: Practical**
Total Contact Hours: 60 (4/week)	**Course Credits: 02**
College Assessment (CA) Marks: 20 Marks	**University Assessment (UA): 30 Marks**

Course Objectives:

- To make students familiar with different components used in home electric supply systems.
- To make students know various equipment used in installation/testing of electrical appliances.
- To make them capable of drawing a simple home electric supply system.

Course Title: Laboratory on PH-114 (Understanding Home Electric Supply)

Course Outcomes:

- On successful completion of this course, students will be able to identify different components in home electric supply system and explain their specifications,
- Use different equipment used in installation/testing of electrical appliances.
- Apply the knowledge gained to draw a line drawing for home electric supply for given loads.

List of Experiment:

1. To study different relays, Miniature Circuit Breakers and fuses and their specifications.
2. Study of type of wires and their specifications.
3. Measurement of electrical energy and electric power of given electric bulb.
4. Introduction of electrical tools used in electrical circuit making.
5. Circuit to control lamps by two switches (Staircase wiring).
6. Study of electricity billing.
7. Study of different types of switches and their specifications.
8. To study soldering and de soldering techniques.
9. Measurement of ac supply parameters.
10. Introduction of symbols used in electrical wiring.
11. Testing of earthing in a utility.
12. Use of measuring instruments and safety precautions.
13. Safety measures and introduction of tools used in home wiring.
14. A simple residential home wiring using necessary electrical components.
15. To make single phase house wiring using given wiring diagram.

- Any eight experiments are to be performed. New experiments can be added to this list with permission from BOS (Physics)

Reference Books:

1) Electric Power Generation, Transmission and Distribution by By S.N. SINGH
2) Home Electrical Wiring: A Complete Guide to Home Electrical Wiring Explained by a Licensed Electrical Contractor by David W Rongey
3) A Guide to the Home Electric System: Residential Handbook of Electric Service (Home Guide Series) Kindle Edition by Paul Wonning
4) Tech-Design Residential Wiring Module Guide by Lab-Volt Systems, Inc.
5) Fundaments of electric circuit by Charles K Alexander and Matthew N Osadiku
6) Electrical circuits fundamentals by Thomas L Floyd
7) Fundaments of electrical circuit theory by D Chattopadhyaya

8) Practical manual of industrial training institute.
9) Laboratory manual of Bharat University Dept. Of electrical engineering.

Course Code: PH-116

Course Title: Energy

Course Code: PH-116	**Course Category: Open Elective (OE)** (To be chosen compulsorily from faculty other than that of the Major)
Course Title: Energy	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA) Marks: 20 Marks	**University Assessment (UA): 30 Marks**
Course Objectives: • To know about the Indian and World Energy Scenario • To know about the Renewable and Non-renewableEnergy Sources • To understand the various modes of Energy Storage	
Course Outcomes:	

On completion of the course students will be able to:

- Understand the availability of Renewable and Non-renewable Energy Sources.
- Understand the significance of renewable energy sources and energy storage.
- Make appropriate choice of energy source depending on usage pattern.

Course Content:

Unit 1: Energy and Energy scenario (10 L, 08 M)

What is power, what is energy, need of power and energy, applications of energy in day-to-day life, electrical appliances, and their power specifications, energy consumption based on power and time of usage.

Indian and World Scenario: Pattern of energy consumption in India and the World, Energy needs of growing economy, Pattern of energy production in India and the World, Long Term Energy Scenario, Energy Pricing, Energy Sector Reforms.

Unit 2: Non-renewable Energy Sources (08 L, 07 M)

Fossil Fuel: Coal, Oil, Gas, Nuclear Resources: Indian and world reserves; Power plants based on these resources: Thermal Power Plants, Gas based Power plants, Nuclear Power Plants; Comparison of these plants in terms of their pros and cons.

Unit 3: Renewable Energy Sources (08 L, 10 M)

Hydel Energy, Solar Energy, Wind Energy, Energy from Biomass and biogas, Hydrogen Energy, Fuel Cell: Basic principle of energy production from these sources, advantages, and limitations of renewable energy sources.

