VISVESVARAYA TECHNOLOGICAL UNIVERSITY

BELAGAVI

Scheme of Teaching and Examination and Syllabus

B.E. in ELECTRONICS AND INSTRUMENTATION ENGINEERING

III - IV SEMESTER

(Effective from Academic year 2022-2023)

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VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Electronics and Instrumentation Engineering

NEP, Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the Academic Year 2022 - 2023)

III Semester

Mathematics-III for EI Engineering		Semester	3
Course Code	BEI301	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 (each module 8 hours)	Total Marks	100
Credits	3	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

- Learn to use the Fourier series to represent periodical physical phenomena in engineering analysis and to enable the student to express non-periodic functions to periodic functions using the Fourier series and Fourier transforms.
- Analyze signals in terms of Fourier transforms
- Develop the knowledge of solving differential equations and their applications in Electronics & Communication engineering.
- To find the association between attributes and the correlation between two variables

Teaching-Learning Process Pedagogy (General Instructions):

These are sample Strategies, teachers can use to accelerate the attainment of the various course outcomes.

- In addition to the traditional lecture method, different types of innovative teaching methodsmay be adopted so that the delivered lessons shall develop students' theoretical and appliedMathematical skills.
- State the need for Mathematics with Engineering Studies and Provide real-life examples.
- Support and guide the students for self–study.
- You will assign homework, grading assignments and quizzes, and documenting students'progress.
- Encourage the students to group learning to improve their creative and analytical skills.
- Show short related video lectures in the following ways:
  - As an introduction to new topics (pre-lecture activity).
  - As a revision of topics (post-lecture activity).
  - As additional examples (post-lecture activity).
  - As an additional material of challenging topics (pre-and post-lecture activity).
  - As a model solution of some exercises (post-lecture activity).

Module-1

Fourier Series and Practical Harmonic Analysis: Periodic functions, Dirichlet's condition. Fourier series expansion of functions with period 2π and with arbitrary period: periodic rectangular wave, Half-wave rectifier, rectangular pulse, Saw tooth wave. Half-range Fourier series. Triangle and half range expansions, Practical harmonic analysis, variation of periodic current. **(RBT Levels: L1, L2 and L3)**

Module-2

Infinite Fourier Transforms: Infinite Fourier transforms, Fourier cosine and sine transforms, Inverse Fourier transforms, Inverse Fourier cosine and sine transforms, discrete Fourier transform (DFT), Fast Fourier transform (FFT). **(RBT Levels: L1, L2 and L3)**

Module-3

Z Transforms : Definition, Z-transforms of basic sequences and standard functions. Properties: Linearity, scaling, first and second shifting, multiplication by n. Initial and final value theorem. Inverse Z-transforms. Application to difference equations **(RBT Levels: L1, L2 and L3)**

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Module-4

Ordinary Differential Equations of Higher Order: Higher-order linear ODEs with constant coefficients - Inverse differential operator, problems. Linear differential equations with variable Coefficients-Cauchy's and Legendre'sdifferential equations–Problems. Application of linear differential equations to L-C circuit and L-C-R circuit. **(RBT Levels: L1, L2 and L3)**

Module-5:

Curve fitting, Correlation, and Regressions: Principles of least squares, Curve fitting by the method of least squares in the form $y = a + \ , \ y = a + bx + cx^2$, and $y = ax^b$. Correlation, Coefficient of correlation, Lines of regression, Angle between regression lines, standard error of estimate, rank correlation.
(RBT Levels: L1, L2 and L3)

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

1. Demonstrate the Fourier series to study the behavior of periodic functions and their applications in system communications, digital signal processing, and field theory.
2. To use Fourier transforms to analyze problems involving continuous-time signals
3. To apply Z-Transform techniques to solve difference equations
4. Understand that physical systems can be described by differential equations and solvesuch equations
5. Make use of correlation and regression analysis to fit a suitable mathematical model for statistical data

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal AssessmentTest component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50%of the coverage of the syllabus, and the second test will be administered after 85-90% of thecoverage of the syllabus. The average of the two tests shall be scaled down to 25 marks
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the twoassignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

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Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with commonquestion papers for the course (**duration 03 hours).**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module(with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.
- Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Books (Name of the author/Title of the Book/Name of the publisher/Edition and Year)Text Books:

1. B. S. Grewal: "Higher Engineering Mathematics", Khanna Publishers, 44thEd., 2021.
2. E. Kreyszig: "Advanced Engineering Mathematics", John Wiley & Sons, 10thEd., 2018.

Reference Books:

1. V. Ramana, "Higher Engineering Mathematics" McGraw-Hill Education, 11thEd., 2017
2. Srimanta Pal & Subodh C.Bhunia, "Engineering Mathematics" Oxford University Press,3rdEd., 2016.
3. N.P Bali and Manish Goyal, "A Textbook of Engineering Mathematics" LaxmiPublications, 10thEd., 2022.
4. C. Ray Wylie, Louis C. Barrett, "Advanced Engineering Mathematics" McGraw–HillBook Co., New York, 6thEd., 2017.
5. Gupta C.B, Sing S.R and Mukesh Kumar, "Engineering Mathematic for Semester I andII", McGraw Hill Education(India) Pvt. Ltd 2015.
6. H.K. Dass and Er. Rajnish Verma, "Higher Engineering Mathematics" S.Chand Publication, 3rdEd.,2014.
7. James Stewart, "Calculus" Cengage Publications, 7thEd., 2019.

Web links and Video Lectures (e-Resources):

- http://nptel.ac.in/courses.php?disciplineID=111
- http://www.class-central.com/subject/math(MOOCs)
- http://academicearth.org/
- VTU e-Shikshana Program
- VTU EDUSAT Program.

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Assignments
- Seminar

ANALOG ELECTRONIC CIRCUITS		Semester	3
Course Code	BEI302	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	4	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:

- Describe the types of BJT/ FET biasing, and Demonstrate the use of BJT/FET amplifiers
- Understand the modeling of BJT/FET for analysis and to design of BJT/FET Amplifiers
- Understand and Demonstrate Generalized Frequency response of BJT and FET amplifiers.
- Design and analyze Power amplifier circuits.
- Understand the concept of Feedback and its effect on amplifier circuits and Oscillator circuits.

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Show Video/animation films to explain the functioning of various techniques.
- Encourage collaborative (Group) Learning in the class
- Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
- Adopt Problem-Based Learning (PBL), which fosters students' Analytical skills, and develops thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in multiple representations.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps to improve the student's understanding

MODULE-1

BJT AC Analysis: Introduction, BJT Transistor Modelling, The "re" transistor model: Common Emitter Fixed Bias Configuration, Voltage Divider Bias, CE Emitter-Bias Configuration, and Emitter-Follower Configuration.

BJT Hybrid Model: The Hybrid equivalent model, Approximate Hybrid Equivalent Circuit: Fixed bias, Voltage-Divider configuration, Emitter follower configuration. (Text1)

MODULE-2

Field Effect Transistors: Introduction, Construction and Characteristics of JFETs, Transfer Characteristics, Depletion type MOSFET, Enhancement type MOSFET.

FET Biasing: Introduction, Fixed bias configuration, Self-bias configuration, Voltage-Divider Biasing. (Text1)

MODULE-3

FET Amplifiers: JFET small signal model, Fixed- bias configuration, Voltage divider configuration, Common Gate Configuration, Source Follower (Common Drain) Configuration.

Frequency Response: Logarithms, Decibels, General Frequency Considerations, Low-Frequency Response-BJT amplifier with RL, Miller Effect Capacitance, High-frequency Response-BJT amplifier, Multistage Frequency Effects.(Text1)

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MODULE-4
Power Amplifiers: Definition and amplifier types, Series fed class A amplifier, Transformer coupled class A amplifier, Class B amplifier operation and Class B amplifier circuits with Transformer coupled push-pull circuit and Complementary-symmetry circuits, Amplifier distortion, Class C and Class D amplifiers. (Text1)
MODULE-5
Feedback and Oscillator Circuits: Feedback concepts, Feedback connection types, effects of negative feedback **Oscillator operation**, Barkhaunsen's criteria, RC phase oscillator using BJT, Tuned oscillator Circuits: BJT based Hartley oscillator, Transistor Crystal oscillator. **Thyristors:** The four layer Diode, SCR, SCR Phase control, Bidirectional Thyristors, IGBTs

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	Design and test BJT Common emitter voltage amplifier without feedback for the given specification. Also determine the gain-bandwidth product, input, and output impedance
2	Design and test frequency response of single stage BJT RC coupled amplifier Also determine the gain-bandwidth product, input, and output impedances
3	Conduct an experiment to draw the Drain and Transfer characteristics of JFET
4	Conduct an experiment to test of Complementary symmetry class B push-pull amplifier
5	Design and conduct Crystal oscillator using BJT
6	Design and conduct Instrumentation amplifier using three operational amplifiers.
7	Design and test Astable and Monostable Multivibrator circuits using 555 Timer for different duty cycle.
8	Conduct an experiment to verify Static V-I characteristics of UJT
	Demonstration Experiments (For CIE)
9	Study of the Drain and Transfer characteristics of MOSFET.
10	Study of the Common Source JFET amplifier and plot its frequency response
11	Study of RC phase shift oscillator using BJT
12	Study of tuned oscillator circuits for the given frequency of Hartley Oscillator using BJT

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1. Analyse the performance parameters of BJT circuits using re and approximate Hybrid model.
2. Explain the construction, working, and performance parameters of JFET and MOSFET.
3. Evaluate the performance of FET amplifiers and Power amplifiers.
4. Analyse the different types of A to D Converters and 555Timer application circuits.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

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CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Books

1. Robert L. Boylestad and Louis Nashelsky, Electronics devices, and Circuit Theory, 11th Edition, Pearson, 2020.
2. D Roy Choudhury and Shail B Jain, Linear Integrated Circuits, 4 th Edition, New age International Limited, 2015

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/108102112
- https://nptel.ac.in/courses/108105158
- https://onlinecourses.nptel.ac.in/noc23_ee77/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Surprise Tests
- Assignments
- Seminars
- Micro Projects can be given to improve the skills in the analog electronics

DIGITAL DESIGN AND HDL		Semester	3
Course Code	BEI303	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	4	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:

- Concepts of simplifying Boolean expression using K-map techniques and Quine Mc Cluskey minimization techniques.
- Design and analysis of combinational logic circuits.
- Methods and analysis of sequential logic circuits.
- Concepts of Verilog HDL-Data Flow models for the design of digital systems.
- Concepts of Verilog HDL Behavioral models for the design of digital systems.

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes

- Show Video/animation films to explain the functioning of various techniques.
- Encourage collaborative (Group) Learning in the class
- Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
- Adopt Problem-Based Learning (PBL), which fosters students' Analytical skills, and develops thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in multiple representations.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps to improve the student's understanding.

MODULE-1

Principles of Combinational Logic: Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps-up to 4 variables, Quine-Mc Cluskey Minimization Technique. (Text 1)

MODULE-2

Logic Design with MSI Components and Programmable Logic Devices: Binary Adders and Subtractors, Decimal Adders, Comparators, Decoders, Encoders, Multiplexers, Programmable Logic Devices (PLDs), Programmable Logic Arrays (PLAs). (Text 2)

MODULE-3

Flip-Flops and their Applications: The Master-Slave Flip-flops (Pulse-Triggered flip-flops): SR flip-flops, JK flip-flops, Characteristic equations, Registers, Counters, Design of Synchronous mod-n Counter using clocked T, JK, D, and SR flip-flops. (Text 2)

MODULE-4

Introduction to Verilog: why HDL, Brief History of HDL, Structure of Verilog module, Operators, Data Types, Styles of Description, Simulation and Synthesis.

