First Semester
Paper I : Mechanics& Properties of Matter
Practical I (Lab-1)

Second Semester
Paper II: Waves & Oscillations
Practical 2 (Lab2)

Third Semester
Paper III: Wave Optics
Practical 3.(Lab 3)

Fourth Semester
Paper IV: Thermodynamics & Radiation Physics
Practical 4.(Lab 4)

Fifth Semester
Paper V: Electricity, Magnetism& Electronics
Paper VI: Modern Physics
Practical 5.(Lab 5)
Practical 6.(Lab 6)

Sixth Semester
PaperVII:Elective (One)
Paper VIII:Cluster Electives (Three)
Practical 7(Lab 7)
Practical 8.(Lab 8)

Proposed Electives in Semester - VI

Paper – VII (one elective is to be chosen from the following0

Paper VII-(A): Analog and Digital Electronics
Paper VII-(B): Materials Science
Paper VII-(C): Renewable Energy

Paper – VIII (one cluster of electives (A-1,2,3 or B-1,2,3 or C-1,2,3) to be chosen *preferably* relating to the elective chosen under paper – VII (A or B or C)

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Cluster 1.
Paper VIII-A-1. Introduction to Microprocessors and Microcontrollers
Paper VIII-A-2.Computational Physics and Programming
Paper VIII-A-3.Electronic Instrumentation

Cluster 2

Paper VIII-B-1.Fundamentals of Nanoscience
Paper VIII-B-2.Synthesis and Characterization of Nanomaterials
Paper VIII-B-3.Applications of Nanomaterials and Devices

Cluster 3

Paper VIII-C-1.Solar Thermal and Photovoltaic Aspects
Paper VIII-C-2.Wind, Hydro and Ocean Energies
Paper VIII-C-3.Energy Storage Devices

NOTE: Problems should be solved at the end of every chapter of all Units.
1. Each theory paper is of 100 marks and practical paper is also of 50 marks.
   Each theory paper is 60 marks University Exam (external) + 40 marks
   (internal). Each practical paper is 50 marks external
2. The teaching work load per week for semesters I to VI is 4 hours per paper for theory
   And 2 hours for all laboratory (practical) work.
3. The duration of the examination for each theory paper is 3.00 hrs.
4. The duration of each practical examination is 3 hrs with 50 marks, which are to be
distributed as   30 marks for experiment
                       10 marks for viva
                       10 marks for record

Practicals	**50 marks**
Formula & Explanation	6
Tabular form +graph +circuit diagram	6
Observations	12
Calculation, graph, precautions & Result	6
Viva-Voce	10
Record	10

***NOTE: Practical syllabus is same for both Mathematics and Non Mathematics combinations

Scheme of instruction and examination to be followed w.e.f. 2017-2018

S. No	Semester	Title of the paper	Credits	Instruction hrs/week	Duration of exam (hrs)	Max Marks (external)
		Thoery				
1	First	Paper I: Mechanics& Properties of Matter	3	4	3	60
2	Second	Paper II: Waves & Oscillations	3	4	3	60
3	Third	Paper III: Wave Optics	3	4	3	60
4	Fourth	Paper IV: Thermodynamics & Radiation Physics	3	4	3	60
5	Fifth	Paper V:Electricity, Magnetism& Electronics	3	4	3	60
		Paper VI: Modern Physics	3	4	3	60
6	Sixth	PaperVII :Elective (One)	3	4	3	60
		Paper VIII: Cluster Electives (Three)	3+3+3	4+4+4	3	60
		Practicals				
1	First	Practical 1	2	2	3	50
2	Second	Practical II	2	2	3	50
3	Third	Practical III	2	2	3	50
4	Fourth	Practical IV	2	2	3	50
5	Fifth	Practical V	2	2	3	50
6		Practical VI	2	2	3	50
7	Sixth	Practical VII: Elective (One)	2	2	3	50
8		Practical VIII:Cluster Electives (Three)	2 +2+2	2+2+2	3+3+3	50+50+50

Model question Paper for all theory papers

Time : 3 hrs   Max marks : 60

Section-A (Essay type)

Answer All questions with internal choice from all units   Marks :8 x 5 = 40

Two questions are to be set from each unit with either or type

Section-B (Short answer type)

Answer any FIVE out of EIGHT questions from all units (I to V) Marks: 4 x 5 = 20

At least one question should be set from each unit.

Dr. V.S.Krishna Govt. Degree College Viskhapatnam
PHYSICS SYLLABUS ADMITTED BATCH W.E.F. 2019-20
B.Sc. 1st Semester Physics
Paper I: Mechanics& Properties of Matter

Work load: 60 hrs per semester

4 hrs/week

UNIT-I (10 hrs)
1. Vector Analysis
Scalar and vector fields, gradient of a scalar field and its physical significance. Divergence and curl of a vector field with derivations and physical interpretation. Vector integration (line, surface and volume), Statement and proof of Gauss and Stokes theorems.

UNIT-II (10 hrs)
2. Mechanics of particles
Laws of motion, motion of variable mass system, Equation of motion of a rocket. Conservation of energy and momentum, Collisions in two and three dimensions, Concept of impact parameter, scattering cross-section, Rutherford scattering-derivation.

UNIT-III (16 hrs)
3. Mechanics of Rigid bodies
Definition of rigid body, rotational kinematic relations, equation of motion for a rotating body, angular momentum, Euler equations and its applications, precession of a top, Gyroscope, precession of the equinoxes.
4. Mechanics of continuous media
Elastic constants of isotropic solids and their relations, Poisson's ratio and expression for Poisson's ratio in terms of y, n, k. Classification of beams, types of bending, point load, distributed load, shearing force and bending moment, sign conventions.

UNIT-IV (12Hrs)
5. Central forces
Central forces, definition and examples, characteristics of central forces, conservative nature of central forces, conservative force as a negative gradient of potential energy, equatglobal ion of motion under a central force.Derivation of Kepler's laws.Motion of satellites, idea of Global Positioning System (GPS).

UNIT-V (12 hrs)
6. Special theory of relativity
Galilean relativity, absolute frames.Michelson-Morley experiment, negative result.Postulates of special theory of relativity.Lorentz transformation, time dilation, length contraction, addition of velocities, mass-energy relation.Concept of four-vector formalism.

REFERENCE BOOKS:

1. B. Sc. Physics, Vol.1, Telugu Academy, Hyderabad
2. Fundamentals of Physics Vol. I - Resnick, Halliday, Krane ,Wiley India 2007
3. Unified Physics, Vol. 1, S.L. Gupata & S. Guptha, Jai Prakash Nath & Co, Meerut.
4. College Physics-I. T. Bhimasankaram and G. Prasad. Himalaya Publishing House.
5. University Physics-FW Sears, MW Zemansky& HD Young,Narosa Publications, Delhi
6. Mechanics, S.G.Venkatachalapathy, Margham Publication, 2003.

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 a bar (scale) by non- uniform bending
4. Surface tension of a liquid by capillary rise method/ or any other method
5. Determination of radius of capillary tube by Hg thread method
6. Viscosity of liquid by Searle's viscometer method/or Ostwald viscometer
7. Bifilar suspension –moment of inertia of a regular rectangular body.
8. Determination of moment of inertia using Fly-wheel
9. Determination of the height of a building using a sextant.
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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Examples

Seminars   - A topic from any of the Units is given to the student and asked to give a brief seminar presentation.

Group discussion   - A topic from one of the units is given to a group of students and asked to discuss and debate on it.

Assignment   - Few problems may be given to the students from the different units and asked them to solve.

Field trip   - Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric power stations / Science Centres, any other such visit etc.

Study project   - Web based study of different satellites and applications.

Domain skills:

Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

*** Documental evidence is to be maintained for the above activities.

Dr VS Krishna Govt. Degree College(A), Visakhapatnam -2019-20

BLUE PRINT(Mechanics)

I B.Sc. (Physics)- SEM-I/Course1 Max Marks-60 Time-3Hrs. Credits:3

UNIT	S.NO.	Topic	Section-A Essay(8 marks)	Section-B Short Answer (4 marks)	Total marks
I	1	Vector Analysis	2	1	20
II	2	Mechanics of particle	2	2	24
III	3	Mechanics of rigid bodies	1	1	12
	4	Mechanics of Continuous media	1	1	12
IV	5	Central Forces	2	1	20
V	6	Special Theory of relativity	2	2	24
		Total Questions	**10**	**8**	**112**

Note: 1. Two numerical problems should be given in section-B (4 Mark Questions)

Dr. V.S. Krishna Govt. Degree College (A), Visakhapatnam
I B.Sc. SEM-I: Physics-2019-20
Course1
Mechanics

Time:3 Hrs.

Credits:3

Max Marks: 60Marks

Section-A

Answer all five Questions　　　　　　　　　　　　　　(5x8M=40 Marks)

1. State and Prove Gauss Theorem of divergence?

   గాస్ అపసరణ సిద్ధాంతంను వ్రాసి నిరూపించండి?

   Or

   State and prove stoke's theorem.

   స్టోక్ సిద్ధాంతమును వ్రాసి నిరూపించండి.

2. Derive Rutherford's Scattering formula?

   రూథర్ఫర్డ్ పరిక్షేపణ సూత్రమును రాబట్టండి

   Or

   Explain the motion of a rocket and derive an expression for the velocity of a variable mass system.

   రాకెట్ చలనమును వివరించి,చరద్రవ్యరాశి వ్యవస్థ వేగమునకు సమీకరణమును ఉత్పాదించుము.

3. Derive the Euler's Equations of motion of a rigid body fixed at one point?

   ధృడ వస్తువు యూలర్ చలన సమీకరణములను ఉత్పాదించుము.

   Or

   Define Three Elastic moduli and derive the relation between them?

   మూడు స్థితిస్థాపక గుణకములను నిర్వచించి, వాటి మధ్య సంబంధములను రాబట్టుము.

4. State Kepler's laws of planetary motion and deduce the 1st Law?

   కెప్లర్ గ్రహ గమన నియమాలు వ్రాసి,మొదటి నియమాన్ని రాబట్టండి.

   Or

   Define central forces.Obtain the equation of motion of a body under central forces.

   కేంద్రియ బలాలను నిర్వచింపుము. కేంద్రియ బల ప్రభావంలో చలించే కణం యొక్క చలన సమీకరణమును ఉత్పాదించుము.

5. Describe Michelson –Morley experiment and write its importance?

   మైకెల్సన్-మొర్లె ప్రయోగమును వర్ణించి,దాని ప్రాముఖ్యతను వ్రాయండి.