Unit 4: Energy Storage and Fuel cells (04 L, 05 M)

Importance of electrical energy storage, batteries: Lead acid battery, Nickel-cadmium battery, introduction to supercapacitors.

Fuel cells: Basic principle of working, applications, pros and cons of fuel cells, hydrogen storage.

Reference Books:

1) A document by Bureau of Energy Efficiency, India
   Link: https://beeindia.gov.in/sites/default/files/1Ch1.pdf
2) Generation Of Electrical Energy by Gupta B. R.S., Chand & Co Ltd
3) Non-Conventional Energy Sources by G. D. Rai, Khanna Publication.
4) Non-Conventional Energy Resources by B. H. Khan, McGraw Hill Publishers. Aubrecht, Gordon J., Energy, Second Edition, Prentice Hall, 1994.
5) Solar Energy: Principles of Thermal Collection and Storage by S.P. Sukhatme, Tata Mc Graw-Hill
6) Solar energy by M P Agarwal, S Chand and Co. Ltd.
7) Solar Energy: Resource Assessment Handbook by Dr. P Jayakumar, APCTT

8) Introduction to Photovoltaics by J. Balfour, M. Shaw and S. Jarosek, Jones & Bartlett Publishers

WEBSITES FOR REFERENCE

1. http://www.energy.gov Module 4: Fuel cell technology
2. http://www.fuelcelltoday.com Fuel cell basics
3. http://en.wikipedia.org/wiki/Renewable_energy

Course Code: PH-117

Course Title: Physics Laboratory Skill

Course Code: PH-117	**Course Category: Skill Enhancement Course (SEC)**
Course Title: Physics Laboratory Skill	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA) Marks: 20 Marks	**University Assessment (UA): 30 Marks**
Course Objectives: • To expose the students to various physics laboratory skills. • To make students ready to work perfectly in physics laboratory.	
Course Outcomes: On completion of the course students will be able to	

- Assess the possible sources of error in the measurements.
- Analyze observed data.
- Present the observed data in a scientific way.
- Work in a physics laboratory safely.

Course Content:

1. **Basic measurement skills: (08 L, 08 M)**
    a. Concept of error, types of errors, sources of errors, methods to avoid errors, importance of taking multiple readings, choice of range during measurement,
    b. Demonstration of above skills by using equipment like vernier caliper, micrometer screw gauge, measuring cylinder, travelling microscope etc.
2. **Data Analysis skills (08 L, 08 M)**
    a. Concept of accuracy, precision, resolution, least count, statistical methods of data analysis: mean, standard deviation, most probable value, estimation of error, care about units during calculations.
    b. Demonstration of above skills by using some dummy data of any experiment like calculation of value of g, using simple pendulum
3. **Data presentation skills (08 L, 08 M)**
    a. Laboratory notebooks writing tips, to what significant figure the measurement/result is to be reported, presenting data in the form of graph: selection of variables, selection of units, selection of scale, types of graphs, how to write a journal sheet.
    b. Demonstration of above skills by using some dummy data of any experiment like calculation of value of g, using simple pendulum and presenting an ideal journal sheet.
4. **Laboratory safety skills (06 L, 08 M)**
    a. A guide to equipment handling and care, precautions to be taken while handling mechanical, electrical, and electronic equipment, precautions to be taken while handling chemicals.
    b. Demonstration of the above skills by examples like precautions to be taken while handling multimeter, CRO for measurement of electrical parameters, handling bar magnets, electromagnets, strong acids etc.

Reference Books:

1. Modern Electronic Instrumentation and measurement Techniques by Albert D. Helfrick and William D. Cooper, PHI
2. Introduction to Measurements and Instrumentation by Arun K. Ghosh, PHI
3. Laboratory Safety Handbook by Fens Laboratory Safety Team, Sabanci University

Web references:

1. https://ncert.nic.in/textbook/pdf/kest104.pdf

Semester – II

Detailed Syllabus

for

F. Y. B. Sc., Physics

Course Code: PH-121

Course Title: Magnetism & Electromagnetism

Course Code: PH-121	**Course Category:Core Course (DSC)**
Course Title: **Magnetism & Electromagnetism**	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA) Marks: 20 Marks	**University Assessment (UA): 30 Marks**
Course Objectives: • To impart knowledge of basic concepts in Magnetism & Electromagnetism. • To provide the knowledge and methodology necessary for solving problems in Physics. • The course also involves the related experiments based on the theory.	
Course Outcomes: On completion of the course students will be able to • Apply the concept and knowledge of Magnetism & Electromagnetism to understandand solve real life problems.	