Verilog Data flow description: Highlights of Data flow description, Structure of Data flow description. (Text 3)

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MODULE-5
Verilog Behavioral description: Behavioral Description Highlights, Structure, Verilog Sequential Statements: IF Statement, Signal and Variable Assignment, Case statement (Exclude Booth Algorithm). **Verilog Structural description:** Highlights of Structural description, Organization of structural description, Binding: Structural description of Full Adder and Ripple Carry Adder.(Text 3)

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	Realization of Boolean expressions using logic gates/Universal Gates
2	Realization of Binary Adder and Subtractor using Universal Gates and IC 7483.
3	Conversion of Binary to Gray Code and Vice-Versa using Ex-OR gates
4	Design of 2 bit Magnitude Comparator using logic gates and 4 bit comparator using IC 7485
5	Verification of truth tables of Master-Slave JK, T, D flip-flops using NAND gates.
6	Design of Johnson and Ring counter using IC 7495.
7	Realization of Asynchronous Mod–N counter using IC-7490, IC74193
8	Design of Synchronous 3 bit UP/DOWN counter using IC 7476.
Demonstration Experiments (For CIE)	
1	To simplify the given Boolean expressions and realize using the Verilog program
2	To simplify the given Boolean expressions and realize using the Verilog program
3	To realize Full Adder circuit using Verilog Data flow description.
4	To realize using Verilog Behavioral description:8:1 mux, 8:3 encoder, Priority encoder

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

- Simplify Boolean functions using K-map and Quine-Mc Cluskey minimization techniques.
- Analyze and design combinational logic circuits.
- Analyze the concepts of Flip Flops (SR, D, T, and JK) and design the synchronous sequential circuits using Flip Flops.
- Model Combinational circuits (adders, subtractors, multiplexers) and sequential circuits using Verilog descriptions

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other

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assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Text Books

1. John M Yarbrough, Digital Logic Applications and Design, Thomson Learning, 2001.
2. Donald D Givone, Digital Principles and Design, McGraw Hill Education (India) Private Limited, 2002.
3. Nazeih M Botros, HDL Programming VHDL and Verilog, Dreamtech press, 2009.

Web links and Video Lectures (e-Resources):

- **https://nptel.ac.in/courses/108105132**
- **https://nptel.ac.in/courses/117105080**
- **https://nptel.ac.in/courses/108103179**
- **https://www.youtube.com/watch?v=CeD2L6KbtVM**
- **https://nptel.ac.in/courses/106105165**

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Surprise Tests
- Assignments
- Seminars
- Micro project can be given to improve skills

MEASUREMENT AND TRANSDUCERS		Semester	3
Course Code	BEI304	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory	Total Marks	100
Credits	3	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

- To provide fundamental knowledge of measurement, instrumentation, and transducers.
- To understand the functional elements of instrumentation/measurement systems.
- To impart the basic concepts of digital instruments, oscilloscopes, and signal generators.
- To develop the skills for the measurement of Resistance, Capacitance, Inductance, and Frequency.
- To illustrate the principle, design, and working of transducers for the measurement of displacement, strain, and temperature.

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- In addition to the traditional lecture method, innovative teaching methods may be adopted so that the delivered lesson shall enable the students to attain the outcomes.
- Show videos/animations to explain the fundamental concepts and workings of instruments/ transducers.
- Encourage collaborative (Group) learning in the class.
- Ask higher-order thinking questions in the class, which promotes critical thinking.
- Adopt Problem-Based Learning (PBL), which fosters students' analytical skills, and develops thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Introduce the topics in a manifold representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how concepts can be applied to real-world problems to enable the students to develop appropriate skills.
- Adopt flipped class technique by sharing the materials/sample videos prior to the class and having discussions on that topic in the succeeding classes.

Module-1

Measurement, Functional Elements of Measurement System and Transducers: Measurement, significance of measurement, instruments and measurement systems, mechanical, electrical and electronic instruments, Classification of Instruments, Deflection & Null type instruments and their comparison, Analog and digital modes of operation, Functions of instruments and measurement systems, Applications of measurement systems, Elements of generalized measurement system, Input-output configuration of measuring instruments and measurement systems, Methods of correction for interfering and modifying inputs.(Text 1)

Module-2

Characteristics of Instruments and Measurement Systems: Measurement system performance, Static characteristics, True value, Static Error, Scale range, and Scale Span, Reproducibility and Drift, Noise, Signal to Noise Ratio, Accuracy and Precision, Significant of Figures, Linearity. (Text 1)

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Bridges Circuits for Measurement of R, L & C: Introduction, Wheatstone bridge, Kelvin Bridge, Practical Kelvin's double bridge. AC bridges: Capacitance Comparison Bridge, Inductance Comparison Bridge, Maxwell's bridge, Schering Bridge, Wien's bridge. (Relevant problems), Wagner's Earth Connection.(Text 2)

Module-3

Digital Voltmeters: Digital Multimeters and Frequency Meters: Introduction, Ramp technique & ramp type DVM, Dual slope integrating type DVM, Successive approximation DVM, Resolution and sensitivity of digital meters. Digital Multimeters, Digital Frequency Meter.

Oscilloscope: Introduction, Basic principle, CRT features, Block diagram of oscilloscope, Dual-beam oscilloscope, Dual trace oscilloscope, Storage Oscilloscope. (Text 2)

Module-4

Electrical Transducers: Electrical Transducers Parameters, Advantages of Electrical Transducers, Active and Passive Transducers, Selection of Transducers.

Resistive and Transducers: Potentiometer, Resistive Pressure Transducer, Resistive Position Transducers, Strain Gauges, Resistance Thermometer, Thermistor. (Text 2)

Module-5

Inductive Transducers: Principles of Working, Variable Reluctance Type Transducer, Differential Output Transducers, Linear Variable Differential Transducer (LVDT).

Capacitive Transducers: Capacitive Pressure Transducers, Load Cell, Piezoelectric Transducers, Photo Electric Transducers, Photo Conductive Cells, Photo- Voltaic Cell.

Temperature Transducers: Introduction, RTD, Resistance Thermometer. Thermocouple.(Text 2)

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

1. Define the measurement, instrument, and transducer, and explain the functional elements of a generalized instrumentation/measurement system.
2. Explain the principle and working of digital instruments, oscilloscopes, and function generators.
3. Discuss the principle, construction, and working of transducers for the measurement of displacement and strain.
4. Analyze and use appropriate circuits for the measurement of resistance, capacitance, inductance, and frequency.
5. Discuss the principle, construction, and working of transducers for the measurement of temperature.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

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Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1. Electrical and Electronic Measurements and Instrumentation – A. K. Sawhney, 17th Edition (Reprint 2004), Dhanpat Rai & Co. Pvt. Ltd., 2004.
2. Electronic Instrumentation - H. S. Kalsi, TMH, 3rd Edition, 2012

Web links and Video Lectures (e-Resources):

- **https://nptel.ac.in/courses/108105153**
- **https://nptel.ac.in/courses/108105064**
- **https://onlinecourses.nptel.ac.in/noc20_bt16/preview**
- **http://nitttrc.edu.in/nptel/courses/video/108105153/L57.html**

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

- Quizzes
- Surprise Tests
- Assignments
- Seminars

MEASUREMENT AND TRANSDUCERS LAB		Semester	3
Course Code	BEIL305	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2	SEE Marks	50
Credits	1	Exam Hours	3
Examination type (SEE)	Practical		

Course objectives:

- Develop the skills for the measurement of Resistance, Capacitance, Inductance, and Frequency.
- Understand the working principle of sensors and transducers.
- Test the response and plot the characteristics of different transducers.
- Interpret and analyze experimental results with theoretical concepts.
- Study and interpret data sheets of different transducers to select the suitable transducer for particular applications and safe operation.

Sl.NO	Experiments
1	Measurement of unknown resistance by Wheatstone bridge and finding the sensitivity of the bridge.
2	Measurement of low resistance using Kelvin double bridge.
3	Measurement of self-inductance using Maxwell's bridge.
4	Measurement of unknown capacitance using Schering's bridge.
5	Measurement of unknown capacitance/frequency using Wein's bridge.
6	Measurement of displacement using LVDT and finding the sensitivity & resolution.
7	Characteristics of Load cell and Cantilever beam using Strain gauge: Plotting the characteristics and finding their sensitivity for Quarter, Half and Full bridge configurations.
8	Temperature measurement using RTD, Thermistor and Thermocouple: Plotting the characteristics and finding their sensitivity.
	Demonstration Experiments (For CIE)
9	Temperature measurement using AD590 / LM35: Plotting the characteristics and finding their sensitivity.
10	Calibration of voltmeter using DC potentiometer.
11	Calibration of ammeter using DC potentiometer.
12	Characteristics of the potentiometric transducer/capacitance transducer.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Measure unknown values of resistance, capacitance and inductance using different bridges.
- Analyze the response and plot the characteristics of displacement measuring transducers such as LVDT and Potentiometric transducer.
- Analyze the response and plot the characteristics of temperature measurement transducers such as RTD, Thermistor, Thermocouple, AD590 and LM35.
- Analyze the response and plot the characteristics of strain gauge type load cell.
- Design, build, and test the circuits for practical applications

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Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE)

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE)

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics

- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

Text Books

- Electrical and Electronic Measurements and Instrumentation – A. K. Sawhney, 17th Edition (Reprint 2004), Dhanpat Rai & Co. Pvt. Ltd., 2004.
- Electronic Instrumentation - H. S. Kalsi, TMH, 3rd Edition, 2012 3.

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Engineering Science Course (ESC/ETC/PLC)

MICRO-ELECTRO-MECHANICAL SYSTEMS [MEMS]		Semester	3
Course Code	BEI306A	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40Hours	Total Marks	100
Credits	3	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

- Know the Microsystems, their fabrication, and application areas.
- Understand the working principles of several MEMS devices.
- Know the mathematical and analytical models of MEMS devices.
- Know the methods used in the fabrication of MEMS devices.
- Understand the different types of Micro manufacturing techniques used in Mems devices development.

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

- Show Video/animation films to explain the functioning of various techniques.
- Encourage collaborative (Group) Learning in the class.
- Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking.
- Topics will be introduced in multiple representations.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps to improve the student's understanding.

Module-1

Overview of MEMS and Microsystems: MEMS and Microsystem, Typical MEMS and Microsystems Products, Evolution of Microfabrication, Microsystems and Microelectronics, Multidisciplinary Nature of Microsystems Design and Manufacture, Miniaturization. Applications of Micro systems in Automotive industry, Applications of Microsystems in other industries. (Text-1)

Module-2

Working Principles of Microsystems: Introduction, Microsensors-Biomedical sensors & Biosensors, Chemical sensors, Optical sensors, Pressure sensor, and Thermal sensors. Microactuation- Actuation using thermal force, shape memory alloys, piezoelectric crystals, and electrostatic force. MEMS with Microactuators- Microgippers, Micromotors and Micropumps. Microaccelerometers, Microfluidics. (Text-1)

Module-3

Engineering Science for Microsystems Design and Fabrication: Introduction, Ions and Ionization, Molecular Theory of Matter and Inter-Molecular Forces, Plasma Physics, Electrochemistry-Electrolysis. (Text-1)

Engineering Mechanics for Microsystems Design: Introduction, Static Bending of Thin Plates, Overview on Finite Element Stress Analysis. (Text-1).

