UG (CBCS) SEMESTER PATTERN SYLLABUS

I TO VI SEMESTERS
## B.Sc. (Physics) (Non-Mathematics Combinations)

**Scheme of instruction and examination to be followed w.e.f. 2016-2017**

<table>
<thead>
<tr>
<th>Semester</th>
<th>Paper</th>
<th>Title of course</th>
<th>Credits</th>
<th>Hrs</th>
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<tbody>
<tr>
<td>I</td>
<td>I</td>
<td>Paper-I: Mechanics &amp; Properties of Matter</td>
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<td>Paper-II : Waves &amp; Oscillations</td>
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<td>Practical III: Optics</td>
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<td>Paper-IV : Thermodynamics &amp; Radiation Physics</td>
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<td>V</td>
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<td>Paper VI: Modern Physics &amp; Medical Physics</td>
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<td>Paper VII (A) : Electronics</td>
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<td>Cluster Elective-I (Cluster-801) **PHY(NM) 801 &amp; PHYNMP 801</td>
<td>Paper VIII-A-1: Introduction to Microprocessors and Microcontrollers</td>
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<td>Practical : A-1: Introduction to Microprocessors and Microcontrollers</td>
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### Cluster Elective-II (Cluster-802) **PHY(NM) 802 & PHYNMP 802**

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<td>VIII-B1</td>
<td>Fundamentals of Nanoscience</td>
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<tr>
<td>Practical VIII-B1</td>
<td>Fundamentals of Nanoscience</td>
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<tr>
<td>VIII-B2</td>
<td>Synthesis and Characterization of Nanomaterials</td>
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<td>VIII-B3</td>
<td>Applications of Nanomaterials and Devices</td>
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<td>Practical VIII-B3</td>
<td>Applications of Nanomaterials and Devices</td>
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### Cluster Elective-II (Cluster-803) **PHY(NM) 803 & PHYNMP 803**

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<td>Solar Thermal and Photovoltaic Aspects</td>
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<td>Solar Thermal and Photovoltaic Aspects</td>
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<td>VIII-C2</td>
<td>Wind, Hydro and Ocean Energies</td>
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<td>VIII-C3</td>
<td>Energy Storage Devices</td>
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<td>Practical VIII-C3</td>
<td>Energy Storage Devices</td>
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Work load: 60 hrs per semester 4 hrs/week

UNIT-I (12 hrs)
Mathematical Background
Scalars and vectors – vector addition - scalar and vector products of vector and their physical significance - vector calculus - gradient of a scalar point function - divergence and curl of vector.

Motion of system
Collisions - Elastic and inelastic collisions - Collisions in one and two dimension - Center of mass - Impact parameter - Scattering cross-section.

UNIT-II (12 hrs)
Mechanics of Rigid body
Rigid body, rotational kinematic relations - Rotational kinetic energy and moment of inertia - Parallel & Perpendicular axes theorems. Angular momentum of a particle - Torque and angular momentum for a system of particles - conservation of angular momentum - Elementary ideas about gyroscopic motion.

UNIT-III (12 hrs)
Central forces
Central force - Definition & examples - General Characteristics of central forces - Conservative nature of central force - Planetary motion - Keller’s laws - Newton’s law of gravitation from Keller’s law, Geostationary Satellite Motion - Uses of communication satellites.

UNIT-IV (12 hrs)
Fluid Flow
The flow of ideal fluids - Stream line motion - Equation of continuity - Bernoulli’s equation - Simple applications - Torricelli’s theorem - Venturimeter - Pitot’s tube - Viscosity and the flow of real fluids - Poiseuille’s equation.

UNIT-V (12 hrs)
Relativistic effects

REFERENCE BOOKS:
1. BSc Physics, Vol.1 - Telugu Academy, Hyderabad
2. Physics for Biology and Premedical Students – D.N. Burns & SGG Mac Donald
5. Properties of Matter - Brijlal & Subrmanyam, S. Chand & Co. 1982
Practical paper 1: Mechanics & Properties of Matter
Work load: 30 hrs per semester 2 hrs/week Minimum of 6 experiments to be done and recorded

1. Viscosity of liquid by the flow method (Poiseuille’s method)
2. Young’s modulus of the material of a bar (scale) by uniform bending
3. Young’s modulus of the material of a bar (scale) by non-uniform bending
4. Surface tension of a liquid by capillary rise method
5. Determination of radius of capillary tube by Hg thread method
6. Viscosity of liquid by Searle’s viscometer method
8. Determination of moment of inertia using Fly-wheel
10. Rigidity modulus of material of a wire-dynamic method (torsional pendulum)

Suggested student activities
Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab.

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Paper II: Waves & Oscillations  
(For Non-Maths Combinations)

II SEMESTER

Work load: 60 hrs per semester  
4 hrs/week

UNIT-I (12 hrs)

Oscillatory Motion
Simple harmonic motion-Equation of motion and solution- energy of simple harmonic oscillator-torsional pendulum-determination of n- Combination of Simple harmonic motions along a line and perpendicular to each other-Lissajous figures.

UNIT-II (12 hrs)

Damped Oscillators
Damped vibrations - Explanation and examples - Forced vibrations -Explanation and examples- Resonance examples -Sharpness of resonance- Q-factor- Volume Resonator- Determination of frequency of a given tuning fork.