- Understanding of the course will create scientific temperament.

Course Content:

Unit1: Magnetostatics **(10 L, 10 M)**

Force on moving charge, Lorentz force equation and definition of B, force on straight conductor carrying current in uniform magnetic field, magnetic dipole moment, Biot-Savart's law, application in magnetic field of straight and circular loop carrying current, Amperes law, application in solenoid, Magnetization Current, Magnetization vector.

Unit2: Electromagnetism **(10 L, 10 M)**

Electromagnetic induction, Faraday's law, electromotive force, E=E,dr, integral and differential forms of Faraday's law, self and mutual inductance, the wave equation satisfied by E and B, self and mutual inductance, transformer, Energy in a static and magnetic field, Maxwell equation Poynting vector

Unit 3: Magnetic properties of matter **(10 L, 10 M)**

Magnetization vector (M), magnetic intensity (H), magnetic susceptibility and permeability, relation between B, H, M, Ferromagnetism, B-H curve and Hysteresis, types of magnets: permanent and electromagnets: their types and properties

Reference Books:

1. Electricity and magnetism by Edward Purcell, McGraw Hill Education
2. Introduction to electrodynamics by David Griffith, Pearson Prentice Hall
3. Electrodynamics by Dr. S. L. Gupta, Dr. V. Kumar, Dr. S.P. Singh, Pragati Prakashan
4. Electromagneticby B. B. Laud, Wiley aster Ltd., New Delhi
5. Foundation of Electromagnetic field by John R. Reitz and Fredrick J., Narossa Publishing House, New Delhi
6. Fundamental Electricity and magnetism: F. Kip, Mc Graw hill Kogakusha Ltd. (2nd Edition).

Course Code: PH-122

Course Title: Ancient Indian Astronomy

Course Code: PH-122	**Course Category: Major Specific IKS (DSC)**
Course Title: Ancient Indian Astronomy	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA) Marks: 20 Marks	**University Assessment (UA): 30 Marks**
Course Objectives: • To introduce the students to developments in Ancient Indian Astronomy • To reveal the scientific base of Ancient Indian Astronomy. • To understand the use of knowledge of astronomy in daily life.	
Course Outcomes: On completion of the course students will be able to:	

- Understand the scientific base of Ancient Indian Astronomy and the developments in it.
- Apply the knowledge of basic concepts in Astronomy in daily life.

Course Content:

Unit 1: Introduction to Ancient Indian Astronomy (10 L, 10 M)

Astronomical Practices in India: Observational Astronomy: The principal and applications of different instruments (Yantras), Jantar Mantar or Raja Jai Singh Sawal.

Some Ancient Indian Astronomers and their work: Āryabha□□a, Varāhamihira, Bhāskara I, Brahmagupta, Bhāskara II, Kerala School of Astronomy, Later Developments

Unit 2: Some concepts in Ancient Indian Astronomy(10 L, 10 M)

(a) Yuga system, Mahayuga& Kalpa system, ayanas, months, tithis and seasons, time units, sun and moon's motion, planet position, ayanachalana, zero-precision year, katapayaadi system, Indian nakshatra system: Concept of Nak□atra, division of the ecliptic and motion of the Sun along it

(b) The Indian Calendar System, Elements of the Indian Calendar Aryabhatiya and the Siddhantic ,Adhikamāsas. Solar and Luni-Solar systems Pachanga, Division of the celestial sphere/ecliptic, significance by pointing out their basis, five elements that constitute Pachanga– and their astronomical significance, computation of elements in a Pachanga.