Module-4

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Scaling Laws in Miniaturization: Introduction, scaling in Geometry, Scaling in Rigid-Body Dynamics-scaling in dynamic force, trimmer force scaling vector. Scaling in Electrostatic Forces, Scaling in Electromagnetic Force, Scaling in Electricity, Scaling in Fluid Mechanics, Scaling in Heat Transfer-scaling in heat conduction and Scaling in heat convection. (Text-1).

Module-5

Overview of micro manufacturing: Introduction, Bulk micro manufacturing-over view of Etching, Isotropic and Anisotropic etching, Wet etchants, Etch stop, Dry etching, Comparison of wet versus dry etching. Surface Micromachining- General description, Process in general, Mechanical problems associated with surface micromachining. The LIGA Process- General description of the LIGA process, Material for substrates and photoresists. Electroplating. SLIGA process. Summary of micro-manufacturing. (Chapter-9,Text Book -1)

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

1. Explain the Microsystems used in MEMS and their application areas.
2. Describe the working principles of MEMS devices
3. Develop mathematical and analytical models of MEMS devices
4. Discuss the scaling in the fabrication of MEMS devices.
5. Describe the different Micro manufacturing techniques used in Mems devices development.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

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Suggested Learning Resources:

Books

1. Tai-Ran Hsu, MEMS and Micro systems: Design and Manufacture,Tata Mc Graw-Hill Edition 2002.

Web links and Video Lectures (e-Resources):

- https://www.nptelvideos.com/video.pnp ?id=788
- https://www.youtube.com/watch?v=j9y0gfN9WMg
- https://www.youtube.com/watch?v=EALXTht-stg
- https://www.youtube.com/watch?v=unj23A8br0U

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Surprise Tests
- Assignments
- Seminars

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Operating Systems		Semester	3
Course Code	BEI306B	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	40Hours	Total Marks	100
Credits	3	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

- Structure of operating system and multiprogramming.
- Process management and File structure.
- Scheme of memory management.
- Resource allocation policies for deadlock prevention or deadlock avoidance.
- Security and various attacks.

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Show Video/animation films to explain the functioning of various techniques.
- Encourage collaborative (Group) Learning in the class.
- Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking.
- Topics will be introduced in multiple representations.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps to improve the student's understanding.

Module-1

Introduction and overview of operating systems: Abstract views of an Operating system, Computing environment and nature of computations Classes of operating systems, Batch processing system, Multi programming systems, Time-sharing systems, Real-time operating systems, distributed operating systems, modern operating systems, Virtual machine operating systems, kernel-based operating systems, microkernel-based operating systems. (Text- 1)

Module-2

Process Management: Processes and Programs, implementing processes, race conditions, critical sections, control synchronization and indivisible operations, synchronization approaches, semaphores. File systems: Files, Directories, and File System Implementation (Text-2)

Module-3

Memory management: Static and Dynamic memory allocation, Memory allocation to a process, Reuse of memory, Contiguous memory allocation, Non-contiguous memory allocation, Paging, Segmentation, and segmentation with paging. (Text-1)

Module-4

Deadlocks: resources, introduction to Deadlocks, the ostrich algorithm, deadlock detection and recovery, Deadlock avoidance, deadlock prevention.(Text-2)

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Module-5

Security and Protection: overview of security and protection, security attacks, formal aspects of security, Encryption, authentication and password security, protection structures, capabilities, classification of computer security, case studies in security and protection. (Text-1)

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

1. Explain the various classes, the structure of the operating system, and multiprogramming.
2. Describe the File systems and process requirements in an operating system.
3. Analyze the management allocation and segmentation.
4. Describes the resource allocation policies to prevent the deadlock.
5. Apply the knowledge of operating system for security and protection.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Books

1. Dhamdhere, Operating Systems – A concept based approach, 3rd Edition, McGraw Hill Education Private (India), 2012.
2. Andrew S Tanenbaum and Herbert Bos, Modern operating systems, 4th Edition, Pearson Education Inc., 2015.

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Web links and Video Lectures (e-Resources):
• https://onlinecourses.nptel.ac.in/noc21_cs72/preview • https://www.youtube.com/watch?v=dv4mXBsv6TI&list=PLacuG5pysFbDQU8kKxbUh4K5c1iL5_k7k
Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning • Quizzes • Surprise Tests • Assignments • Seminars

NANO SCIENCE & NANO TECHNOLOGY		Semester	3
Course Code	BEI306C	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40Hours	Total Marks	100
Credits	3	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

- Understanding of state-of-the-art nanoscale fabrication and characterization
- Know the concept of Self-Assembly and Self-Organization.
- Describe the concept of Fullerenes, Characterization of Carbon Nanotubes and Quantum dots
- Understanding Semiconductor Nanostructures for Quantum Computation

Teaching-Learning Process (General Instructions)

These are sample Strategies; which teachers can use to accelerate the attainment of the various course outcomes.

- Show Video/animation films to explain the functioning of various techniques.
- Encourage collaborative (Group) Learning in the class.
- Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking.
- Topics will be introduced in multiple representations.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps to improve the student's understanding.

Module-1

Nanoscale Fabrication and Characterization: Nanolithography: Introduction, Cross-Cutting Technologies: Resists and Masks, Photon-Based Nanolithography Techniques, Electron Beam Lithography, Focused Ion Beam Lithography, Emerging Nanolithography.

Module-2

Self-Assembly and Self-Organization: The advantages of Self-Assembly, Intermolecular Interactions and Molecular Recognition, Self-Assembled Monolayers (SAM), Electrostatic Self-Assembly, and Self-Organization in Block Copolymers.

Scanning Probe Microscopes: Introduction, Basics of SPM, Scanning Tunneling Microscope, other scanned probe microscopes, near-field scanning optical microscope (NSOM).

Module-3

Fullerenes: Families of Fullerenes, Reactivity, potential applications.

Carbon nanotubes: Molecular and Supramolecular Structure, Intrinsic Properties of Individual Single-wall Carbon Nanotubes, Synthesis, and Characterization of Carbon Nanotubes, Modification, and Applications of Nanotubes.

Module-4

Quantum dots: Introduction, Quantum confinement-3D Quantum Dot, Quantum dots formed by Ion Implementation.

Nanocomposites: Introduction, Nanolayered Composites, Nanofilamentary and Nanowire Composites, Nanoparticulate Composites.

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Module-5

Semiconductor Nanostructures for Quantum Computation: Nanostructures for Quantum Computation, Quantum Computation Algorithms, Superposition and Quantum Parallelism, Requirements for Physical Realizations of Quantum Computers, Spin as a Physical Realization of Qubit, Quantum Computation with Electron spins in Quantum Dots, Quantum Computation with Phosphorus Nuclei in Silicon.

Course outcome (Course Skill Set)

At the end of the course, the student will be able to:

1. Understand the principles of Fabrication and Characterization of materials on the nanoscale.
2. Describe the advantages of Self-assembly, self-organization, and different methods of Scan probing.
3. Explain the properties and applications of carbon and carbon nanotubes.
4. Describe the properties of Quantum dots and the properties of nano composites.
5. Apply the knowledge to characterize semiconductor nanostructures for quantum computation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1. Massimiliano Di Ventra, Stephane Evoy and Janes R. Heflin Jr. Introduction to Nanoscale Science and Technology, Springer Science + Business Media LLC@2004, Reprinted 2009

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/113106093.
- https://www.youtube.com/watch?v=qUEbxTkPIWI
- https://www.digimat.in/nptel/courses/video/102107058/L01.html

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Surprise Tests
- Assignments
- Seminars

POWER ELECTRONICS		Semester	3
Course Code	**BEI306D**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours	Total Marks	100
Credits	3	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:

- To introduce students to the basic theory of power semiconductor devices and passive components.
- To familiarize students to the principle of operation, design and synthesis of different power conversion circuits and their applications.
- To provide strong foundation for further study of power electronic circuits and systems.
- Based on the static and dynamic characteristics, their limitation chooses these devices for various applications.
- Understand and analyze various gate drive circuits and protection circuits of devices.

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Show Video/animation films to explain the functioning of various techniques.
- Encourage collaborative (Group) Learning in the class.
- Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking.
- Topics will be introduced in multiple representations.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps to improve the student's understanding.

MODULE-1

Introduction: Applications of power electronics, power semiconductor devices, control characteristics, types of power electronic circuits, peripheral effects. Power BJTs, switching characteristics, switching limits, base-drive control, introduction to IGBT, and MOSFET, isolation of gate and base drives.

MODULE-2

Thyristors: Introduction, static characteristics of SCR, two transistor model, turn-on and turn off methods, di/dt and dv/dt protection of SCR, series and parallel operation of thyristors, thyristor firing circuit using UJT. Commutation Techniques: Introduction, natural commutation, forced commutation: self-commutation, impulse commutation.

MODULE-3

Controlled Rectifiers: Introduction, principle of phase controlled converter operation, single-phase semi converters, full converters and dual converters. AC Voltage Controllers: Introduction, principle of ON-OFF and phase control, single-phase bidirectional controllers with resistive and inductive loads.

MODULE-4

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Thyristors:-Basic structure, V-I characteristics, device operation, switching characteristics, Gate drive circuits, protection, series and parallel operation

Gate Turn-off Thyristor (GTO): Basic structure and operation, GTO switching characteristics, GTO turn-on transient, GTO turn -off transient, over-current protection of GTOs

MODULE-5

DC Choppers: Introduction, principle of step-down operation, step-down chopper with R- L loads, Principle of step-up operation, Classification of DC Choppers. DC Drives: Introduction, basic characteristics of DC Motors, operating modes single phase Full converter drives, Introduction to stepper motor

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

- Explain static and dynamic characteristics of power semiconductor devices.
- Analyze operation, model, characteristics, and turn-on and turn-off methods of devices.
- Describe the converter circuits and their operation using Thyristors, BJT, MOSFET etc.
- Analyze, evaluate and apply the power converter circuits in Industry
- Apply the knowledge in the Domestic/Industrial control system applications.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

Suggested Learning Resources:

Text Books

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1. Power Electronics - M. H. Rashid, Prentice Hall of India Pvt. Ltd., 2nd Edition New Delhi, 2002.
2. Power Electronics: Converters, Applications and Design - Ned Mohan, Tore M. Undeland and William P. Robbins, 3rd Edition, John Wiley and Sons, 2003.Advanced C - Peter D. Hipson, Sams Publishing, USA, 1992

Reference Books

1. Power Electronics- M. D. Sing and Khanchandani K. B., Tata McGraw Hill Publishing Company Limited, Reprint 2001.
2. Power Electronics - Cyril W. Lander, 3rd Edition, McGraw Hill, 1993.
3. Fundamentals of Power Semiconductor Devices-B. JayantBaliga, 1st Edition, International Thompson Computer Press, 1995
4. Semiconductor Device Modeling with Spice- G. Massobrio, and P. Antognetti, McGraw-Hill, 2nd Edition

Web links and Video Lectures (e-Resources):

- **https://archive.nptel.ac.in/courses/108/102/108102145/**
- **https://www.youtube.com/watch?v=djbJm-xWo2w&list=PLgwJf8NK-2e5Hnu82T1CYLZ8kbZs4Jx8x&index=2**

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Surprise Tests
- Assignments
- Seminars

Ability Enhancement Course – III

STATIC & DYNAMIC CHARACTERISTICS AND ERROR ANALYSIS IN INSTRUMENTATION SYSTEMS		Semester	3
Course Code	BEI358A	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:1:0:0	SEE Marks	50
Total Hours of Pedagogy	15 hours	Total Marks	100
Credits	1	Exam Hours	1
Examination nature (SEE)	Theory		

Course objectives:

After completion of the course, the students will be able to

- To impart fundamentals of static and dynamic characteristics of instrumentation systems.
- To acquire the basic knowledge of errors in measurement systems and their analysis.

