Tulsiramji Gaikwad-Patil College of Engineering & Technology, Nagpur

(An Autonomous Institution Affiliated to RTM Nagpur University, Nagpur)

SCHEME OF INSTRUCTIONS & SYLLABI

Programme: Electronics & Communication Engineering (NBA Accredited)

Scheme of Instructions: Second Year B.Tech. in Electronics & Communication Engineering

Semester–IV

Sr. No.	Course Category	Course Code	Course Title	T/P	Contact Hours			Credits	Exam Scheme			ESE Duration (Hours)	Total Marks
					L	P	Hrs.		CT/IA	CA	ESE		
1	**PCC**	BEC42401	Analog Systems Design	T	4	-	4	4	30	10	60	3	100
2	**PCC**	BEC42402	Signals & Systems	T	3	-	3	3	30	10	60	3	100
3	**MDM**	BIT42416	Python for Data Handling & Automation	T	2	-	2	2	14	6	30	2	50
4	**OEC**	BEC42403	OE-II - Digital System & Microprocessor	T	2	-	2	2	14	6	30	2	50
5	**VSEC**	BEC42404	Electronics Workshop (Idea Lab)	P	-	4	4	2	-	50	50	-	100
6	**HSSM**	BBA42401	Business Economics & Entrepreneurship	T	2	-	2	2	14	6	30	2	50
7	**VEC**	BSH42415	Intellectual Property Rights	T	2	-	2	2	14	6	30	2	50
8	**PCC**	BEC42405	Analog Systems Design Lab	P	-	2	2	1	-	25	25	-	50
9	**PCC**	BIT42417	Python for Data Handling & Automation Lab	P	-	2	2	1	-	25	25	-	50
10	**AEC**	BSH424XX	Liberal Learning Module-IV	P	-	2	2	1	50	-	-	-	50
			Total	-	**15**	**10**	**25**	**20**	**166**	**144**	**340**	**14**	**650**

Course Category	BSC/ESC (Basic Science Course/Engineering Science Course.)	PCC (Programme Core courses)	PEC (Programme Elective courses)	OEC (Open Elective Course)	Multi-disciplinary courses	VSEC (Skill Course)	VEC (Value Education Courses)	Humanities Social Science & Management		Experiential Learning Courses	CC (Liberal Learning Courses)	VAC (Value added Course)
								AEC (Ability Enhancement Course)	IKS (Indian Knowledge System)			
Credits		9	-	2	2	2	-	1		-	-	-
Cumulative Sum	16/13	21	-	6	4	6	2	6		2	4	2

PROGRESSIVE TOTAL CREDITS: 64+20=84

				June, 2026	1.00
Chairperson	Vice-Principal / Director Academics	Director (Administration)	Principal	Date of Release	Version

Applicable for AY 2026-27

TULSIRAMJI GAIKWAD-PATIL COLLEGE OF ENGINEERING & TECHNOLOGY
Wardha Road, Nagpur - 441108
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Department of Electronics and Communication Engineering

Program: B. Tech Electronics and Communication Engineering

Semester-IV	**BEC42401: Analog System Design**				
Teaching Scheme		**Examination Scheme (Th)**		**Examination Scheme (P)**	
Theory (Th)	4 Hrs./week	**CT-I**	15 Marks	-	-
Practical (P)	-	**CT-II**	15 Marks	-	-
Total Credits	**4 (Th) = 4**	**CA**	10 Marks	-	-
Duration of ESE: 3 Hrs.		**ESE**	60 Marks	-	-
		Total Marks	**100 Marks**	-	-

Pre-Requisites: Basic Programming Concepts / Computer Programming

Course Objectives:

1	To introduce the fundamental operating principles, key parameters, and basic configurations of operational amplifiers (op-amps).
2	To familiarize students with the design and operation of linear op-amp circuits for signal processing and conditioning applications.
3	To explain the operation, characteristics, and practical applications of non-linear op-amp circuits.
4	To impart knowledge on the internal architecture, functional components, and regulation mechanisms of DC power supplies.
5	To teach the concepts and design methodologies for active filter circuits and signal-generating oscillators using op-amps.