Unit 3: Applications of Astronomy in daily life(10 L, 10 M)

Applications in Yajnya (in ancient times), Agriculture, meteorology, Ayurveda, Architecture, Navigation.

Reference Books:

1. Indian Astronomy-A Source Book by B.V. Subbayappa and K.V. Sarma, Nehru Cenre, Mumbai
2. Hindu Astronomy by G.R. Kaye, Archeological Survey of India
3. Origin and Growth of Astronomy in Indian Context by M N Vahia, Nisha Yadav, Srikumar Menon
4. The story of Astronomy in India by Chander Mohan..an online book.

Course Code: PH-123

Course Title: Laboratory-II

Course Code: PH-123	**Course Category: Core Course (DSC)**
Course Title: Laboratory-II	**Type: Practical**
Total Contact Hours: 60 (4/week)	**Course Credits: 02**
College Assessment (CA) Marks: 20 Marks	**University Assessment (UA): 30 Marks**
Course Objectives: • To create and withstand a community of learning in which students acquire knowledge and learn to apply with due consideration for ethical, ecological and monetary issues. • To provide knowledge-based services to satisfy the needs of society and the industry by providing hands on experience in core field.	

- To acquaint the students to experiment, analyze, interpret in the field of basic Physics.

Course Outcomes:

- Students would perform basic experiments related to electricity and magnetism also get familiar with various measuring instruments.
- Student would learn the importance of accuracy of measurements.
- It gives an opportunity for the students to learn about one of the fundamental interfaces of electricity and magnetism.
- Students would gain practical knowledge about electricity and magnetism and measurements such as: Resistance, Voltage, current etc.

List of Experiment

1) Verification of Norton's theorem.
2) Determination of time constant of LR circuit.
3) Verification of maximum power transfer theorem.
4) To verify Joule's law.
5) To compare capacitances using De Sauty's bridge.
6) To study charging and discharging of condenser through resistor.
7) To study characteristics of series RC circuit.
8) Study of transformer
9) To determine turn ratio and efficiency of transformer.
10) To determine angle of prism.
11) To determine unknown wavelengths using spectrometer.
12) Study of transformer: Efficiency determination
13) To determine Self-Inductance of a Coil by Rayleigh's Method.

- Any eight experiments are to be performed. New experiments can be added to this list with permission from BOS (Physics).

Reference Books:

1) Textbook of Practical Physics by H. P. Shrivastava
2) B Sc Practical Physics by M. N. Srinivasan
3) University Practical Physics by D. C. Tayal
4) Practical Physics by Gupta and Kumar

Course Code: PH-124

Course Title: Understanding SolarThermal & Photovoltaic System

Course Code: PH-124	**Course Category:Minor Course (MIN)**
Course Title: Understanding Solar Thermal & Photovoltaic System	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA) Marks: 20 Marks	**University Assessment (UA): 30 Marks**
Course Objectives:	

- To understand different applications of solar energy.
- To understand the methods and principles of the conversion of solar energy into thermal and electrical energy.
- Understand the common instruments used for converting solar energy in other forms.

Course Outcomes: On completion of the course students will be able to:

- Understand the nature of solar energy and its applications.
- Understand the methods and principles of the conversion of solar energy in thermal and electrical energy.
- Get an overview of different terminologies used in solar thermal and photovoltaic systems.
- Make a proper choice of solar energy technology depending on application/requirement.

Course Content:

Unit 1: Understanding solar energy: (08 L, 14 M)

Nature of solar radiation, availability of solar radiation, geographical distribution, measurement of solar radiation.

Unit 2: Solar to thermal energy: Applications (08 L, 14 M)

Conversion of solar energy to thermal energy, different ways, different applications: solar water heaters, solar dryers, solar cookers.

Unit 3: Solar to Electrical Energy (06L,10 M)

Introduction to solar photovoltaics, cell-module-array, power production: from milliwatt to megawatt, terminologies used, types of solar modules.

Unit 4:Solar photovoltaic applications: Stand Alone System (04 L, 6 M)

Example of standalone system: Solar lantern, explanation using block diagram.