UNIT-III (12 hrs)

Wave Motion
Progressive waves-Equation of a progressive wave-sinusoidal waves-Velocity of waves in elastic media-Standing waves-Transverse vibrations of stretched strings, overtones and harmonics. Sonometer verification of laws of transverse vibrations in a stretched string- beats (qualitative analysis only).

UNIT-IV (12 hrs)

Acoustics

UNIT-V (12 hrs)

Ultrasonics
Ultrasonics - properties of ultrasonic waves- production of ultrasonic waves by piezoelectric and magnetostriction methods- detection of ultrasonics - Applications of ultrasonic waves.

REFERENCE BOOKS
1. BSc Physics, Vol.1 -Telugu Academy, Hyderabad
2. Physics for Biology and Premedical Students –D.N. Burns & SGG Mac Donald
Work load: 30 hrs per semester 2 hrs/week Minimum of 6 experiments to be done and recorded

1. Volume resonator experiment
2. Determination of g by compound/bar pendulum
3. Simple pendulum normal distribution of errors-estimation of time period and the error of the mean by statistical analysis
4. Determination of the force constant of a spring by static and dynamic method.
5. Determination of the elastic constants of the material of a flat spiral spring.
6. Coupled oscillators
7. Verification of laws of vibrations of stretched string –sonometer
8. Determination of frequency of a bar –Melde’s experiment.
9. Study of a damped oscillation using the torsional pendulum immersed in liquid-decay constant and damping correction of the amplitude.
10. Formation of Lissajous figures using CRO.

Suggested student activities
Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab.

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Paper III: Optics  
(For Non- Maths Combinations)  
III SEMESTER

Work load: 60 hrs per semester  
4 hrs/week

UNIT –I (12 hrs)

Geometric optics
Aberrations in lenses-Chromatic Aberration-Achromatic Combination of lenses- 
Monochromatic defects - Spherical aberration- Astigmatism - Coma - Curvature and 
Distortion - Minimizing aberration.

UNIT-II (12 hrs)

Interference
The superstition principle- Condition for Interference- Classification of Interferences 
methods-.Interference with white light and appearance of Young’s interference fringes- 
Intensity in interference pattern- Lloyd’s single mirror- Interference due to plane parallel 
edge shaped films - Colours in thin films - Newton rings, Determination of wavelength of 
light-Michelson’s interferometer.

UNIT-III (12 hrs)

Diffraction
The Fresnel and Fraunhoffer diffraction phenomena-Fraunhoffer diffraction of single Slit 
normal incidence and oblique incidence - Resolving power -limits of resolution for telescopes 
and microscope- Fraunhoffer diffraction by double slit-Intensity-pattern-Diffraction grating-
Wavelength determination in Normal incidence and Minimum deviation.

UNIT-IV (12hrs)

Polarization
Types of Polarized light-Polarization by reflection, Brewster’s law- Dichroism the Polaroid- 
double refraction- the calcite crystal-the principal plane O and E rays-the Nicol Prism- Law 
of Mauls - the quarter wave plate and half wave plate-Plane, Circularly, elliptically polarized 
light-Production and analysis -Optical activity-Specific rotatory power - Polarimeter.

UNIT V: (12 hrs)

Holography & Fiber Optics
Holography: Basic principle of holography-Gabor hologram and its limitations- applications 
of holography. Introduction - different types of fibers- rays and modes in an optical fiber- 
fiber material- principles of fiber communication (qualitative treatment only)- applications.

REFERENCE BOOKS
1. BSc Physics, Vol.2, Telugu Academy, Hyderabad
2. Physics for Biology and Premedical Students –D.N. Burns & SGG Mac Donald
Practical Paper III: Optics

Work load: 30 hrs 2 hrs/week

1. Determination of radius of curvature of a given convex lens-Newton’s rings.
2. Resolving power of grating.
3. Study of optical rotation —polarimeter.
4. Dispersive power of a prism.
7. Resolving power of a telescope.
8. Refractive index of a liquid-hallow prism
9. Determination of thickness of a thin fiber by wedge method
10. Determination of refractive index of liquid-Boy’s method.

Suggested student activities
Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab.

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Paper IV: Thermodynamics & Radiation Physics  
(For Non-Mathematics Combinations)  
IV SEMESTER

Work load: 60 hrs per semester  
4 hrs/week

UNIT-I (12 hrs)

Kinetic theory of Gases

UNIT-II (12 hrs)

Thermodynamics
The first law of thermodynamics - work done in isothermal and adiabatic changes - Reversible and irreversible process - Carnot’s cycle - Carnot’s theorem - Second law of thermodynamics - Kelvin’s and Clausius statements - Entropy - physical significance - Change in entropy in reversible and irreversible processes - Entropy and disorder - Entropy of universe.