Course Content

Unit I	**Op-Amp Fundamentals:** Block diagram of operational amplifier, Differential amplifiers using transistors & its configurations, Op-Amp parameters, virtual ground concept, Ideal OP-Amp, Equivalent circuit, Voltage Transfer curve, Inverting & non inverting configurations.
Unit II	**Linear Op Amp Circuits:** Voltage follower, Summing amplifier, scaling and averaging amplifier, Subtractor, Instrumentation amplifier and applications, Integrator and differentiators, current to voltage converters, voltage to current converters, Peak detector, Log and antilog amplifiers and analog multipliers.
Unit III	**Nonlinear Op Amp Circuits:** Comparators, Schmitt trigger, Precision Rectifier. Signal Generators: Sinusoidal and Non-Sinusoidal Oscillators, Sample/Hold circuits, Phase lock loops, Clippers & Clampers.
Unit IV	**Data Converters:** Digital to Analog (D/A) Converter, Analog to Digital (A/D) Converter, D/A Converter (DAC 0800), A/D Converter (ADC 0804). Special Function Ic's: PLL (IC 565), Monolithic timers (IC 555), Performance Specifications,
Unit V	OPAMP based Wein Bridge and Phase Shift oscillators, Transistorized Hartley &Colpitts oscillator, Crystal oscillators, Evaluation of figure of merit for all above oscillator circuits. Design of Butterworth Active Filters LPF, HPF, BPF, BRF etc,

Text Books

T.1	Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", PHI / Pearson Education, 2015.
T.2	Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", McGraw-Hill, 2014.
T.3	K. R. Botkar, "Integrated Circuits", Khanna Publishers, 2010.

Reference Books

R.1	National Semiconductor, "Linear Integrated Circuits Data Book / Manual", National Semiconductor, 1980.
R.2	Texas Instruments, "Voltage Regulator Handbook", Texas Instruments, 1977.
R.3	Gene E. Tobey, Jerald G. Graeme, and Lawrence P. Huelsman, "Operational Amplifiers: Design

	and Applications", McGraw-Hill, 1971.
R.4	
Useful Links	
1	https://nptel.ac.in/courses/117/105/117105147/
2	https://nptel.ac.in/courses/117/107/117107094/
3	http://nptel.ac.in/courses/117103064

CO	Course Outcomes	CL	Class Sessions
CO1	**Explain** the fundamental principles, ideal and non-ideal parameters, and basic open-loop and closed-loop configurations of operational amplifiers.	2	9
CO2	**Analyze** linear op-amp circuits for signal conditioning applications, including amplifiers, summers, subtractors, integrators, and differentiators	4	9
CO3	**Evaluate** non-linear op-amp circuits such as comparators, Schmitt triggers, precision rectifiers, and sample-and-hold circuits for wave-shaping and switching applications**.**	5	9
CO4	**Analyze** the functional blocks, voltage regulation techniques, and operational characteristics of DC power supply units	4	9
CO5	**Design** active filter networks and signal generator circuits (oscillators) to meet specified frequency response and output waveform criteria.	6	9

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Semester-IV	**BEC42402: Signals & Systems**				
Teaching Scheme		**Examination Scheme (Th)**		**Examination Scheme (P)**	
Theory (Th)	3 Hrs./week	**CT-I**	15 Marks	-	-
Practical (P)	-	**CT-II**	15 Marks	-	-
Total Credits	**3 (Th) = 3**	**CA**	10 Marks	-	-
Duration of ESE: 3 Hrs.		**ESE**	60 Marks	-	-
		Total Marks	**100 Marks**	-	-

Pre-Requisites:

Course Objectives:

1	Analyze fundamental signal properties, operations, and LTI system behavior using convolution.
2	Represent periodic signals using harmonically related complex exponentials and evaluate convergence.
3	Evaluate continuous-time signals using magnitude, phase spectra, and transform properties.
4	Apply Laplace transforms and inverse techniques to continuous-time differential equations and systems
5	Calculate entropy, source encoding (Huffman coding), efficiency, and Hamming distance.

