KUVEMPU UNIVERSITY

Bachelor of Science (B.Sc.) Semester Scheme

Curriculum Structure for Undergraduate Programme

III and IV Semester (2025-26)

Sl. No.	Course/ Paper Code	Title of the Paper	Subject Category	Teaching Hours / Week	Semester End Exam.	Internal assessment	Total Marks	Credits	Duration of Exam
1	2	3	4	5	6	7	8	9	10
Semester - III									
1	24MCP-T3	Electricity and Electrostatics	Theory	04	80	20	100	03	4 Hrs
2	24MCP -P3	Lab Experiments related to Electricity and Electrostatics	Practical	04	40	10	50	02	4 Hrs
3	24ELPh1	Electricity and Magnetism in Everyday life	Elective	02	40	10	50	02	2 Hrs
	Total			10	160	40	200	07	-----
Semester – IV									
4	24MCP-T4	Electrodynamics and Optics	Theory	04	80	20	100	03	4 Hrs
5	24MCP-P4	Laboratory experiments related to Electrodynamics and Optics	Practical	04	40	10	50	02	4 Hrs
6	24ELPh2	Renewable Energy sources	Elective	02	40	10	50	02	2 Hrs
	Total			08	160	40	200	07	-----

THEORY PAPER

SEMESTER – III

24MCP-T3: Electricity and Electrostatics

No. of teaching hours/week: 4 Total teaching hours: 60

Course Learning Objectives: The learning objectives of this course are

- Gaining a comprehensive understanding of the basic principles of electricity and electric currents
- Understanding the principles of transient currents and network analysis.
- Comprehend the concept of alternating currents and frequency filters.
- Getting to know about the working of rectifiers and electrical measurements of importance.
- Gaining insight into electrostatic phenomena occurring in nature

Course Outcomes: After completing this course, the students will be able

- To obtain expressions for the growth and decay of current in series LR circuit.
- To describe charging and discharging of a capacitor through a resistor in a series RC circuit.
- To give a qualitative description of series LCR circuit.
- To work on problems related to network analysis.
- To derive expressions for mean and RMS values of sinusoidal AC, Complex representation of AC using j notation.
- To describe series and parallel resonant circuits.
- To explain frequency filters and their applications.
- To have a comprehensive understanding of rectifiers, Zener diode and related problems.
- To describe Ballistic Galvanometer and Cathode ray oscilloscope.
- To explain electrostatic phenomena in detail
- To obtain an expression for electric field due to a dipole

UNIT I

1. TRANSIENT CURRENTS:

Brief discussion of L, C and R. Growth and decay of current in a series LR circuit fed with direct emf; Derivation of expression for current in (growth & decay) – graphical representation, explanation of time constant. Charging and discharging of a capacitor through a resistance in series RC circuit fed with direct emf – derivation of expression for charge variation both in charging and discharging processes--mention of expression for voltage and current variation – explanation of time constant in each case.

Series LCR circuit fed with direct emf – qualitative discussion- mention of expression for transient charge, condition for oscillation and expression for frequency (no derivation), Problems. **7 Hrs**

2. NETWORK ANALYSIS:

Statements of current and voltage divider theorems; Mesh current method of circuit analysis - Thevenin's and Norton's theorems – DC and AC statements – proof in case of DC circuits, problems involving DC circuits - Maximum power transfer theorem – AC and DC statements, proof for DC circuit, and problems with DC circuits **8 Hrs**

UNIT II

3. ALTERNATING CURRENTS:

Types of AC (sinusoidal and non-sinusoidal) – derivation of expression for mean and RMS values of sinusoidal AC and relation between them - Complex representation of AC using j notation, phase factor ($\omega t - \theta$); derivation of expressions for current and impedance in case of series LR and RC circuits; Response of LCR circuits fed with alternating emf – derivation of expressions for current and impedance (using j notation), phase relation between current and applied emf.