UNIT-III (12 hrs)

Low temperature Physics

UNIT-IV (12 hrs)

Measurement, laws and theories of radiation

UNIT-V (12 hrs)

Thermoelectricity

REFERENCE BOOKS
1. BSc Physics, Vol.2, Telugu Academy, Hyderabad
2. Physics for Biology and Premedical Students – D.N. Burns & SGG Mac Donald
5. Electricity and Magnetism, N. Subramanyam and L. Brijlal, S. Chand & Co.
6. University Physics, HD Young, MW Zemansky, FW Sears, Narosa Publishers, New Delhi
Practical Paper IV: Thermodynamics & Radiation Physics

Work load: 30 hrs 2 hrs/week Minimum of 6 experiments to be done and recorded

1. Specific heat of a liquid – Joule’s calorimeter – Barton’s radiation correction
2. Thermal conductivity of bad conductor – Lee’s method
3. Thermal conductivity of rubber.
4. Measurement of Stefan’s constant.
5. Specific heat of a liquid by applying Newton’s law of cooling correction.
7. Thermo emf - thermo couple potentiometer
8. Thermal behavior of an electric bulb (filament/torch light bulb)
9. Measurement of Stefan’s constant - emissive method
10. Study of variation of resistance with temperature - thermistor.

Suggested student activities

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab.

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Paper V: Electricity, Magnetism & Electronics  
(For Non-Maths Combinations)  
V Semester 

Work load: 60 hrs per semester  
4 hrs/week 

UNIT-1 (12 hrs) 
Electric field and potential  
Coulomb’s law - Gauss’s law statement and its proof- applications of Gauss Law to uniformly charged sphere and an infinite conducting sheet of charge-Electrical potential - equi-potential surfaces- potential due to a point charge and charged spherical shell -Equi-potential surfaces with examples. 

UNIT-II (12 hrs) 
Capacitance and dielectrics  
Derivation of expression for capacity due to a parallel plate capacitor with and without dielectric and a spherical capacitor- Energy stored in a capacitor. Electric dipole moment Dielectrics with examples- effect of electric field-electric displacement D- Electric polarization P- permeability &susceptibility (Definitions only) - relation between D,E and P-Dipole moment of heart. 

UNIT-III (12 hrs) 
Current electricity  
Current and current density-drift velocity expression- Kirchhoff’s laws -statement and explanation and application to Wheatstone bridge- sensitivity of Wheatstone bridge- Carey-Foster’s bridge- experimental measurement of temperature coefficient of resistance- strain gauge-piezoelectric transducers (applications only). 

UNIT-IV (12 hrs) 
Electromagnetism  

UNIT-V (12 hrs) 
Basic Electronics  
PN junction diode, Zener diode and its V-I characteristics - half and full wave rectifiers - PNP and NPN transistors - Transistor configurations - CE transistor characteristics - h-parameters -Transistor as an amplifier. Number system- conversion of binary to decimal and vice versa- De Morgan’s theorems statements - logic gates - verification of truth tables- NAND and NOR gates as universal gates- Half and Full adders. 

REFERENCE BOOKS 
1. B.Sc., Physics, Vol.3, Telugu Academy, Hyderabad  
5. Principles of Electronics, V.K. Mehta, S.Chand & Co.,  
Practical Paper V: Electricity, Magnetism & Electronics

Work load: 30 hrs 2 hrs/week Minimum of 6 experiments to be done and recorded

1. Figure of merit of a moving coil galvanometer.
2. LCR circuit series/parallel resonance, Q factor.
3. Determination of ac-frequency –sonometer.
4. Verification of Kirchhoff’s laws and maximum power transfer theorem.
5. Field along the axis of a circular coil carrying current.
6. PN Junction Diode Characteristics
7. Zener Diode Characteristics
8. Transistor CE Characteristics- Determination of hybrid parameters
10. Verification of De Morgan’s Theorems.

Suggested student activities
Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab.

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UNIT-I (12 hrs)
Spectroscopy
Introduction - Zeeman Effect - Experimental verification - Paschen Back effect - Stark effect - Explanations (elementary ideas only) - Raman Effect, hypothesis, classical and quantum theory of Raman effect- Experimental arrangement for Raman Effect and its application.

UNIT-II (12 hrs)
Fundamentals of quantum mechanics

UNIT-III (12 hrs)
Matter Waves and uncertainty principle
Dual nature of radiation- de Broglie’s theory of matter waves- expression for wavelength, properties of matter waves- Davison and Germer experiment on electron diffraction - Discussion of results. Heisenberg’s uncertainty principle for position and momentum (x and p)- energy and time (E and t)- Experimental illustrations of uncertainty principal.

UNIT-IV: (12 hrs)
Radioactivity and radiation protection
The nature of radioactive emissions- law of Radioactive decay, derivation- decay constant-Half life and mean life periods - units of radio activity- Carbon and Uranium dating (explanation) - Age of earth and rocks - Radioactive isotopes as tracers - Natural radioactivity- Biological effects of radiation- Radiation monitors.

UNIT-V (12 hrs)
Crystal Structure
Diffraction of X-rays by crystals- Bragg’s law-experimental techniques- Laue’s method and powder diffraction method.
Superconductivity
Introduction - experimental facts- critical temperature - critical field - Meissner effect - Isotope effect - Type I and type II superconductors - applications of superconductors.

REFERENCE BOOKS
1. B.Sc Physics, Vol.4, Telugu Academy, Hyderabad.
Practical Paper VI: Modern Physics & Medical Physics

Work load: 30 hrs 2 hrs/week Minimum of 6 experiments to be done and recorded

1. e/m of an electron by Thomson method.
2. Determination of Planck’s Constant (photocell).
3. Verification of inverse square law of light using photovoltaic cell.
4. Study of absorption of α-rays.
5. Study of absorption of β-rays.
7. Determination of M & H.
8. Analysis of powder X-ray diffraction pattern to determine properties of crystals.