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- In addition to the traditional lecture method, innovative teaching methods may be adopted so that the delivered lesson shall enable the students to attain the outcomes.
- Show videos/animations to explain the fundamental concepts static and dynamic characteristics.
- Encourage collaborative (Group) learning in the class.
- Ask higher order thinking questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how concepts can be applied to the real world problem to enable the students to develop appropriate skills.
- Adopt flipped class technique by sharing the materials / sample videos prior to the class and have discussions on the that topic in the succeeding classes.

MODULE-1

Measurement system performance, Static calibration and error calibration curve, accuracy and precision, indications of precision, significant figures, static error, static correction, scale range and scale span, reproducibility and drift, repeatability, static sensitivity, linearity, hysteresis, threshold, dead time and dead zone, resolution

MODULE-2

Noise, signal to noise ratio, sources of noise, Johnson noise, power spectrum density, noise factor and noise figure, loading effects, Input and output impedances – input impedance, input admittance, output impedance, output admittance, generalized impedance and stiffness concepts, static stiffness and static compliance.

MODULE-3

Limiting errors, relative limiting errors, types of errors, gross errors, systematic errors, random errors, central value, Statistical treatment of data – histogram, arithmetic mean, measure of dispersion from the mean, range, average deviation, standard deviation, variance, normal or Gaussian curve of errors, probable error.

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MODULE-4
Dynamic response – steady state and transient response, dynamic characteristics, Dynamic analysis of measurement systems – time domain analysis, different types of inputs, frequency domain analysis, Transfer function, Time domain response – zero order system, first order system, response of a first order system to step & ramp input, frequency response of first order system.
MODULE-5
Response of second order systems – overd amped, critically damped and under damped systems, Step response of second order system, time domain specifications, Frequency response of first order system, frequency response of second order system, dead-time elements.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

- List, define and explain all static and dynamic characteristic of instrument and measurement systems.
- Discuss the different types of errors and their interpretation.
- Discuss and analyze the dynamic response of instrument and measurement systems in time domain and frequency domain.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

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Suggested Learning Resources:

Text Books

1. Electrical and Electronic Measurements and Instrumentation – A. K. Sawhney, 17th Edition (Reprint 2004), Dhanpat Rai & Co. Pvt. Ltd., 2004.

Reference Books

1. Electronic Instrumentation - H. S. Kalsi, TMH, 3rd Edition, 2012
2. Instrumentation: Devices and Systems- C. S. Rangan, G. R. Sarma, V. S. V. Mani, 2nd Edition (32nd Reprint), McGraw Hill Education (India), 2014.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/112107242
- https://www.youtube.com/watch?v=5eOgWyfXjr8
- https://www.youtube.com/watch?v=Hlvbr5DCEfM

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- List the characteristics / specifications of all instruments available in the labs.
- Verifying the characteristics / specifications of all instruments available in the labs.
- Observe and analyze the errors encountered during the conduction of lab experiments
- Study the dynamic response of the instruments available in the labs.

NETWORK ANALYSIS		Semester	3
Course Code	BEI358B	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:1:0:0	SEE Marks	50
Total Hours of Pedagogy	15 hours	Total Marks	100
Credits	1	Exam Hours	1
Examination nature (SEE)	Theory		

Course objectives:
This course will enable students to:

- Apply mesh and nodal techniques to solve an electrical network.
- Solve different problems related to Electrical circuits using Network Theorems and Two port network.
- Familiarize with the use of Laplace transforms to solve network problems.
- Be familiar with the most fundamental Graph theory topics and results.

Teaching-Learning Process (General Instructions)
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain functioning of various concepts.
- Encourage collaborative (Group) Learning in the class .
- Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking.
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in a multiple representation.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
- Adopt Flipped class technique by sharing the materials / Sample Videos prior to the class and have discussions on the that topic in the succeeding classes.
- Give Programming Assignments.

MODULE-1

Basic concepts
Types of Sources, Loop analysis, Nodal analysis with independent DC and AC Excitations. (Textbook 1: 2.3, 4.1, 4.2, 4.3, 4.4, 10.6)

MODULE-2

Network theorems: Super position theorem, Thevenin's theorem, Norton's Theorem (for DC networks only), Maximum power transfer theorem (for AC & DC networks).
(Textbook 2: 9.2, 9.4, 9.5, 9.7)

MODULE-3

Laplace transform and its Applications: Step Ramp, Impulse, Solution of networks using Laplace transform, Initial value and final value theorem (Textbook 3: 7.1, 7.2, 7.4, 7.7, 8.4)

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MODULE-4
Two port networks: Short- circuit Admittance parameters, Open- circuit Impedance parameters (Textbook 3: 11.1, 11.2, 11.3)
MODULE-5
Graph theory: Graph of a network, concepts of: tree & co-tree, incidence matrix, tie-set & cut-set schedules. (Text book 2:8.2,8.3,8.4,8.5,8.6)

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

- Analyse and solve Electric circuit, by applying loop analysis, Nodal analysis and by applying network Theorems
- Apply Laplace transforms to solve electric networks
- Apply Two-port network formulation for analyzing electric circuits
- Apply graph theoretic formulation for the solutions of network equations.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Examination (CIE)

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is **01 hour.** The student has to secure a minimum of 35% of the maximum marks meant for SEE.

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Suggested Learning Resources:

Text Books

1. Engineering circuit analysis, William H Hayt, Jr, Jack E Kemmerly, Steven M Durbin, Mc Graw Hill Education, Indian Edition 8e.
2. Networks and Systems, D Roy Choudhury, New age international Publishers, second edition.
3. Network Analysis, M E Van Valkenburg, Pearson, 3e

Reference Books

1. Electronic Instrumentation - H. S. Kalsi, TMH, 3rd Edition, 2012
2. Instrumentation: Devices and Systems- C. S. Rangan, G. R. Sarma, V. S. V. Mani, 2nd Edition (32nd Reprint), McGraw Hill Education (India), 2014.

Web links and Video Lectures (e-Resources):

- https://nptel.ac.in/courses/108106098
- https://nptel.ac.in/courses/108102042

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Practical implementation of circuits and theorem verification in labs
- Simulation of network circuits and theorems
- Assignments
- Surprise quizzes / tests

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Digital Design Lab using Pspice / MultiSIM		Semester	3
Course Code	BEI358C	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	12 Lab slots	Total Marks	100
Credits	1	Exam Hours	2
Examination nature (SEE)	Practical		

Course objectives:

This course enables the students to

- To provide hands-on experience in designing and implementing digital circuits.
- The experiments are designed to give students ability to design, build and implement digital circuits & systems.
- The Pspice /Multisim simulator helps to evaluate the design of combinational and sequential circuits.

Sl. No	Experiments
1	Implementation of De Morgan's theorem and SOP/POS expressions using Pspice/Multisim.
2	Implementation of Half Adder, Full Adder, Half Subtractor and Full Subtractor using Pspice/Multisim.
3	Design and implementation of 4-bit Parallel Adder/ Subtractor using IC 7483 using Pspice/Multisim.
4	To realize Binary to Gray code conversion and vice versa using Pspice/Multisim.
5	To realize BCD to excess 3 and vice versa using Pspice/Multisim.
6	To realize Priority encoder and 3:8 Decoder using Pspice/Multisim.
7	To realize One / Two bit comparator using Pspice/Multisim.
8	To realize 4:1 Multiplexer using gates with Pspice/Multisim.
9	To realize 1:8 Demux with Pspice/Multisim.
10	To realize the following flip-flops using NAND Gates (a)T type (b) JK Master slave (c) D type using Pspice/Multisim.
11	To design and implement the 3-bit Mod-N synchronous counters using Pspice/Multisim.
12	To design and implement the Binary ripple counters (up/down) using Pspice/Multisim.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

- Demonstrate the truth table of various expressions and combinational circuits using logic gates.
- Design various combinational circuits such as adders, subtractors, comparators, multiplexers and code converters.
- Construct flips-flops and counters.
- Design and implement synchronous counters..

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

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Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

Suggested Learning Resources:

Text Books

1. Digital Logic Applications and Design by John M Yarbrough, Thomson Learning, 2001
2. Digital Principles and Design by Donald D Givone, McGraw Hill, 2020

AEC LAB USING PSPICE / MULTISIM / COMSOL		Semester	3
Course Code	BEI358D	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Total Hours of Pedagogy	12 Lab slots	Total Marks	100
Credits	1	Exam Hours	2
Examination nature (SEE)	Practical		

Course objectives:

This course enables the students to

- To provide practical exposure to the students on designing, setting up, executing and debugging various electronic circuits using simulation software.
- To give the knowledge and practical exposure on simple applications of analog electronic circuits.

Sl. No	Experiments
1	Experiments to realize diode clipping (single, double ended) circuits.
2	Experiments to realize diode clamping (positive, negative) circuits.
3	Experiments to realize Full wave rectifier without filter (and set-up to measure the ripple factor, Vp-p, Vrms, etc.).
4	Design and conduct an experiment on Series Voltage Regulator using Zener diode to determineline/load regulation characteristics.
5	Realize BJT Darlington Emitter follower without bootstrapping and determine the gain, input and output impedances (other configurations of emitter follower can also be considered).
6	Experiment to realize Input and Output characteristics of BJT Common emitter configuration and evaluation of parameters.
7	Experiments to realize Transfer and drain characteristics of a MOSFET.
8	Set-up and study the working of class A power amplifier and calculate the efficiency
9	Set up and study the response of a two stage RC-coupled amplifier and calculate gain and bandwidth
10	To design and test the Common emitter-Common base cascade amplifier to determine the gain and bandwidth from its frequency response.
11	Design and set-up the Wein bridge oscillator and determine the frequency of oscillation
12	Design and set-up the oscillator circuits (Hartley/ Colpitts using BJT/FET) and determine the frequency of oscillation

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

- Explain the circuit schematic and its working.
- Study the characteristics of different electronic devices.
- Design and test simple electronic circuits as per the specifications using discrete electronic components.
- Compute the parameters from the characteristics of active devices.
- Familiarize with EDA software which can be used for electronic circuit simulation.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE

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minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

Suggested Learning Resources:

Text Books

1. David A Bell, "Fundamentals of Electronic Devices and Circuits Lab Manual, 5th Edition, 2009, Oxford University Press.
2. Muhammed H Rashid, "Introduction to Pspice using Or CAD for circuits and electronics", 3rd Edition, Prentice Hall, 2003.

IV Semester

SIGNAL CONDITIONING AND DATA ACQUISITION CIRCUITS		Semester	4
Course Code	**BEI401**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:
This course will enable the students to

- Define and describe Op Amp, basic concepts, characteristics and specifications
- Gain knowledge about Linear and nonlinear applications of Op-amp.
- Design and develop circuits like, amplifiers, filters, Timers to meet industrial requirements.
- Get a firm grasp of basic principles of op-amp.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only traditional lecture method, but different type of teaching methods may be adopted to develop the outcomes.
- Show Video/animation films to explain evolution of communication technologies.
- Encourage collaborative (Group) Learning in the class
- Ask at least three HOTS (Higher order Thinking) questions in the class, which promotes critical thinking
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that is possible, it helps to improve the students' understanding.