Course Content

Unit I	**Continuous-Time Signals and Systems:** Signals, Signal Transformations of the Independent Variable, Periodic Signals, Signal Energy and Power, Even and Odd Signals, Exponential and Sinusoidal Signals, LTI Systems: The Convolution Integral / Sum, Complex Exponential and Sinusoidal Signals, Systems and Properties.
Unit II	**Fourier Series:** The Response of LTI Systems to Complex Exponentials, Fourier Series Representation, Linear Combinations of Harmonically Related Complex Exponentials, Determination of the Fourier Series Representation, Convergence of the Fourier Series, Properties, Parseval's Relation
Unit III	**Continuous Fourier Transform:** Fourier Transform Representation, Condition of Existence of Fourier Transform, Linearity, Time Shifting, Phase Spectrum and Magnitude Spectrum, Properties of Fourier Transform, Frequency Shifting, Frequency Translation Theorem, Signum Function, Sine Function, Cosine Function
Unit IV	**Laplace Transformation**: Introduction, Properties of Laplace Transform, First Shifting Theorem, Laplace Transform of Derivatives and Integrals, Second Shifting Theorem, Periodic Functions, Inverse Laplace Transform.
Unit V	**Information Theory:** Basic of Information Theory, Entropy of Source, Maximum Entropy, Source Encoding, Discrete Memoryless Source, Huffman Coding, Average Code Word, Entropy, Efficiency, Redundancy, Hamming Distance, Hamming Weight.

Text Books

T.1	S. S. Mungray, “Signals and Systems”, BPB Publications, 2013.
T.2	I. J. Nagrath, S. N. Sharan, and R. Ranjan, “Signals and Systems”, McGraw-Hill Education, 2001.
T.3	Harish Parthasarathy, “A Textbook of Signals and Systems”, I.K. International Publishing House, 2005.
	A. Anand Kumar, “Signals and Systems”, PHI Learning, 2013.

Reference Books

R.1	Simon Haykin and Barry Van Veen, “Signals and Systems”, John Wiley & Sons, 2002.
R.2	K.Lindner, “Signals and Systems”, McGraw Hill International, 1999.
R.3	B.P. Lathi, "Modern Digital and Analog Communication Systems", 3rd Edition, Oxford University Press, c1998

Useful Links

1	https://vlab.amrita.edu/?sub=3&brch=81

2	http://ssl-iitg.vlabs.ac.in/Signal%20and%20their%20properties%205(theory).html
3	http://vlabs.iitkgp.ernet.in/dsp/index.html#
4	https://www.slideshare.net/kanusinghal3/medical-applications-of-dsp

CO	Course Outcomes	CL	Class Sessions
CO1	**Analyze** continuous-time signals and evaluate LTI system responses using time-domain operations and convolution	4	9
CO2	**Derive** Fourier series representations to analyze the frequency content and LTI response of periodic signals.	4	9
CO3	**Apply** Continuous Fourier Transform properties to determine the magnitude and phase spectra of continuous-time signals.	3	9
CO4	**Solve** continuous-time system equations and analyze signal behavior using Laplace and inverse Laplace transforms.	3	9
CO5	**Compute** information metrics like entropy and implement source coding techniques such as Huffman and Hamming codes.	5	9

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Semester-IV	**BIT42416: Python for Data Handling & Automation**				
Teaching Scheme		**Examination Scheme (Th)**		**Examination Scheme (P)**	
Theory (Th)	2 Hrs./week	**CT-I**	07 Marks	-	-
Practical (P)	-	**CT-II**	07 Marks	-	-
Total Credits	**2 (Th) = 2**	**CA**	06 Marks	-	-
Duration of ESE: 3 Hrs.		**ESE**	30 Marks	-	-
		Total Marks	**50 Marks**	-	-

Pre-Requisites: C Programming

Course Objectives:

1	To understand core Python control structures, functions, and modular programming concepts.
2	To master data handling using core data structures (Lists, Tuples, Dictionaries, Sets) and file operations.
3	To learn file automation, exception handling, and basic data processing techniques relevant to electronics and communication engineering.

Course Content

Unit I	**Python Fundamentals, Control Flow & Functions:** Introduction to Python, Syntax, Data Types, Variables, Operators. Decision Control: if, if-else, if-elif-else statements. Loop Control: while loop, for loop, break, continue, pass statements. Functions: Defining functions, arguments, return values, recursion, lambda functions, modules, and packages.
	Activity1: Write Python programs to calculate ECE metrics (e.g., Ohm's law, signal power, filter frequency response) using control loops and modular functions.
Unit II	**Data Handling, Strings, Data Sets:** Data Handling: Sequences & Collections, Strings: String operations, slicing, formatting, built-in string methods. Lists & Tuples: Operations, indexing, slicing, comprehension, built-in functions. Dictionaries & Sets: Key-value operations, dictionary methods, set theory operations, and applications in data organization.
	Activity1: Process and clean dummy sensor log datasets using lists and dictionaries to filter noise and aggregate readings.
Unit III	**File Handling, Exception Handling & Basic Automation:** File I/O: Opening, reading, writing, appending files (txt, csv). Working with file paths. Exception Handling: try, except, else, finally blocks, built-in exceptions. Scripting & Automation: Automated directory manipulation, parsing log files, OS interactions using built-in modules (os, sys, shutil).
	Activity1: Develop an automated script to read incoming serial/log data files from a system folder, parse critical error logs, and generate a summary text report.