   Or

State basic postulates of Einstein's special theory of relativity and derive the equation

$E=MC^2$

ఐనస్టీన్ ప్రత్యేక సాపేక్షతా సిద్ధాంతం ప్రతిపాదనలు వ్రాసి, $E=MC^2$ అనే సమీకరణమును ఉత్పాదించండి

Section-B

Answer any five questions   **(5X4M= 20 Marks)**

6. Define curl of a vector and explain its physical significance.

సదిశ యొక్క కర్ల్ నిర్వచించి దాని యొక్క భౌతిక ప్రాముఖ్యతను వివరించండి.

7. Define impact parameter and scattering cross section.

అభిఘాత పరామితి మరియు పరిక్షేపణ మధ్యచ్ఛేదములను నిర్వచింపుము

8. Derive an expression for precessional velocity of a top.

బొంగరము పురస్సరణ వేగమునకు సమీకరణమును రాబట్టండి

9. Explain types of beams and types of bending?

దూలములు మరియు వంపులలో రకాలను వివరించండి

10. A clock showing correct time when at rest, loses one hour in a day when it is moving. What is its velocity ?

ఒక గడియారం విరామ స్థితిలో ఉన్నపుడు సరియైన కాలాన్ని చూపుతుంది. అది ఏ వేగముతో ప్రయాణిస్తే రోజుకు ఒక గంట కాలాన్ని కోల్పోతుంది.

11. Show that central force is a conservative.

కేంద్రీయ బలము నిత్యత్వము అని చూపండి.

12. A rocket of mass 40 kg has got a fuel of mass 360 kg inside it. The exhaust velocity of the fuel is 2 km/s. The fuel is burning at the rate of 4 kg/s. Find the final velocity of rocket.

40 kg ద్రవ్యరాశిగల రాకెట్ లో 360 kg ద్రవ్యరాశిగల ఇంధనం ఉన్నది. బహిర్గత వాయువుల వేగం 2 km / s ఇంధనం 4 kg / s రేటున మండుచున్నపుడు రాకెట్ పొందే వేగాని లెక్కించండి.

13. Explain length contraction and time dilation.

దైర్ఘ్య సంకోచం మరియు కాల వృద్ధి లను వివరించండి.

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B.Sc. 2nd Semester Physics
Paper II: Waves & Oscillations

Work load: 60 hrs per semester   **4 hrs/week**

UNIT-I (12 hrs)
1. Simple Harmonic oscillations
Simple harmonic oscillator and solution of the differential equation-Physical characteristics of SHM, torsion pendulum-measurements of rigidity modulus, compound pendulum-measurement of 'g', Principle of superposition,beats, combination of two mutually perpendicular simple harmonic vibrations of same frequency and different frequencies. Lissajous figures.

UNIT-II (12 hrs)
2. Damped and forced oscillations
Damped harmonic oscillator, solution of the differential equation of damped oscillator. Energy considerations, comparison with un-damped harmonic oscillator, logarithmic decrement, relaxation time, quality factor, differential equation of forced oscillator and its solution, amplitude resonance and velocity resonance.

UNIT-III (10 hrs)
3. Complex vibrations
Fourier theorem and evaluation of the Fourier coefficients, analysis of periodic wave functions-square wave, triangular wave, saw tooth wave, simple problems on evolution of Fourier coefficients.

UNIT-IV (17hrs)
4. Vibrating strings: 8 hrs
Transverse wave propagation along a stretched string, general solution of wave equation and its significance, modes of vibration of stretched string clamped at ends, overtones and harmonics. Energy transport and transverse impedance.
5. Vibrations of bars: 9 hrs
Longitudinal vibrations in bars-wave equation and its general solution. Special cases (i) bar fixed at both ends (ii) bar fixed at the midpoint (iii) bar fixed at one end. Tuning fork.

UNIT-V (9 hrs)
6. Ultrasonics: 9hrs
Ultrasonics, properties of ultrasonic waves, production of ultrasonics by piezoelectric and magnetostriction methods, detection of ultrasonics, determination of wavelength of ultrasonic waves.Applications of ultrasonic waves.

REFERENCE BOOKS:
1. BSc Physics Vol.1, Telugu Academy, Hyderabad.
2. Waves and Oscillations. N. Subramanyam and Brijlal, Vikas Pulications.

3. Unified Physics Vol., Mechanics, Waves and Oscillations, Jai Prakash Nath&Co.Ltd.
4. Fundamentals of Physics. Halliday/Resnick/Walker ,Wiley India Edition 2007.
5. Waves & Oscillations. S.Badami, V. Balasubramanian and K.R. Reddy,Orient Longman.
6. College Physics-I. T. Bhimasankaram and G. Prasad. Himalaya Publishing House.
7. Science and Technology of Ultrasonics- Baldevraj, Narosa, New Delhi,2004
8. Introduction to Physics for Scientists and Engineers. F.J. Buche. McGraw Hill.

Practical Paper II: Waves & Oscillations

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

Examples

Seminars   - A topic from any of the Units is given to the student and asked to give a brief seminar presentation.

Group discussion   - A topic from one of the units is given to a group of students and asked to discuss and debate on it.

Assignment   - Few problems may be given to the students from the different units and asked them to solve.

Field trip   - Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric power stations / Science Centres, any other such visit etc.

Study project   - Web based study of different satellites and applications.

Domain skills:

Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

*** Documental evidence is to be maintained for the above activities.

Dr VS Krishna Govt. Degree College(A), Visakhapatnam -2019-20

BLUE PRINT(Waves & Oscillations)

I B.Sc. (Physics)- SEM-II/Course 2- Max Marks-60

Time-3Hrs. Credits:3

Module	S.No.	Topic	Section-A Essay (8 Marks)	Section-B Short Answer (4 marks)		Total marks
I	1	Simple Harmonic Oscillations	2	2		24
II	2	Damped and Forced Oscillations	2	1		20
III	3	Complex Vibrations	2	1		20
IV	4	Vibrations of Bars	1	1		12
	5	Vibrations of Strings	1	2		16
V	6	Ultrasonics	2	1		20
		Total Questions	10	8		112

Note: 1. Two numerical problems should be given in section-B (4 Mark Questions).

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Dr. V.S. Krishna Govt. Degree College (A), Visakhapatnam

I B.Sc. SEM-II: Physics-2019-20
Course 2
Waves & Oscillations

Time:3 Hrs.

Credits:3
Max Marks: 60Marks

Section –A

Answer all five questions   (5x8M=40 Marks)

1. Explain the mathematical theory of Liner Combinations of simple harmonic vibrations of same frequency?
   ఒకే పౌనఃపున్యము కలిగియున్న సరళహరాత్మక చలనముల సమ్మేళనము గణితాత్మక సిద్ధాంతమును వివరించుము

   (Or)

   Define Torsional pendulum and how you determine modulus of rigidity by using torsional pendulum.
   విమోటన లోలకమును నిర్వచించి, దాని నుపయోగించి విమోటన గుణకమును ఎట్లా కనుగొంటారు?

2. Find the equation of damped harmonic motion and obtain its solution.
   అవరుద్ధ హరాత్మక చలనము సమీకరణమును కనుగొని, దాని పరిష్కారమును రాబట్టండి.

   (Or)

   Derive the equation of motion of driven harmonic oscillator and find its solution?

   బలాత్కృత డోలక చలనము సమీకరణమును కనుగొని, దాని పరిష్కారమును రాబట్టండి.

3. Analyse a square wave with the help of fouriers theorem?
   ఫురియే సిద్ధాంతము సహాయముతో చతురస్ర తరంగాన్ని విశ్లేషించండి

   (Or)

   State and explain Fourier theorem.Evaluate Fourier coefficients.
   ఫురియే సిద్ధాంతము వ్రాసి వివరించండి. ఫురియే గుణకములను ఉత్పాధించుము.

4. Obtain wave equation and its solution for longitudinal vibrations in a bar?
   కడ్డీలో ఏర్పడె అనుదైర్ఘతరంగ సమీకరణాన్ని ఉత్పాదించి,దాని పరిష్కారమును కనుగొనండి.

   (Or)

   Derive the equation for the velocity of transverse wave along a stretched string?
   సాగదీసిన తీగలో తిర్యక్ తరంగ వేగమునకు సమీకరణమును ఉత్పాదించుము?

5. Explain magnotostriction method for producing ultrasonics?
   అయస్కాంత విరూపణ పద్ధతిన అతిధ్వనులను ఉత్పత్తి చేసే విధానాన్ని వివరించుము.

   (Or)

   Explain Piezo electric method for producing ultrasonics?
   పీడన విద్యుత్ పద్ధతిన అతిధ్వనులను ఉత్పత్తి చేసే విధానాన్ని వివరించుము.

Section-B

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6. Define Simple harmonic motion and give three examples.

సరళ హరాత్మక చలనమును నిర్వచించి మూడు ఉదాహరణలను తెలపండి.

7. A body of mass 4.9 kg hangs from a spring and oscillates with a period of 0.6 sec. How much will the spring shorten when the body is removed?

4.9kg ద్రవ్యరాశి గల వస్తువు స్ప్రింగ్ నుండి ప్రేలాడదీసి 0.6sec.ఆవర్తన కాలంతో కంపిస్తోంది. వస్తువును తెలగించినపుడు స్ప్రింగ్ ఎంత

సంకోచిస్తుంది?

8. Explain relaxation time and quality factor.

రిలాక్సేషన్ మరియు గుణభాజకములను వివరించండి.

9. State Fourier Theorem and write its limitations.

ఫురియే సిద్ధాంతమును వ్రాసి, దాని అవధులు తెలపండి.

10. What are the Laws of Transverse vibrations of Strings?

తీగలలో తిర్యక తరంగాల నియమాలను వ్రాయండి.

11. A steel wire 50cm long has mass of 5 grams is stretched with a tension of 400N. Find the frequency of the wire in fundamental mode of vibration?

50cm పొడవు మరియు 5grams ద్రవ్యరాశి గల స్టీల్ తీగ 400N. తన్యతా బలమును కలిగిఉన్నది.ప్రాధమిక కంపన రీతిలో ఉన్న తీగ

పౌనఃపున్యమును కనుగొనండి .

12. What are ultrasonics and write the applications of ultrasonics

అతిధ్వనులు అనగానేమి ? వాటి అనువర్తనాలను వ్రాయండి .

13. Explain about the tuning fork.

శ్రుతి దండమును గూర్చి వివరించండి.

Work load:60 hrs per semester   **4 hrs/week**

UNIT-I (8 hrs)
1. Aberrations:
Introduction – monochromatic aberrations, spherical aberration, methods of minimizing spherical aberration, coma, astigmatism and curvature of field, distortion. Chromatic aberration-the achromatic doublet. Achromatism for two lenses (i)in contact and (ii) separated by a distance.