Module-1

Introduction to Operational Amplifiers: Introduction, Block schematic of an Op-amp, Power supply connections, Characteristics of an Ideal OP-AMP, Inverting Amplifier, Non-inverting Amplifier, Voltage follower, Differential Amplifier, CMRR. (Relevant problems).
Operational Amplifier Characteristics: DC characteristics – Input bias current, Input offset current, Input offset voltage, Total output offset voltage, Thermal drift. AC characteristics – Frequency response, Slew rate, PSRR. Basic Op-amp applications: Scale changer/Inverter, Summing amplifier: Inverting summing amplifier, Non-inverting Summing amplifier, Subtractor, Instrumentation Amplifier. (Relevant problems).

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

Module-2

Operational Amplifier Applications: V – I and I – V converter, Op-amp circuit using diodes, sample and hold circuit, Differentiator and Integrator.

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Comparator and waveforms generator: Comparator, Regenerative comparator (Schmitt Trigger), Astable mutivibrator, Monostable multivibrator and Triangular waveform generator. Phase shift oscillator, Wien bridge oscillator. (Relevant problems).

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

Module-3

Voltage Regulators: Introduction, Series Op-amp regulator, IC voltage regulators, 723 general purpose regulators, switching regulator.

Active filters: First and Second order LPF, First and Second orders HPF, Band Pass Filters, Band Reject filters. (Design examples).

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

Module-4

555 Timer: Description of Functional Diagram, Monostable operation, Applications of Monostable Multivibrator: Frequency Divider & Pulse Width Modulation. Astable operation, Applications of Astable Multivibrator: FSK Generator and Pulse Position Modulation.

Phase Locked Loops: Basic Principles, Analog phase Detector/comparator, Voltage controlled oscillator, PLL applications: Frequency Multiplication/Division, Frequency translation, FM demodulation

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

Module-5

Data Acquisition Systems: Types of instrumentation systems, Components of analog data acquisition system, Digital data acquisition system.

Data Converters: Digital to Analog Converters: Basic DAC techniques, Weighted Resistor DAC, R – 2R Ladder DAC, DAC 0800 (Data sheet: Features and description only). Analog to Digital Converters: Functional diagram of ADC, Flash ADC, Counter type ADC, Successive approximation ADC, Dual slope ADC. ADC 0809 (Data sheet: Features, specifications and description only), DAC/ADC specifications.

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

1. Understand the basic principles and operation of op-amp.
2. Design and develop basic Op-amp. circuits
3. Design and develop Op-amp. circuits to meet the practical applications
4. Design regulator circuits and filter circuits
5. Understand the operation and applications of 555 timer and PLL.
6. Understand data acquisition system components and implement the op-amp circuits in electronic gadgets.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.

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- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to **50 marks**

Suggested Learning Resources:

Text Books

1. "Linear Integrated Circuits", D. Roy Choudhury and Shail B. Jain, 4th edition, Reprint 2010, New Age International. (Module -1,2,3,4 & 5)
2. "Op - Amps and Linear Integrated Circuits", Ramakant A. Gayakwad, 4th edition, PHI (Module-3)
3. "A course in Electrical & Electronic Measurements & Instrumentation", A K Sawhney, Dhanpat Rai Publications, 19th edition, 2011.(Module-5)

Reference Books:

1. "Operational Amplifiers and Linear Integrated Circuits", Robert. F. Coughlin & Fred. F. Driscoll, PHI/Pearson, 2006
2. "Op - Amps and Linear Integrated Circuits", James M. Fiore, Thomson Learning, 2001
3. "Design with Operational Amplifiers and Analog Integrated Circuits", Sergio Franco, TMH, 3e, 2005

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Surprise Tests
- Assignments
- Seminars

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EMBEDDED CONTROLLERS		Semester	4
Course Code	**BEI402**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	4	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:
This course will enable the students to:

- Understand the difference between a Microprocessor and a Microcontroller and embedded microcontrollers and different architectures. Familiarize the basic architecture of 8051 microcontroller.
- Learn instructions and Program 8051microcontroller using Assembly Level Language, addressing modes, directives.
- Learn basics of C for 8051 and C program for 8051
- Understand the operation and use of inbuilt Timers/Counters and Serial port of 8051
- Interface 8051 to external memory and I/O devices using its I/O ports. Understand the interrupt system of 8051 and the use of interrupts

Teaching-Learning Process (General Instructions)
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
- Show Video/animation films to explain the functioning of various techniques.
- Encourage collaborative (Group) Learning in the class
- Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyse information rather than simply recall it.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps to improve the students' understanding.
- Give Programming Assignments.

MODULE-1

Introduction: Microprocessor and Microcontroller, Microprocessor survey, RISC and CISC CPU Architecture. Harvard and Von-Neumann CPU Architecture. 8051 Microcontroller Architecture. Pin functions description. Input/ Output port pins and circuits. Internal and External memory Architecture. 8051 Reg. banks and stack. 8051 flag bits and PSW Register. Special function Registers. Timer /Counter, Serial data input/ output. Interrupts. program counter and ROM space in the 8051.

Teaching-Learning Process RBT Levels	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

MODULE-2

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Addressing modes directives instruction set of 8051 Microcontroller. 8051 data types and directives, Immediate and Register addressing modes. Accessing memory using various addressing modes. Bit addressing for I/O and RAM. 8051 data types and directives. Jump Loop and CALL Instructions Arithmetic and Logic Instructions and programming. I/O port programming. Assembly Language program various instruction set	
Teaching-Learning Process RBT Levels	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3
MODULE-3	
8051 programming in C. Advantages of programming 8051 in C. Data types and time delay in 8051 C. I/o programming. Bit addressable programming. Logic operations. data conversion programs. Accessing Code ROM Space, data serialization using 8051 C.	
Teaching-Learning Process RBT Levels	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3
MODULE-4	
Timer/ Counter, Serial communication in 8051. Programming 8051 timer/ counter, programming timer 0 and 1 in 8051 C. Basics of serial communication. 8051 connections to RS-232. 8051 serial port programming in assembly and C	
Teaching-Learning Process RBT Levels	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3
MODULE-5	
Interfacing 8051: Interfacing of 8051 with ADC-0804, DAC, LCD , Stepper motor and keyboard and their 8051 Assembly and C language interfacing programming. Interrupts: Programming Timer Interrupts, External hardware Interrupts and serial communication Interrupts. Interrupts priority & Interrupt programming in C.	
Teaching-Learning Process RBT Levels	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

PRACTICAL COMPONENT OF IPCC*(May cover all / major modules)*

Sl.NO	Experiments
1	Program for 8 bit and 16-bit addition. square root of 8 bit and 16 bit for 8051 microcontroller
2	Program using 8051 in Block, Move, Exchange.
3	Program in sorting, finding largest and smallest element in an array
4	Counters - For Hex and BCD up/ down count.
5	Boolean and Logical Instructions. (Bit Manipulation).
6	Code Conversions ---> ASCII to Decimal, Decimal to ASCII, BCD to ASCII
7	Subroutines using CALL and RETURN instructions
8	Programs to generate delay, programs using serial port and on chip timer/ counter.
	Demo experiments for CIE
9	Stepper motor Interface to 8051 Microcontroller with C Program
10	DC Motor Interface to 8051 Microcontroller with C Program
11	DAC Interface for to generate sine wave, square wave, triangular wave, Ramp wave through 8051Microcontroller with C Program.
12	Keyboard Interfacing
Assessment Details (both CIE and SEE)	

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The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Text Books

1. The 8051 Microcontroller and Embedded systems-using assembly and C", Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinaly,PHI,2006/pearson,2006
2. The 8051 Microcontroller architecture. Programming and applications", Kenneth J Alyala Thomson learning 2005

Web links and Video Lectures (e-Resources):

- VTU e-shikshana programmes
- VTU Edu-sat programmes
- https://nptel.ac.in/courses/106105193
- https://nptel.ac.in/courses/108105102

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Developing programming skills by carrying out mini projects.
- Quizzes
- Assignments
- Seminars
- Micro project as activity based learning

CONTROL SYSTEMS		Semester	4
Course Code	**BEI403**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 8-10 Lab slots	Total Marks	100
Credits	4	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:
This course will enable the students to:

- Understand the basic concepts & mathematical modelling of systems
- Draw block diagram & reduction for a given system
- Obtain Transfer functions by reduction and Signal Flow graph techniques.
- Analyze the system response in time and frequency domain
- Understand and Design of control systems using state space analysis

Teaching-Learning Process (General Instructions)
These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Always start every class hour with preamble of what was covered in previous class and what would be discussed in the present class.
- Encourage group discussion and arrange debate on certain topics.
- Solve problems by considering some real time examples.
- After solving some numerical examples, invite students to solve some other numerical problems directly on to the black board. So that one will be boosting students confidence level.
- At the end of each topics give sufficient assignments covering all types of possible numerical problems which might have appeared in various other universities question papers.
- Arrange seminars by the students on certain intriguing topics relevant to syllabus by the students.

MODULE-1

Modelling of Systems and Block diagram: Introduction to Control Systems, Types of Control Systems, with examples. Concept of mathematical modelling of physical systems- Mechanical, Translational (Mechanical accelerometer, systems excluded), and Rotational systems, Analogous systems based on force voltage analogy and force current analogy. Introduction to Block diagram algebra. Numerical problems on all topics.

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE-2

Signal Flow graph: Introduction to Signal Flow graph, Mason's gain formula. Obtaining Transfer functions for the given SFG using Mason's gain formula.
Time response analysis: Introduction. Standard test signals, response of first order & second order systems for unit step input. Steady state errors & Error constants. Numerical problems on all topics.

Teaching-Learning Process	Chalk and talk method, You Tube Videos, Power Point Presentation.
RBT Levels	L1, L2, L3

MODULE-3

Concepts of stability: The Concept of stability. Necessary conditions for stability. Hurwitz stability criterion. Routh stability criterion. Relative stability analysis using RH Criterion.
The Root Locus Technique: Introduction. Root locus concepts. Construction of root loci. Stability analysis

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Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3
MODULE-4	
Frequency domain Analysis: Introduction to frequency domain analysis, Correlation between time & frequency response, Bode plots. Numerical problems on all topics. Polar Plot: Introduction to Polar plot and Nyquist plots, Nyquist stability criterion. Stability analysis using Polar plot. Numerical problems on all topics.	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3
MODULE-5	
State space Analysis: Concept of state, state variables and state model. State diagrams and State models for Linear continuous-time systems (Electrical systems): State space representation using Physical and Phase variables. Derivation of transfer functions from the state model. Numerical problems on all topics.	
Teaching-Learning Process **RBT Levels**	Chalk and talk method, You Tube Videos, Power Point Presentation. L1, L2, L3

PRACTICAL COMPONENT OF IPCC*(May cover all / major modules)*

Sl.NO	Experiments
	Study of Control System toolbox and Matrix operations [STUDY EXPERIMENT]
1	Unity and non-unity feedback system using MATLAB
2	Block diagram reduction technique using MATLAB
3	Simulation of P, PI, PD & PID controllers
4	Simulation of dc motor characteristics using MATLAB
5	Simulation of poles and zeros of a transfer function
6	State model for classical transfer function &vice versa using MATLAB
7	Transfer function analysis of 3rd order using Simulink
8	Determine the transfer function for given closed loop system in block diagram representation.
9	**Demo experiments for CIE** Determine the steady state errors of a given transfer function
10	Stability analysis using Bode plot using MATLAB
11	Stability analysis using Root locus using MATLAB
12	Stability analysis using Nyquist plot using MATLAB

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

1. Apply modelling knowledge in implementation physical systems.
2. Perform the reduction of block diagram &analyze using Signal flow graph.
3. Comment on performance of a system by evaluating various parameters.
4. Model a system by applying the concept of State Space analysis

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

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CIE for the theory component of the IPCC (maximum marks 50)

- IPCC means practical portion integrated with the theory of the course.
- CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.
- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.
- Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for **25 marks)**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva-voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

Suggested Learning Resources:

Text Books

1. *Control Systems Engineering,* I. J. Nagarath and M. Gopal ,New Age International (P) Limited, Publishers, Fifth edition – 2012.
2. *Modern Control Engineering*, K. Ogata, Pearson Education Asia/ PHI, 4thEdition, 2002.
3. *Automatic Control Systems*, Benjamin C. Kuo, John Wiley India Pvt. Ltd., 8thEdition, 2008.
4. *Feedback and Control System*, Joseph J Distefano III et al., Schaum's Outlines, TMH, 2nd Edition 2007.
5. *Feedback Control Systems,* S.C. Goyal and U.A. Bakshi, Technical Publications, Pune.