Text Books

T.1	Yashavant Kanetkar, *Let Us Python*, BPB Publications, 2020
T.2	Dr. R. Nageswara Rao, Core Python Programming, Dreamtech Press, 2021
T.3	Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press, 2017

Reference Books

R.1	Allen B. Downey, Think Python: How to Think Like a Computer Scientist, O'Reilly Media, 2015.
R.2	Paul Barry, Head First Python, O'Reilly Media, 2016
R.3	Al Sweigart, Automate the Boring Stuff with Python, No Starch Press, 2019

Useful Links

1	https://www.python.org/doc/
2	nptel.ac.in/courses/106106182

CO	Course Outcomes	CL	Class Sessions
CO1	**Develop** Python scripts using core control structures and modular functions to solve computational problems.	3	9
CO2	**Utilize** Python data structures (Lists, Tuples, Dictionaries, Sets) for structured data manipulation and storage.	4	9
CO3	**Implement** file handling, exception handling, and automation scripts for processing real-world data files.	4	9

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Semester-IV | **BEC42403: Open Elective-II- Digital System & Microprocessor**

Teaching Scheme		Examination Scheme (Th)		Examination Scheme (P)	
Theory (Th)	2 Hrs./week	**CT-I**	07 Marks	-	-
Practical (P)	-	**CT-II**	07 Marks	-	-
Total Credits	**2 (Th) = 2**	**CA**	06 Marks	-	-
Duration of ESE: 3 Hrs.		**ESE**	30 Marks	-	-
		Total Marks	**50 Marks**	-	-

Pre-Requisites:

Course Objectives:

1	Understand the fundamentals of number systems, Boolean algebra, and digital logic.
2	Apply Boolean algebra and K-map techniques to analyze and design combinational circuits.
3	Analyze the architecture, instruction set, and basic programming of the 8085 microprocessor.

Course Content

Unit I	Digital System Fundamentals: Number systems: Binary, Decimal, Octal and Hexadecimal, Number system conversions and binary arithmetic, 1's and 2's complement, Logic gates and Boolean algebra, De Morgan's theorems, Boolean expression simplification
	Activity 1: Perform number system conversions and verify basic Boolean logic using logic gates.
Unit II	Karnaugh Map (K-map), Combinational circuits: Adders, Subtractors, Multiplexers, Demultiplexers, Encoders and Decoders
	Activity 2: Design and implement basic combinational circuits such as adders, subtractors, multiplexers, and decoders using simulation software or a digital trainer kit.
Unit III	Microprocessor and Applications: Introduction to microprocessors 8085, Architecture and features, Pin Diagram, Registers and flag register, Address bus, data bus and control bus, Instruction set and addressing modes, Basic 8085 assembly language programming
	Activity 3: Write and execute simple 8085 assembly language programs for arithmetic and logical operations and observe the results using an 8085 simulator.

Text Books

T.1	R. P. Jain, "Modern Digital Electronics", McGraw-Hill Education, 2020.
T.2	A. Anand Kumar, "Fundamentals of Digital Circuits", PHI Learning, 2016.

Reference Books

R.1	Ramesh S. Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", Penram International Publishing, 2013.
R.2	B. Ram, "Fundamentals of Microprocessors and Microcomputers", Dhanpat Rai Publications, 2012.

Useful Links

1	https://nptel.ac.in/courses/108105113
2	https://nptel.ac.in/courses/108105132
3	https://nptel.ac.in/courses/117104072

CO	Course Outcomes	CL	Class Sessions
CO1	**Explain** the basics of number systems, Boolean algebra, and digital logic.	2	9
CO2	**Apply** Boolean simplification and analyze basic combinational circuits.	3	9
CO3	**Analyze** the 8085 architectures, instruction set, and basic assembly programming.	4	9

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Semester-IV | **BEC42404: Electronics Workshop (Idea Lab)**