UNIT-II (14hrs)
2. Interference
Principle of superposition – coherence-temporal coherence and spatial coherence-conditions for interference of light. Fresnel's biprism-determination of wavelength of light –change of phase on reflection. Oblique incidence of a plane wave on a thin film due to reflected and transmitted light (cosine law) –colors of thin films-
Interference by a film with two non-parallel reflecting surfaces (Wedge shaped film). Determination of diameter of wire, Newton's rings in reflected light. Michelson interferometer, Determination of wavelength of monochromatic light using Newton's rings and Michelson Interferometer.

UNIT-III (14hrs)
3. Diffraction
Introduction, distinction between Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction –Diffraction due to single slit- Fraunhoffer diffraction due to double slit-Fraunhoffer diffraction pattern with N slits (diffraction grating).Resolving power of grating, Determination of wavelength of light in normal incidence and minimum deviation methods using diffraction grating,
Fresnel's half period zones-area of the half period zones-zone plate-comparison of zone plate with convex lens-difference between interference and diffraction.

UNIT-IV(10 hrs)
4.Polarisation:
Polarized light: methods of polarization polarization by reflection, refraction, double refraction, scattering of light-Brewster's law-Mauls law-Nicol prism polarizer and analyzer-Quarter wave plate, Half wave plate-optical activity, determination of specific rotation by Laurent's half shade polarimeter - Babinet's compensator - idea of elliptical and circular polarization

UNIT-V (14hrs)
5. Lasers and Holography

Lasers: introduction, spontaneous emission, stimulated emission. Population Inversion, Laser principle-Einstein coefficients-Types of lasers-He-Ne laser, Ruby laser- Applications of lasers. Holography: Basic principle of holography-Gabor hologram and its limitations, Applications of holography.

6. Fiber Optics

Introduction- different types of fibers, rays and modes in an optical fiber, fiber material, principles of fiber communication (qualitative treatment only), advantages of fiber optic communication.

REFERENCE BOOKS:
1. BSc Physics, Vol.2, Telugu Akademy, Hyderabad
2. A Text Book of Optics-N Subramanyam, L Brijlal, S.Chand& Co.
3. Unified Physics Vol.II Optics & Thermodynamics – Jai Prakash Nath&Co.Ltd., Meerut
4. Optics,F..A. Jenkins and H.G. White, Mc Graw-Hill
5. Optics, AjoyGhatak,Tata Mc Graw-Hill.
6. Introduction of Lasers – Avadhanulu, S.Chand& Co.
7. Principles of Optics- BK Mathur, Gopala Printing Press, 1995
8.

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Practical Paper III: Wave Optics

</div>

Work load:30 hrs   **2 hrs/week**

Minimum of 6 experiments to be done and recorded
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.
5. Determination of wavelength of light using diffraction grating-minimum deviation method.
6. Determination of wavelength of light using diffraction grating-normal incidence method.
7. Resolving power of a telescope.
8. Refractive index of a liquid-hallow prism
9. Determination of thickness of a thin wire 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

Examples

Seminars   - A topic from any of the Units is given to the student and asked to give a brief seminar presentation.

Group discussion   - A topic from one of the units is given to a group of students and asked to discuss and debate on it.

Assignment   - Few problems may be given to the students from the different units and asked them to solve.

Field trip   - Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric power stations / Science Centres, any other such visit etc.

Study project   - Web based study of different satellites and applications.

Domain skills:
Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

*** Documental evidence is to be maintained for the above activities.

Dr. V.S.Krishna Govt. Degree College Viskhapatnam
PHYSICS SYLLABUS ADMITTED BATCH W.E.F. 2019-20
B.Sc. 3rd Semester Physics
Paper III: Wave Optics

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S.No.	Unit	Topic	Essay Questions	Short Answer Questions	Marks
1	I		2	1	20
2	II		2	1 Short Answer Question and 1 Numerical Problem	24
3	III		2	2	24
4	IV		2	1 Short Answer Question and 1 Numerical Problem	24
5	V		2	1	20
TOTAL	5		8	8	112

It is suggested that ONE Numerical Problem from unit II and another ONE from unit IV should be set in the question paper (Total two numerical problems)

Dr. V.S.Krishna Govt. Degree College Viskhapatnam
PHYSICS SYLLABUS ADMITTED BATCH W.E.F. 2019-20
B.Sc. 3rd Semester Physics
Paper III: Wave Optics

MODEL QUESTION PAPER

Time : 3 Hours   Max. Marks : 60

Section – A
Answer ALL Questions

1. a) What is chromatic aberration? Derive the conditions for achromatism when two Lenses are (1) in contact (2) separated by a distance?

    వర్ణవిపథనము అనగా ఏమి? రెండు కటకములు (1) ఒకదానినొకటి తాకుతున్నప్పుడు (2) కొంత దూరములో ఉన్నప్పుడు అవర్ణతకు నిబంధనలను ఉత్పాదించుము.

    Or

    b) What is spherical aberration? Describe various methods for minimisation of spherical aberration.

    గోళీయవిపథనము అనగా ఏమి? గోళీయవిపథనము నివారించు వివిధ పద్ధతులను వర్ణించుము.

2. a) What is a Bi-prism? Describe an experiment to determine the wavelength of monochromatic light using Bi-prism?

    ద్విపట్టకము అనగానేమి? ద్విపట్టకమునుపయోగించి ఏకవర్ణ కాంతి తరంగదైర్ఘ్యమును కనుగొను ప్రయోగమును వర్ణించుము.

    Or

    b) Describe the principal, construction and working of a Michelson interferometer. What are various fringes that can be obtained with it.

    మైకెల్ సన్ వ్యతికరణ మాపకము సూత్రము, నిర్మాణము మరియు పనిచేయు పద్ధతినివర్ణించుము.

    ఈ వ్యతికరణ మాపకములో ఏర్పడు వివిధరకాల పట్టికలను తెలుపుము.

3. a) Discuss Fraunhofer diffraction at double slit for normal incidence?

    కాంతి అభిలంబ పతనమునకు ఫ్రాన్ హోఫర్ తరగతి జంటచీలికల వివర్తనమును వివరించుము.

    Or

    b) Describe the construction and working of a zone plate with necessary theory.

    మండల ఫలకము నిర్మాణము మరియు పనిచేయువిధమును తగు సిద్ధాంతముతో వివరించుము.

4. a) With a neat diagram describe the construction and working of Nicol prism. What are its uses?

    చక్కని పటము సహాయముతో నికాల్ పట్టకము నిర్మాణమును మరియు పనిచేయు విధమును వివరించుము.

    Or

    b) What is optical activity? Describe how the specific rotation of sugar solution is determined using Laurent's Half Shade Polarimeter.

ధ్రువణ భ్రమణత అనగానేమి? లారెంట్ అర్ధఛాయా ధ్రువణమాపకమునుపయోగించి చక్కర

ద్రావణము యొక్క, విశిష్టభ్రమణ సామర్థ్యమునెట్లు నిర్ణయించెదరు?

5.   a) Explain the principal and working of Ruby Laser.

రూబీ లేజర్ సూత్రమును పనిచేయువిధమును వివరించుము.

<center>Or</center>

b)Explain the principle and applications of holography. What are the limitations of Gabor'a hologram?

హోలోగ్రఫీ సూత్రమును అనువర్తనములను వివరించుము. గేబర్ హోలోగ్రాం పరిమితులను

తెలుపుము.

<center>Section – B</center>
<center>**Answer any FIVE questions of the following**</center>

6.   Write a short note on Coma.

కేంద్రకావరణము(కోమా) పై లఘువ్యాఖ్య ప్రాయుము.

7.   What are non-reflecting films?

అపరావర్తకపొర అనగానేమి?

8.   Sodium light of wavelength 5890 A^0 passes through narrow slits 2mm apart. The interference pattern is seen at a distance of 1.25 m away from the centre of the slits. Determine the fringe width.

రెండు సన్నని చీలికల మధ్య దూరము 2mm. ఈచీలికలపై 5890 A^0 తరంగదైర్ఘ్యముగల

సోడియం ఆవిరి దీపము యొక్క కాంతి పతనమగుచున్నది. చీలికలనుండి 1.25m

దూరములోవ్యతికరణవ్యాహమును పరిశీలించినప్పుడు వ్యతికరణ పట్టికల మందమును

కనుగొనుము.

9.   Differentiate between Fresnel and Fraunhofer diffraction.

ఫ్రెసెల్ మరియు ఫ్రాన్ హోఫర్ తరగతి వివర్తనములకు గల తేడాలను ప్రాయుము.

10.   Obtain an expression for the resolving power of a diffraction grating.

వివర్తనజాలకము యొక్క పృధక్కరణ సామర్థ్యమునకు సమీకరణము రాబట్టుము.

11.   For a slab of flint glass the angle of polarization is found to be 62^0 24^1. Calculate the refractive index of the flint glass?

ఒక ఫ్లింట్ గాజుఫలకము యొక్క ధ్రువణకోణము 62^0 24^1. ఫ్లింట్ గాజు వక్రీభవన గుణకమును

లెక్కించుము.

12.   Write a short note on double refraction.

ద్వవక్రీభవనముపై లఘువ్యాఖ్య ప్రాయుము.

13.   Explain step-index and graded index optical fibres.

స్టెప్ - ఇండెక్స్ మరియు గ్రేడెడ్ - ఇండెక్స్ దృశాతంతువులను వివరించుము.

Work load: 60 hrs per semester   **4 hrs/week**

UNIT-I (10 hrs)

1. Kinetic theory of gases

Introduction –Deduction of Maxwell's law of distribution of molecular speeds, experimental verification. Transport phenomena – Mean free path - Viscosity of gases-thermal conductivity-diffusion of gases.

UNIT-II(12 hrs)

2. Thermodynamics

Introduction- Isothermal and adiabatic process- Reversible and irreversible processes-Carnnot's engine and its efficiency-Carnot's theorem-Second law of thermodynamics. Kelvin's and Claussius statements-Entropy, physical significance –Change in entropy in reversible and irreversible processes-Entropy and disorder-Entropy of Universe–Temperature-Entropy (T-S) diagram and its uses - Change of entropy of a perfect gas-change of entropy when ice changes into steam.

UNIT-III(12 hrs)

3. Thermodynamic potentials and Maxwell's equations

Thermodynamic potentials-Derivation of Maxwell's thermodynamic relations-Clausius-Clayperon's equation-Derivation for ratio of specific heats-Derivation for difference of two specific heats for perfect gas.Joule Kelvin effect-expression for Joule Kelvin coefficient for perfect and vander Waal's gas.