Series resonance – discussion from the expression for current, explanation of half power frequency, band

width and quality factor, derivation of expression for quality factor in terms of bandwidth and resonant frequency, significance of Q – factor, effect of resistance on sharpness of resonance; Variation of voltage with frequency of source across L and C in a series LCR circuit - Voltage magnification.
Parallel resonance (LR in parallel with C) - expression for current and impedance (no derivation) - Comparison between series and parallel resonance - Power in an AC circuit- derivation of expression for average power, power factor and its significance; Problem solving. **12 Hrs**

4. FREQUENCY FILTERS:
Types of frequency filters - derivation of expression for cut-off frequency in high pass and low pass RC filters, Band pass and band stop filters - working using circuits (qualitative discussion) – Mention of applications of frequency filters. **3 Hrs**

UNIT III

5. RECTIFIERS:
Half wave rectifier – construction and working; Full wave rectifier - construction and working using two semiconductor diodes – Derivation of expression for ripple factor and efficiency (by deriving the expression for I_{dc} and I_{rms}); Full wave Bridge rectifier (Qualitative discussion), Role of filters in rectifiers – LC and π section filters (qualitative); Zener diode - construction and working – VI characteristics - Zener breakdown, Zener diode as a voltage regulator, Construction and working in case of (a) input voltage variation and (b) load variation; Problem solving. **6 Hrs**

6. ELECTRICAL MEASUREMENTS:
Ballistic Galvanometer – construction and theory of BG, Charge sensitivity – origin of damping and damping correction, Logarithmic decrement, expression for decrement (derivation); Principles of experiments to determine capacitance by absolute method and high resistance by leakage, Mention of applications of BG.
Cathode ray oscilloscope – construction of CR tube – block diagram of CRO - brief explanation of function of each block, Time – base with simple circuit – uses of CRO, Measurement of voltage and frequency (using time base and Lissajous figures), Watt hour meter (brief explanation); **9 Hrs**

UNIT IV

7. SCALAR AND VECTOR FIELDS: Scalar and vector fields, Examples; Gradient of a scalar field, Divergence and curl of a vector field, div curl and curl grad; Problem Solving; Laplacian operator, Concept of Line, Surface and Volume integrals; physical examples. Gauss and Stokes theorem (statements only) **4 hrs**

8. ELECTRIC FIELD AND POTENTIAL: Coulomb's Law, Electric field due to discrete distribution of charges; Electric flux; Gauss law in electrostatics; Curl E=0—Conservative nature of electrostatic field; Electric potential; Energy density in an electrostatic field--derivation from a parallel plate capacitor. Loss of energy due to sharing of charges between two conductors. **5 hrs**

9. ELECTRIC DIPOLE Concept of Electric dipole; Physical examples- potential and field due to a dipole, torque on a dipole and its energy in an uniform electric field; Effect of non- uniform fields (qualitative). Electric field in a dielectric medium-electric polarization- $D=\epsilon_0 E+P$ (simple derivation)- dielectric susceptibility, para electrics and ferro electrics (qualitative). Applications of ferroelectrics. Clausius- Mosotti equation (no derivation). **6 hrs**

NOTE: Sufficient number of problems that would enhance the understanding of the subject are to be worked out in each section

REFERENCE BOOKS:

1. Introduction to Electrodynamics – David J Griffths, 5th edition, Cambridge University Press (2023).
2. Electricity and magnetism – Mahajan A.S and Rangwala, McGraw-Hill, *(***1963***)*
3. Electricity and magnetism – Berkeley physics course Vol II., McGraw-Hill Education (1984).
4. Fundamentals of physics – Halliday, Resnick and Walker – 6th edition, Wiley India (New Delhi) (**2010***).*
5. Electrodynamics – David Jackson, John Wiley & Sons Inc , (1998).
6. Electromagnetics – B.B. Laud, 4th edition, New Age International Private Limited, (***2022***).
7. Fundamentals of Electricity and magnetism – D.N Vasudeva, S Chand & Company *(*2011).
8. Electricity and magnetism – Brijlal and Subramanyam. 2nd Edition, Ratan Prakashan Mandir, (1966).
9. Feynman lectures on Physics – vol II. 1st Edition, Pearson Education India, (2012).
10. Electricity and magnetism – K.K.Tewari, 3rd Edition., S. Chand Publishing, *(***2007).**
11. Fundamentals of Electricity and magnetism – Arthur F Kip, ***McGraw-Hill,*** **(1962***).*
12. Electricity and magnetism –R. Murugeshan., S. Chand Publishing (2017).
13. Text book of Electronics - Basavaraj.B.,2nd edition, Vikas Publishing House, (2009).
14. Basic electronics –B. L. Theraja, S. Chand Publishing **(2006).**
15. Text book of electrical technology – B.L.Thereja., 1st edition, S Chand Publishing (2006).

