GOVERNMENT COLLEGE FOR MEN (A), KADAPA

B.Sc. (HONOURS) PHYSICS Single Major
w.e.f. 2024-25 (Revised in May 2024)
SEMESTER-III COURSE 5 : OPTICS

Hours: 45 3 hrs/week

Course objective: The course on Optics aims to provide students with a fundamental understanding of the behaviour and properties of light and its interaction with matter.

Learning Outcomes

On successful completion of this course, the student will be able to:

- Explain about the different aberrations in lenses and discuss the methods of minimizing them
- Understand the phenomenon of interference of light and its formation in (i) Lloyd's single mirror due to division of wave front and (ii) Thin films, Newton's rings and Michelson interferometer due to division of amplitude.
- Distinguish between Fresnel's diffraction and Fraunhoffer diffraction and observe the diffraction patterns in the case of single slit and the diffraction grating and to describe the construction and working of zone plate and make the comparison of zone plate with convex lens
- Explain the various methods of production of plane, circularly and polarized light and their detection and the concept of optical activity.
- Comprehend the basic principle of laser, the working of He-Ne laser and Ruby lasers and their applications in different fields. To understand the basic principles of fibre optic communication and explore the field of Holography and Nonlinear optics and their applications.

CO-PO mapping:
(1: Low 2: Medium 3: High 4.No correlation)

	PO1	PO 2	PO 3	PO 4	PO 5
CO 5	2	1	3	2	2

UNIT-I Aberrations 9hrs

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 INTERFERENCE 9hrs

Principle of superposition – 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 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. Determination of wavelength of monochromatic light using Newton's rings and Michelson Interferometer.

UNIT-III DIFFRACTION9hrs

Introduction, distinction between Fresnel and Fraunhoffer diffraction, Fraunhoffer diffraction – Diffraction due to single slit-Fraunhoffer, Fraunhofer diffraction pattern with N slits (diffraction grating). Resolving power of grating, Determination of wavelength of light in normal incidence 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 POLARISATION 9hrs

Polarized light: methods of polarization by reflection, refraction, double refraction, Brewster's lawMauls law- Nicol prism polarizer and analyser, Quarter wave plate, Half wave plate-optical activity, determination of specific rotation by Laurent's half shade Polarimeter. Idea of elliptical and circular polarization

UNIT-V LASERS AND HOLOGRAPHY 9hrs

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.

REFERENCE BOOKS:

1. BSc Physics, Vol .2, Telugu Academy, 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, Ajay Ghatak, Tata Mc Graw-Hill.
6. Introduction of Lasers – Avadhanulu, S. Chand & Co.
7. Principles of Optics- BK Mathur, Gopala Printing Press, 1995

Practical Course on OPTICS

COURSE OBJECTIVE:

To develop practical skills in the use of laboratory equipment and experimental techniques for studying light and its interactions with matter.

LEARNING OUTCOMES:

1. Mastery of experimental techniques: Students should become proficient in using laboratory equipment and experimental techniques for studying light and its interactions with matter.

2. Application of theory to practice: Students should be able to apply theoretical concepts learned in lectures to real-world situations, and understand the limitations of theoretical models.

3. Accurate recording and analysis of data: Students should be able to accurately record and analyze experimental data, including understanding the significance of error analysis and statistical methods.

4. Critical thinking and problem solving: Students should be able to identify sources of error, troubleshoot experimental problems, and develop critical thinking skills in experimental design and analysis.

5. Understanding of physical principles: Students should develop an understanding of the physical principles governing optics, including reflection, refraction, diffraction, interference, and polarization.

Work load: 30 hrs per semester **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. Determination of wavelength of laser light using diffraction grating.

8. Resolving power of a telescope.

9. Refractive index of a liquid-hallow prism

10. Determination of thickness of a thin wire by wedge method

11. Determination of refractive index of liquid-Boy's method.

STUDENT ACTIVITIES

Suggested student activities

UNIT-I Aberrations:

Ask students to observe and sketch the different images produced by the lens at different distances. Build a simple optical system with two lenses in contact and ask students to calculate the focal length and magnification of the system. Then, introduce a thin glass plate between the lenses to simulate the effects of chromatic aberration and ask students to observe and discuss the changes in the image produced.