UNIT-IV(12 hrs)

4. Low temperature Physics

Introduction-Joule Kelvin effect-Porous plug experiment - Joule expansion-Distinction between adiabatic and Joule Thomson expansion-Expression for Joule Thomson cooling-Liquefaction of helium, Kapitza's method-Adiabatic demagnetization, Production of low temperatures -applications of substances at lowtemperature-effects of chloro and fluoro carbons on ozone layer.

UNIT-V(14 hrs)

5. Quantum theory of radiation

Blackbody-Ferry's black body-distribution of energy in the spectrum of black body-Wein's displacement law,Wein's law, Rayleigh-Jean's law-Quantum theory of radiation-Planck's law-Measurement of radiation-Types of pyrometers-Disappearing filament optical pyrometer-experimental determination – Angstrompyrheliometer-determination of solar constant, Temperature of Sun.

REFERENCE BOOKS:

1. BSc Physics, Vol.2, Telugu Akademy, Hyderabad
2. Thermodynamics, R.C.Srivastava, S.K.Saha& Abhay K.Jain, Eastern Economy Edition.
3. Unified Physics Vol.2, Optics & Thermodynamics, Jai Prakash Nath&Co.Ltd., Meerut
4. Fundamentals of Physics. Halliday/Resnick/Walker.C. Wiley India Edition 2007
5. Heat, Thermodynamics and Statistical Physics-N Brij Lal, P Subrahmanyam, PS Hemne, S.Chand& Co.,2012
6. Heat and Thermodynamics- MS Yadav, Anmol Publications Pvt. Ltd, 2000
7. University Physics, HD Young, MW Zemansky,FW Sears, Narosa Publishers, New Delhi

Practical Paper IV: Thermodynamics & Radiation Physics

2 hrs/week

Work load: 30 hrs

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.
6. Heating efficiency of electrical kettle with varying voltages.
7. Thermoemf- 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

Examples

Seminars — A topic from any of the Units is given to the student and asked to give a brief seminar presentation

Group discussion — A topic from one of the units is given to a group of students and asked to discuss and debate on it.

Assignment — Few problems may be given to the students from the different units and asked them to solve.

Field trip — Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric power stations / Science Centres, any other such visit etc.

Study project — Web based study of different satellites and applications.

Domain skills:

Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

*** Documental evidence is to be maintained for the above activities.

Dr. V.S. Krishna Govt. Degree College (A), Visakhapatnam
II B.Sc. SEM-III: Course 3 2019-20
THERMODYNAMICS
BLUE PRINT

S.No	unit	Topic	Section-A Essay (8 Marks)	Section-B Short Answer (4 marks)	Total marks
1	I	Kinetic Theory of Gases	2	1	20
2	II	Thermodynamics	2	2	24
3	III	Thermodynamics Potentials and Maxwell 's Equations	2	1	20
4	IV	Low Temperature physics	2	2	24
5	V	Quantum Theory of radiations	2	2	24
		Total Questions	10	8	112

Note: 1. Two numerical problems should be given in section-B (4 Mark Questions). FROM THERMODYNAMICS and LOW TEMPERATURE PHYSICS each.

Dr. V.S. Krishna Govt. Degree College (A), Visakhapatnam
II B.Sc. SEM-III: Course 3 2019-20
THERMODYNAMICS

Credits :3
Max Marks: 60Marks

Time:3 Hrs.

Section –A

(5X8=40M)

Answer ALL questions

1a) Derive an expression for Maxwell's Law of distributions of Molecular speeds in a gas?

ఒక వాయువు లోని అణువులు ఏవిదంగా వితరణ చెంది ఉంటాయో తెలిపే మాక్స్ వెల్ అను వేగా

వితరణ సమీకరణాన్ని ఉత్పాదించండి .

OR

b) Define transport phenomena.

వాయువుల అభిగమన దృగ్గిషయాలు తెలపండి.

2 a) State and explain the second law of Thermodynamics. Derive an expression for the efficiency of Carnot's Engine?

ఉష్ణగతిక శాస్త్ర గతిక రెండవ నియమాన్ని నిర్వచించండి.కార్నో యంత్రం యొక్క దక్షత కు సమీకరణాన్ని

ఉత్పాదించండి.

OR

b) Explain principle of increase of entropy and entropy disorder.

ఎంట్రోపి పెరుగుదల మరియు ఎంట్రోపి క్రమ రాహిత్యం ను వివరించండి.

3 a) Define the four Thermodynamics potentials. Obtain Maxwell's Thermodynamic equations using these potentials?

నాలుగు ఉష్ణ గతిక సక్మాలను నిర్వచించి , వాటినుపయోగించి మాక్స్ వెల్ ఉష్ణ గతిక

సమీకరణాలను రాబట్టండి.

OR

b) Derive the equation Cp-Cv=R

Cp-Cv=R సమీకరణమును ఉత్పాదించండి.

4 a)Derive an expression for Joule-Thomson cooling.

జౌల్ థామ్సన్ శీతలీకరణానికి సమాసాన్ని ఉత్పదించండి.

OR

b) What is adiabatic demagnetization? How is this principal used in producing law temperature?

స్థిరో ష్ణక నిరయస్కాంతీకరణం అనగానేమి? దీనిని ఉపయోగించి అల్ప ఉష్ణోగ్రతలను ఎలా పొందవచ్చనో

వివరించండి.

5a). Explain Ferry's black body and Wien's black body.

పెట్రి కృష్ణవస్తువు మరియు వీన కృష్ణవస్తువును వివరించండి.

O

b) What is Pyrometer? Explain construction and working of disappearing filament optical pyrometer?

పైరోమీటర్ అనగానేమి. అదృశ్యమయ్యే తీగ గల దృశ్యపైరోమీటర్ ను వివరించండి.

Section –B

(5X4=20 Marks)

Answer any Five of the following questions

6. Write a short note on "Mean free path" of a molecule in a gas?

వాయు అణువుల స్వేచ్ఛాపథమద్యమం గురించి వివరించండి.

7. Calculate the efficiency of a Carnot engine working between the temperatures 150° C and 30°C.

150˚C మరియు 30˚C ల మధ్య పని చేసే కార్నోయంత్రం యొక్క దక్షతను లెక్కించండి.

8. Define Entropy. Show that in a reversible process entropy remains constant.

ఎంట్రోపిని నిర్వచించండి.ద్విగతప్రక్రియలోని ఎంట్రోపి స్థిరంగా ఉంటుందనిచూపండి

9. Write the working of Angstrom's Pyroheliometer?

ఆంగ్ స్ట్రామ్ పైరో హీలియో మీటర్ పనిచేయు విధమును వ్రాయండి.

10. Calculate the temperature of inversion in case of H_2 and CO_2 from the given data Tc for H_2 is -239.9°C and for CO_2 IS 31°C.

ఇచ్చిన దత్తాంశం నుండి H_2 మరియు CO_2 ల విలోమన ఉష్ణోగ్రత లను లెక్కించండి.

H_2 యొక్క Tc = -239.9˚C , CO_2 యొక్క Tc = 31˚C.

11. Define solar constant. Explain briefly how is it measured?

సౌర స్థిరాంకం ను నిర్వచించి ,దానిని ఎలా కనుగొంటారో క్లుప్తంగా వివరించండి .

12. What is ozone layer? What are the uses of the ozone layer?

ఓజోన్ పొర అనగానేమి ? దాని ఉపయోగాలు వ్రాయుము .

13. Explain Joule Thomson effect.

జౌల్ థామ్సన్ ప్రభావం ను వివరించండి

4 hrs/week

Work load: 60 hrs per semester

UNIT-I (12 hrs)

1. **Electric field intensity and potential:**
   Gauss's law statement and its proof- Electric field intensity due to (1) Uniformly charged sphere and (2) an infinite conducting sheet of charge. Electrical potential – equipotential surfaces- potential due to i) a point charge, ii)charged spherical shell and uniformly charged sphere.

2. **Dielectrics:**
   Electric dipolemoment and molecular polarizability- Electric displacement D, electric polarization P – relation between D, E and P- Dielectric constant and susceptibility. Boundary conditions at the dielectric surface.

UNIT-II (12 hrs)

3. **Electric and magnetic fields**
   Biot-Savart's law, explanation and calculation of B due to long straight wire, a circular current loop and solenoid – Lorentz force – Hall effect – determination of Hall coefficient and applications.

4. **Electromagnetic induction**
   Faraday's law-Lenz's law- Self and mutual inductance, coefficient of coupling, calculation of self inductance of a long solenoid, energy stored in magnetic field.Transformer - energy losses - efficiency.

UNIT-III (12 hrs)

5. **Alternating currents and electromagnetic waves**
   Alternating current - Relation between current and voltage in LR and CR circuits,vector diagrams, LCR series and parallel resonant circuit, Q –factor, power in ac circuits.

6. **Maxwell's equations**
   Idea of displacement current - Maxwell's equations (integral and differential forms) (no derivation), Maxwell's wave equation (with derivation), Transverse nature of electromagnetic waves.Poynting theorem (statement and proof), production of electromagnetic waves (Hertz experiment).

UNIT-IV (12 hrs)

7. **Basic electronics:**
   PN juction diode, Zener diode, Tunnel diode, I-V characteristics, PNP and NPN transistors, CB, CE and CC configurations – Relation betweenα, β and γ - transistor (CE) characteristics -Determination of hybrid parameters, Transistor as an amplifier.

UNIT-V: (12 hrs)

8. **Digital electronics**

Number systems - Conversion of binary to decimal system and vice versa.Binary addition and subtraction (1's and 2's complement methods).Laws of Boolean algebra - De Morgan's laws-statement and proof, Basic logic gates, NAND and NOR as universal gates, exclusive-OR gate, Half adder and Full adder, Parallel adder circuits.

REFERENCE BOOKS

1. BSc Physics, Vol.3, Telugu Akademy, Hyderabad.
2. Electricity and Magnetism, D.N. Vasudeva. S. Chand & Co.
3. Electricity, Magnetism with Electronics, K.K.Tewari, R.Chand& Co.,
4. Principles of Electronics, V.K. Mehta, S.Chand& Co.,
5. Digital Principles and Applications, A.P. Malvino and D.P.Leach, Mc GrawHill Edition.

Practical Paper V:Electricity, Magnetism & Electronics

Paper-V

Work load: 30 hrs   **2 hrs/week**

Minimum of 6 experiments to be done and recorded

1. Figure of merit of a moving coil galvonometer.
2. LCR circuit series/parallel resonance, Q factor.
3. Determination of ac-frequency –sonometer.
4. Verification of Kirchoff'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
9. Logic Gates- OR,AND,NOT and NAND gates. Verification of Truth Tables.
10. Verification of De Morgan's Theorems.