Unit 5:Solar photovoltaic applications: Grid-connected System (04 L, 6 M)

Introduction, block diagram, role of each component.

Reference Books:

1. Solar Energy by S P Sukhatme, J K Nayak, McGraw Hill Education.
2. Solar thermal Energy by Sreekumar, New Age International Private Limited.
3. Off-Grid PV Systems: Design and Installation, GSES, First Edition International.
4. Grid-Connected PV Systems Design and Installation – International version, GSES

Course Code: PH-125

Course Title: Laboratory on PH-124 (Understanding Solar, Thermal & Photovoltaic System)

Course Code: PH-125	**Course Category:Minor Course (MIN)**
Course Title: Laboratory on PH-124 (Understanding Solar, Thermal &Photovoltaic System)	**Type: Practical**

Total Contact Hours: 60 (4/week)	**Course Credits: 02**
College Assessment (CA) Marks: 20 Marks	**University Assessment (UA): 30 Marks**
Course Objectives: • To demonstrate how simple solar energy measurement can be done. • To demonstrate the working of some simple solar energy equipment.	
Course Outcomes: On completion of the course students will be able to • Use simple methods for measurement of some parameters related to solar energy. • Apply the knowledge gained for constructing some simple solar energy systems.	

List of Experiment:

1. Calculation of different angles related to the position of sun.
2. Calculation of angle of incidence of solar radiation on horizontal surface
3. Measurement of solar radiation as a function of tilt angle using a simple instrument or mobile app.
4. Measurement of solar energy availability over a period.
5. Study of solar cell voltages in series and in parallel
6. Study of solar cell currents in series and in parallel
7. Study of different types of solar cookers: Box type and parabolic type.
8. Performance of box type of solar cooker.
9. Study of different types of solar water heating systems: FPC based and ETC based.
10. Study of simple stand alone solar photovoltaic system: understanding components in it and their use.
11. Study of different components used in a typical solar photovoltaic system: module, inverter, charge controller, batteries, distribution boxes, fuses etc.

Any eight experiments are to be performed. New experiments can be added to this list with permission from BOS (Physics)

Reference Books:

1) Solar Energy by S P Sukhatme, J K Nayak, McGraw Hill Education.
2) Solar thermal Energy by Sreekumar, New Age International Private Limited.
3) Off-Grid PV Systems: Design and Installation, GSES, First Edition International.
4) Grid-Connected PV Systems Design and Installation – International version, GSES

Course Code: PH-126

Course Title: Materials in Today's World

Course Code: PH-126	**Course Category:Open Elective Course(OE)**
Course Title: Materials in Today's World	**Type: Theory**
Total Contact Hours: 30 (2/week)	**Course Credits: 02**

College Assessment (CA) Marks: 20 Marks	University Assessment (UA): 30 Marks

Course Objectives: This course is intended to provide an introduction to

- The various states of matter along with a distinction between matter and materials
- The development of materials over the ages
- The classification of materials and their properties
- Advanced class of materials and their applications

Course Outcomes: On completion of the course students will be able to

- Define the possible states of matter and their basic properties.
- Explain the chronological development that materials have gone through for achieving their present stage
- Compare and classify materials and their properties
- Define advanced materials and their fascinating behavior

Course Content:

Unit 1: States of Matter **(04 L, 04 M)**

Overview of the different states of matter: Solid, Liquid, Gas, Plasma, Basic properties of solid state: Structural, electrical, optical, magnetic, chemical.

Unit 2:History and Evolution of Materials **(06L, 06 M)**

Materials: Drivers of human civilization, Development of materials: Stone age, Copper age, Bronze age, Iron age, Explanation with examples to mark this development.

Unit 3:Classification of Materials **(10 L, 10 M)**

Metals & Alloys, Non-Metals, Ceramics, Polymers, Composites etc. with examples and applications, Performance, Composition & Structure; Physical and Chemical properties; Processing & Synthesis of various classes of materials.

Unit 4:Trends in Advanced Materials **(08 L, 10 M)**

Breakthroughs in Materials Development, overview of Advanced Materials and their applications: Semiconductors, Biomaterials, Smart Materials (Materials of the Future), Nano-structured Materials.