Teaching Scheme		Examination Scheme (Th)		Examination Scheme(P)	
Theory (Th)	-	**INT**	-	**INT**	-
Practical (P)	4 Hrs./week	**ESE**	-	**ESE**	-
Total Credits	**2**	**CA**	-	**CA**	50 Marks
		ESE	-	**ESE-P**	50 Marks
		Total Marks	-	**Total Marks**	**100 Marks**

Pre-Requisites: IOT Lab

Course Objectives:

1.	**To introduce** basic electronic components, measuring instruments, and PCB design techniques.
2.	**To train** students on electronic circuit fabrication, soldering, and PCB prototyping using IDEA Lab equipment.
3.	**To impart** hands-on experience in 3D modeling, rapid prototyping, and CAD-based enclosure design for electronic projects.
4.	**To enable** students to work with CNC routing, laser cutting, and digital fabrication tools for system prototyping.
5.	**To develop** embedded system prototypes using microcontroller boards, sensors, and IoT hardware integration.

List of Experiments

1	Construction and testing of a half-wave rectifier circuit & a bridge rectifier circuit.	**CO1**
2	Study and application of an NPN transistor as an electronic switch.	**CO1**
3	Soldering and desoldering of electronic components on a general-purpose PCB.	**CO2**
4	Study of Arduino UNO, ESP32 development boards, and their pin configurations.	**CO2**
5	Interfacing an LDR sensor with Arduino to implement an automatic night lamp.	**CO3**
6	Interfacing a soil moisture sensor with Arduino to detect dry and wet soil conditions.	**CO3**
7	Interfacing an ultrasonic sensor to measure distance and detect nearby objects.	**CO3**
8	Study of the 3018 CNC PCB fabrication machine, its components, axes, spindle, and operating controls.	**CO4**
9	Introduction to PCB design software and preparation of a simple schematic circuit.	**CO4**
10	Fabrication of a simple single-sided PCB using 3018 CNC PCB fabrication machine.	**CO4**
11	Developing an IoT-based environmental monitoring system using temperature, humidity, and other suitable sensors.	**CO5**
12	Developing a smart irrigation system using a soil moisture sensor, controller, and relay-operated pump.	**CO5**
13	Design, assembly, and testing of a simple electronic project such as a transistor-based LED flasher or light-activated circuit.	**CO5**

Text Books

T.1	R. S. Khandpur, Printed Circuit Boards: Design, Fabrication, Assembly and Testing, McGraw-Hill Education, 2005.
T.2	Ian Gibson, David Rosen, and Brent Stucker, Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Springer, 2015.
T.3	C. K. Singh, Workshop Practice and Electronics Fabrication Techniques, New Age International, 2018.

Reference Books

R.1	Simon Monk, Make Your Own PCBs with KiCAD, McGraw-Hill Education, 2017.
R.2	Brian Evans, Practical 3D Printers: the Science and Art of 3D Printing, Apress, 2012.

Useful Links	
L.1	AICTE IDEA Lab Portal: https://idealab.aicte-india.org/
L.2	NPTEL Course on Electronic Systems Design / PCB Design: https://nptel.ac.in/

CO	Course Outcomes	CL	Class Sessions
CO1	**Construct and test** basic discrete electronic circuits, including rectifiers and transistor switches.	3	8
CO2	**Demonstrate** soldering skills and identify pin configurations of development boards like Arduino UNO and ESP32.	3	8
CO3	**Interfacing** environmental sensors (LDR, soil moisture) with microcontrollers to monitor physical conditions.	6	8
CO4	**Interface** distance sensors and operate automated PCB fabrication equipment like the 3018 CNC machine.	6	8
CO5	**Design** circuit schematics, fabricate single-sided PCBs, and build integrated IoT/smart automation systems.	6	8

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Semester-IV	**BBA42401: Business Economics & Entrepreneurship**				
Teaching Scheme		**Examination Scheme (Th)**		**Examination Scheme (P)**	
Theory (Th)	2 Hrs./week	**CT-I**	07 Marks	-	-
Practical (P)	-	**CT-II**	07 Marks	-	-
Total Credits	**2 (Th) = 2**	**CA**	06 Marks	-	-
Duration of ESE: 3 Hrs.		**ESE**	30 Marks	-	-
		Total Marks	**50 Marks**	-	-

Pre-Requisites:

Course Objectives:

1	To familiarize students with economic concepts relevant for business decision-making.
2	To understand what is demand, its types, elasticity and how consumer takes buying decisions.
3	To understand the concept of entrepreneurship, intrapreneurship and qualities of an entrepreneur.