Web links and Video Lectures (e-Resources):

- VTU e-shikshana programme
- VTU Edu-sat programmes

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- https://nptel.ac.in/courses/107106081

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Developing programming skills by carrying out mini projects.
- Quizzes
- Assignments
- Seminars
- Group Discussions

SIGNAL CONDITIONING AND DATA ACQUISITION CIRCUITS LAB		Semester	4
Course Code	**BEIL404**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	3
Examination nature (SEE)	Practical		

Course objectives:

This laboratory course enables students to

- Understand the working of Op-amp. as amplifier, inverter and scale changer
- Realize and test amplifier and oscillator circuits for the given specifications
- Implement filtering circuits for signal processing applications
- Realize the Op-amp circuits for the applications such as DAC, implement mathematical functions

Sl.NO	Experiments
1	Design and implement Inverting Amplifier, Non-Inverting Amplifier and Voltage Follower
2	Realize Full wave Precision rectifier using op.amp.
3	Design and implement Butterworth Second order Low-pass filter
4	Design and implement Butterworth Second order High-pass filter
5	To design and implement RC Phase shift oscillator
6	To design and implement Wein Bridge oscillator
7	To design and implement Astable Multivibrator using 555 timer
8	To realize Sample and Hold circuit using discrete components
	Demonstration Experiments (For CIE)
9	To design and implement 4 bit R-2R DAC using discrete components
10	Implement 8-bit DAC using IC DAC 0800 IC
11	Implement 8-bit ADC using ADC 0809 IC
12	Implement 3 bit Flash ADC using ICs

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Sketch/draw circuit schematics, construct circuits on breadboards, analyze and troubleshoot circuits containing Op-amps, resistors, diodes, capacitors and independent sources.
2. Memorize and reproduce the manufacturer's data sheets of IC 555 timer, IC μa741 op-amp and data converters like IC ADC 0800 and IC DAC 0809.
3. Design and evaluate analog integrated circuits like Amplifiers, Oscillators, Active filters, Precision Rectifiers and Voltage level detectors, and compare the experimental results with theoretical values.
4. Demonstrate and analyze the working of Sample-Hold, Programmable gain amplifier and Analog Multiplexer circuits in data acquisition system.
5. Design and evaluate different resolution data converters using discrete components and ICs.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/

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course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are**50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

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Suggested Learning Resources:

1. "Linear Integrated Circuits", D. Roy Choudhury and Shail B. Jain, 4th edition, Reprint 2010, New Age International.
2. "Op - Amps and Linear Integrated Circuits", Ramakant A. Gayakwad, 4th edition, PHI
3. "A course in Electrical & Electronic Measurements & Instrumentation", A K Sawhney, Dhanpat Rai Publications, 19th edition, 2011.
4. "Operational Amplifiers and Linear Integrated Circuits", Robert. F. Coughlin & Fred. F. Driscoll, PHI/Pearson, 2006
5. "Op - Amps and Linear Integrated Circuits", James M. Fiore, Thomson Learning, 2001
6. "Design with Operational Amplifiers and Analog Integrated Circuits", Sergio Franco, TMH, 3e, 2005

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Engineering Science Course (ESC/ETC/PLC)

BIOMEDICAL INSTRUMENTATION		Semester	4
Course Code	**BEI405A**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:
This course will enable the students

- To understand the fundamental knowledge of Bio-medical Instrumentation,
- To understand the science associated with the measurement of biological variables such as pressure, temperature etc related to human body,
- To understand the complexities associated with the measurement of the biological parameters and the care that are to be taken for the measurement since it is concerned with human life.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
- Show Video/animation films to explain the functioning of various techniques.
- Encourage collaborative (Group) Learning in the class
- Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in multiple representations.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Fundamentals of Biomedical Instrumentation: Sources of biomedical signals, Basic Medical Instrumentation system, Performance requirements of medical instrumentation systems. PC based medical instruments, General constraints in design of biomedical instrumentation systems.
Bioelectric Signals and Electrodes : Origin of Bioelectric signals, Types of bioelectric signals-ECG, EEG, EMG,
Recording electrodes: Electrode – Tissue interface, polarization, skin contact- impedance, Silver-silver chloride electrodes, Electrodes for ECG, EEG, EMG, Microelectrodes.(Text book 1)

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Module-2
Electrocardiograph: Physiology of the heart, Electrical activity of the heart and Electrocardiogram (ECG), Normal & Abnormal cardiac Rhythms, Block diagram-description of an Electrocardiograph, ECG leads, Effects of artifacts on ECG Recordings, Multi- channel ECG machine.(Text book 1) Electroencephalograph: Block diagram description of an Electroencephalograph, 10-20 electrode systems, computerized analysis of EEG. Electromyography, Biofeedback instrumentation.(Textbook 1)
Module-3
Patient Monitoring System: Bedside patient monitoring systems, Central monitors, Measurement of heart rate Average heart rate meter, Instantaneous heart rate meter, Measurement of pulse rate, Definition of oximeter & Pulse oximeter. Blood Pressure Measurement: Introduction, Indirect methods of blood pressure measurement: Korotkoff's method, Rheographic method, differential auscultatory technique, Oscillometric technique. Measurement of Respiration Rate: Impedance pneumography, CO2 method of respiration rate measurement, Apnoea detectors.(Text book 1)
Module-4
Blood Flow Measurement: Electromagnetic blood flow meter- Principle and Square wave electromagnetic flowmeter. Doppler shift blood flow velocity meter, Blood flow measurement by Doppler imaging. Cardiac Output Measurement: Measurement of continuous cardiac output derived from the aortic pressure waveform, ultrasound method. Cardiac Pacemakers and Defibrillators: Need for cardiac pacemaker, External pacemaker, Implantable pacemaker, Types of Implantable pacemakers, Programmable pacemakers, Power sources for Implantable pacemaker. Cardiac Defibrillator: Need for a Defibrillator, DC defibrillator, Pacer-Cardioverter-Defibrillator (Textbook 1)
Module-5
Therapeutic Instruments: Cardiac-assist devices, Pump oxygenators, Total artificial heart, Hemodialysis, Lithotripsy, Ventilators, Infant incubators, Drug infusion pumps, Ambulatory and Implantable Infusion systems, Anesthesia Machines, Electrosurgical unit.(Textbook 2) Patient Safety: Electric shock hazards, Leakage currents, Electrical safety analyzer, Testing of Biomedical equipment.(Textbook 1)
Course outcome (Course Skill Set) At the end of the course, the student will be able to : 1. Acquire knowledge about origin of bio-potential, bio-signals and their measurement 2. Describe the problem, identify and formulate solution in the field of Bio-Medical Engineering for current and future issues 3. Describe the cardiac, brain and muscular physiological systems with the related diagnostic measurement methods. 4. Recognize the therapeutic methods of treatment and the associated instrumentation. 5. Identify and judge patient safety issues related to biomedical instrumentation. 6. Describe the principle and working of cardiac pacemakers, defibrillators, BP measurement, blood flow meters, CO measurement, respiration measurements and their implementation

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Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books:

1. Handbook of Biomedical Instrumentation - R.S.Khandpur, 2nd Edition, Tata McGraw- Hill, 2003
2. Medical Instrumentation: Application and Design – John G Webster, 3rd Edition, John Wiley & Sons, 2006.

Reference Book:

1. Biomedical Instrumentation & Measurement - Leslie Cromwell, Fred J Weibell& Erich A Pfeiffer, 2nd Edition, Prentice Hall of India, 2001.

Web links and Video Lectures (e-Resources):

- https://lecturenotes.in/subject/27/biomedical-instrumentation-bi/video
- https://www.electrical4u.com/introduction-to-biomedical-instrumentation/

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Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Visit to hospitals, clinics and diagnostic centres.
- Quizzes
- Assignment
- Seminars

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COMPUTER ORGANIZATION AND ARCHITECTURE		Semester	4
Course Code	**BEI405B**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:
This course will enable the students

- Explain the basic sub-systems of a computer, their organization, structure and operation.
- Illustrate the concept of programs as sequences of machine instructions.
- Demonstrate different ways of communicating with I/O devices
- Describe the memory hierarchy and concept of virtual memory.
- Illustrate the organization of simple pipelined processor and other computing systems.

Teaching-Learning Process (General Instructions)
These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Lecture method (L) does not mean only the traditional lecture method, but a different type of teaching method may be adopted to develop the outcomes.
- Show Video/animation films to explain the functioning of various techniques.
- Encourage collaborative (Group) Learning in the class
- Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in multiple representations.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.
- Adopt the Flipped class technique by sharing the materials/Sample Videos prior to the class and have discussions on the topic in the succeeding classes.

Module-1

Basic Structure of Computers: Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Software, Performance -Processor Clock, Basic Performance Equation (upto1.6.2 of Chap1 of Text).

Machine Instructions and Programs: Numbers, Arithmetic Operations and Characters, IEEE standard for Floating point Numbers, Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing (up to 2.4.6 of Chap 2 and 6.7.1 of Chap 6 of Text).

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Module-2
Programming Concept: Addressing Modes, Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions (from2.4.7 of Chap2, except 2.9.3, 2.11 & 2.12 of Text).
Module-3
Input/ Output Organization: Accessing I/O Devices, Interrupts -Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Direct Memory Access (upto 4.2.4 and 4.4 except 4.4.1 of Chap4 of Text).
Module-4
Memory System: Basic Concepts, Semiconductor RAM Memories-Internal organization of memory chips, Static memories, Asynchronous DRAMS, Read Only Memories, Cash Memories, Virtual Memories, Secondary Storage Magnetic Hard Disks (5.1, 5.2, 5.2.1, 5.2.2, 5.2.3, 5.3, 5.5 (except 5.5.1 to 5.5.4), 5.7 (except 5.7.1), 5.9, 5.9.1 of Chap 5 of Text).
Module-5
Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hardwired Control, Microprogrammed Control (up to 7.5 except 7.5.1 to 7.5.6 of Chap 7 of Text).
Course outcome (Course Skill Set) At the end of the course, the student will be able to : 1. Explain the basic organization of a computer system. 2. Describe the addressing modes, instruction formats and program control statement. 3. Explain different ways of accessing an input/ output device including interrupts. 4. Illustrate the organization of different types of semiconductor and other secondary storage memories. 5. Illustrate simple processor organization based on hard wired control and microprogrammed control.
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.
Continuous Internal Evaluation: • There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component. • Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks • Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two

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assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)

- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky: Computer Organization, 5th Edition, Tata McGraw-Hill,2002.