Suggested student activities

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

Examples

Seminars	- A topic from any of the Units is given to the student and asked to give a brief seminar presentation.
Group discussion	- A topic from one of the units is given to a group of students and asked to discuss and debate on
Assignment	- Few problems may be given to the students from the different units and asked them to solve.
Field trip	- Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric power stations / Science Centres, any other such visit etc.
Study project	- Web based study of different satellites and applications.

Domain skills

Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

*** **Documental evidence is to be maintained for the above activities.**

Dr VS Krishna Govt. Degree College(A), Viskahapatnam
(w.e.f 2019-20)

Electricity, magnetism & Electronics.

BLUE PRINT(~~Modern Physics~~) Paper - 5

III B.Sc. (Physics)- SEM-V Max Marks-60 Time-3Hrs. Credits:3

S.No.	Module/ UNIT	Topic	Section-A Essay Questions (8 Marks)	Section-B Short Answer (4 marks)	Total marks
1	I	1- Electric Field Intensity and Poterntial	1	1	
		2. Dielectrics	1		20
2	II	3. Electric and magnet Fields	1	1	
		3. Electromagnetic Induction	1	1	24
3	III	4. Alternating Currents	1	1	
		5. Maxwell's equations	1	1	24
4	IV	Basic Electronics	2	1	20
5	V	Digital Electronics	2	2	24

Note: 1. Two numerical problems should be given in section-B (4 Mark Questions)

Dr. V.S. KRISHNA GOVT. DEGREE COLLEGE (A) : VISAKHAPATNAM.
SEMESTER - V   III B.Sc Physics
Paper III (Electric City & Electronics) Paper - III

SECTION (A)

Answer all the Questions అన్ని ప్రశ్నలకు సమాధానములు వ్రాయుము ?   8 X 5 = 40 Marks

1. (a)   Derive Electric filed due to uniformly charged sphere ?

   ఏకరీతిగా అవేశించబడిన గోళం వృష్ట్య "విద్యుత్క్షేత్రమునకు సమీకరణమును రాబట్టుము?

   (or)

   (b)   Define D, E and P and derive relation between them ?

   D, E మరియు P లను నిర్వచించి వాని మధ్యగల సంబంధమును రాబట్టుము?

2. (a)   Explain Biot-Savart law. Derive an equation for magnetic induction due to long current carrying conductor ?

   బయో–సవర్ట్ నియమమును వివరించుము. ఒక పొడవైన విద్యుత్ వాహక తీగ వృష్ట్య అయస్కాంత ప్రేరణ క్షేత్ర తీవ్రతను కనుగొనుము?

   (or)

   (b)   Define Coefficient of Self inductance, Calculate the self inductance due to a long Solenoid?

   స్వయం ప్రేరణ గుణాంక్ నిర్వచించుము. ఒక పొడవైన సాలినాయిడ్ యొక్క స్వయంప్రేరణ గుణాంక్ సమీకరణము రాబట్టుము?

3. (a)   Explain LCR parallel resonance circuit with necessary theory?

   సమాంతర LCR అనునాదవలయాన్ని సిద్ధాంతపరంగా వివరించండి?

   (or)

   (b)   Obtain an equation for Poynting Theorem ?

   పాయింటింగ్ సిద్ధాంతమునకు సమీకరణమును రాబట్టుము?

4. (a)   What is a Zener Diode? Explain the V-I Characteristics of a Zener Diode ?

   జీనర్ డయోడ్ అనగానేమి? జీనర్ డయోడ్ యొక్క V-I అభిలక్షణములను వివరించుము?

   (or)

   (b)   Explain the Mechanism of current flow in a NPN transistor ?

   NPN ట్రాన్సిస్టర్లో విద్యుత్ ప్రవాహమును యంత్రాంగమును వివరించుము?

5. (a)   State and Prove De-Morgan's Theorems ?

   డీ–మోర్గన్ సిద్ధాంతములను తెలిపి నిరూపించుము?

   (or)

   (b)   Explain about Full Adder ?

   ఫుల్అడ్డర్ గురించి వివరించుము?

PART (B)

Answer any five questions? ఎవైన 5 (ప్రశ్నలకు సమాధానములను వ్రాయుము   (5 X 4 = 20 Marks)

6. Obtain an expression for Electric Potential due to a Point Charge

   ఒక బిందు ఆవేశమువల్ల ఎర్పడే విద్యుత్ పొటన్షియల్సకు సమాసరణను ఉత్పాదించుము?

7. Write a short note on Hall effect ?

   హాల్ ప్రభావము పై లఘుటీకను వ్రాయుము?

8. state and explain the "Faraday's laws of Electromagnetic Induction"?

   "ఫెరడె విద్యుత్ అయస్కాంత (పేరణ" సూత్రములను తెలిపి వివరించుము?

9. A Series circuit of R=25 ohm and L=0.02 henry is to be used at a frequency 500HZ Find its Impedance ?

   R=25 ఓమూలు మరియు L=0.02 హెన్రీలు కలిగి ఉన్న శ్రేణి వలయమునం 500 హెర్ట్స్సమూర్తిచున్యము వద్ద ఉపయోగించిన దాని ఆవరోధమును కనుగొనుము?

10. Write only the Maxwell equations in differential form and Integral form ?

    అవకలన పద్దతిలోను మరియు సమాకలన పద్దతిలోను మాక్స్వెల్ సమీకరణములను మాత్రమే వ్రాయుము?

11. Explain how transistor acts as an amplifier ?

    (టాన్సిస్టరు, వర్ధకము వలె ఎ విధముగా పనిచేయును ?

12. Write a brief note on Half Adder ?

    అర్ధసంకలని (Half Adder) గురించి లఘుటీకను వ్రాయుము?

13. Convert binary number (1011.101)₂ into decimal system

    (1011.101)₂ అను ద్విఆధారసంఖ్యను దశాంశ సంఖ్యాసరీతిలో మార్చుము.

Work load: 60 hrs per semester   4 hrs/week

UNIT-I (12 hrs)

1. Atomic and molecular physics

Introduction –Drawbacks of Bohr's atomic model- Sommerfeld's elliptical orbits-relativistic correction (no derivation).Vector atom model and Stern-Gerlach experiment - quantum numbers associated with it. L-S and j- j coupling schemes.Zeeman effect and its experimental arrangement.

Raman effect, hypothesis, Stokes and Anti Stokes lines. Quantum theory of Raman effect. Experimental arrangement – Applications of Raman effect.

UNIT-II (12 hrs)

2. Matter waves & Uncertainty Principle

Matter waves, de Broglie's hypothesis - wavelength of matter waves, Properties of matter waves - Davisson and Germer experiment – Phase and group velocities.

Heisenberg's uncertainty principle for position and momentum (x and p), & energy and time (E and t). Experimental verification - Complementarity principle of Bohr.

UNIT-III (12 hrs)

3. Quantum (wave) mechanics

Basic postulates of quantum mechanics-Schrodinger time independent and time dependent wave equations-derivations. Physical interpretation of wave function. Eigen functions, Eigen values. Application of Schrodinger wave equation to particle in one dimensional infinite box.

UNIT-IV(12 hrs)

4. General Properties of Nuclei

Basic ideas of nucleus -size, mass, charge density (matter energy), binding energy, angular momentum, parity, magnetic moment, electric moments. Liquid drop model and Shell model (qualitative aspects only) - Magic numbers.

5. Radioactivity decay:

Alpha decay: basics of α-decay processes. Theory of α-decay, Gamow's theory, Geiger Nuttal law.β-decay, Energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis.

UNIT-V (12 hrs)

6. Crystal Structure

Amorphous and crystalline materials, unit cell, Miller indices, reciprocal lattice, types of lattices, diffraction of X-rays by crystals, Bragg's law, experimental techniques, Laue's method and powder diffraction method.

7. Superconductivity:

Work load: 60 hrs per semester   **4 hrs/week**

UNIT-I (12 hrs)

1. **Atomic and molecular physics**

Introduction –Drawbacks of Bohr's atomic model- Sommerfeld's elliptical orbits-relativistic correction (no derivation).Vector atom model and Stern-Gerlach experiment - quantum numbers associated with it. L-S and j- j coupling schemes.Zeeman effect and its experimental arrangement.

Raman effect, hypothesis, Stokes and Anti Stokes lines. Quantum theory of Raman effect. Experimental arrangement – Applications of Raman effect.

UNIT-II (12 hrs)

2. **Matter waves & Uncertainty Principle**

Matter waves, de Broglie's hypothesis - wavelength of matter waves, Properties of matter waves - Davisson and Germer experiment – Phase and group velocities.

Heisenberg's uncertainty principle for position and momentum (x and p), & energy and time (E and t). Experimental verification - Complementarity principle of Bohr.

UNIT-III (12 hrs)

3. **Quantum (wave) mechanics**

Basic postulates of quantum mechanics-Schrodinger time independent and time dependent wave equations-derivations. Physical interpretation of wave function. Eigen functions, Eigen values. Application of Schrodinger wave equation to particle in one dimensional infinite box.

UNIT-IV(12 hrs)

4. **General Properties of Nuclei**

Basic ideas of nucleus -size, mass, charge density (matter energy), binding energy, angular momentum, parity, magnetic moment, electric moments. Liquid drop model and Shell model (qualitative aspects only) - Magic numbers.

5. **Radioactivity decay:**

Alpha decay: basics of α-decay processes. Theory of α-decay, Gamow's theory, Geiger Nuttal law.β-decay, Energy kinematics for β-decay, positron emission, electron capture, neutrino hypothesis.

UNIT-V (12 hrs)

6. **Crystal Structure**

Amorphous and crystalline materials, unit cell, Miller indices, reciprocal lattice, types of lattices, diffraction of X-rays by crystals, Bragg's law, experimental techniques, Laue's method and powder diffraction method.

7. **Superconductivity:**

Introduction - experimental facts, critical temperature - critical field - Meissner effect – Isotope effect - Type I and type II superconductors - BCS theory (elementary ideas only) - applications of superconductors.