Reference Books:

1) Advanced Materials: Classification, properties, applications and processing techniques of composites by Lokesh KS, Prasad P, Grin Verlag
2) Nanotechnology: Principles and Practices by Sulabha K. Kulkarni, Springer
3) Material Science by S. L. Kakani, Amit Kakani. New Age International Publishers.
4) Material Science by G.K.Narula and K.S.Narula, Tata McGraw Hill.

5) Materials Science and Engineering: An introduction by William D. Callister, Jr. and David G. Rethwisch, John Wiley & Sons, Inc.
6) Understanding Materials Science: History, Properties, Applications by Rolf E. Hummel, Springer-Verlag, New York
7) Essentials of Materials Science and Engineering by Donald R. Askeland and Pradeep P. Fulay, Cengage learning, Canada

Course Code: PH-127

Course Title: Computational Physics

Course Code: PH-127	**Course Category: Skill Enhancement Course**
Course Title: Computational Physics	**Type: Theory**

Total Contact Hours: 30 (2/week)	**Course Credits: 02**
College Assessment (CA) Marks: 20 Marks	**University Assessment (UA): 30 Marks**
Course Objectives: • Toimpartknowledgeofbasicconcepts incomputer programming. • Toprepare algorithms and flowcharts for solving problems. • To design, code and test simple programs in C for various problems in Physics.	
Course Outcomes: On completion of the course students will be able to • Applytheconceptandknowledgeo f basic programming to prepare programs for basic problems in Physics. • Visualize data and analyze it using graphical methods. • Improve scientific and computational temperament.	

Course Content:

Unit 1: Algorithms, Flowchart, and introduction to C Language: (6 L, 06 M)

Algorithms, Flowcharts, Writing algorithm and flowcharts for simple exercises. Overview of C: Basic structure of C program, Variables and Data Types, Constants, Operators, and expressions. Managing Input and Output Operations:scanf(), printf(),.

Explanation of above concepts using 5 simple programs.

Unit 2: Decision making and Branching statements (6 L, 06 M)

Simple if statement, if…else statement, nested if…else statement, switch statement. Decision making and looping: While statement, do statement and for statement, unconditional branching: break, continue, return. Self-Study Component: Execution of c program, Evaluation of Expression.

Explanation of above concepts using 5 simple programs.

Unit 3:Arrays (6 L, 06 M)

Declaration and initialization of 1D arrays, 2D- declaration and initialization of 2D arrays, operations on strings without using built-in functions. Self-Study Component: Generate 1D and 2D array.

Explanation of above concepts using 5 simple programs.

Unit 4: User-defined Functions: (4 L, 04 M)

Elements of user-defined functions, categories of functions, parameter passing technique- call by value and call by reference, structure, and unions.

Explanation of above concepts using 5 simple programs.

Unit 5:Gnuplot (08 L, 08 M)

Introduction, basic gnuplot commands: simple plots, plotting data from a file, saving, and exporting plotted functions and data for graphical visualization. Mathematical expressions, Built in functions, User-defined variables, and functions. Curve fitting: Linear least square fitting of data.

Programs (indicative only):

- Plotting data from the output file.
- Plotting functions (inbuilt), histograms, and graphs.
- Overlapping plots.
- Least square fit of data points.

Reference Books:

1) Let Us C by Yashwant Kanetkar, BPB Publications.
2) Gnuplot in Action Understanding data with Graphs by Philipp K. Janert, Manning Publications company.
3) Theory and problems of programming with C-Schaum series by Byron S Gottfried.
4) Graphics under C by Yashavant Kanetkar- BPB Publications-New Delhi.
5) Programming in C by Stephen G. Kochan, CBS Publishers and Distributers Delhi
6) Computational Physics by V K Mittal, RC Verma and SC Gupta-Ane Books India.
7) Numerical methods with Computer programs in C++ by Pallab Ghosh-PHI.
8) Programming in C by Reema Thareja, Oxford University Press.
9) Schaum's outlines, Programming with C by Byron Gottfried, Tata McGraw-Hill Publication.