Reference Book:

1. David A. Patterson, John L. Hennessy: Computer Organization and Design-The Hardware/ Software Interface ARM Edition, 4th Edition, Elsevier,2009.
2. William Stallings: Computer Organization & Architecture,7th Edition, PHI, 2006.
3. Vincent P. Heuring & Harry F. Jordan: Computer Systems Design and Architecture, 2nd Edition, Pearson Education, 2004.

Web links and Video Lectures (e-Resources):

- https://onlinecourses.nptel.ac.in/noc20_cs64/preview
- https://nptel.ac.in/courses/106106166
- https://nptel.ac.in/courses/106106092

Activity Based Learning (Suggested Activities in Class)/ Practical Based Learning

- Quizzes
- Assignment
- Seminars

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EMBEDDED C		Semester	4
Course Code	BEI405C	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40 Hours	Total Marks	100
Credits	3	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:

- Embedded C is an extension of C language and it is used to develop micro-controller-based applications.
- Embedded C language implementation, programming, & debugging.
- Understand embedded controller hardware and software stack and their respective differences from traditional software development.
- Recognize and use important concepts such as HAL (Hardware Abstraction Layer) to write Embedded C code that is portable to different embedded controllers.
- Utilize hardware/software signalling mechanism to implement effective communication between embedded software stack and hardware.

Teaching-Learning Process (General Instructions)

These are sample Strategies; that teachers can use to accelerate the attainment of the various course outcomes.

- Show Video/animation films to explain the functioning of various techniques.
- Encourage collaborative (Group) Learning in the class.
- Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking.
- Topics will be introduced in multiple representations.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps to improve the student's understanding.

MODULE-1

Programming Embedded Systems in C Introduction , What is an embedded system, Which processor should you use, Which programming language should you use, Which operating system should you use, How do you develop embedded software, Conclusions.

MODULE-2

Reading Switches Introduction, Basic techniques for reading from port pins, Example: Reading and writing bytes, Example: Reading and writing bits (simple version), Example: Reading and writing bits (generic version), The need for pull-up resistors, Dealing with switch bounce, Example: Reading switch inputs (basic code), Example: Counting goats, Conclusions.

MODULE-3

Adding Structure to the Code Introduction, Object-oriented programming with C, The Project Header (MAIN.H), The Port Header (PORT.H), Example: Restructuring the „Hello Embedded World" example, Example: Restructuring the goat-counting example, Further examples, Conclusions.

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MODULE-4
Meeting Real-Time Constraints Introduction, Creating „hardware delays" using Timer 0 and Timer 1, Example: Generating a precise 50 ms delay, Example: Creating a portable hardware delay, Why not use Timer 2?, The need for „timeout" mechanisms, Creating loop timeouts, Example: Testing loop timeouts, Example: A more reliable switch interface, Creating hardware timeouts, Example: Testing a hardware timeout, Conclusions.
MODULE-5
Case Study: Intruder Alarm System Introduction, The software architecture, Key software components used in this example, running the program, the software, Conclusions.

Course outcomes (Course Skill Set):

At the end of the course, the student will be able to:

- Know about programming concepts in embedded system design
- Understand features and concepts of embedded programming languages and
- Able to describe how microcontroller based embedded systems are programmed and implemented in real time applications.
- Write simple programs and implement the same embedded hardware.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

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Suggested Learning Resources:

Text Books

1. Embedded C - Michael J. Pont, 2nd Ed., Pearson Education, 2008
2. Advanced C - Peter D. Hipson, Sams Publishing, USA, 1992

Reference Books

1. PICmicro MCU C-An introduction to programming, The Microchip PIC in CCS C – Nigel Gardner

Web links and Video Lectures (e-Resources):

- **https://www.mygreatlearning.com/blog/embedded-c/**
- **https://github.com/aaronjense/Learn-Embedded-Systems**
- **https://log2base2.com/courses/c-programming?utm_src=search&utm_target=scpro25off&gclid=Cj0KCQjwz8emBhDrARIsANNjS6r6QNb9aGm0JEjtW--EPwRiSZwlc_sPeruUeVTsi9xh4CWIg3QuzIaAm5mEALw_wcB**

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Quizzes
- Surprise Tests
- Assignments
- Seminars

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MATHEMATICS FOR ELECTRONICS & INSTRUMENTATION		Semester	4
Course Code	**BEI405D**	CIE Marks	50
Teaching Hours/Week (L: T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	3	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

- To have an insight into the application of Laplace transform techniques to continuous time signals and systems.
- To relate Fourier Transforms as a special case of LT and its applications
- To apply z-transforms to discrete time signals and realize the importance of ROC.
- To relate the DTFT as a special case of ZT and its properties.
- To develop proficiency in solving constant coefficient differential difference equations representing the engineering applications in electronics and instrumentation, using LT, FT, ZT & DTFT as applicable.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- In addition to the traditional lecture method, different types of innovative teaching methods may be adopted so that the delivered lessons shall develop students' theoretical and applied mathematical skills.
- State the need for Mathematics with Engineering Studies and Provide real-life examples.
- Support and guide the students for self–study.
- You will also be responsible for assigning homework, grading assignments and quizzes, and
- documenting students' progress.
- Encourage the students for group learning to improve their creative and analytical skills.
- Show short related video lectures in the following ways:
  - As an introduction to new topics (pre-lecture activity).
  - As a revision of topics (post-lecture activity).
  - As additional examples (post-lecture activity).
  - As an additional material of challenging topics (pre-and post-lecture activity).
  - As a model solution for some exercises (post-lecture activity).

Module-1

Standard continuous time signals, s-plane and the Laplace Transform of some elementary functions and signals, Location of poles and zeros on the s-plane, Important properties of Laplace Transform, Laplace Transform of derivatives, Laplace Transform of Integrals.

Continuous Time (CT) systems – RC, RL, RLC circuits, their time domain transfer function, Laplace transform of the current in the CT systems. More examples of second and third order impulse and transfer functions and their Laplace transforms.

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Module-2
The Inverse Laplace Transform: Definition, Typical Inverse Laplace Transforms, properties of Inverse Laplace Transform, Inverse Laplace Transform of derivative, Inverse Laplace Transform of integrals. Convolution Theorem, Evaluation of Integrals. Applications of Laplace Transform: Solution of Ordinary Differential Equations with constant coefficients.
Module-3
Fourier transform as a special case of Laplace Transforms. Fourier transform properties and examples for non-periodic continuous time signals. Properties and problems, Finding inverse FT by partial fraction expansions. Applications of Fourier Transform: Solution of Ordinary Differential Equations with constant coefficients.
Module-4
Sampling theorem and derivation of DT signals from continuous time signals, Standard Discrete Time (DT) signals – both causal and non-causal. The z-plane and the Z-Transform of some elementary functions and signals, Location of poles, zeros and ROC on the Z-plane, Important properties of Z-Transform – Convolution and Modulation. The inverse Z-Transform using partial fraction expansion.
Module-5
Discrete Time Fourier Transform (DTFT) as a special case of Z-Transforms. DTFT properties and examples for non-periodic discrete time signals. Properties and problems, Finding inverse DTFT by partial fraction expansions. Applications of DTFT: Solution of Ordinary Difference Equations with constant coefficients.
Course outcomes (Course Skill Set) At the end of the course, the student will be able to: 1. Apply Laplace transforms to continuous time signals 2. Analyze the inverse Laplace Transforms, its properties and its applications in solving continuous time domain problems. 3. Relate FT to LT and use Fourier transforms to analyze problems involving continuous-time domain problems 4. Apply Z- Transform techniques to solve discrete time domain problems 5. Solve mathematical models represented constant coefficient differential and difference equations using appropriate transforms
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together. **Continuous Internal Evaluation:** • There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component. • Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks • Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be

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planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25 marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)

- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1. Signals and Systems, 2ed, Simon Haykin & Barry Van Veen, 2021, Wiley Publications, ISBN-10 : 9354243150, ISBN-13 : 978-9354243158
2. Continuous and Discrete Time Signals and Systems, Mrinal Mandal & Amir Asif, Cambridge University Press, 2007, ISBN-13 : 978 – 1108477864
3. Advanced Engineering Mathematics, Kreyszig, John Wiley & Sons Publishers, 10th Edition, 2010.
4. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 43rd Edition, 2015.

Web links and Video Lectures (e-Resources):

- http://www.efunda.com/math/math_home/math.cfm
- https://archive.nptel.ac.in/courses/111/102/111102129/
- https://onlinecourses.nptel.ac.in/noc22_ee28/preview

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

- Form multiple teams in the class and conduct an interactive quiz based on concepts of the course.

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Ability Enhancement Course / Skill Enhancement Course - IV

PROGRAMMING IN MATLAB /SciLab		Semester	4
Course Code	**BEI456A**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	2
Examination nature (SEE)	Practical		

Course objectives:

- Preparation: To prepare students with fundamental knowledge/ overview in the field of basic signal. Processing computations.
- Core Competence: To equip students with a basic foundation in mathematics fundamentals required for comprehending the operation and application of signal processing.
- Professionalism & Learning Environment: To inculcate in students an ethical and professional attitude by providing an academic environment inclusive of effective communication, teamwork, ability to relate engineering issues to a broader social context, and life-long learning needed for a successful professional career.

Sl.NO	Experiments
1	Programs on basic algebra functions.
2	Programs on basic operations of vector.
3	Programs on basic operations of matrix.
4	Program to generate discrete waveforms.
5	Program to perform basic operation on signals
6	Program to perform convolution & correlation of two given sequences
7	Programs using Tables
8	Programs to plot different types of graphs
9	Verify sampling theorem.
10	Demonstrate Amplitude Modulation
11	Simulate automatic car parking indicator system
12	Create light animations with MATLAB and Arduino Uno

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Understand the basics of Linear Algebra
2. Analyse different types of signals and systems.
3. Analyse the properties of discrete time signals & systems

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

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Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

Suggested Learning Resources:

1. Digital Signal Processing Using MATLAB, John G Proakis and Vinay K Ingle, Cengage Learning, 2011
2. MATLAB Basic Functions Reference (mathworks.com).