UNIT-II Interference:

Ask students to measure the diameter of the central bright spot and the diameter of the nth ring for different values of n, and then calculate the wavelength of light.

UNIT-III Diffraction:

Build a simple diffraction grating using a piece of cardboard and some sewing needles. Ask students to measure the distance between the needles, count the number of lines per unit length, and then calculate the grating spacing and the wavelength of light.

UNIT-IV Polarisation:

Ask students to measure the angle of rotation of the polarized light before and after passing through the sample, and then calculate the specific rotation of the sample.

UNIT-V Lasers and Holography:

Demonstrate the principle of holography using a laser beam, a beam splitter, and a photographic plate. Ask students to record a hologram of a simple object and then reconstruct the image using a laser beam.

Model Question paper
GOVERNMENT COLLEGE For Men(A),
Kadapa II BSc, SEMESTER- III: PHYSICS -
wef 2024-25 COURSE 5 : OPTICS

Time: 3Hours **Max Marks:60**

SECTION-A

Answer any **FIVE** of the following. Each question carry 4 Marks (5x4 =20 Marks)

1. Explain spherical aberration?
2. Write short notes on Astigmatism?
3. Write conditions required to obtain sustained interference fringes ?
4. Write short notes on formation of colors on thin films?
5. Write differences between Fresnel and Fraunhofferdiffractions ?
6. State and explain Malus law?
7. The refractive indices for red and blue colours of thin lens made of glass are 1.540 and 1.575, calculate dispersive power?
8. Write applications of Lasers?

SECTION-B

Answer any FIVE of the following. Each carry 8 Marks (5x8 = 40 Marks)

9. What is achromatic doublet? Derive condition for achromatic doublet when lenses are in contact?
10. Explain formation of Newton rings. Derive expression for wavelength of monochromatic light from Newton rings?
11. Explain diffraction due to single slit?
12. Explain construction and working of Zone plate?
13. Explain construction and working of Nicol prism?
14. Describe Laurentz polarimeter? Explain an experiment to determine the specific rotation of sugar solution using it?
15. Explain construction and working of He-Ne Laser?
16. Define holography? Explain principle of holography?

GOVERNMENT COLLEGE FOR MEN (A), KADAPA

B.Sc. (HONOURS) PHYSICS Single Major

w.e.f. 2024-25 (Revised in May 2024))

SEMESTER-III

COURSE 6: HEAT AND THERMODYNAMICS

Hours: 45 3 hrs/week

Objective:

The course on Heat and Thermodynamics aims to provide students with a fundamental understanding of the principles of heat and energy transfer and their applications in various fields

Learning outcomes*:*

The student should be able

- Understand the basic aspects of kinetic theory of gases, Maxwell-Boltzmann distribution law, equipartition of energies, mean free path of molecular collisions and the transport phenomenon in ideal gases
- Gain knowledge on the basic concepts of thermodynamics, the first and the second lawof thermodynamics, the basic principles of refrigeration, the concept of entropy, the thermodynamic potentials and their physical interpretations. Understand the working of Carnot's ideal heat engine, Carnot cycle and its efficiency
- Develop critical understanding of concept of Thermodynamic potentials,the formulation of Maxwell's equations and its applications.
- Differentiate between principles and methods to produce low temperature, liquefy air, and understand the practical applications of substances at low temperatures.
- Examine the nature of black body radiations and the basic theories

CO-PO mapping:

(1: Low 2: Medium 3: High 4.No correlation)

	PO1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 6	**2**	**1**	**3**	**2**	**3**

UNIT-I KINETIC THEORY OF GASES: 9hrs

Kinetic Theory of gases- Introduction, Postulates of kinetic theory, Maxwell's law of

distribution of molecular velocities, Mean free path, Principle of equipartition of energy, Transport phenomenon in ideal gases: viscosity and Thermal conductivity.