Suggested student activities

Student seminars, group discussions, assignments, field trips, study project and experimentation using virtual lab.

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B.Sc. PHYSICS SYLLABUS UNDER CBCS w.e.f. 2015-16
(Revised in November 2017) For Non-Mathematics Combinations
III Year B.Sc. Semester - VI

Elective VII (A): Electronics
Semester –VI
Elective Paper –VII-(A): Analog and Digital Electronics

No. of Hours per week: 04                                                                         Total Lectures: 60

Unit-I (12 Hours)
Field Effect Transistors
FET Construction and Working- characteristics and uses- MOSFET-enhancement MOSFET-depletion MOSFETconstruction and working- drain characteristics of MOSFET- applications of MOSFET-Photo electric devices- Structure and operation and characteristics-spectral response and application of LDR- LED - LCD.

Unit-II (12Hours)
Operational Amplifiers

Unit-III (12 Hours)
Applications of Op-Amp
Op- Amp as voltage amplifier- Inverting amplifier- Non-inverting amplifier- voltage follower-summing amplifier- difference amplifier-comparator- integrator-differentiator.

Unit-IV (12 Hours)
Data processing circuits

Unit-V (12 Hours)
Sequential digital circuits

Reference Books
1. Digital Electronics by G.K.Kharate Oxford University Press
2. Unified Electronics by Agarwal and Agarwal.
3. Op- Amp and Linear ICs by Ramakanth A Gayekwad, 4th edition PHI
5. Digital Circuit design by Morris Mano,PHI
6. An Introduction to Operational Amplifiers and their Applications by SV Subramanian, Laxmi Publications.
Minimum of 6 experiments to be done and recorded
1) Characteristics of FET
2) Characteristics of MOSFET
3) Characteristics of LDR
4) Characteristics of Op-amp.(IC741)
5) Op-Amp as amplifier/inverting amplifier
6) Op-Amp as integrator/differentiator
7) Op-Amp as summing amplifier/difference amplifier
8) IC 555 as astable multivibrator
9) IC 555 as monostable amplifier
10) Master slave flip-flop
11) JK flip-flop

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Semester –VI
Cluster Electives VIII-A

No. of Hours per week: 04                                                                   Total Lectures: 60

Unit – I (10 Hours)

Introduction to microcontrollers
General purpose of computer systems, architecture of embedded system, classification, applications and purposes, challenges and designs, operational and non-operational quality attributes, elemental description of embedded processors and micro controllers.

Unit –II (10 Hours)

Microprocessors
Organization of microprocessor based system, 8085 microprocessor, its pin diagram and architecture, concept of data bus, and address bus, 8085 programming, instruction classification, stacks and its implementation, hardware and software interrupts.

Unit– III (15 Hours)

8051 microcontroller
Block diagram, assembly language programming, programme counter, ROM memory, data types and directives, flag bits PSW register, jump, loop and call constructions.

8051 I/O Programming
Introduction to I/O port programming, pin out diagram, I/O port pin programming, bit manipulation, addressing modes, accessing memory, arithmetic and logic instructions.

Unit – IV (13 Hours)

Timers
Programming of 8051 timers, counter programming, interrupts, external hardware interrupts, serial communication interrupts, interrupt priority.

Embedded system programming
Structure of programming, infinite loop, compiling, linking locating, down loading and debugging.

Unit – V (12 Hours)

Embedded system design and development
Embedded system development environment, file type generated after cross compilation, dissembler, decompiler, simulator, emulator and debugging. Embedded product life cycle: Embedded product development life cycle, trends in embedded industry.

Reference Books
1) Embedded Systems.. Architecture, programming and design, R Kamal, 2008, TMH
2) The 8051 micro controller and embedded systems using Assembly and C, M.A.Mazidi, J.G.Mazidi and R.D.McKinlay, second Ed., 2007 pearson Education India

Minimum of 6 experiments to be done and recorded

1. To find that the given numbers is prime or not.
2. To find the factorial of a number.
3. Write a program to make the two numbers equal by increasing the smallest number and decreasing the largest number.
4. Use one of the four ports of 8051 for O/P interfaced to eight LED’s. Simulate binary counter (8 bit) on LED’s.
5. Program to glow first four LED then next four using TIMER application.
6. Program to rotate the contents of the accumulator first right and then left.
7. Program to run a countdown from 9-0 in the seven segment LED display.
8. To interface seven segment LED display with 8051 microcontroller and display ‘HELP’ in the seven segment LED display.
9. To toggle ‘1234’ as ‘1324’ in the seven segment LED.
10. Interface stepper motor with 8051 and write a program to move the motor through a given angle in clock wise or counter clockwise direction.
11. Application of embedded systems: Temperature measurement, some information on LCD display, interfacing a keyboard.

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### Semester VI

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#### UNIT-I (12hrs)
**Fundamentals of C language**
C character set-Identifiers and Keywords-Constants-Variables-Data types-Declarations of variables-Declaration of storage class-Defining symbolic constants-Assignment statement.

**Operators**
Arithmetic operators-Relational operators-Logic operators-Assignment operators-Increment and decrement operators-Conditional operators.

