**Shiksha Mandal's**
**BAJAJ COLLEGE OF SCIENCE, WARDHA.**
**(Formerly, Jankidevi Bajaj College of Science, Wardha)**
**Syllabus For**
**Undergraduate Programme (B.Sc.) Electronics Major**

## Program description:

Op-Amp, Power Supply, IC 555 and Circuit Maker are the fundamental areas of study in electronics that are concerned with the behavior and manipulation of electronic signals. This course covers the principles, techniques, and applications of both analogue and digital electronics.

Throughout the course, students will gain hands-on experience with electronic circuit. Emphasis will also be placed on the analysis and interpretation of circuit behavior through experimental testing.

Upon completion of this course, students will have a strong understanding of analogue and digital electronics, electronic Instrumentation, electronic communication, microprocessor, 'C' language, Microcontroller 8051 and will be able to apply this knowledge to the design and implementation of a wide range of electronic systems.

## Programme Objective:

The objectives of the B.Sc. program (Electronics major) are:

1. To prepare students for successful careers in the electronics industry as electronic circuit designers, electronics consultants, testing professionals, and entrepreneurs.
2. To provide students with the necessary knowledge and skills to compete for advanced degree programs such as M.Sc. (Electronics) and other related fields of study. Upon completion of the program, graduates should be equipped with the foundational knowledge and practical skills required for further academic and professional development in the field of electronics.

## Programme Outcomes:

Upon completion of the B.Sc. program (Electronics major), graduates will have the following outcomes:

1. Possess a solid understanding of the core subjects in electronics, including electronic components, electronic measuring and testing instruments, analogue and digital ICs, electronic circuit design and implementation, and troubleshooting and maintenance of electronic and electrical devices.
2. Demonstrate proficiency in assembly language and high-level language programming, as well as interfacing electronic devices with computers and other systems.
3. Be equipped with the knowledge and skills needed to develop industrial and entrepreneurial applications in the field of electronics, and to contribute to the advancement of the industry through innovation and problem-solving. Graduates will be well-prepared to enter the workforce as electronics professionals, or to pursue advanced studies in the field.

**SYLLABUS AS PER NEP-2020 FOR B.Sc. SEMESTER IV (ELECTRONICS)**

**TO BE IMPLEMENTED FROM ACADEMIC SESSION 2024-25**

**APPROVED IN BoS MEETING HELD ON 26/03/2024.**

**B.Sc. PART II - SEMESTER IV**
**Course Name: Major: Electronics DSC – IV**
## OP-AMP Applications & Electronic Instrumentation
**Subject code:**

**Credits: 6 (4 Th, 2 Pr)** **No. of Lectures: 60** **No. of Practical Hrs.:60**

**Course Description:**

The fourth semester of the UG course focuses on Op Amp Applications and Electronic Instrumentation, which deals with Oscillators, multivibrators, ADC, DAC, transducers, Instrumentation, and biomedical instrumentation.

**Course Objective and Course Outcome Framework**

| SN | Course Objectives | Course Outcomes |
|---|---|---|
| | **Students will try to learn:** | **After successful completion ofthe course student will be able to:** |
| 1. | To analyze the different RC and LC oscillator circuits using OPAMP and to determine the frequency of oscillation. | Assemble the different oscillator circuits using OPAMPs for various frequencies. |
| 2. | To understand the operationand design of various multivibrator, S/H and IA circuits using OPAMP for a given specification. | Know and assemble multivibrator circuits using OPAMP in various configuration to determine its frequency. |
| 3. | To understand A/D and D/A converters and analyze their characteristics and classification. | Classify, analyze and assemble A/D and D/A converters. |
| 4. | To provide basic knowledge about the various types of transducers, sensors, actuators, and instrumentation system based on these transducers. | Students will be able to explain principle of operation of various transducers, sensors, actuators, and their use in developing electronic instrumentation system. |
| 5. | To provide fundamental concepts of basic electronic and PC based instrumentation system. | Students will be able to describe various functional blocks of basic electronic and PC based instrumentation system. |
| 6. | To provide fundamental knowledge of biomedical instrumentation system and its safety codes. | Students will be able to describe functional blocks of biomedical instrumentation system such as ECG, EEG and EMG and its safety codes. |