UNIT-II: THERMODYNAMICS: 9hrs

Introduction- Reversible and irreversible processes, Carnot's engine and its efficiency, Carnot's theorem, Thermodynamic scale of temperature,Second law of thermodynamics Entropy: Physical significance, Change in entropy in reversible and irreversible processes; TemperatureEntropy (T-S) diagram and its uses; change of entropy when ice changes into steam.

UNIT-III: THERMODYNAMIC POTENTIALS AND MAXWELL'S EQUATIONS: 9hr

Thermodynamic Potentials-Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy and their significance, Derivation of Maxwell's thermodynamic relations from thermodynamic potentials, Applications to (i) Clausius-Clayperon's equation (ii) Joule-Kelvin coefficient for ideal and Van der Waals' gases.

UNIT-IV: LOW TEMPERATURE PHYSICS: 9hrs

Methods for producing very low temperatures, Joule Kelvin effect, porous plug experiment, Joule expansion, Distinction between adiabatic and Joule Thomson expansion, Expression for Joule Thomson cooling, Production of low temperatures by adiabatic demagnetization (qualitative).

UNIT-V: QUANTUM THEORY OF RADIATION: 9hrs

Spectral energy distribution of black body radiation, Wein's displacement law and RayleighJean's law (No derivations), Planck's law of black body radiation-Derivation, Deduction of Wein's law and Rayleigh- Jean's law from Planck's law, Solar constant and its determination using Angstrom pyro heliometer, Estimation of surface 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 and Thermodynamics -N BrijLal, P Subrahmanyam, 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

Model Question paper

GOVT COLLEGE For Men (A) , Kadapa
II BSc, SEMESTER- III: PHYSICS (Hons) -
2024-25 COURSE-VI: HEAT AND THERMODYNAMICS

Time: 3 Hrs Max. Marks :60

Section –A

Answer any *FIVE* of the following. Each carry 4 mark. 5X4 = 20 marks

1. Write postulates of kinetic theory of gases?
2. Write differences between reversible and irreversible process?
3. Write short notes on entropy of the universe?
4. Derive Clausius – Clapeyron latent heat equation using Maxwells equations?
5. Write applications of substances at low temperatures?
6. Write characteristics of black body spectrum?
7. A heat engine draw heat from the source at temperature 1127^0C and reject to the sink at temperature 7^0C. Calculate its efficiency?
8. Explain Raleigh Jeans formula?

Section –B

Answer any *FIVE* of the following. Each carry 8 mark. 5X8 = 40 marks

9). What are transport phenomena? Derive expression for coefficient of viscosity of gas based on thekinetic theory?

10). Derive expression for Maxwells law of distribution of molecular velocities?

11). Explain Carnot engine? Derive expression for its efficiency?

12). What is entropy? Explain change in entropy in reversible and irreversible process?

13). Write thermodynamic potentials? Derive Maxwells equations from thermodynamic potentials?

14). What is Joule Kelvin effect? Explain porous plug experiment? Write its results

15). What is adiabatic demagnetization? Explain experiment how low temperature can be obtained in this method?

16). Explain solar constant? Explain how it is determined experimentally?

****

Practical Course on HEAT AND THERMODYNAMICS

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

Objective:

The objectives for practicals in Heat and Thermodynamics can vary depending on the specific course or program, but here are some general objectives that may apply, to develop practical skills in the use of laboratory equipment and experimental techniques for studying heat and thermodynamics.

LEARNING OUTCOMRES:

1. Mastery of experimental techniques: Students should become proficient in using laboratory equipment and experimental techniques for studying heat and thermodynamics.
2. Application of theory to practice: Students should be able to apply theoretical concepts learned in lectures to real-world situations, and understand the limitations of theoretical models.
3. Accurate recording and analysis of data: Students should be able to accurately record and analyze experimental data, including understanding the significance of error analysis and statistical methods.
4. Critical thinking and problem solving: Students should be able to identify sources of error, troubleshoot experimental problems, and develop critical thinking skills in experimental design and analysis.
5. Understanding of physical principles: Students should develop an understanding of the physical principles governing heat and thermodynamics, including the laws of thermodynamics, heat transfer, and thermodynamic cycles.