#### UNIT-II (12hrs)
**Expressions and I/O Statements**
Arithmetic expressions-Precedence of arithmetic operators-Type converters in expressions-Mathematical (Library) functions - Data input and output-The getchar and putchar functions-Scanf-Printf simple programs.

**Control statements**
If -Else statements-Switch statements - The operators- GO TO - While, Do - While, FOR statements-BREAK and CONTINUE statements.

#### UNIT-III (12hrs)
**Arrays**
One dimensional and two dimensional arrays - Initialization - Type declaration - Inputting and outputting of data for arrays - Programs of matrices addition, subtraction and multiplication.

**User defined functions**
The form of C functions - Return values and their types - Calling a function - Category of functions. Nesting of functions-ANSI C functions - Function declaration. Scope and life time of variables in functions.

#### UNIT-IV (12hrs)
**Linear and Non-Linear equations**
Solution of Algebra and transcendental equations-Bisection, Falsi position and Newton- Rhapsion methods-Basic principles-Formulae-algorithms.

**Simultaneous equations**

#### UNIT-V (12hrs)
**Interpolations**
Reference books:
1. Introductory methods of Numerical Analysis: Sastry
2. Numerical Methods: Balaguruswamy
3. Programming in ANSI C (TMH) : Balaguruswamy

Cluster Elective Paper-VIII-A-2: Practical:
Computational Methods and Programming 2hrs/Week

Minimum of 6 experiments to be done and recorded
1. Write a program that reads an alphabet from keyboard and display in the reverse order.
2. Write a program to read and display multiplication of tables.
3. Write a program for converting centigrade to Fahrenheit temperature and Fahrenheit temperature centigrade.
4. Write a program to find the largest element in an array.
5. Write a program based on percentage calculation, the grade by entering the subject marks. (If percentage > 60 I class, if percentage between 50&60 II class, if percentage between 35&50 III class, if percentage below 35 fail).
6. Write a program for generation of even and odd numbers up to 100 using while, do-while and for loop.
7. Write a program to solve the quadratic equation using Bisection method.
8. Write a program for integration of function using Trapezoidal rule.
9. Write a program for solving the differential equation using Simpson’s 1/3rd rule.

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Semester –VI

No. of Hours per week: 04                                                                 Total Lectures:60

Unit – I (12Hours)

Basic of measurements
Instruments accuracy, precision, sensitivity, resolution range, errors in measurement, Multimeter, principles of measurement of dc voltage and dc currents, ac current and resistance, specifications of multimeter and their significance.

Unit -11 (12 Hours)

Electronic Voltmeter
Advantage over conventional multimeter for voltage measurement with respect to input impedance and sensitivity, principles of voltage measurement (block diagram only), specification of an electronic voltmeter/multimeter and their significance.

Unit– III (12 Hours)

CRO
Block diagram of basic CRO, construction of CRT, electron gun, electrostatic focusing and acceleration (only explanation), time base operation, synchronization, front panel controls, specifications of CRO and their significance- Applications CRO- Measurement of voltage, dc and ac frequency, time period, special features of dual trace, digital storage oscilloscope, block diagram and principle of working.

Unit – IV (12 Hours)

Digital Multimeter
Block diagram, working, frequency and period measurement using universal counter, frequency counter, accuracy and resolution.

Digital instruments
Principle and working of digital instruments, characteristics of a digital meter, working principle of digital voltmeter.

Unit – V (12 Hours)

Signal generators
Block diagram explanation, specifications of low frequency signal generators, pulse generator-function generator-working- Brief idea for testing, specifications- Distortion factor meter-wave analysis.

Bridges
Block diagram, working of basic LCR bridge – specifications – block diagram and working.

Reference Books
1. A text book in electrical technology by B.L.Thereja (S.Chand&Co)
2. Digital circuits and systems by Venugopal 2011 (Tata Mcgraw Hill)
3. Digital Electronics by SubrathaGhoshal 2012 (Cengage Learning)
Cluster Elective Paper-VIII-A-3
Practical: Electronic Instrumentation 2hrs/Week

Minimum of 6 experiments to be done and recorded
1. Study the loading effect of a multimeter by measuring voltage across a low and high resistance.
2. Study the limitations of a multimeter for measuring high frequency voltage and currents.
3. Measurement of voltage, frequency, time period and phase angle using CRO.
5. Measurement of rise, fall and delay times using a CRO.

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UNIT-I (12 hrs)
Materials and Crystal Bonding

UNIT-II (12 hrs)
Defects and Diffusion in Materials

UNIT-III (12 hrs)
Mechanical Behaviour of Materials
Different mechanical properties of engineering materials -Creep - Fracture- Technological properties - Factors affecting mechanical properties of a material – Heat treatment - Cold and hot working - Types of mechanical tests- Metal forming process -Powder - Misaligning - Deformation of metals.