REFERENCE BOOKS

1. BSc Physics, Vol.4, Telugu Akademy, Hyderabad
2. Molecular Structure and Spectroscopy by G. Aruldhas. Prentice Hall of India, New Delhi.
3. Modern Physics by R. Murugeshan and Kiruthiga Siva Prasath. S. Chand & Co.
4. Modern Physics by G. Aruldhas & P. Rajagopal. Eastern Economy Edition.
5. Concepts of Modern Physics by Arthur Beiser. Tata McGraw-Hill Edition.
6. Quantum Mechanics, Mahesh C Jain, Eastern Economy Edition.
7. Nuclear Physics, Irving Kaplan, Narosa publishing House.
8. Nuclear Physics, D.C.Tayal, Himalaya Publishing House.
9. Elements of Solid State Physics, J.P.Srivastava, Prentice Hall of India Pvt., Ltd.
10. Solid State Physics, A.J. Dekker, McMillan India.

Paper-VI

Practical Paper VI:Modern 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.
6. Determination of Range of β-particles.
7. Determination of M & H.
8. Analysis of powder X-ray diffraction pattern to determine properties of crystals.
9. Energy gap of a semiconductor using junction diode.
10. Energy gap of a semiconductor using thermister.

Note: For all the above 8 practical papers the book "B.Sc Practical Physics" by C.L. Arora Published by S.Chand & Co, New – Delhi may be followed.

NOTE: Problems should be solved at the end of every chapter of all units.

Suggested student activities

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

Examples

Seminars   - A topic from any of the Units is given to the student and asked to give a brief seminar presentation.

Group discussion   - A topic from one of the units is given to a group of students and asked to discuss and debate on it.

Assignment — Few problems may be given to the students from the different units and asked them to solve.

Field trip — Visit to Satish Dhawan Space Centre, Sriharikota / Thermal and hydroelectric power stations / Science Centres, any other such visit etc.

Study project — Web based study of different satellites and applications.

Domain skills:
Logical derivation, experimentation, problem solving, data collection and analysis, measurement skills

*** **Documental evidence is to be maintained for the above activities.**

Dr VS Krishna Govt. Degree College(A), Viskahapatnam

(w.e.f 2019-20)

BLUE PRINT(Modern Physics) Paper - 6

III B.Sc. (Physics)- SEM-V Max Marks-60 Time-3Hrs. Credits:3

S.No.	Module/ UNIT	Topic	Section-A Essay Questions (8 Marks)	Section-B Short Answer (4 marks)	Total marks
1	I	Atomic & Molecular Physics	2	2	24
2	II	Matter waves & Uncertainity principle	2	1	20
3	III	Quantum Mechanics	2	1	20
4	IV	4.General properties of nucleus	1	2	16
		5.Radioactivity	1	-	8
5	V	6.Crystal structure	1	2	16
		7.Superconductivity	1	-	8
		Total Questions	10	8	112

Note: 1. Two numerical problems should be given in section-B (4 Mark Questions)

Dr.V .S.Krishna Government Degree College(A) ,Visakhapatnam.

III B.Sc   Semester-V   paper-6   Modern physics

Time-3hours   Model paper (wef 2017-2018)   Max.marks: 60

Section –A   (5x8=40)

Answer any **FIVE** questions from the following.

1. Explain the two main concepts of Vector Atom Model. Explain the Stern- Gerlach experiment.
సదిక పరమాణునమూనాలోని రెండు ముఖ్యాంశాలను వివరించు. స్టెర్న్- గెర్లాక్ ప్రయోగాన్ని వివరించు.(OR)

What is Raman effect?Describe an experiment to study Raman effect
రామన్ ఫలితం అనగానేమి? రామన్ ఫలితాన్ని వివరించే ఒక ప్రయోగాన్ని వర్ణించు.

2. What are Matter waves? Describe Davission - Germer experiment on Electron diffraction
·ద్రవ్య తరంగాలు అనగానేమి ?ఎలక్ట్రాన్ వివర్తనం వివరించే డేవిసన్ – గేర్మర్ ప్రయోగాన్ని వివరించు(OR)

Explain Heigenberg uncertinity principle for (a) Position and Momentum and (b)Time and Energy
స్థానం,ద్రవ్యవేగంలకు మరియు కాలము, శక్తిలకు సంబంధించిన హైజెంబెర్గ్ అనిశ్చితత్వ నియమాలను వివరించు.

3. Derive the Time Independent Schroedinger wave Equation .
కాలంపై ఆధారపడని ష్రోదింగర్ తరంగ సమీకరణం ఉత్పాదించండి.(OR)

Write the postulates of Quantum Mechanics. Apply Schroedinger wave equation to particle in one dimentional box.
క్వాంటమ్ యాంత్రిక శాస్త్రం యొక్క ఉపపాదనలను రాయండి. ఏకమితీయ పెట్టెలోని కణానికి శ్రోదింగర్ తరంగ సమీకరణాన్ని అనువర్తించు.

4. Explain Liquid drop model and Shell model of nucleus.
పరమాణు కేంద్రకం యొక్క ద్రవ బిందు నమూనా మరియు కర్పర నమూనా లను వివరించు. (OR)

Explain Gamow`s theory of Alpha decay.
ఆల్ఫా క్షీణత యొక్క గెమో సిద్ధాంతాన్ని వివరించండి.

5. Describe the powder diffraction method for the analysis of crystal structure.
స్పటికనిర్మాన విశ్లేసణలోని చూర్ణ వివర్తన పద్ధతిని వివరించు.

(OR)

Explain superconductivity and Meisner effect.Write any two applications of Superconductivity.
అతివాహకత్వం మరియు మైస్నార్ ఫలితంలను వివరించు.అతివాహకత్వం యొక్క ఏవైనా రెండు అనువర్తనాలను వ్రాయుము.

Section – B

Answer any **FIVE** of the following.   (5X4=20)

6. Explain L-S coupling and J-J coupling.

L-S సంధానం, J-J సంధానంలను వివరించు

7. Derive an equation for the wavelength of matter waves.

ద్రవ్యతరంగాల తరంగ ధైర్ఘ్యానికి సమీకరణాన్ని ఉత్పాదించండి.

8. Derive Time Dependent Schrodinger Wave equation.

కాలంపై ఆధారపడే శ్రోదింగర్ తరంగ సమీకరణాన్ని ఉత్పాదించండి

9. Explain Geiger-Nuttal Law

గైగెర్ – నట్టల్ సూత్రాన్ని వివరించు

10. Derive Braggs Law.

బ్రాగ్ సూత్రాన్ని ఉత్పాదించు.

11. Explain Type- I and Type- II Superconductors.

మొదటి రకం మరియు రెండవ రకం అతివాహకాలను వివరించు

12. A sample was excited by the 4358 A line of frequency. A Raman line was observed at 4447 A. Calculate the Raman Shift.

ఒక సాంపెల్ ను 4358 A తో ఉత్తేజితం చేసినప్పుడు 4447A వద్ద రామన్ రేఖ కనిపించిది. రామన విస్తాపనాన్ని లెక్కించుము.

13. Calculate the mass number of a nucleus whose radius is 3.9×10^{-15} m.(Given $R_0 = 1.3 \times 10^{-15}$ m).

3.9 x 10 -15 m వ్యాసార్థముగల పరమాణు కేంద్రకం యొక్క ద్రవ్యరాశి సంఖ్యను లెక్కించుము.($R_0 = 1.3 \times 10^{-15}$ m)

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

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

Unit-I (14 Hours)
1. FET-Construction, Working, characteristics and uses; MOSFET-enhancement MOSFET, depletion MOSFET, construction and working , drain characteristics of MOSFET, applications of MOSFET
2. Photo electric devices: Structure and operation, characteristics, spectral response and application of LDR, LEDand LCD

Unit-II (10Hours)
3. Operational Amplifiers: Characteristics of ideal and practical Op-Amp (IC 741), Basic differential amplifiers, Op-Amp supply voltage, IC identification, Internal blocks of Op-Amp, its parameter off set voltages and currents, CMRR, slew rate, concept of virtualground.

Unit-III (10 Hours)
4. 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(14 Hours)
5. Data processing circuits: Multiplexers, De-multiplexers, encoders, decoders, Characteristics for Digital ICs -RTL, DTL, TTL, ECL CMOS (NAND & NOR Gates).
6. IC 555 Timer -Its pin diagram,internal architecture, Application as astablemultivibrator and mono stable multivibrator.

Unit-V (12 Hours)
7. Sequential digital circuits:Flip-flops, RS, Clocked SR, JK, D, T, Master-Slave, Flip- flop, Conversion of Flip flops.
8. Code Converters: Design of code converter, BCD to 7 segment, binary/BCD to gray, gray to binary/BCD ,design of counters using state machine.

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
4. Digital Principles and Applications by Malvino and Leach, TMH, 1996, 4th edition.
5. Digital Circuit design by Morris Mano,PHI
6. Switching Theory and Logic design by A.AnandKumar ,PHI

7. operations amplifier by SV Subramanyam.

Elective Paper-VII Practical: Analog and Digital Electronics
2hrs/Week

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

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

Unit – I (10Hours)
1. 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 (10Hours)
2. Microprocessors:Organisation of microprocessorbased 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 (15Hours)
3. 8051 microcontroller:Introduction , block diagram, assembly language programming, programme counter, ROM memory, data types and directives, flag bits PSW register, jump, loop and call constructions
4. 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)
5. Timers:Programming of 8051 timers, counter programming, interrupts, externalhardware interrupts, serial communication interrupts, interrupt priority.
6. Embedded system programming:Structure of programming, infinite loop, compiling, linking locating, down loading and debugging.

Unit –V (12Hours)
7. Embedded system design and development:Embedded system development environment, file type generated after cross compilation, dissembler, decompiler, simulator, emulator and debugging.
8. 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
3) Introduction to embedded systems K.V. Shibu, 1st edition, 2009 McGraw Hill

4) Micro Controllers in practice, I Susnea and Mitescu,2005,springer

Elective Paper-VIII-A-1 Practical: Introduction to Microprocessors and Microcontrollers 2hrs/Week

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.

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

UNIT-I (12hrs)
1. 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.
2. Operators: Arithmetic operators-Relational operators-Logic operators-Assignment operators-Increment and decrement operators-Conditional operators.

UNIT-II (12hrs)
3. 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.
4. Control statements:If -Else statements -Switch statements - The operators - GO TO - While, Do - While, FOR statements - BREAK and CONTINUE statements.

UNIT-III (12hrs)
5. Arrays: One dimensional and two dimensional arrays - Initialization - Type declaration - Inputting and outputting of data for arrays - Programs of matrices addition, subtraction and multiplication
6. User defined functions: The form of C functions - Return values and their types - Calling a function - Category of functions. Nesting of functions.Recursion.ANSI C functions- Function declaration. Scope and life time of variables in functions.