# B.Sc. PART II - SEMESTER IV

## *Course Name:* Major: Electronics DSC – IV

## *Paper Name:* OP-AMP Applications & Electronic Instrumentation

## Course Code: UEL240T

## Course Outline

**Unit I**

Concept of feedback: Types- positive and negative feedback, Barkhausen criterion,Oscillators, types (AF and RF), basic oscillator action, L-C oscillator: Colpitts oscillator, RC oscillator using OP Amp ,Phase shift oscillator, Wein bridge oscillator, Oscillator stability, Crystal oscillator, NOTgate based crystal oscillator.

**Unit II**

Advanced applications of OPAMP: Astable multivibrator (asymmetric and symmetric), Monostable multivibrator (simple circuit) , Concept and working of sample andholdcircuit,Conceptofinstrumentationamplifier(threeOPAmpcircuit) and working.

**Unit III**

Need of D/A and A/D converter, D/A converter and its Parameters: Range,Resolution, Linearity and speed, Types of D/A converter: Weighted type D/A, limitations of weighted type D/A, R-2R or binary ladder D/A converter using Op Amp.

Need for A/D conversion, Sampling theorem, Types of A/D converter: Single slope A/D converters, Dual slope A/D converter, Counter type, Successive approximation type, Flash type, Accuracy and resoltion of A/D concerter.

**Unit IV**

Sensors, Actuators,Transducers, Active and passive transducers, Characteristics (static anddynamic),
Passive: Thermistor (NTC & PTC), LM35, L.D.R., Photo-transistor Active : Piezo-electric transducer Digital: Pressure sensor (MPXV4006DP).

Block diagram of temperature measurement system using thermister, and LM35, Advantages of LM35 over thermister, Lux meter using LDR, Colorimeter using LDR, Insect repellent using piezo buzzer.

**Unit V**

Block diagram for electronic system, Defining the system characteristics, Concept of calibration, Standards for calibration. Sysytem characteristics, Instrumentation Systems: Analog, Digital, Real, Virtual, Dedicated, Versatile, Stand alone, PC based instrumentation system.

**Unit VI**

Biomedical Instrumentation: Biometrics, Man-Instrument system and its components, Introduction tophysiological systemofbody, Problems encountered in measurement of living system, Sources andgeneration ofbioelectric potentials, Restingand Actionpotentials,BlockdiagramandworkingofEEG,ECGandEMG, Electrical shock hazards, Precautions, Safety codes in biomedical instrumentation.

## B.Sc. II (SEM IV) ELECTRONICS PRACTICALS
## *Course Name:* Major: Electronics DSC – IV

## *Paper Name:* OP-AMP Applications & Electronic Instrumentation

## Course Code: UEL240P

Students are expected to perform at least 5 experiments from section A and 5 experiments from sectionB.

### Section A

1. Study of OP-amp based Wein bridge oscillator.
2. Study of OP-amp based Phase shift oscillator.
3. Study of Colpitt's oscillator.
4. Study of Op-amp as astable multi vibrator.
5. Study of Op-amp as Mono stable multi vibrator.
6. Study of Instrumentationamplifier.
7. Study of successive approximation ADC.
8. Study of Flash type ADC.
9. Study of Single slope ADC.
10. Study of Dual slope ADC.
11. Study of Binary weighted DAC.
12. Study of ladder type DAC
13. Study of NOT gate based crystal oscillator.
14. Study of Sample and hold circuit.

### Section B

1. Study transfer characteristics of NTC type thermistor.
2. Study resolution in characteristics of NTC type thermistor.
3. Study transfer characteristics of LM 35
4. Study transfer characteristics of Water heater (around 300W)
5. Study of ON/ OFF type thermo-state using LM 35
6. Study transfer characteristics of LDR
7. Study transfer characteristics of Piezo-electric transducer
8. Comparative study of accuracy in 3 ½ digit, 4 ½ digit, 5 ½ digit Multimeters
9. Directivity study of carbon Mic.
10. "Look up table" based o/p using microcontroller IC interface using R.T.C.