UNIT-IV (12 hrs)
Magnetic Materials

UNIT-V (12 hrs)
Dielectric Materials

Reference books
Elective Paper-VII-B
Practical Materials Science 2hrs/Week

Minimum of 6 experiments to be done and recorded

1. Measurement of susceptibility of paramagnetic solution (Quinck’s Tube Method)
3. Determination of coupling coefficient of a piezoelectric crystal.
4. Measurement of the dielectric constant of a dielectric Materials
5. Study the complex dielectric constant and plasma frequency of metal using surface plasmon resonance (SPR)
7. Study the hysteresis loop of a Ferroelectric Crystal.
8. Study the B-H curve of ‘Fe’ using solenoid and determine energy loss from hysteresis.
Semester –VI
Cluster Electives VIII-B
Cluster Elective Paper –VIII-B-1: Fundamentals of Nanoscience

No. of Hours per week: 04                                                                  Total Lectures:60

UNIT-I (12hrs)

Background and history
Emergence of Nanoscience with special reference to Feynman and Drexler- Role of particle size-
Spatial and temporal scale- Concept of confinement- strong and weak confinement with suitable
example- Development of quantum structures-Basic concept of quantum well- quantum wire and
quantum dot. Finite size Zero- One and Two Dimensional Nanostructures- Concept of Surface and
Interfacial Energies.

UNIT-II (12hrs)

Classification of Nanomaterials
Inorganic nanomaterials- carbon nanotubes and cones- Organic nanomaterials- dendrimers-micelles-
liposomes- block copolymers- Bionanomaterials-Biomimtric- bioceramic and nanotherapeutics-
Nanomaterials for molecular electronics and optoelectronics.

UNITS-III (12hrs)

Macromolecules
Classification of polymers- chemistry of polymerization- chain polymerization- step polymerization,
coordination polymerization- Molecular weight of polymers-number average and weight average
molecular weight- degree of polymerization- Kinetics of free radical polymerization- derivation of
rate law - Preparation and application of polyethylene-PVC-Teflon.

UNIT-IV (12hrs)

Molecular & Nanoelectronics
Semiconductors, Transition from crystal technology to nanotechnology- Tiny motors, Gyroscopes
and accelerometers- Nano particle embedded wrinkle resistant cloth- Transparent Zinc Oxide sun
screens- Bio-systems- Nanoscale processes in environment- Nanoscale structures- Novel phenomena
and Quantum control and quantum computing.

UNIT-V (12hrs)

Biomaterials
Implant materials: Stainless steels and its alloys, Ti and Ti based alloys-Polymeric Implant materials-
Soft tissue replacement implants- Sutures- Surgical tapes and adhesives, heart valve implants-
Artificial organs-Hard Tissue replacement Implants- Internal Fracture Fixation Devices- Wires- Pins-
Screws- Fracture Plates.

Reference Books
1. T. Pradeep: Textbook of Nanoscience and Nanotechnology Chapter (McGraw-Hill Professional,
   2012), Access Engineering.

Elective Paper- VIII-B-1
Practical: Fundamentals of Nanoscience 2hrs/Week

Minimum of 6 experiments to be done and recorded

2. Surface Enhanced Raman Scattering Activity of Silver Nanoparticles
3. Conversion of Gold Nanorods into Gold Nanoparticles
4. Bimetallic Nanoparticles
5. Processing and Development of Nanoparticle gas sensor
6. Magnetic separation/identification studies of nanoparticles
7. Harvesting light using nano-solar cells
8. Nano-Forensic analysis to identify, individualize and evaluate evidence using nanophase materials
9. Comparison of the performance of nanoparticles based conductive adhesives and conventional non conductive adhesives.
10. Electrodeposition and corrosion behavior of nanostructured composite film
11. Photocatalytic activity of nanomaterials

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Semester –VI

No. of Hours per week: 04                                                             Total Lectures:60

Unit-I (12 hrs)
Nanomaterials synthesis

Unit-II (12 hrs)
Classification of materials
Types of materials, Metals, Ceramics (Sand glasses) polymers, composites- semiconductors-Metals and alloys- Phase diagrams of single component- binary and ternary systems- diffusion- nucleation and growth -Metallic glasses- Preparation-structure -properties like electrical, magnetic- thermal and mechanical, applications.

UNITS-III (12 hrs)
Glasses
The glass transition - theories for the glass transition-Factors that determine the glass-transition temperature- Glass forming systems and ease of glass formation- preparation of glass materials-Applications of Glasses- Electronic applications- Electrochemical applications- optical applications- Magnetic applications.

UNITS-IV (12 hrs)
Liquid Crystals
Mesomorphism of anisotropic systems-Different liquid crystalline phase and phase transitions- Thermal and electrical properties of liquid crystals- Types Liquid Crystals displays- few applications of liquid crystals.

UNITS-V (12 hrs)
Characterization Methods
XRD, SEM, TEM, AFM, XPS and PL characterization techniques for nano materials-Electrical and mechanical properties- Optical properties by IR and Raman Spectroscopy.

References books
3. Nanotechnology in Microelectronics & Optoelectronics, J.M Martine Duart, R.J Martin Palma, F. Agullo Rueda, Elsevier
Cluster Elective Paper-VIII-B-2:
Practical: Synthesis and Characterization of Nanomaterials 2hrs/Week

Minimum of 6 experiments to be done and recorded

1. Synthesis of nanocrystalline films of II-VI compounds doped with rare earths by chemical process.
2. Synthesis of Alkaline earth aluminates in nanocrystalline form by combustion synthesis.
3. Preparation of surface conducting glass plate by spray pyrolysis method
4. Preparation of surface conducting glass plate by chemical route
5. Fabrication of micro fluidic nanofilter by polymerisation reaction
6. Absorption studies on the nanocrystalline films and determination of absorption coefficient.
7. Determination of band gap from the absorption spectra using Tauc’s plots.
8. Study of Hall effect in semiconductors and its application in nanotechnology.
UNIT-I (12 hrs)
Optical properties
Coulomb interaction in nanostructures-Concept of dielectric constant for nanostructures and charging of nanostructure-Quasi-particles and excitons- Excitons in direct and indirect band gap semiconductor nanocrystals- Quantitative treatment of quasi-particles and excitons- charging effects.