UNIT-IV (12hrs)
7. Linear and Non - Linear equations: Solution of Algebra and transcendental equations-Bisection, Falsi position and Newton-Rhapson methods-Basic principles-Formulae-algorithms
8. Simultaneous equations: Solutions of simultaneous linear equations-Guass elimination and Gauss Seidel iterative methods-Basic principles-Formulae – Algorithms.

UNIT-V (12hrs)
9. Interpolations: Concept of linear interpolation-Finite differences-Newton's and Lagrange's interpolation formulae-principles and Algorithms
10. Numerical differentiation and integration: Numerical differentiation-algorithm for evaluation of first order derivatives using formulae based on Taylor's series-Numerical integration-Trapezoidal and Simpson's 1/3 rule- Formulae-Algorithms.

Reference books:
1. Introductory methods of Numerical Analysis: Sastry
2. Numerical Methods: Balaguruswamy
3. Programming in ANSI C (TMH) : Balaguruswamy

4. Programming with 'C'- Byron Gottafried, Tata Mc Graw Hill

Elective PaperVIII-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 $1/3^{rd}$ rule.

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

Unit – I (12Hours)

1. 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 (10 Hours)

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

Unit– III (14 Hours)

3. 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)

4. Digital Multimeter:Block diagram,working, frequency and period measurement using universal counter, frequency counter ,accuracy and resolution.
5. Digital instruments:Principle and working of digitalinstruments, characteristics of a digital meter, working principle of digital voltmeter.

Unit – V (12 Hours)

6. 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.
7. 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)

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.
4. Measurement of time period and frequency using universal counter/frequency counter.
5. Measurement of rise, fall and delay times using a CRO.
6. Measurement of distortion of a RF signal generator using distortion factor meter.
7. Measurement of R, L and C using a LCR bridge/ universal bridge.

B.Sc. 6ᵗʰ Semester Physics

Paper VII-(B)Elective (Materials Science)

Elective Paper –VII-(B): Materials Science

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

UNIT-I (12 hrs)

1.Materials and Crystal Bonding: Materials, Classification, Crystalline, Amorphous, Glasses; Metals, Alloys, Semiconductors, Polymers, Ceramics, Plastics, Bio-materials, Composites, Bulk and nanomaterials. Review of atomic structure – Interatomic forces – Different types of chemical bonds – Ioniccovalent bond or homopolar bond – Metallic bond – Dispersion bond – Dipole bond – Hydrogenbond – Binding energy of a crystal.

UNIT-II (12 hrs)

2. Defects and Diffusion in Materials: Introduction – Types of defects - Point defects- Line defects- Surface defects- Volume defects- Production and removal ofdefects- Deformation-irradiation- quenching- annealing- recovery - recrystallization andgrain growth. Diffusion in solids- Fick's laws of diffusion.

UNIT-III(12 hrs)

3. Mechanical Behavior of Materials: Different mechanical properties of engineering materials – Creep – Fracture – Technologicalproperties – Factors affecting mechanical properties of a material – Heat treatment - Cold andhot working – Types of mechanical tests – Metal forming process – Powder – Misaligning – Deformation of metals.

UNIT-IV (12 hrs)

4. Magnetic Materials:Dia-, Para-, Ferri- and Ferromagnetic materials, Classical Langevin theory of dia magnetism, Quantum mechanical treatment of paramagnetism. Curie's law, Weiss's theory of ferromagnetism, Ferromagnetic domains.Discussion of B-H Curve.Hysteresis and energy Loss.

UNIT-V (12 hrs)

5. Dielectric Materials:Dielectric constant, dielectric strength and dielectric loss, polarizability, mechanism of polarization,factors affecting polarization, polarization curve and hysteresis loop, types of dielectric materials, applications; ferroelectric, piezoelectric and pyroelectric materials, Clausius -Mosotti equation.

Reference books

1. Materials Science by M.Arumugam, Anuradha Publishers. 1990, Kumbakonam.
2.Materials Science and Engineering V.Raghavan, Printice Hall India Ed. V 2004. New Delhi.
3. Elementary Solid State Physics, 1/e M. Ali Omar, 1999, Pearson India
4. Solid State Physics, M.A. Wahab, 2011, Narosa Publications

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)
2. Measurement of magnetic susceptibility of solids.
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.

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

UNIT-I (12hrs)
1. 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. Physics of the solid state – size dependence of properties, crystal structures, Lattice vibrations, Energy bands:- Insulators Semiconductors and conductors.

UNIT-II (12hrs)
2. 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)
3. 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, determination of molecular weight of polymers by viscometry, Osmometry and light scattering methods.Kinetics of free radical polymerization, derivation of rate law.Preparation and application of polyethylene, PVC, Teflon.

UNIT-IV (12hrs)
4. 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. Single electron transistors, Quantum dots, Quantum wires.

UNIT-V (12hrs)
5. Biomaterials: Implant materials: Stainless steels and its alloys, Ti and Ti based alloys, Ceramic implant materials; Hydroxyapatite glass ceramics, Carbon Implant materials, 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, and Screws, Fracture Plates.

Reference Books

1. T. Pradeep: Textbook of Nanoscience and Nanotechnology Chapter (McGraw-Hill Professional, 2012), Access Engineering.
2. C. N. R. Rao, A. Mu''ller, A. K. Cheetham, "The Chemistry of Nanomaterials :Synthesis, Properties and Applications", Wiley-VCH, 2006.
3. C. Breachignac P. Houdy M. Lahmani, "Nanomaterials and Nanochemistry", Springer, 2006.
4. Guozhong Cao, "Nanostructures and Nanomaterials: Synthesis, Properties, and Applications", World Scientific Publishing Private, Ltd., 2011.
5. Zhong Lin Wang, "Characterization of Nanophase Materials", Wiley-VCH, 2004.
6. Carl C. Koch, "Nanostructured Materials: Processing, Properties and Potential Applications", William Andrew Publishing Norwich, 2006.

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

Minimum of 6 experiments to be done and recorded
1. Determination of the Band Gap of Semiconductor Nanoparticles.
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

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

Unit-I (12 hrs)
1. Nanomaterials synthesis: Synthesis and nanofabrication, Bottom-Up and Top-Down approach with examples. Chemical precipitation methods, sol-gel method, chemical reduction, hydrothermal, process. Physical Mehtods- ball milling, Physical Vapour deposition (PVD), Sputtering, ChemicalVapor deposition (CVD), pray pyrolysis, Biological methods- Synthesis using micro organisms and bacteria, Synthesis using plant extract, use of proteins and DNA templates.

Unit-II (12 hrs)
2. 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. Diffusional and diffusionless transformations.Mechanical properties.Metallic glasses. Preparation, structure and properties like electrical, magnetic, thermal and mechanical, applications.

UNITS-III (12 hrs)
3. 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: Introduction: Electronic applications, Electrochemical applications, optical applications, Magnetic applications.

UNITS-IV (12 hrs)
4. 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)
5. 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
1. Encyclopedia of Nanotechnology by M.Balakrishna Rao and K.Krishna Reddy, Vol.I to X, Campus books.
2. Nano: The Essentials-Understanding Nanoscinece & Nanotechnology by T.Pradeep; Tata Mc. Graw Hill

3. Nanotechnology in Microelectronics & Optoelectronics, J.M Martine Duart, R.J Martin Palma, F. Agullo Rueda, Elsevier
4. Nanoelectronic Circuit Design, N.K Jha, D Chen, Springer
5. Handbook of Nanophysics- Nanoelectronics & Nanophotonics, K.D Sattler, CRC Press
6. Organic Electronics-Sensors & Biotechnology- R. Shinar & J. Shinar, McGraw-Hill

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.
9. Measurement of electrical conductivity of semiconductor film by Four Probe method and study of temperature variation of electrical conductivity.

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

UNIT-I (12 hrs)
1. 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. Radiative processes: General formalization-absorption, emission and luminescence. Optical properties of heterostrctures and nanostructures.

UNIT-II (12 hrs)
2. Electrical transport:
Carrier transport in nanostrcutures.Hall effect, etermination of carrier mobility and carrier concentration; Coulomb blockade effect, thermionic emission, tunneling and hoping conductivity. Defects and impurities: Deep level and surface defects.

UNIT-III (12 hrs)
3. Applications: Applications of nanoparticles, quantum dots, nanowires and thin films for photonic devices (LED, solar cells). Single electron transfer devices (no derivation). CNT based transistors. Nanomaterial Devices: Quantum dots heterostructures lasers, optical switching and optical data storage. Magnetic quantum well; magnetic dots - magnetic data storage.Micro Electromechanical Systems (MEMS), Nano Electromechanical Systems (NEMS).

UNIT-IV(12 hrs)
4. Nanoelectronics: Introduction, Electronic structure of Nanocrystals,Tuning the Band gap of Nanoscale semiconductors, Excitons, Quantumdot, Single electron devices, Nanostructured ferromagnetism,Effect of bulk nanostructuring of magnetic properties, Dynamics of nanomagnets, Nanocarbon ferromagnets, Giant and colossal magneto-resistance, Introduction of spintronics, Spintronics devices and applications.

UNIT-V (12 hrs)
5. 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.).
2.S.K. Kulkarni, Nanotechnology: Principles & Practices (Capital Publishing Company).
3. K.K. Chattopadhyay and A.N. Banerjee, Introduction to Nanoscience & Technology (PHI Learning Private Limited).
4. Richard Booker, Earl Boysen, Nanotechnology (John Wiley and Sons).

Cluster Elective Paper-VIII-B-3: Practical: Applications of Nanomaterials and Devices
2hrs/Week

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.

Paper-VII-(C) Elective (Renewable Energy)

Elective Paper –VII-C: Renewable Energy

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

UNIT-I (12 hrs)

1. **Introduction to Energy:** Definition and units of energy, power, Forms of energy, Conservation of energy, second law of thermodynamics, Energy flow diagram to the earth. Origin and time scale of fossil fuels, Conventional energy sources, Role of energy in economic development and social transformation.

2. **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. Effect of pollution due to thermal power station, nuclear power generation, hydroelectric power stations on ecology and environment.

UNIT-II (12 hrs)

3. **Global Energy Scenario:** Energy consumption in various sectors, projected energy consumption for the next century, exponential increase in energy consumption, energy resources, coal, oil, natural gas, nuclear and hydroelectric power, impact of exponential rise in energy usage on global economy.

4. **Indian Energy Scene:** Energy resources available in India, urban and rural energy consumption, energy consumption pattern and its variation as a function of time, nuclear energy - promise and future, energy as a factor limiting growth, need for use of new and renewable energy sources.

UNIT-III (12 hrs)

5. **Solar energy:** Solar energy, Spectral distribution of radiation, Flat plate collector, solar water heating system, Applications, Solar cooker. Solar cell, Types of solar cells, Solar module and array, Components of PV system, Applications of solar PV systems.