Course Content

Unit I	**Introduction to Business Economics:** Meaning, nature, and scope of Business Economics, Micro vs. Macro Economics, Basic principles: scarcity, choice, opportunity cost, marginal analysis, Role of economics in managerial decision-making, Concept of economic models and optimization, Goals of the firm: profit maximization vs. value maximization.
Unit II	**Demand and Consumer Behaviors**: Concept of demand; determinants of demand, Law of Demand, Elasticity of Demand (Price, Income, Cross), Measurement of elasticity, Consumer equilibrium (Cardinal and Ordinal approaches), Indifference curve analysis, budget line, consumer equilibrium, Demand Forecasting: qualitative & quantitative methods
Unit III	**Introduction to Entrepreneurship and Intrapreneur:** Evolution of the concept of entrepreneurship. The entrepreneur: characteristics and functions, types of entrepreneurs, distinction between manager and an entrepreneur. Intrapreneur: concept, characteristics, barriers, intrapreneurial climate and culture. Factors contributing to entrepreneurship development. Theories of entrepreneurship. Indian entrepreneurs and their ventures (cases).

Text Books

T.1	D. N. Dwivedi, “Managerial Economics”, Vikas Publishing House, 2015.
T.2	H. L. Ahuja, “Business Economics”, S. Chand Publishing, 2019.
T.3	R. L. Varshney and K. L. Maheshwari, “Managerial Economics”, Sultan Chand & Sons, 2014.
T.4	D. F. Kuratko and T. V. Rao, “Entrepreneurship: A South-Asian Perspective”, Cengage Learning, 2012.
T.5	Satish Taneja, “Entrepreneurship Development”, Himalaya Publishing House, 2012.

Reference Books

R.1	Paul Samuelson and William D. Nordhaus, “Economics”, McGraw-Hill Education, 2010.
R.2	P. L. Mehta, “Managerial Economics: Analysis, Problems and Cases”, Sultan Chand & Sons, 2016.
R.3	Norman M. Scarborough and Jeffrey R. Cornwall, “Essentials of Entrepreneurship and Small Business Management”, Pearson, 2016.
R.4	S. S. Khanka, “Entrepreneurial Development”, S. Chand & Co., 2016.

Useful Links

1	https://onlinecourses.nptel.ac.in/noc20_lw03
2	https://nptel.ac.in/courses/110105075
3	https://nptel.ac.in/courses/110106141

CO	Course Outcomes	CL	Class Sessions
CO1	**Explain** key microeconomic and macroeconomic principles to assess their impact on business decision-making and market conditions.	2	8
CO2	**Analyze** consumer behavior patterns and evaluate quantitative and qualitative demand forecasting techniques for market estimation.	4	8
CO3	**Formulate** entrepreneurial strategies by examining the roles, key traits, and decision-making processes of successful entrepreneurs.	6	8

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Semester-IV	**BSH42415: Intellectual Property Rights**				
Teaching Scheme		**Examination Scheme (Th)**		**Examination Scheme (P)**	
Theory (Th)	2 Hrs./week	**CT-I**	07 Marks	-	-
Practical (P)	-	**CT-II**	07 Marks	-	-
Total Credits	**2 (Th) = 2**	**CA**	06 Marks	-	-
Duration of ESE: 3 Hrs.		**ESE**	30 Marks	-	-
		Total Marks	**50 Marks**	-	-

Pre-Requisites: -

Course Objectives:

1	To understand the fundamental concepts, types, and importance of Intellectual Property Rights (IPR).
2	To study the legal procedures for the protection of patents, copyrights, trademarks, industrial designs, and geographical indications.
3	To understand IPR management, commercialization, licensing, and assignment, along with the fundamentals of cyber law and data protection.

Course Content

Unit I	**Foundations of IPR, Competition Law, and Their Interface** **Basics of IPR:** Function of IPR, public good, incentive theory, and different forms of IPR. **Core Principles of Competition Law:** Introduction to competition law, anti-competitive agreements, abuse of dominance, and regulation of combinations. **The IPR–Competition Interface:** The relationship, economic interactions, and fundamental tensions between IPR and competition policy.
Unit II	**Comparative Global Frameworks & Market Restraints** **US & EU Perspectives:** Economics of US Antitrust law, IP/competition issues, and the EU experience regarding IP and competition law. **Licensing & Market Behaviour:** Technology transfer agreements, market allocation, horizontal and vertical agreements, and key licensing issues.
Unit III	**Indian Legal Framework, Enforcement & Emerging Issues** **Indian Legal Provisions:** Indian Competition Act and IPR protection, statutory provisions, and harmonization of IP protection with competition law in India. **Enforcement & Corporate Transactions:** Anti-competitive agreements and abuse of dominance within IPR enforcement, along with IPR issues in mergers and acquisitions.