## Reference Books


1. Digital and analogue Techniques, G. N. Navaneeth,V. M. Gokhale,R. G. Kale, Kitab Mahal.
2. Digital Principles and Applications, A. P. Malvino, D. P. Leach, McGraw Hill Book Co.
3. Op-Amp and Linear Circuits, Gaikwad, PHI,
4. Principles of Digital Electronics, M. B. Matsagar, V. S. Kale, Vision publication
5. Modern Digital Electronics, R. P. Jain, Tata McGraw Hill publishing co.ltd.
6. Digital Fundamentals, Floyd, Jain, Pearson,
7. 2000 Solved Problems in Digital Electronics, S. P.Bali, Tata McGraw Hill publishing co.ltd.
8. Electronic Circuits and Systems: Analog and Digital, Y.N.Bapat, Tata McGraw Hill Publishing co.ltd.
9. Digital Electronics and Logic Design, B. S. Nair, Prentice Hall
10. Digital Computer Electronics, Malvino, Brown, Tata McGraw Hill
11. Fundamentals of Digital Electronics, C.V.Dhuley and V.M. Ghodki Applied Electronics and Instrumentation, C. M. Dhir,Tata McGraw Hill
12. Digital Instrumentation, Bouwens, Tata McGraw Hill
13. Electronic Instrumentation, Khedkar
14. Modern Electronic Instrumentation and Measurement Techniques, Cooper, Prentice Hall.


## Web Resources

Students are advised to make use of the resources available on the internet. Some useful links related to electronics are given below.

1. M.I.T. open course ware video lectures are available athttp://ocw. mit.edu/OcwWeb/Electrical-Engineering-and-Computer-Science/6- 002Spring-2007/VideoLectures/index.htm
2. www.electronics-tutorials.com
3. http ://electronics .howstuffworks.com
4. www.science-ebooks.com/electronics
5. http://computer.howstuffworks.com
6. www.geocities.com/CapeCanaveral/1221/elec1.htm
7. http://101 science.com/eleclinks.htm
8. www.electro-tech-online.com/blogs/gayan-soyza/23-useful-electronic-links.html
9. www.discovercircuits.com/resources/tutorials.html
10. www.electronics-lab.com/

**B.Sc. PART II - SEMESTER IV**
**Course Name: Electronics Minor - IV**

# Paper Name: OP-AMP Applications & Electronic Instrumentation

**Course Code: UEL241T**

**Credits: 6 (4 Th, 2 Pr)** **No. of Lectures: 60** **No. of Practical Hrs.:60**

**Course Description:**

The fourth semester of the UG course focuses on Op Amp Applications and Electronic Instrumentation, which deals with Oscillators, multivibrators, ADC, DAC, transducers, Instrumentation and biomedical instrumentation.

## Course Objective and Course Outcome Framework

| SN | Course Objectives | Course Outcomes |
|---|---|---|
| | **Students will try to learn:** | **After successful completion of the course student will be able to:** |
| 1. | To analyze the different RC and LC oscillator circuits using OPAMP and to determine the frequency of oscillation. | Assemble the different oscillator circuits using OPAMPs for various frequencies. |
| 2. | To understand the operation and design of various multivibrator, S/H and IA circuits using OPAMP for a given specification. | Know and assemble multivibrator circuits using OPAMP in various configuration to determine its frequency. |
| 3. | To understand A/D and D/A converters and analyze their characteristics and classification. | Classify, analyze, and assemble A/D and D/A converters. |
| 4. | To provide basic knowledge about the various types of transducers, sensors, actuators, and instrumentation system based on these transducers. | Students will be able to explain principle of operation of various transducers, sensors, actuators, and their use in developing electronic instrumentation system. |
| 5. | To provide fundamental concepts of basic electronic and PC based instrumentation system. | Students will be able to describe various functional blocks of basic electronic and PC based instrumentation system. |
| 6. | To provide fundamental knowledge of biomedical instrumentation system and its safety codes. | Students will be able to describe functional blocks of biomedical instrumentation system such as ECG, EEG and EMG and its safety codes. |