PRACTICAL PAPER
SEMESTER– III

24MCP-P3: Electricity and Electrostatics

Each experiment is of 4 hour duration. Minimum of 8 experiments must be performed in the Semester. Suitable error analysis of the experimental results is to be carried out.

(One experiment per week per batch to be conducted in 4 hours duration)

1) Series resonance.
2) Parallel resonance.
3) Self-inductance – Anderson's bridge.
4) Dielectric constant – RC circuit.
5) Low pass and high pass filters – cut-off frequency.
6) Helmholtz tangent galvanometer - Reduction factor 'K' and B_H
7) Field on the axis of a circular coil – both sides.
8) Network theorems – Maximum power transfer, Thevenin's & Norton's theorems.
9) Half wave rectifiers - without & with filters
10) Full wave rectifiers- without & with filters. (using two diodes)
11) Current sensitivity of BG.
12) Thermo emf of a thermocouple using potentiometer – melting point.
13) Measurement of L and C by equal voltage method.
14) Measurement of DC and AC voltages using CRO.
15) Impedance of series R-C circuit - determination of frequency of A.C.
16) Desauty Bridge- verification of laws of combination.
17) Charging and discharging of a capacitor- energy dissipated during charging, time constant.

Open Elective paper
Semester III
24ELPh1: Electricity and Magnetism in Everyday Life

Note: Students who have taken Physics as one of the major subjects can opt for this elective paper
No. of teaching hours/week: 2 Total teaching hours: 30

Course Learning Objectives:

- To understand the basic principles of electricity and magnetism in an intuitive manner.
- To explore the applications of electromagnetic concepts in everyday life.
- To promote scientific awareness and reasoning about common electrical and magnetic phenomena.

Course Outcomes: After successful completion of this course, students will be able to:

- Understand the principles of electric charge, current, resistance, magnetism, and electromagnetic waves.
- Explain the functioning of everyday devices like electric bulbs, fans, magnets, mobile phones, and microwave ovens.
- Appreciate the role of electricity and magnetism in modern technology and sustainable energy use.
- Identify safety measures and energy conservation practices at home.

UNIT I

Basics of Electricity and magnetism: Static electricity and electric charge, Electric current, voltage, and resistance; Conductors, insulators, and semiconductors, Simple electric circuits and Ohm's law, Series and parallel connections; Permanent and temporary magnets; Electromagnets and their uses; Electromagnetic induction: the principle behind generators and transformers; Working of simple DC and AC motors;

(10 hours)

UNIT II

Electrical Power and Domestic Wiring: Physics of alternating current: Alternating and Direct current; current, voltage, power and phase; Phase, neutral and ground in electrical connections; A model domestic wiring; Single phase and three phase currents; Working of MCB, ELCB; Safety precautions and rules in handling electrical appliances; Importance of earthing. **(10 hours)**

UNIT III:

Storing electric and magnetic energy: Batteries and their types; Charging and discharging of batteries; Construction and working of Lithium-ion batteries; Advantages and disadvantages of Lithium-ion batteries.Capacitors: Principle behind storing of charges and energy in a capacitor; Applications;
Magnetic storage devices -- Computer Hard disks, magnetic tapes etc., **(10 hours)**

REFERENCE BOOKS:

1. Physics-Part-II, David Halliday and Robert Resnick, Wiley Eastern Limited,(2001).
2. Modern Electronic Instrumentation and Measurement Techniques, A D Helfrick and W D Cooper, PHI, (2016).
3. Electronic Devices and Circuits, David A Bell, PHI, (2004).
4. Electricity and Magnetism, Edward M. Purcell, 3rd edition, CUP, (2013).