Minimum of six experiments to be done and recorded

Experiments

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. Thermo emf- thermo couple - Potentiometer
8. Thermal behavior of an electric bulb (filament/torch light bulb)
9. Measurement of Stefan's constant- emissive method
10. Study of variation of resistance with temperature - Thermistor.

Activities

Unit I: Kinetic Theory of Gases Activity:

Speed Distribution Analysis Students can conduct a simple experiment using gas molecules (e.g., small balls) in a container. They can measure the speeds of the molecules using a motion sensor or stopwatch and analyze the distribution of molecular velocities. They can compare the observed distribution with the expected Maxwell's law of distribution.

Unit II: Thermodynamics Activity:

Heat Engine Efficiency Calculation Students can work in groups to design a simple heat engine (e.g., using a syringe and a small turbine). They can measure the temperature changes and calculate the efficiency of their engine. They can compare their calculated efficiency with the theoretical Carnot efficiency to understand the limitations of real heat engines.

Unit III: Thermodynamic Potentials and Maxwell's Equations Activity:

Thermodynamic Relations Verification Students can solve numerical problems involving different thermodynamic potentials (internal energy, enthalpy, Helmholtz free energy, and Gibbs free energy) and verify the Maxwell's thermodynamic relations. They can compare the calculated values using different relations to ensure consistency.

Unit IV: Low Temperature Physics Activity:

Adiabatic Demagnetization Experiment They can discuss the distinction between adiabatic and Joule-Thomson expansions.

Unit V: Quantum Theory of Radiation Activity:

Black Body Radiation Spectrum Analysis They can estimate the surface temperature of the Sun using the solar constant and Angstrom pyro heliometer data.

GOVERNMENT COLLEGE FOR MEN (A), KADAPA
B.Sc. (HONOURS) PHYSICS Single Major
w.e.f. 2024-25 (Revised in May 2024)

SEMESTER-III

COURSE 7: ELECTRONIC DEVICES AND CIRCUITS

Hours: 45 3 hrs/week

COURSE OBJECTIVE:

The course on Electronic Devices and Circuits aims to provide students with a fundamental understanding of electronic devices and their applications in various circuits.

LEARNING OUTCOMES:

- Understand the behavior of P-N junction diodes in forward and reverse bias conditions and analyze the impact of junction capacitance on diode characteristics.
- Analyze and compare the characteristics and operation of different BJT configurations (CB, CE, and CC) and demonstrate proficiency in biasing techniques.
- Comprehend the operation and characteristics of FETs, including JFETs and MOSFETs, and explain the working principles and characteristics of UJTs.
- Describe the operation and applications of various photoelectric devices such as LEDs, photo diodes, phototransistors, and LDRs.
- Understand the operation of rectifiers (half-wave, full-wave, and bridge), analyze the ripple factor and efficiency, and demonstrate knowledge of different filter types and three-terminal voltage regulators

CO-PO mapping:

(1: Low 2: Medium 3: High 4.No correlation)

	PO1	PO 2	PO 3	PO 4	PO 5
CO 5	2	3	2	3	2

UNIT I: PN JUNCTION DIODES:

P-N junction Diode, Formation of depletion region, Forward and Reverse bias Ideal Diode,

Diode equation – Reverse saturation current – Tunnel Diode- Construction, working, V-I characteristics and Applications, Zener diode – V I characteristics, Applications

UNIT –II: BIPOLAR JUNCTION TRANSISTOR AND ITS BIASING:

(D.C) Transistor construction, working of PNP and NPN Transistors, Active, Cutoff and Saturation conditions, Configurations of Transistor - CB, CE, and CC, Input and Output Characteristics of CB and CE configurations. Hybrid parameters of a Transistor and equivalent circuit, BJT Transistor Biasing – Need for stabilization, Thermal runaway, Stability factor, Biasing methods - Voltage-Divider Bias.