6. **Wind Energy:** Introduction, Principle of wind energy conversion, Components of wind turbines, Operation and characteristics of a wind turbine, Advantages and disadvantages of wind mills, Applications of wind energy.

UNIT-IV (12 hrs)

7. **Ocean Energy:** Introduction, Principle of ocean thermal energy conversion, Tidal power generation, Tidal energy technologies, Energy from waves, Wave energy conversion, Wave energy technologies, advantages and disadvantages.

8. **Hydrogen Energy:** History of hydrogen energy - Hydrogen production methods - Electrolysis of water, Hydrogen storage options – Compressed and liquefied gas tanks, Metal hydrides; Hydrogen safety - Problems of hydrogen transport and distribution - Uses of hydrogen as fuel.

UNIT-V (12 hrs)

9. **Bio-Energy**

Energy from biomass – Sources of biomass – Different species – Conversion of biomass into fuels – Energy through fermentation – Pyrolysis, gasification and combustion – Aerobic and anaerobic bio-conversion – Properties of biomass – Biogas plants – Types of plants – Design and operation – Properties and characteristics of biogas.

References:
1. Solar Energy Principles, Thermal Collection &Storage, S.P.Sukhatme: Tata McGraw Hill Pub., New Delhi.
2. Non-Conventional Energy Sources, G.D.Rai, New Delhi.
3. Renewable Energy, power for a sustainable future, Godfrey Boyle, 2004,
4. The Generation of electricity by wind, E.W. Golding.
5. Hydrogen and Fuel Cells: A comprehensive guide, Rebecca Busby, Pennwell corporation (2005)
6. Hydrogen and Fuel Cells: Emerging Technologies and Applications, B.Sorensen, Academic Press (2012).
7. Non-Conventional Energy Resources by B.H. Khan, Tata McGraw Hill Pub., 2009.
8. Fundamentals of Renewable Energy Resources byG.N.Tiwari, M.K.Ghosal, Narosa Pub., 2007.

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.
4. Measurement of I-V characteristics of solar cell.
5. Study the effect of input light intensity on the performance of solar cell.
6. Study the characteristics of wind.

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

UNIT-I (12 hrs)

1. Basics of Solar Radiation: Structure of Sun, Spectral distribution of extra terrestrial radiation, Solar constant, Concept of Zenith angle and air mass, Definition of declination, hour angle, solar and surface azimuth angles; Direct, diffuse and total solar radiation, Solar intensity measurement – Thermoelectric pyranometer and pyrheliometer.

2. Radiative Properties and Characteristics of Materials: Reflection, absorption and transmission of solar radiation throughsingle and multi covers; Kirchoff's law – Relation between absorptance, emittance and reflectance; Selective Surfaces - preparation and characterization, Types and applications; Anti-reflective coating.

UNIT-II (14 hrs)

3. Flat Plate Collectors (FPC) : Description of flat plate collector, Liquid heating type FPC, Energy balance equation,Efficiency, Temperature distribution in FPC, Definitions of fin efficiency and collector efficiency, Evacuated tubular collectors.

4. Concentrating Collectors: Classification, design and performance parameters; Definitions of aperture, rim-angle, concentration ratio and acceptance angle; Tracking systems; Parabolic trough concentrators; Concentrators with point focus.

Unit-III (14 hrs)

5. Solar photovoltaic (PV) cell: Physics of solar cell –Type of interfaces, homo, hetero andschottky interfaces, Photovoltaic Effect, Equivalent circuit of solar cell, Solar cell output parameters, Series and shunt resistances and its effect on cell efficiency; Variation of efficiency with band-gap and temperature.

6. Solar cell fabrication: Production of single crystal Silicon: Czokralski (CZ) and Float Zone (FZ) methods, Silicon wafer fabrication, Wafer to cell formation, Thin film solar cells, Advantages, CdTe/CdS cell formation, Multi-junction solar cell; Basic concept of Dye-sensitized solar cell, Quantum dot solar cell.

UNIT-IV (8 hrs)

Solar PV systems: Solar cell module assembly – Steps involved in the fabrication of solar module, Module performance, I-V characteristics, Modules in series and parallel, Module protection – use of Bypass and Blocking diodes, Solar PV system and its components, PV array, inverter, battery and load.

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; Field experience; PV market analysis and economics of SPV systems.

Reference Books:
1. Solar Energy Utilization, G. D. Rai, Khanna Publishers
2. Solar Energy- Fundamentals, design, modeling and applications, G.N. Tiwari, Narosa Pub., 2005.
3. Solar Energy-Principles of thermal energy collection & storage, S.P. Sukhatme, Tata Mc-Graw Hill Publishers, 1999.
4. Solar Photovoltaics- Fundamentals, technologies and applications, Chetan Singh Solanki, PHI Learning Pvt. Ltd.,
5. Science and Technology of Photovoltaics, P. Jayarama Reddy, BS Publications, 2004.

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

Minimum of 6 experiments to be done and recorded
1. Measurement of direct solar radiation using pyrheliometer.
2. Measurement of global and diffuse solar radiation using pyranometer.
3. Measurement of emissivity, reflectivity and transsivity.
4. Measurement of efficiency of solar flat plate collector.
5. Performance testing of solar air dryer unit.
6. Effect of tilt angle on the efficiency of solar photovoltaic panel.
7. Study on solar photovoltaic panel in series and parallel combination.

B.Sc. 6th Semester Physics
Cluster Elective Paper –VIII-C-2 :Wind, Hydro and Ocean Energies

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

UNIT-I
1. Introduction: Wind generation, meteorology of wind, world distribution of wind, wind speed variation with height, wind speed statistics, Wind energy conversion principles; General introduction; Types and classification of WECS; Power, torque and speed characteristics.

2. Wind Measurements: Eolian features, biological indicators, rotational anemometers, other anemometers, wind measurements withballoons.

UNIT-II
3. Wind Energy Conversion System: Aerodynamic design principles; Aerodynamic theories; Axial momentum, blade element andcombine theory; Rotor characteristics; Maximum power coefficient; Prandlt's tip losscorrection.

4. Design of Wind Turbine: Wind turbine design considerations; Methodology; Theoretical simulation of wind turbinecharacteristics; Test methods.

UNIT-III
5. 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, Economics of wind energyutilization; Wind energy in India; Environmental Impacts of Wind farms.

UNIT-IV
6. Small Hydropower Systems: Overview of micro, mini and small hydro systems; Hydrology; Elements of pumps andturbine; Selection and design criteria of pumps and turbines; Site selection;Speed and voltage regulation; Investment issues load management and tariff collection; potential of small hydro power in India.Wind and hydro based stand-alone hybrid power systems.

UNIT-V
7.Ocean Thermal, Tidal and Wave Energy Systems: Ocean Thermal - Introduction, Technology process, Working principle, Resource and site requirements, Location of OCET system, Electricity generation methods from OCET,Advantages and disadvantages, Applications of OTEC,

8. Tidal Energy - Introduction, Origin and nature of tidal energy, Merits and limitations, Tidal energy technology,Tidal range power, Basic modes of operation of tidal systems.Wave Energy – Introduction, Basics of wave motion, Power in waves, Wave energy conversion devices, Advantages anddisadvantages, Applications of wave energy.

Reference Books:
1. Dan Charis, Mick Sagrillo, LanWoofenden, "Power from the Wind", New Society Pub., 2009.

2. Erich Hau, "Wind Turbines-Fundaments, Technologies, Applications, Economics", 2ndEdition, Springer Verlag, BerlinHeidelberg, NY, 2006.
3. Joshue Earnest, Tore Wizelius, Wind Power and Project Developmen", PHI Pub., 2011.
4. T. Burton, D. Sharpe, N. Jenkins, E. Bossanyi, Wind Energy Handbook, John Wiley Pub., 2001.
5. Paul Gipe, "Wind Energy Basics", Chelsea Green Publications, 1999.
6. Khan, B.H., "Non-Conventional Energy Resources", TMH, 2nd Edition, New Delhi, 2009.
7. Tiwari, G.N., and Ghosal, M.K, Renewable Energy Resources – Basic Principles and applications, Narosa Publishing House,2007.

Cluster Elective Paper- VIII-C-2 Practical: Wind, Hydro and Ocean Energies 2hrs/Week

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.
4. Performance evaluation of vertical and horizontal axes wind turbine rotors.
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.

B.Sc. 6th Semester Physics
Cluster Elective Paper –VIII-C-3 :Energy Storage Devices

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

UNIT-I (12 hr)

1. **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, fossil fuels and synthetic fuels. Hydrogen for energy storage.

UNIT-II (12 hrs)

2. **Electrochemical Energy Storage Systems:**Batteries: Primary, Secondary, Lithium, Solid-state and molten solvent batteries; Leadacid batteries; Nickel Cadmium Batteries; Advanced Batteries. Role of carbon nano-tubes inelectrodes.

UNIT-III (12 hrs)

3. **Magnetic and Electric Energy Storage Systems:**Superconducting Magnet Energy Storage(SMES) systems; Capacitor and battery:Comparison and application; Super capacitor: Electrochemical Double Layer Capacitor(EDLC), principle of working, structure, performance and application.

UNIT-IV (12 hrs)

4. **Fuel Cell:** Fuel cell definition, difference between batteries and fuel cells, fuel cell components, principle and working of fuel cell, performance characteristics,efficiency, fuel cell stack, fuel cell power plant: fuel processor, fuel cell powersection, power conditioner, Advantages and disadvantages.

UNIT-V (12 hrs)

5. **Types of Fuel Cells:** Alkaline fuel cell, polymer electrolyte fuel cell, phosphoric acid fuel cell,molten carbonate fuel cell; solid oxide fuel cell,proton exchange membrane fuel cell, problems with fuel cells, applications of fuel cells.

REFERENCE BOOKS

1. J. Jensen and B. Squrensen, Fundamentals of Energy Storage, John Wiley, NY, 1984.
2. M. Barak, Electrochemical Power Sources: Primary and Secondary Batteries by, P. Peregrinus,IEE,1980.
3.P.D.Dunn, Renewable Energies, Peter Peregrinus Ltd, London, 1986.
4. B.Viswanathan and M. A. Scibioh, Fuel Cells-Principles and Applications, University Press, 2006.
5. Hart, A.B and G.J.Womack, Fuel Cells: Theory and Application, Prentice Hall, NewYork, 1989.

Cluster Elective Paper –VIII-C-3: Practical: Energy Storage Devices
2hrs/Week

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.
5. Performance estimation of a fuel cell.
6. Study of effect of temperature on the performance of fuel cell.