Recommended Activities for students
Plot magnetic lines of force for different types of magnets.
Prepare a chart to demonstrate electric wiring of a simple house;

Demonstrate charging and discharging of a capacitor using an electric bulb, resistor and a capacitor

THEORY PAPER

SEMESTER – IV

24MCP-T4: Electrodynamics and Optics

No. of Teaching hours per week: 4 Total teaching hours: 60

Course Learning Objectives: The learning objectives of this course are

- Gaining a comprehensive understanding of the phenomena due to steady and changing currents
- Internalising the concept that light is an electromagnetic wave
- Understand the meaning and significance of geometrical optics
- Getting to know about the working of basic optical instruments such as eye-piece and telescope
- Gaining a basic understanding of the phenomena of interference, diffraction and polarization of light

Course Outcomes: After completing this course, the students will be able

- To arrive at basic laws of magnetostatics and Lorentz force law.
- To obtain Maxwell's field equations and wave equations for electric and magnetic fields in vacuum and material medium
- To show the transverse nature of electromagnetic waves
- To explain Fermat's principle, laws of reflection, defects in lenses and concept of achromatisation
- To give a description of the construction and working of Ramsden and Huygen's eye pieces and compare their characteristics
- To discuss Huygen's principle and explain the nature of plane and spherical wavefronts of light waves.
- To explain the meaning of coherent sources and their formation in Lloyd's mirror, biprism
- To give a detailed description of construction and working of Michelson's interferometer
- To distinguish between Fresnel and Fraunhoffer diffraction and describe the phenomena of diffraction at a straight edge and single slit
- To give a complete description of diffraction gratings, nature of spectra due to gratings and compare between prism spectra and grating spectra
- To give a detailed description of Huygen's construction of O and E rays in different cases
- To describe the nature of linearly, circularly and elliptically polarized light
- To define the meaning of retarding plates and their action on light.

UNIT-I

1. MAGNETOSTATICS

Biot Savart's law; Ampere's circuital law – statement – proof from line integral over an irregular path which encloses a current - comparison of Gauss' law and Ampere's law – application of Ampere's law to calculate magnetic fields due to (a) a straight long conductor (b) a long solenoid. Characteristics of magnetic field - **Div B** = 0 (qualitative) Current loop as a magnetic dipole, illustration from the magnetic field due to a circular current loop - expression for torque on a current loop (magnetic dipole) in a magnetic field. Mention of Lorentz force **F**=q (**E**+**v**X**B**) on a charged particle **6 Hrs**

2. ELECTRODYNAMICS:

Faraday's law of Electromagnetic induction; Limitations of Ampere's law, Maxwell's concept of displacement current, derivation of expression for displacement current density from charging of a capacitor – significance of displacement current;

Maxwell's field equations; Derivation of electromagnetic wave equation (for **E** and **B**) for free space, velocity of electromagnetic waves, light as an electromagnetic wave, Electromagnetic wave equation for dielectric medium, expression for refractive index; Plane wave solutions of EM wave equation in free space (expression only) – to show that **E** and **B** are perpendicular to each other, transverse nature of EM waves (derivation), relation between **E** and **B** components (qualitative)- diagram of a EM wave, characteristics of EM waves; Poynting theorem (statement and expression); Production and detection of EM waves--Hertz experiment. **9 Hrs**

UNIT-II

3. GEOMETRICAL OPTICS:

Fermat's principle-derivation of law of refraction. Meaning of thick lens, Cardinal points, A lens system due to the combination of two thin lenses separated by a finite distance (thick lens), obtaining the expression for the cardinal points. Defects of lenses, types; conditions for minimizing the spherical aberration, Achromatization; derivation of condition for achromatization of two thin lenses not in contact; Mention of the expression for condition of achromatization of two thin lenses in contact. **9 Hrs**

4. OPTICAL INSTRUMENTS :

Types of eye pieces, Ramsden and Huygen's eye pieces - construction, working and expression for focal length(derivation); position of cardinal points in each case, comparision between Ramsden and Huygen's eye pieces. **3 Hrs**

5. WAVE THEORY OF LIGHT:

Wave front; Huygen's principle; Explanation of refraction of a plane wave front at a plane surface, expression for refractive index- derivation of lens makers formula in the case of double convex lens using spherical wave front. **3 Hrs**