UNIT-III: FIELD EFFECT TRANSISTORS & POWER ELECTRONIC DEVICES:

Difference between JFET and BJT, Construction and working of JFET, Drain and Transfer Characteristics, MOSFET - Depletion-type, and Enhancement-Type MOSFETs. FET Biasing: Voltage Divider Biasing. UJT- Construction, working, V-I characteristics. SCR – Construction, Working and Characteristics

UNIT IV: PHOTO ELECTRIC DEVICES:

Light-Emitting Diodes (LEDs) - Construction, working, characteristics and Applications, IR Emitters, Photo diode - Construction, working characteristics and Applications, Phototransistors - Construction, working and characteristics, Applications, Structure and operation of LDR, Applications

UNIT-V: POWER SUPPLIES:

Rectifiers: Half wave, Full wave and bridge rectifiers - Efficiency (with derivations), ripple factor- Zener diode as Voltage Regulator, Filters- choke input (inductor), L-section, π-section filters. Three terminal fixed voltage IC-regulators (78XX and 79XX)

REFERENCE BOOKS:

1. Electronic Devices and Circuit Theory --- Robert L. Boylestad& Louis Nashelsky.
2. Electronic Devices and Circuits I – T.L.Floyd- PHI Fifth Edition
3. Integrated Electronics – Millmam& Halkias.
4. Electronic Devices & Circuits – Bogart.
5. Sedha R.S., A Text Book Of Applied Electronics, S.Chand& Company Ltd

MODEL PAPER

GOVERNMENT COLLEGE FOR MEN (A) :: KADAPA
DEPARTMENTOFPHYSICS
III-SEMESTER END EXAMINATION
MODULE–II: ELECTRONIC DEVICES AND CIRCUITS
(As Approved in the BOS meeting held on 28th Aug. 2024 for batch 2024-2025)

Time: 3 hrs **Max. Marks=60**

SECTION-A

Answer any **FIVE** questions **5×4=20**

1. Explain the V-I characteristics of a Zener diode?
2. Define the Active, Cutoff, and Saturation regions of a BJT?
3. Define the stability factor (S) of a transistor circuit and explain its importance in amplifier design?
4. What are the Difference between JFET and BJT?
5. Describe the construction of an SCR and its terminal identification?
6. What are the applications of LEDs?
7. What factors affect the sensitivity of a photodiode?
8. Explain the Zener diode as Voltage Regulator?

SECTION-B **5×8=40**

Answer any **FIVE** questions

9. Compare and contrast the behavior of a P-N junction diode under forward and reverse bias?
10. Describe the construction and working principal of a tunnel diode?
11. Explain the construction and working of NPN and PNP transistors?
12. Describe the Voltage-Divider Biasing method for BJTs. What are its advantages and limitations compared to other biasing methods?
13. Describe the construction of a UJT and its symbol?
14. Describe the internal structure of a Light-Emitting Diode (LED)?
15. Describe the structure and operation of a Light Dependent Resistor (LDR).
16. Explain the operation of a Full-wave rectifier. Derive an expression for its efficiency and ripple factor?

SEMESTER-III

COURSE 7: ELECTRONIC DEVICES AND CIRCUITS

Practicals Credits: 1 **2 hrs per week**

COURSE OBJECTIVE:

The course objectives for a practical course in Electronic Devices and Circuits might provide hands-on experience with the fundamental principles of electronic devices and circuits.

LEARNING OUTCOMES:

- Understand the principles of electronic devices and circuits and their applications in real-world scenarios.
- Analyze and design electronic circuits using diodes, transistors, and operational amplifiers.
- Understand the importance of biasing and stability in electronic circuits and how to achieve them.
- Develop the skills to design and analyze amplifier circuits and to understand the concept of feedback and its application in electronic circuits.
- Analyze and design simple oscillators, power supplies, and filters.
- Gain hands-on experience with electronic test equipment such as multimeters, oscilloscopes, and function generators.
- Develop skills in circuit construction, measurement, and testing.
- Learn how to troubleshoot and diagnose electronic circuit problems.
- Understand the safety procedures for working with electronic circuits and equipment.