Course Code: PH-128
Course Title: Laboratory onComputational Physics

Course Code: PH-128	Course Category:Skill Enhancement Course

Course Title: **Laboratory on Computational Physics**	**Type: Laboratory**
Total Contact Hours: 60 (4/week)	**Course Credits: 02**
College Assessment (CA) Marks: 20 Marks	**University Assessment (UA): 30 Marks**

Course Objectives:

- Toimpartknowledgeofbasicconcepts incomputer programming.
- To design, code and test simple programs in C for various problems in Physics.
- Learn how to plot functions and plot a data using gnuplot.

Course Outcomes:

- Applytheconceptandknowledgeo f basic programming to prepare program for basic problems in Physics.
- Student will be able to visualizing data and analyzing it using graphical method.
- Understandingofthecoursewillcreatescientific and computational temperament.

Course Content:

1) Write a program that converts degree Fahrenheit (F) to degree Celsius (C) using the formula

$$C = \frac{(F - 32)}{1.8}$$

2) Write a program to generate and display a table of n and n^2, for integer values of n ranging from 1 through 10. Be sure to print appropriate column headings.
3) Write a program to generate and print a table of the first 10 factorials.
4) Write a program using if-else statement which determines whether an integer value typed in by the user is even or odd, and then displays an appropriate message at the terminal.
5) Use of switch operation to write a program to evaluate simple expressions of form like addition, subtraction and multiplication.
6) Write a Program to calculate and display the volume of a CUBE having its height (h=10cm), width (w=12cm) and depth (8cm).
7) Write a C program to calculate area and circumference of a circle.
8) Write a program to find the largest of three numbers using ternary operators.
9) Write a program to print whether a given number is even or odd.
10) Write a program to insert 5 elements into an array and print the elements of the array.
11) Write a Program to perform addition of all elements in Array.
12) Write a Program to multiply two 3 X 3 Matrices.
13) Write a program to find the roots of quadratic equation.
14) Write a Program to perform addition of all elements in Array.
15) Write a program for addition of two matrices of any order in C.

16) Write a program to add, subtract, multiply and divide two integers using user-defined type function with return type.
17) Write a program to find biggest among three numbers using pointer.
18) Write a program to find the sum of all the elements of an array using pointers.
19) Write a program to multiply two 2 X 2 matrix using pointers.
20) Define a structure "complex" (typedef) to read two complex numbers and perform addition, subtraction of these two complex numbers and display the result.
21) Write a program using recursive functions to calculate the factorial of a positive integer.
22) Write a program to read a series of items that are present in a file and display the data in columns or tabular form using C Programming.
23) Write a program using C for Sorting numbers in ascending descending order using Bubble sort or Sequential sort.
24) Write a program to plot a circle of a given radius and center using C or Gnuplot.
25) Write simple scripts for Gnuplot and use them through the call command.
26) Write a program using Gnuplot for linear least square fit of data points.
27) Write a program using Gnuplot for plotting functions (inbuilt) graphs.
28) Write a program using Gnuplot for generation of pseudo-random numbers using inbuilt functions and plot frequency distribution.
29) Write a program using Gnuplot for plotting data from the output file created by a c-program.
30) Write a program using Gnuplot for 3-D plot for any physical equation.

Note: Perform at least 08 experiments from following.

Reference Books:

1) Let Us C by Yashwant Kanetkar, BPB Publications.
2) Gnuplot in Action Understanding data with Graphs by Philipp K. Janert, Manning Publications company.
3) Theory and problems of programming with C-Schaum series by Byron S Gottfried.
4) Graphics under C by Yashavant Kanetkar- BPB Publications-NewDelhi.
5) Programming in C by Stephen G. Kochan, CBS Publishers and Distributers Delhi
6) Computational Physics by V K Mittal, RC Verma and SC Gupta-Ane Books India.
7) Numerical methods with Computer programs in C++ by Pallab Ghosh-PHI.
8) Programming in C by Reema Thareja, Oxford University Press, 2016.
9) Schaum's outlines, Programming with C by Byron Gottfried, Tata McGraw-Hill Publication.