UNITS III and IV

6. INTERFERENCE OF LIGHT:

Condition for sustained interference, formation of coherent sources in a biprism and Lloyd's mirror; Explanation of measurement of distance between two coherent sources in case of Biprism. Interference at a thin film in reflected light (theory), in transmitted light (qualitative), colors of thin films (qualitative); Theory of Newton's rings; Michelson's interferometer- Construction, working, mention of Applications – Theory of intereference at an Air wedge **10 Hrs**

7. DIFFRACTION OF LIGHT:

Types of diffraction--Fresnel's and Franuhofer diffraction- differences; Fresnel's half period zones-explanation of rectilinear propagation of light. Zone plate(qualitative), comparision between zone plate and convex lens. Fresnel's diffraction at a straight edge(theory). Franuhofer diffraction at single slit(qualitative). Plane Diffraction Grating- Construction, Plane transmission grating-normal incidence (theory) and oblique incidence (qualitative); Dispersive and Resolving power of a grating; Comparison of grating- and prism spectra. Fraunhofer diffraction at a circular aperture-Airy's disc (qualitative) **12 Hrs**

8. POLARIZATION:

Types of crystals-Examples; Double refraction at a uniaxial crystal-Huygen's construction for O and E wave fronts in the case of optic axis in the plane of incidence and parallel to crystal surface-oblique and normal incidence(in detail), Retarding plates- half wave and quarter wave plate, Production and detection

of linearly, circularly and elliptically polarized light (with theory); Optical activity-origin due to asymmetric molecules; Fresnel's theory of optical activity; Kerr effect and Faraday effect. (Qualitative).

8 Hrs

NOTE: Sufficient number of problems that would enhance the understanding of the subject are to be worked out in each section

REFERENCE BOOKS:

1. Introduction to Electrodynamics – David J Griffths, 1st edition, Prentice Hall (1981)
2. Classical Electrodynamics—J. D. Jackson, 2nd edition, John Wiley & Sons (1975)
3. Electromagnetics—B. B. Laud , 2nd edition, New Age International Private Limited (2011).
4. Optics- Brijlal and Subramayam, S. Chand Publications (2012)
5. Optics and Atomic physics – D.P Khandelwal, Himalaya Publishing house (1989)
6. Optics and Atomic physics – Satya prakash, 3rd edition, RATAN PRAKASHAN (1984)
7. Physics Volume II – Halliday and Resnick, 5th edition, Wiley (2007)
8. Optics and Spectroscopy – R. Murugeshan and Kiruthiga Sivaprasath, S Chand publications (1997)
9. Optics – Ajoy Ghatak, 1st edition, Mcgraw-Hill Education (2009)
10. Fundamentals of Physics – Jenkins and White, McGraw-Hill Book Co. (1937*)*
11. Berkely Physics course – Volume –II, McGraw-Hill Education (1984)

PRACTICAL PAPER
SEMESTER IV
24MCP-P4: Electrodynamics and Optics

Each experiment is of 4 hour duration. Minimum of 8 experiments must be performed in the Semester. Suitable error analysis of the experimental results is to be carried out.

(One experiment per week per batch to be conducted in 4 hours duration)

1. Interference at a wedge- determination of thickness.
2. Newton's Rings- determination of radius of curvature, graphical method.
3. Biprism- determination of wave length.
4. Diffraction grating -minimum deviation, mercury spectrum.
5. Diffraction at a straight wire-diameter, error estimation.
6. Resolving power of a telescope.
7. Diffraction at a straight edge- wavelength determination.
8. Polarimeter - specific rotation of sugar.
9. L.B. photo meter inverse square law and absorption coefficient of glass plate.
10. Dispersive power of grating.
11. Resolving power of grating.
12. Resolving power of prism.

Open Elective paper
Semester IV
24ELPh2: Renewable Energy Sources;

Note: Students who have taken Physics as one of the three major subjects can opt for this elective paper

No. of teaching hours /week: 2 Total teaching hours: 30

Course Objectives:

- To provide an overview of various renewable energy sources and technologies.
- To familiarize students with the basic scientific principles behind renewable energy conversion.
- To develop awareness of the environmental, social, and economic impacts of energy choices.
- To motivate students towards sustainability and green energy careers.