Minimum of 6 experiments to be done and recorded

1. V-I Characteristics of junction diode
2. V-I Characteristics of Zener diode
3. Transistor characteristics – CB configuration
4. Transistor characteristics – CE configuration
5. FET input and output characteristics
6. UJT characteristics
7. LDR characteristics
8. Full wave and Bridge rectifier with filters

STUDENT ACTIVITIES

Unit I: PN Junction Diodes

Activity: V-I Characteristic Analysis

Students can analyze the V-I characteristics of a PN junction diode by using a simple circuit setup. They can measure the voltage across the diode for different values of forward and reverse bias currents and plot the corresponding current-voltage graph. They can discuss the behavior of the diode in different bias conditions.

Unit II: Bipolar Junction Transistor and Its Biasing

Activity: Transistor Configuration Analysis Students can analyze the characteristics of different transistor configurations (CB, CE, CC) using a transistor tester or a circuit setup. They can measure and compare the input/output characteristics, gain, and voltage levels for each configuration. They can discuss the advantages and disadvantages of each configuration.

Unit III: Field effect transistors & Power electronic devices

Activity: FET Transfer Characteristic Analysis

Students can analyse the transfer characteristics of a FET by measuring the drain current (ID) for different gate-source voltages (VGS). They can plot the transfer characteristic curve and observe the variations in ID with VGS. They can discuss the operation modes of FETs based on the transfer characteristics.

Unit IV: Photoelectric Devices :

Activity: LED and Photodiode Circuit Demonstration

Students can set up simple LED and photodiode circuits to demonstrate their operation. They can observe the emission of light from an LED when a suitable voltage is applied and measure the current. They can also detect light using a photodiode and measure the output current for different light intensities.

Unit V: Power Supplies :

Activity: Rectifier Efficiency Calculation

Students can analyse the efficiency of different rectifier circuits (half wave, full wave, and bridge rectifiers) by measuring the input and output power. They can calculate the rectifier efficiency and compare the results for different rectifier configurations. They can discuss the factors affecting efficiency and the importance of regulation

GOVERNMENT COLLEGE FOR MEN (A), KADAPA

B.Sc. (HONOURS) PHYSICS Single Major
w.e.f. 2024-25 (Revised in May 2024)
SEMESTER-III
COURSE 9: ANALOG AND DIGITAL ELECTRONICS
Hours: 45 **Credits-3** **3 hrs/week**

COURSE OBJECTIVE:

The course on Analog and Digital Electronics aims to provide students with a fundamental understanding of the principles of electronic circuits and their applications in both analog and digital systems.

LEARNING OUTCOMES:

On successful completion of this course, the student will be able to:

- Understand Principles and Working of Operational Amplifier
- Apply their knowledge on OP-Amp in different Applications
- To understand the number systems, Binary codes and Complements.
- To understand the Boolean algebra and simplification of Boolean expressions.
- To analyze logic processes and implement logical operations using combinational logic circuits.
- To understand the concepts of sequential circuits and to analyze sequential systems in terms of state machines

CO-PO mapping:

(1: Low 2: Medium 3: High 4.No correlation)

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 8	2	3	1	2	3	2

UNIT-I: OPERATIONAL AMPLIFIERS

a) Concept of feedback in CE amplifier, negative and positive feedback, advantages and disadvantages of negative feedback, Basic concepts of differential amplifier, Block diagram of op amp and its equivalent circuit, IC Diagram (IC 741), Ideal voltage transfer curve, Open loop Op-Amp configurations- differential, inverting and non-inverting Op-Amps.

b) Voltage Series Feedback Amplifier (Non-Inverting Op amp): Gain and

Bandwidth derivations: Voltage Shunt Feedback Amplifier (Inverting Op amp): Gain and Bandwidth derivations

UNIT-II: PRACTICAL OPERATIONAL AMPLIFIER AND APPLICATIONS

a) Characteristics of an Ideal and Practical Operational Amplifier (IC 741), Input offset voltage, Inputbiascurrent, Input offset current, total output offset voltage, CMRR, slew rate and concept of virtual ground.

b) Applications of Op-Amp: Linear Applications: Voltage Follower, Summing Amplifier, Subtracting Amplifier, Averaging Amplifier, Difference Amplifier, Integrator and Differentiator, Square Wave response of Integrator and Differentiator (Brief explanation only)