UNIT-II (12 hrs)
Electrical transport
Carrier transport in nanostructures-Hall effect- determination of carrier mobility and carrier concentration- Coulomb blockade effect- thermionic emission- tunnelling and hoping conductivity- Defects and impurities- Deep level and surface defects.

UNIT-III (12 hrs)
Applications of nanoparticles

UNIT-IV (12 hrs)
Nanoelectronics

UNIT-V (12 hrs)
Nanobiotechnology and Medical application
Introduction, Biological building blocks- size of building blocks and nanostructures, Peptide nanowires and protein nanoparticles- DNA double nanowires- Nanomaterials in drug delivery and therapy- Nanomedicine-Targeted gold nanoparticles for imaging and therapy.

Reference books:
1. C.P. Poole, Jr. Frank J. Owens, Introduction to Nanotechnology (Wiley India Pvt. Ltd.).
Minimum of 6 experiments to be done and recorded

1. Synthesis of metal nanoparticles by chemical route.
2. Synthesis of semiconductor nanoparticles.
3. Surface Plasmon study of metal nanoparticles by UV-Visible spectrophotometer.
4. XRD pattern of nanomaterials and estimation of particle size.
5. To study the effect of size on color of nanomaterials.
6. Prepare a disc of ceramic of a compound using ball milling, pressing and sintering, and study its XRD.
7. Fabricate a thin film of nanoparticles by spin coating (or chemical route) and study transmittance spectra in UV-Visible region.
8. Fabricate a pn-diode by diffusing Al over the surface of n-type Si and study its I-V characteristics.
Semester –VI
Elective Paper –VII-C: Renewable Energy
No. of Hours per week: 04                                                                 Total Lectures: 60

UNIT-I (12 hrs)
Introduction to Energy
Definition and units of energy- power- Forms of energy- Conservation of energy- Conventional energy sources- Role of energy in economic development and social transformation.
Environmental Effects
Environmental degradation due to energy production and utilization- air and water pollution- depletion of ozone layer- global warming - biological damage due to environmental degradation.

UNIT-II (12 hrs)
Global Energy Scenario
Energy consumption in various sectors, projected energy consumption for the next century- exponential increase in energy consumption-impact of exponential rise in energy usage on global economy.
Indian Energy Scene
Energy resources available in India- urban and rural energy consumption, nuclear energy - promise and future- need for use of new and renewable energy sources.

UNIT-III (12 hrs)
Solar energy
Solar energy- Spectral distribution of radiation- Flat plate collector, solar water heating system- Solar cell- Types of solar cells, solar module and array- Components of PV system- Applications of solar PV systems.
Wind Energy
Introduction, Principle of wind energy conversion- Components of wind turbines-Operation and characteristics of a wind turbine,

UNIT-IV (12 hrs)
Ocean Energy
Introduction, Principle of ocean thermal energy conversion- Tidal power generation- Tidal energy technologies- Energy from waves.
Hydrogen Energy

UNIT-V (12 hrs)
Bio-Energy
Energy from biomass - Sources of biomass - Different species - Conversion of biomass into fuels - Energy through fermentation- gasification and combustion -Aerobic and anaerobic bio-conversion.
References:
3. Renewable Energy, power for a sustainable future, Godfrey Boyle, 2004,

Elective Paper-VII-C
Practical: Renewable Energy
2hrs/Week

Minimum of 6 experiments to be done and recorded
1. Preparation of copper oxide selective surface by chemical conversion method.
2. Performance testing of solar cooker.
3. Determination of solar constant using pyrheliometer.
5. Study the effect of input light intensity on the performance of solar cell.
6. Study the characteristics of wind.
Semester-VI  
Cluster Electives –VIII-C  
Elective Paper –VIII-C-1: Solar Thermal and Photovoltaic Aspects  

No. of Hours per week: 04  
Total Lectures: 60  

UNIT-I (12 hrs)  
Basics of Solar Radiation  
Structure of Sun, Spectral distribution of extra terrestrial radiation, Solar constant, definition of declination, hour angle, solar and surface azimuth angles; Solar intensity measurement, pyrheliometer.  
Radiative Properties and Characteristics of Materials  
Reflection, absorption and transmission of solar radiation through single and multi covers; Kirchhoff’s law – Relation between absorptance, emittance and reflectance;  

UNIT-II (12 hrs)  
Flat Plate Collectors (FPC)  
Description of flat plate collector-Liquid heating type FPC- Definitions of fin efficiency and collector efficiency- Evacuated tubular collectors.  
Concentrating Collectors  
Classification- design and performance parameters- Definitions of aperture- rim angle- concentration ratio and acceptance angle- Tracking systems.  