Course Outcomes: Upon successful completion of the course, students will be able to:

- Understand the working principles of various renewable energy technologies.
- Compare renewable and non-renewable sources in terms of efficiency and environmental impact.
- Identify appropriate renewable energy systems for rural and urban contexts.

UNIT I:

Introduction to Energy and Sustainability: Types of energy: Renewable vs Non-renewable, Energy demand and global/Indian energy scenario; Environmental consequences of conventional energy sources; Energy efficiency and sustainability principles. **(4 Hours)**

UNIT II:

Solar Energy: Basics of solar radiation and measurement, Estimation of solar radiation on horizontal and inclined surfaces; Solar thermal systems: solar water heaters, solar cookers; - Principle of Solar cell, Photovoltaic system for electric power generation. Photovoltaic (PV) technology: materials, functioning, efficiency; Applications: street lighting, solar pumps, rooftop PV systems **(8 Hours)**

UNIT III

Wind energy: Fundamentals, wind turbines, site selection; Small and large-scale wind power systems; Basic components of wind energy conversion system (WECS)
Biomass Energy: Sources of biomass: : plant, animal, agricultural waste; Biofuels; Biomass conversion technologies-fixed dome; Urban waste to energy conversion. (**6 hours**)

UNIT IV

Tidal Power: Tides and waves as energy suppliers; fundamental characteristics of tidal power, harnessing of tidal energy-- advantages and limitations.
Ocean Thermal Energy Conversion: Working Principle; Benefits (**6 hours**)

UNIT V

Green Energy: Introduction, Fuel cells: Classification of fuel cells-— H_2; Operating principle; Benefits of hydrogen energy, hydrogen production technologies (electrolysis method only), applications of hydrogen energy; Issues associated with hydrogen energy**.** **(6 hours)**

Suggested activities for students:

- Poster presentation on the theme of renewable energy sources.
- Discussion among students about how the use of renewable energy sources should be encouraged.

REFERENCE BOOKS:

1. Non-Conventional Energy Sources G. D Rai, Khanna Publishers (1988)
2. Solar Energy: Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, 3rd edition (2009)
3. Renewable Energy: Power for a Sustainable Future, Godfrey Boyle, Oxford University Press (2012)
4. Solar Photovoltaics: Fundamentals, Technologies and Applications, C. S. Solanki, PHI (2013)
5. Energy Technology, S. Rao and Dr. B.B. Parulekar, Khanna Publication (1994)
6. Solar energy, Subhas P Sukhatme, Tata McGraw Hill, 2n Edition (1996)
7. Principles of Energy conversion, A. W. Culp Jr., McGraw Hill (1996)
8. Non-Conventional Energy Resources, Shobh Nath Singh, Pearson (2018)

THEORY EXAMINATION QUESTION PAPER PATTERN FOR
ELECTIVE/OPTIONAL PAPERS
(Semesters III & IV)
B.Sc. Semester-III/IV Degree Examination; 2025-26
(Semester Scheme; New Syllabus: 2024-25)

Paper Title _____

Paper Code: _____

Time: 2 Hours Max. Marks: 40

Instructions to candidates:

1) All sections are compulsory
2) Draw neat and labelled diagrams wherever necessary.

SECTION-A

Answer **all** the following questions: **(2×5=10)**

1.
2.
3.
4.
5.

SECTION-B

Answer any **SIX** of the following: **(5×6=30)**

6.
7.
8.
9.
10.
11.
12.
13.

Internal Assessment for Elective Paper

Sl. No.	Internal Assessment	Maximum Marks
01.	Two Session Tests with proper record for assessment (Each test for 20 marks) Total marks in two tests/10=4	4
02.	Assessment of Skill Development activities/Seminars/Group Discussion/ Assignment etc., with proper record	3
03.	Attendance with proper record	3
TOTAL MARKS		10

- Attendance Marks-breakup

<75% - 00 Marks
75-85% - 1 Mark
85-95% - 2 Marks
>95% - 3 Marks

NOTE: The question paper pattern and internal assessment structure for theory and practical papers of Major Course Physics (MCP) are as given in the Syllabus for Ist and IInd Semester. The pattern given there is applicable for all theory and practical papers from Semester I to Semester VI

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