UNIT-III: NUMBER SYSTEMS, CODES AND LOGIC GATES

a) Number Systems and Codes: Decimal, Binary, Octal and Hexadecimal number systems, conversions, Binary addition, Binary subtraction using 1's and 2's complement methods, BCD code and Gray code – Conversions

b) Logic Gates: Construction and truth tables of OR, AND, NOT gates, Universal gates – Basic construction and truth tables of NOR & NAND, Realization of logic gates using NAND and NOR, XOR and XNOR Logic gates symbol and their truth tables. De Morgan's Laws, Boolean Laws, Simplification of Boolean Expressions using Boolean Laws

UNIT-IV: ARITHMETIC CIRCUITS & DATA PROCESSING CIRCUITS

a) Half Adder and Full Adder: Explanation of truth tables and Circuits. Half Subtractor and Full Subtractor: Explanation of truth tables and Circuits, 4 - bit binary Adder/Subtractor.

b) Multiplexers - 2 to 1 Multiplexer, 4 to 1 multiplexer, De-multiplexers: 1 to 2 Demultiplexer, 1 to 4 Demultiplexer, Applications of Multiplexers and Demultiplexers Decoders: 1 of 2 decoders, 2 of 4 decoders, Encoders: 4 to 2 Encoder, 8 to 3 Encoder, Applications of decoders and encoders

UNIT-V: SEQUENTIAL LOGIC CIRCUITS & CODE CONVERTERS

a) Combinational Logic vs Sequential Logic Circuits, Sequential Logic circuits: Flip-flops, Basic NAND, NOR Latches, Clocked SR Flip-flop, JK Flip-flop, D Flip-flop, Master-Slave Flip- flop, Conversion of Flip flops.

b) Code Converters: BCD to Decimal Converter, BCD to Gray Code Converter, BCD to 7 segment Decoders

Reference Books:

1. OP-Amps and Linear Integrated Circuit, R. A. Gayakwad, 4th edition, 2000, Prentice Hall
2. Operational Amplifiers and Linear ICs, David A. Bell, 3rd Edition, 2011,
3. Digital Principles and Applications, A.P. Malvino, D.P.Leach and Saha, 7th Ed., TMH
4. Fundamentals of Digital Circuits, Anand Kumar, 2nd Edn, 2009, PHI Learning Pvt. Ltd.
5. Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (1994)
6. R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)

Model Question Paper

GOVERNMENT COLLEGE FOR MEN (A) :: KADAPA
DEPARTMENTOFPHYSICS
III-SEMESTER END EXAMINATION
MODULE–*9*: ANALOG AND DIGITAL ELECTRONICS

Time: 3Hours **Max. Marks=60**

SECTION-A

Answer any FIVE questions **5×4=20**

1. Write a short note on inverting and non-inverting Op-Amps?
2. Compare the frequency response characteristics of voltage series and shunt feedback amplifiers?
3. Explain the common-mode rejection ratio (CMRR) and its significance in differential amplifiers?
4. Explain the behavior of an integrator?
5. Write about BCD and Gray code with example?
6. What are universal gates and discuss those gates with examples?
7. Design a 4-bit binary Subtractor circuit using Full Adders and Full Subtractors?
8. What is the difference between combinational logic circuits and sequential logic circuits?

SECTION-B

Answer any five questions **5×8=40**

9. Explain the negative and positive feedback mechanisms in CE amplifiers?
10. Explain the derivation of the voltage gain band width of a non-inverting op-amp amplifier with series feedback?
11. Explain the characteristics of ideal op-amp?
12. Explain about the number system?
13. Discuss about basic logic gates?
14. Discuss the working of half and full adder and give their truth tables?
15. What is a 2-to-1 multiplexer and how does it operate? Construct the truth table for a 2-to-1 multiplexer?
16. Draw the characteristic table for a JK flip-flop? Explain its operation.