# B.Sc. PART II - SEMESTER IV

## Course Name: Electronics Minor - IV

## Paper Name: OP-AMP Applications & Electronic Instrumentation

## Course Code: UEL241T

### Unit I

Concept of feedback: Types- positive and negative feedback, Barkhausen criterion, Oscillators, types (AF and RF), basic oscillator action, L-C oscillator: Colpitts oscillator, RC oscillator using OP Amp ,Phase shift oscillator, Wein bridge oscillator, Oscillator stability, Crystal oscillator, NOTgate based crystal oscillator.

### Unit II

Advanced applications of OPAMP: Astable multivibrator (asymmetric and symmetric), Monostable multivibrator (simple circuit) , Concept and working of sample andholdcircuit,Conceptofinstrumentationamplifier(threeOPAmpcircuit) and working.

### Unit III

Need of D/A converter, D/A converter and its Parameters: Range, Resolution, Linearity and speed, Types of D/A converter: Weighted type D/A, limitations of weighted type D/A, R-2R or binary ladder D/A converter using Op Amp.

### Unit IV

Need for A/D conversion, Sampling theorem, Types of A/D converter: Single slope A/D converters, Dual slope A/D converter, Counter type, Successive approximation type, Flash type, Accuracy and resoltion of A/D concerter.

### Unit V

Sensors, Actuators, Transducers, Active and passive transducers, Characteristics (static anddynamic),
Passive : Thermister (NTC & PTC), LM35, L.D.R., Photo-transistor Active :
Piezo-electric transducer

### Unit VI

Biomedical Instrumentation: Biometrics, Man-Instrument system and its components, Introduction to physiological system of body, Problems encountered in measurement of living system, Sources andgeneration ofbioelectric potentials, Restingand Action potentials, Block diagram and working of EEG, ECG and EMG, Electrical shock hazards, Precautions, Safety codes in biomedical instrumentation.

## B.Sc. II (SEM IV) ELECTRONICS PRACTICALS

### Course Name: Electronics Minor - IV

### Paper Name: OP-AMP Applications & Electronic Instrumentation

### Course Code: UEL241P

Students are expected to perform at least 5 experiments from section A and 5 experiments from section B.

### Section A

1. Study of OP-amp based Wein bridge oscillator.
2. Study of OP-amp based Phase shift oscillator.
3. Study of Colpitt's oscillator.
4. Study of Op-amp as astable multi vibrator.
5. Study of Op-amp as Mono stable multi vibrator.
6. Study of Instrumentation amplifier.
7. Study of successive approximation ADC.
8. Study of Flash type ADC.
9. Study of Single slope ADC.
10. Study of Dual slope ADC.
11. Study of Binary weighted DAC.
12. Study of ladder type DAC
13. Study of NOT gate based crystal oscillator.
14. Study of Sample and hold circuit.

### Section B

1. Study transfer characteristics of NTC type thermistor.
2. Study resolution in characteristics of NTC type thermister
3. Study transfer characteristics of LM 35
4. Study transfer characteristics of Water heater (around 300W)
5. Study of ON/ OFF type thermo-state using LM 35
6. Study transfer characteristics of LDR
7. Study transfer characteristics of Piezo-electric transducer
8. Comparative study of accuracy in 3 ½ digit, 4 ½ digit, 5 ½ digit Multimeters
9. Directivity study of carbon Mic.
10. "Look up table" based o/p using microcontroller IC interface using R.T.C.