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VIRTUAL INSTRUMENTATION USING LABVIEW		Semester	4
Course Code	**BEI456B**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	2
Examination nature (SEE)	Practical		

Course objectives:

- To learn LabVIEW programming to the intermediate level
- To learn LabVIEW programming for clustering, stacking and file i/o operations
- To develop LabVIEW code for different signal processing functions such as DCT, Convolution etc.,

Sl.NO	Experiments
1	LabVIEW program for implementation of combinational Boolean functions
2	LabVIEW program for implementation of sequential Boolean functions
3	LabVIEW program for bundle and unbundle cluster
4	LabVIEW program for flat and stacked sequence
5	LabVIEW program to implement simple state machine
6	LabVIEW program to demonstrate file I/O [Create, Read, Write, Close operations]
7	LabVIEW program to demonstrate string operations [subset, search and replace, match pattern]
8	LabVIEW program to demonstrate waveform operations [ADC and DAC operations]
	Demonstration Experiments (For CIE)
9	LabVIEW program to implement Discrete Cosine Transform
10	LabVIEW program to convolute two signals
11	LabVIEW program to demonstrate windowing technique
12	LabVIEW program to study instrumentation amplifier to acquire an ECG Signal

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Able to develop the virtual instrumentation using lab view.
- Able to execute basic arithmetic and Boolean operation
- Able to perform looping operations

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

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Continuous Internal Evaluation (CIE):

CIE marks for the practical course are**50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

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Suggested Learning Resources:

- Virtual Instrumentation using labview, Jovitha Jerome PHI learning Private Limited, New Delhi.
- https://www.ni.com/docs/en-US/bundle/labview/page/lvhelp/labview_help.html

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PYTHON PROGRAMMING FOR INSTRUMENTATION		Semester	4
Course Code	BEI456C	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	3
Examination nature (SEE)	Practical		

Course objectives:

- To use Low-cost Arduino boards as Data acquisition Cards.
- To connect sensors to computers using Arduino Boards
- To serial read/write, Parallel read/write, Analog read/write using Arduino boards into computer.
- To use timer functions in computer / trigger-based events from computer.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Show Video/animation films to explain the functioning of various techniques.
- Encourage collaborative (Group) Learning in the class
- Ask at least three HOTS (Higher-order Thinking) questions in the class, which promotes critical thinking
- Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop thinking skills such as the ability to evaluate, generalize, and analyze information rather than simply recall it.
- Topics will be introduced in multiple representations.
- Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
- Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Sl.NO	Experiments
1	Study of Instrumentino [https://pypi.org/project/instrumentino/]
2	Study of firmata protocol [https://realpython.com/arduino-python/]
3	Study of PyVISA [https://www.pythonforthelab.com/blog/how-control-arduino-computer-using-python/]
4	Study of Arduino PySerial [https://github.com/WaveShapePlay/ArduinoPySerial_LearningSeries]
5	Study of Python GUI Application With wxPython.[https://realpython.com/python-gui-with-wxpython/#creating-a-skeleton-application]
6	Using python code, reading water level using serial port of Arduino Uno.
7	Using python code, reading real time audio level using serial port of Arduino Uno.
8	Using python code, reading real time air quality [MQ135 sensor] using serial port of Arduino Uno.
	Demonstration Experiments (For CIE)
9	Using python code, reading real time temperature using serial port of Arduino Uno.
10	Controlling speed of a DC Motor using python program with GUI.
11	Using python code, reading and controlling the status of LED Lights connected in the port.

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12	Using python code, reading distance using suitable sensor using serial port of Arduino Uno.

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Understand different python libraries for instrumentation and data acquisition
- Understand and able to create GUI for instrumentation applications
- Understand the use of Arduino Uno as a simple data acquisition card to acquire analog data

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation (CIE):

CIE marks for the practical course are **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment is to be evaluated for conduction with an observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments are designed by the faculty who is handling the laboratory session and are made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled down to **30 marks** (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Semester End Evaluation (SEE):

- SEE marks for the practical course are 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the Head of the Institute.
- The examination schedule and names of examiners are informed to the university before the conduction of the examination. These practical examinations are to be conducted between the schedule mentioned in the academic calendar of the University.
- All laboratory experiments are to be included for practical examination.

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- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% of Marks allotted to the procedure part are to be made zero.

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ARDUINO UNO PROGRAMMING		Semester	4
Course Code	**BEI456D**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	0:0:2:0	SEE Marks	50
Credits	1	Exam Hours	2
Examination nature (SEE)	Practical		

Course objectives:

- To learn Arduino Uno / ESP32 Microcontroller programming and interfacing
- To impart necessary and practical knowledge of components of Internet of Things
- To develop skills required to build real-life IoT based projects.

Sl.NO	Experiments
1	**To interface digital, I/O [Switches, LED, Motor Interface]**
2	To demonstrate timer function with digital I/O [LED ON/OFF every 2 seconds, LED on after 2 seconds when switch is on]
3	To interface Analog input [temperature sensor, potentiometer etc.,]
4	To interface Analog output [LED ON Time adjustment, Motor speed adjustment with PWM]
5	To interface serial communication devices [Interfacing with computer, GSM modem etc.,]
6	To interface stepper motor and vary the speed and direction of rotation
7	To demonstrate interrupt in Arduino
8	To demonstrate I2C Communication
	Demonstration Experiments (For CIE)
9	To demonstrate sending and receiving data through Bluetooth to a Mobile phone
10	To demonstrate automatic Temperature control system – to swich on FAN in the temperature exceeds certain value.
11	To demonstrate temperature data acquisition and transmitting to cloud server [Thingspeak or equivalent]
12	Real time case study by students

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

1. Explain the concepts of Internet of Things and its hardware and software components
2. Interface I/O devices, sensors & communication modules
3. Remotely monitor data and control devices.
4. Develop real life IoT based projects

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

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Continuous Internal Evaluation (CIE):

CIE marks for the practical course are**50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

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- Department shall conduct a test of 100 marks after the completion of all the experiments listed in the syllabus.
- In a test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The marks scored shall be scaled down to **20 marks** (40% of the maximum marks).

The Sum of scaled-down marks scored in the report write-up/journal and marks of a test is the total CIE marks scored by the student.

Suggested Learning Resources:

1. https://www.arduino.cc
2. https://www.raspberrypi.org/
3. Course in Internet of Things (IOT) Using Arduino - NIELIT Delhi Centre
4. Vijay Madisetti, Arshdeep Bahga, Internet of Things. "A Hands on Approach", University Press
5. Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, "Introduction to Internet of Things: A practical Approach", ETI Labs
6. Pethuru Raj and Anupama C Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press
7. Jeeva Jose, "Internet of Things", Khanna Publishing House, Delhi
8. Adrian McEwen, "Designing the Internet of Things", Wiley
9. Raj Kamal, "Internet of Things: Architecture and Design", McGraw Hill

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BIOLOGY FOR ENGINEERS		Semester	4
Course Code	BBOK407	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	3:0:0:0	SEE Marks	50
Total Hours of Pedagogy	40	Total Marks	100
Credits	03	Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:

- To familiarize the students with the basic biological concepts and their engineering applications.
- To enable the students with an understanding of bio design principles to create novel devices and structures.
- To provide the students an appreciation of how biological systems can be re-designed as substitute products for natural systems.
- To motivate the students, develop the interdisciplinary vision of biological engineering.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

- Explanation via real life problem, situation modelling, and deliberation of solutions, hands-on sessions, reflective and questioning /inquiry-based teaching.
- Instructions with interactions in classroom lectures (physical/hybrid).
- Use of ICT tools, including YouTube videos, related MOOCs, AR/VR/MR tools.
- Flipped classroom sessions (~10% of the classes).
- Industrial visits, Guests talks and competitions for learning beyond the syllabus.
- Students' participation through audio-video based content creation for the syllabus (as assignments).
- Use of gamification tools (in both physical/hybrid classes) for creative learning outcomes.
- Students' seminars (in solo or group) /oral presentations

Module-1

BIOMOLECULES AND THEIR APPLICATIONS (QUALITATIVE): Carbohydrates (cellulose-based water filters, PHA and PLA as bioplastics), Nucleic acids (DNA Vaccine for Rabies and RNA vaccines for Covid19, Forensics – DNA fingerprinting), Proteins (Proteins as food – whey protein and meat analogs, Plant based proteins), lipids (biodiesel, cleaning agents/detergents), Enzymes (glucose-oxidase in biosensors, lignolytic enzyme in bio-bleaching).

Module-2

HUMAN ORGAN SYSTEMS AND BIO DESIGNS - 1 (QUALITATIVE): Brain as a CPU system (architecture, CNS and Peripheral Nervous System, signal transmission, EEG, Robotic arms for prosthetics. Engineering solutions for Parkinson's disease).Eye as a Camera system (architecture of rod and cone cells, optical corrections, cataract, lens materials, bionic eye).Heart as a pump system (architecture, electrical signalling - ECG monitoring and heart related issues, reasons for blockages of blood vessels, design of stents, pace makers, defibrillators).

Module-3

HUMAN ORGAN SYSTEMS AND BIO-DESIGNS - 2 (QUALITATIVE): Lungs as purification system (architecture, gas exchange mechanisms, spirometry, abnormal lung physiology - COPD, Ventilators, Heart-lung machine).Kidney as a filtration system (architecture, mechanism of

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filtration, CKD, dialysis systems). Muscular and Skeletal Systems as scaffolds (architecture, mechanisms, bioengineering solutions for muscular dystrophy and osteoporosis).

Module-4

NATURE-BIOINSPIRED MATERIALS AND MECHANISMS (QUALITATIVE): Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces), Plant burrs (Velcro), Shark skin (Friction reducing swim suits), Kingfisher beak (Bullet train). Human Blood substitutes - haemoglobin-based oxygen carriers (HBOCs) and perfluorocarbons (PFCs).

Module-5

TRENDS IN BIOENGINEERING (QUALITATIVE): Bioprinting techniques and materials, 3D printing of ear, bone and skin. 3D printed foods. Electrical tongue and electrical nose in food science, DNA origami and Biocomputing, Bioimaging and Artificial Intelligence for disease diagnosis. Self-healing Bio concrete (based on bacillus spores, calcium lactate nutrients and biomineralization processes) and Bioremediation and Biomining via microbial surface adsorption (removal of heavy metals like Lead, Cadmium, Mercury, Arsenic).

Course outcome (Course Skill Set)

At the end of the course, the student will be able to :

1. Elucidate the basic biological concepts via relevant industrial applications and case studies.
2. Evaluate the principles of design and development, for exploring novel bioengineering projects.
3. Corroborate the concepts of biomimetics for specific requirements.
4. Think critically towards exploring innovative biobased solutions for socially relevant problems.

Assessment Details (both CIE and SEE)

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Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

3. The students have to answer 5 full questions, selecting one full question from each module. Marks scored shall be proportionally reduced to 50 marks

Suggested Learning Resources:

Text Books

1. Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022
2. Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
3. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
4. Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
5. Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.
6. Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.
7. Bio-Inspired Artificial Intelligence: Theories, Methods and Technologies, D. Floreano and C. Mattiussi, MIT Press, 2008.
8. Bioremediation of heavy metals: bacterial participation, by C R Sunilkumar, N Geetha A C Udayashankar Lambert Academic Publishing, 2019.
9. 3D Bioprinting: Fundamentals, Principles and Applications by Ibrahim Ozbolat, Academic Press, 2016.
10. Electronic Noses and Tongues in Food Science, Maria Rodriguez Mende, Academic Press, 2016 01062022
11. Blood Substitutes, Robert Winslow, Elsevier, 2005

Web links and Video Lectures (e-Resources):

- VTU EDUSAT / SWAYAM / NPTEL / MOOCS / Coursera / MIT-open learning resource
- https://nptel.ac.in/courses/121106008
- https://freevideolectures.com/course/4877/nptel-biology-engineers-other-non-biologists
- https://ocw.mit.edu/courses/20-020-introduction-to-biological-engineering-design-spring-2009
- https://ocw.mit.edu/courses/20-010j-introduction-to-bioengineering-be-010j-spring-2006
- https://www.coursera.org/courses?query=biology
- https://onlinecourses.nptel.ac.in/noc19_ge31/preview
- https://www.classcentral.com/subject/biology
- https://www.futurelearn.com/courses/biology-basic-concepts

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