Text Books

T.1	Steven D. Anderman, The Interface Between Intellectual Property Rights and Competition Policy, Cambridge University Press, 2007.
T.2	N. K. Acharya, Text Book on Intellectual Property Rights, 8th ed. Hyderabad, India: Asia Law House, 2021.
T.3	R. Radhakrishnan and S. Balasubramanian, Intellectual Property Rights: Text and Cases. New Delhi, India: Excel Books, 2008.

Reference Books

R.1	C. B. Gopalakrishnan, A Treatise on Intellectual Property Laws, 2nd ed. New Delhi, India: LexisNexis, 2012.
R.2	S. R. Myneni, Law of Intellectual Property, 12th ed. Hyderabad, India: Asia Law House, 2024.
R.3	J. P. Misra, An Introduction to Intellectual Property Rights, 3rd ed. (Reprint). Allahabad, India: Central Law Publications, 2023.

Useful Links

1	Preview: Intellectual Property | SWAYAM
2	https://onlinecourses.nptel.ac.in/noc16_hs17

CO	Course Outcomes	CL	Class Sessions
CO1	**Explain** the basic principles of IPR, competition law, and their interface.	2	8
CO2	**Describe** global frameworks related to IP licensing and market restraints.	2	8
CO3	**Outline** the provisions of the Indian Competition Act regarding IPR.	2	8

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Department of Electronics and Communication Engineering

Program: B. Tech Electronics and Communication Engineering

Semester-IV | **BEC42405: Analog Systems Design Lab**

Teaching Scheme		Examination Scheme (Th)		Examination Scheme(P)	
Theory (Th)	-	INT	-	INT	-
Practical (P)	2 Hrs./week	ESE	-	ESE	-
Total Credits	1	CA	-	CA	25 Marks
		ESE	-	ESE-P	25 Marks
		Total Marks	-	Total Marks	50 Marks

Pre-Requisites: Electronics System & Design Lab

Course Objectives:

1.	To introduce the fundamental operating principles, key parameters, and basic configurations of operational amplifiers (op-amps).
2.	To familiarize students with the design and operation of linear op-amp circuits for signal processing and conditioning applications.
3.	To explain the operation, characteristics, and practical applications of non-linear op-amp circuits.
4.	To impart knowledge on the internal architecture, functional components, and regulation mechanisms of DC power supplies.
5.	To teach the concepts and design methodologies for active filter circuits and signal-generating oscillators using op-amps.

List of Experiments

1	Analyze Frequency response of Inverting & Non inverting Op Amp Using IC 741	CO1
2	Implement Adder & Subtractor Circuit using Op Amp	CO2
3	Analyze input & output waveform of Integrator & Differentiator Circuit using Op Amp	CO2
4	Observe waveform of clipper & clamper circuit using Op Amp	CO2
5	Observe waveform of Schmitt trigger circuit as square wave generator.	CO3
6	Observe waveform of function generator using Op Amp (Sine, Square, Triangular)	CO3
7	Design Astable Multivibrator using Op amp IC 741.	CO3
8	Design Astable Multivibrator using IC 555 timer	CO3
9	Implement series & shunt voltage regulators.	CO4
10	Analyze active filters circuit LPF, HPF, BPF, BRF	CO5

Text Books

T.1	Ramakant A. Gayakwad, “Op-Amps and Linear Integrated Circuits”, PHI / Pearson Education, 2015.
T.2	Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, McGraw-Hill, 2014.
T.3	K. R. Botkar, “Integrated Circuits”, Khanna Publishers, 2010.

Reference Books

R.1	National Semiconductor, “Linear Integrated Circuits Data Book / Manual”, National Semiconductor, 1980.
R.2	Texas Instruments, “Voltage Regulator Handbook”, Texas Instruments, 1977.
R.3	Gene E. Tobey, Jerald G. Graeme, and Lawrence P. Huelsman, “Operational Amplifiers: Design and Applications”, McGraw-Hill, 1971.