SEMESTER-III

COURSE 9: ANALOG AND DIGITAL ELECTRONICS

Practical Credits: 1 2 hrs/week

COURSE OBJECTIVES:

The course objectives for a practical course in Analog and Digital Electronics might provide students with hands-on experience in designing, constructing, and testing analog and digital electronic circuits

LEARNING OUCOMES:

- Understand the principles of analog and digital electronic circuits and their applications in real-world scenarios.
- Analyze and design analog electronic circuits using diodes, transistors, and operational amplifiers.
- Analyze and design digital electronic circuits using logic gates, flip-flops, and counters.
- Understand the importance of biasing, feedback, and stability in electronic circuits and how to achieve them.
- Develop the skills to design and analyze amplifier circuits and digital systems

Minimum six experiments to be done and recorded.

- To study the operational amplifier as inverting feedback amplifier with verifying gain
- To study the operational amplifier as non-inverting feedback amplifier with verifying gain
- To study operational amplifier as adder
- To study operational amplifier as subtractor
- To study operational amplifier as differentiator
- To study operational amplifier as integrator
- Logic Gates- OR, AND, NOT and NAND gates. Verification of Truth Tables.
- Verification of De Morgan's Theorems.
- Construction of Half adder and Full adders-Verification of truth tables
- Flip flops

STUDENT ACTIVITIES

UNIT-I: OPERATIONAL AMPLIFIERS

Circuit Analysis: Students can be asked to analyze different operational amplifier circuits such as inverting and non-inverting amplifiers, summing amplifiers, difference amplifiers, and integrators. They can be asked to calculate the gain, input and output impedance, and frequency response of the circuits. **Circuit Design:** Students can be asked to design different operational amplifier circuits such as audio amplifiers, filters, and oscillators. They can be asked to select the appropriate op-amp and other components such as resistors, capacitors, and inductors to meet the desired specifications.

UNIT-II: PRACTICAL OPERATIONAL AMPLIFIER AND APPLICATIONS

Design an inverting amplifier circuit: Students can be asked to design and build an inverting amplifier circuit using an operational amplifier and a few passive components. They can then measure the gain and frequency response of the circuit using an oscilloscope and a function generator. They can also compare the measured values with the theoretical calculations and simulation results

Build a summing amplifier circuit: Students can be asked to build a summing amplifier circuit using an operational amplifier and several input signals. They can then measure the output voltage of the circuit and compare it with the expected value. They can also investigate the effect of changing the input signal amplitudes and the resistor values on the circuit performance.

UNIT-III: NUMBER SYSTEMS, CODES AND LOGIC GATES

Convert numbers between different bases: Students can be asked to convert numbers between binary, decimal, and hexadecimal bases. They can practice converting both integer and fractional numbers, and verify their results using online conversion tools or calculators.

Design a binary adder circuit: Students can be asked to design and build a binary adder circuit using logic gates such as XOR, AND, and OR gates. They can then test the circuit by adding two binary numbers and comparing the result with the expected value.

UNIT-IV: ARITHMETIC CIRCUITS & DATA PROCESSING CIRCUITS

Design a data processing circuit: Students can be asked to design and build a data

processing circuit that performs a specific function, such as filtering, modulation, or demodulation. They can use op-amps, filters, modulators, and demodulators to implement the circuit and test its performance using simulated or realworld signals.

Implement a digital signal processing algorithm: Students can be asked to implement a digital signal processing algorithm, such as a Fourier transform, a discrete cosine transform, or a digital filter. They can use software tools such as MATLAB or Python to simulate the algorithm and test its performance using sample signals.

UNIT-V: SEQUENTIAL LOGIC CIRCUITS & CODE CONVERTERS

Design a flip-flop circuit: Students can be asked to design and build a flip-flop circuit using logic gates and test its operation by creating a sequence of logic signals. They can also compare the performance of different types of flip-flops, such as SR, D, JK, and T, and discuss their advantages and disadvantages in sequential circuits. Implement a counter circuit: Students can be asked to design and build a counter circuit that counts up or down using flip-flops. They can use different types of counters, such as ripple, synchronous, or Johnson, and test their operation by connecting the output to LEDs or other indicators. **Design a code converter circuit:** Students can be asked to design and build a code converter circuit that converts a binary code to another code, such as Gray code, BCD, or ASCII. They can use logic gates, multiplexers, and decoders to implement the circuit, and test its operation by inputting different codes