## Reference Books


1. Digital and analogue Techniques, G. N. Navaneeth, V. M. Gokhale, R. G. Kale, Kitab Mahal.
2. Digital Principles and Applications, A. P. Malvino, D. P. Leach, McGraw Hill Book Co.
3. Op-Amp and Linear Circuits, Gaikwad, PHI,
4. Principles of Digital Electronics, M. B. Matsagar, V. S. Kale, Vision publication
5. Modern Digital Electronics, R. P. Jain, Tata McGraw Hill publishing co.ltd.
6. Digital Fundamentals, Floyd, Jain, Pearson,
7. 2000 Solved Problems in Digital Electronics, S. P. Bali, Tata McGraw Hill publishing co.ltd.
8. Electronic Circuits and Systems: Analog and Digital, Y.N.Bapat, Tata McGraw Hill Publishing co.ltd.
9. Digital Electronics and Logic Design, B. S. Nair, Prentice Hall
10. Digital Computer Electronics, Malvino, Brown, Tata McGraw Hill
11. Fundamentals of Digital Electronics, C.V.Dhuley and V.M. Ghodki Applied Electronics and Instrumentation, C. M. Dhir, Tata McGraw Hill
12. Digital Instrumentation, Bouwens, Tata McGraw Hill
13. Electronic Instrumentation, Khedkar
14. Modern Electronic Instrumentation and Measurement Techniques, Cooper, Prentice Hall.


## Web Resources

Students are advised to make use of the resources available on the internet. Some useful links related to electronics are given below.

1. M.I.T. open course ware video lectures are available athttp://ocw. mit.edu/OcwWeb/Electrical-Engineering-and-Computer-Science/6-002Spring-2007/VideoLectures/index.htm
2. www.electronics-tutorials.com
3. http ://electronics .howstuffworks .com
4. www.science-ebooks.com/electronics
5. http://computer.howstuffworks.com
6. www.geocities.com/CapeCanaveral/1221/elec1.htm
7. http://101 science.com/eleclinks.htm

**B.Sc. PART II - SEMESTER IV**

## Skill Enhancement Course (SEC)

**Course Name: Circuit Maker Simulation Software**

**Course Code: UEL243P**

***(Approved in BoS Meeting held on 11.03.2025 to be implemented from the academic Session 2025-26)***

**Credits: 2 (4Pr)** **No. of Practical Hrs: 60**

Course description:
This course provides an introduction to simulation software and complete guideline to use simulation software in general and CircuitMaker2000 in particular. Students will understand the fundamentals of CircuitMaker2000 and its importance in the field of circuit design and analysis. The course will also prepare students for performing various analyses with analog and digital circuits and enable them to setup their own virtual laboratory.

**Learning objectives:**

Upon completion of this course, learners will be able to:

1. Demonstrate an understanding of simulation software
2. Use various electronic components to explore their circuits
3. Perform various simulation on analog circuits.
4. Analyse digital circuits and use of various instruments virtually
5. Design and setup his/her own virtual laboratory to understand and apply knowledge.

**Unit I**: Introduction to CircuitMaker Need of Simulation Software, CircuitMaker Basics, Installation of CircuitMaker, Starting Circuit Maker, CircuitMaker Workspace, Connectivity, About the CircuitMaker Windows, Anatomy of a Schematic Drawing, Drawing a Schematic, Using the Browse tab in the Panel Placing a Transistor, Placing the Resistors, Placing +V and Ground Devices Changing Resistor Label-Values, Wiring the Circuit Together

**Unit-II:** Tools and Analog Simulation Tools: Wire Tool, Text Tool, Delete Tool, Arrow Tool, Zoom Tool, Rotate Button, Mirror Button, Grid, Title Block and Borders. Setting Up Analog Analyses: Always Set Defaults, Operating Point Analysis, Transient Analysis, DC Sweep, AC Analysis (Frequency Sweep), Parameter Sweep, Fourier Analysis, Transfer Function Analysis., Noise Analysis, Temperature Sweep. Simulation Examples.

**Unit-III:** Digital Logic Simulation and Tools Probe Tool, Reset Button, Trace Button, Run/Pause Button, Step Button, Tile Windows Buttons, Drawing digital Circuits Digital Options, Setting Breakpoints in a Circuit, Digital Instruments: Pulser, Data Sequencer, Pattern Editor. Digital Simulation Examples.

**Reference Book:**

1. CircuitMaker 2000 user manual

**List of Practical:**

Practical based on Schematic Drawing, Editing, analog and digital simulations

* * *