UNIT-III (12 hrs)  
Solar photovoltaic (PV) cell  
Physics of solar cell -Type of interfaces- homo- hetero and schottky interfaces- Photovoltaic Effect- Equivalent circuit of solar cell- Solar cell output parameters.  
Solar cell fabrication  
Production of single crystal Silicon- Czokralski (CZ) and Float Zone (FZ) methods- Silicon wafer fabrication- Wafer to cell module assembly - Thin film solar cells- advantages.  

UNIT-IV (12 hrs)  
Solar PV systems  

UNIT-V (12 hrs)  
Solar thermal applications  
Solar hot water system (SHWS)- Types of SHWS- Standard method of testing the efficiency of SHWS- Passive space heating and cooling concepts- Solar desalinator and drier- Solar thermal power generation.  
Solar PV applications  
SPV systems- Stand alone- hybrid and grid connected systems- System installation- operation and maintenances.
Reference Books:

Cluster Elective Paper- VIII-C-1
Practical: Solar Thermal and Photovoltaic Aspects 2hrs/Week

Minimum of 6 experiments to be done and recorded
5. Performance testing of solar air dryer unit.
7. Study on solar photovoltaic panel in series and parallel combination.

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Semester - VI
Cluster Elective Paper – VIII-C-2: Wind, Hydro and Ocean Energies

No. of Hours per week: 04                         Total Lectures: 60

UNIT-I

Introduction
Wind Measurements: Eolian features- biological indicators- rotational anemometers- other anemometers- wind measurements with balloons.

UNIT-II

Wind Energy Conversion System
Aerodynamic design principles- Aerodynamic theories-axial momentum-blade element and combine theory-Rotor characteristics- Maximum power coefficient - Design of Wind Turbine- Wind turbine design considerations

UNIT-III

Wind Energy Application
Wind pumps- Performance analysis- design concept and testing- Principle of wind energy generation- Standalone-grid connected and hybrid applications of wind energy conversion systems.

UNIT-IV

Small Hydropower Systems
Overview of micro- mini and small hydro systems- Hydrology- Elements of pumps and turbine- Selection and design criteria of pumps and turbines- Investment issues load management and tariff collection- potential of small hydro power in India.

UNIT-V

Ocean Thermal-Tidal and Wave Energy Systems

Reference Books:
Minimum of 6 experiments to be done and recorded

1. Estimation of wind speed using anemometer.
2. Determination of characteristics of a wind generator
3. Study the effect of number and size of blades of a wind turbine on electric power output.
5. Study the effect of density of water on the output power of hydroelectric generator.
6. Study the effect of wave amplitude and frequency on the wave energy generated.
Semester - VI
Cluster Elective Paper –VIII-C-3: Energy Storage Devices

No. of Hours per week: 04                                                                 Total Lectures:60

UNIT-I (12 hr)
Energy Storage
Need of energy storage- Different modes of energy storage- Flywheel storage- Electrical and magnetic energy storage- Capacitors- electromagnets- Chemical Energy storage-Thermo-chemical-photo-chemical- bio-chemical- electro-chemical.

UNIT-II (12 hrs)
Electrochemical Energy Storage Systems

UNIT-III (12 hrs)
Magnetic and Electric Energy Storage Systems
Superconducting Magnet Energy Storage (SMES) systems- Capacitor and battery- Comparison and applications - Super capacitor-Electrochemical Double Layer Capacitor (EDLC) principle of working - and application.

UNIT-IV (12 hrs)
Fuel Cell
Fuel cell definition- difference between batteries and fuel cells- fuel cell components- principle and working of fuel cell- characteristics- efficiency- fuel cell stack- fuel cell power plant.

UNIT-V (12 hrs)
Types of Fuel Cells

REFERENCE BOOKS
Minimum of 6 experiments to be done and recorded
1. Study of charge and discharge characteristics of storage battery.
2. Study of charging and discharging behavior of a capacitor.
3. Determination of efficiency of DC-AC inverter and DC-DC converters
4. Study of charging characteristics of a Ni-Cd battery using solar photovoltaic panel.
B.Sc. (Physics)
(Non-Mathematics Combinations)
Scheme of instruction and examination to be followed w.e.f. 2015-2016

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| 1    | Sixth    | Paper VII : Elective [one]
Paper VIII: Cluster Electives [Three] | 4                      | 3                      | 75                   |

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Model question Paper for all theory papers in semester-VI

Time : 3 hrs
Max marks : 75

Section-A
Answer any FIVE from the following TEN questions
Marks: 5X10 = 50

Section-B
Answer any FIVE from the following TEN questions
Marks : 5X5 = 25

Instruction to Paper Setter :
Two questions must be given from each UNIT in Section-A and Section-B
Model question Paper for all theory papers  
Semesters - I to V

*Time: 3 Hours*  
*Max. Marks: 75*

**SECTION - A**

Answer any FIVE of the following Questions:  
(5 X 10 = 50 Marks)

1. (a)  
(b)  

2. (a)  
(b)  

3. (a)  
(b)  

4. (a)  
(b)  

5. (a)  
(b)  

**SECTION – B**

Answer any THREE of the following questions:  
(3 X 5 = 15 Marks)

6.  
7.  
8.  
9.  
10.  

**SECTION – C**

Answer any TWO of the following questions:  
(2 X 5 = 10 Marks)

11.  
12.  
13.  
14.  
15.  

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