Useful Links	
L.1	https://nptel.ac.in/courses/117/105/117105147/
L.2	https://nptel.ac.in/courses/117/107/117107094/
L.3	http://nptel.ac.in/courses/117103064

CO	Course Outcomes	CL	Class Sessions
CO1	**Measure and evaluate** op-amp parameters and configurations using laboratory test equipment.	5	8
CO2	**Construct and test** linear op-amp circuits for signal conditioning**.**	6	8
CO3	**Implement and troubleshoot** non-linear op-amp circuits for switching and wave-shaping applications.	4	8
CO4	**Design, assemble, and validate** regulated DC power supplies**.**	6	8
CO5	**Design, simulate, and characterize** active filters and oscillator circuits**.**	6	8

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Department of Electronics and Communication Engineering

Program: B. Tech Electronics and Communication Engineering

Semester-III | **BIT42417: Python for Data Handling & Automation Lab**

Teaching Scheme		Examination Scheme (Th)		Examination Scheme(P)	
Theory (Th)	-	**INT**	-	**INT**	-
Practical (P)	2 Hrs./week	**ESE**	-	**ESE**	-
Total Credits	**1**	**CA**	-	**CA**	25 Marks
		ESE	-	**ESE-P**	25 Marks
		Total Marks	-	**Total Marks**	**50 Marks**

Pre-Requisites: Computer Programming Lab

Course Objectives:

1.	To implement basic Python programming structures, loops, and custom functions for numerical computation.
2.	To apply built-in data structures (lists, tuples, dictionaries, and sets) to organize and process structured data.
3.	To perform file I/O operations and handle structured data formats like CSV and JSON.
4.	To implement exception handling mechanisms for robust execution of automation scripts.
5.	To automate repetitive system tasks, file operations, and data reporting using Python scripting modules.

List of Experiments

1	Write Python programs to demonstrate control flow structures (if-else, for, while) for signal threshold classification.	**CO1**
2	Develop modular Python scripts using functions and lambda expressions to calculate ECE circuit metrics (e.g., power dissipation, resonant frequency).	**CO1**
3	Implement data manipulation techniques on Python Strings, Lists, and Tuples to clean and parse simulated sensor streams.	**CO1**
4	Perform key-value operations using Python Dictionaries and Sets to organize component inventories and remove duplicate data records.	**CO2**
5	Write a Python program to read, clean, and write raw numerical data stored in text (.txt) files.	**CO2**
6	Implement automated CSV file reading, writing, and column-wise data extraction for logged telemetry data.	**CO3**
7	Create robust Python scripts using try-except-finally blocks to handle file-not-found, type, and value errors gracefully.	**CO3**
8	Develop a script using the os and shutil modules to automate file system tasks (directory creation, file sorting, and bulk renaming).	**CO4**
9	Build an automated log analyzer script that parses system log files, filters error codes, and exports a summary report.	**CO4**
10	Implement basic data aggregation, statistical analysis, and plot generation on tabular dataset using Python libraries.	**CO5**
11	Develop an end-to-end automation tool that fetches input raw data files, processes data metrics, and outputs formatted text/CSV reports.	**CO5**

Text Books

T.1	Y. Kanetkar, “Let Us Python”, BPB Publications, 2020.
T.2	Dr. R. Nageswara Rao, “Core Python Programming”, Dreamtech Press, 2021.
T.3	R. Thareja, “Python Programming: Using Problem Solving Approach”, Oxford University Press, 2017.

Reference Books

R.1	A. B. Downey, “Think Python: How to Think Like a Computer Scientist”, O'Reilly Media, 2015.
R.2	P. Barry, “Head First Python”, O'Reilly Media, 2016.

R.3	A. Sweigart, “Automate the Boring Stuff with Python”, No Starch Press, 2019.

Useful Links	
L.1	https://www.python.org/doc/
L.2	https://nptel.ac.in/courses/106106182

CO	Course Outcomes	CL	Class Sessions
CO1	**Apply** Python syntax, control statements, and functions to write structured programs for basic calculations.	3	8
CO2	**Utilize** native Python data structures (lists, tuples, dictionaries, sets) to store and manipulate structured dataset collections.	3	8
CO3	**Execute** file operations and implement exception handling mechanisms for error-free data handling.	3	8
CO4	**Construct** automated scripts using OS-level modules for file management, log parsing, and repetitive system tasks.	6	8
CO5	**Design** an end-to-end Python automation project to process, summarize, and report engineering datasets.4	6	8

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