Maharashtra Education Society's

Abasaheb Garware College

Karve Road, Pune – 411 004.

(Autonomous)

(Savitribai Phule Pune University, Pune)

Three Year B.Sc. Degree Program in Electronic Science

(Faculty of Science and Technology)

Syllabi under CBCS NEP(1.0) 2023 Pattern

T.Y.B.Sc. (Electronic Science)

Choice Based Credit System Syllabus

To be implemented from Academic Year 2025-2026

CREDIT FRAMEWORK IN NEP

		VERTICAL 1		VERTICAL 2	VERTICAL 3	VERTICAL 4	VERTICAL 5	VERTICAL 6	
LEVEL	SEMESTER	MAJOR		MINOR	OE	VSC,SEC	AEC,VEC, IKS	FP,CEP,CC,RP	CUM.CR /SEM
		MANDATORY	ELECTIVES						
4.5	I	4+2	0	0	2+2	2(VSC)+ 2(SEC)	2(AEC)+2(VEC)+2(IKS)	2(CC)	
		6	0	0	4	4	6	2	22
	II	4+2	0	2	2+2	2(VSC)+ 2(SEC)	2(AEC)+2(VEC)	2(CC)	
		6	0	2	4	4	4	2	22
	CUM CR	12	0	2	8	8	10	4	44
5	III	4+2+2	0	4	2	2(VSC)	2(AEC)	2(FP)+2(CC)	
		8	0	4	2	2	2	4	22
	IV	4+2+2	0	4	2	2(SEC)	2(AEC)	2(CEP)+2(CC)	
		8	0	4	2	2	2	4	22
	CUM CR	16	0	8	4	4	4	8	44
5.5	V	2+2+2+2+2	2+2	4	0	2(VSC)	0	FP/CEP 2	
		10	4	4	0	2	0	2	22
	VI	2+2+2+2+2	4	4	0	0	0	4(INTERNSHIP)	
		10	4	4	0	0	0	4	22
	CUM CR	20	8	8	0	2	0	6	44
	Total	48	8	18	12	14	14	18	132
						8(VSC)+ 6(SEC)	8(AEC)+4(VEC)+ 2(IKS)	8(CC)+6(FP/CEP)+ 4(INTERNSHIP)	

T.Y.B.Sc. (ELECTRONIC SCIENCE)

Semester	Vertical Name	Course Code	Course Title	Theory/Practical	Credits
V	Major Core	ELS-301-MJ	Modern Communication Systems	Theory	2
		ELS-302-MJ	Process Control Systems	Theory	2
		ELS-303-MJ	Microcontroller Architecture and Programming	Theory	2
		ELS-304-MJP	Electronic Science Practical Course V	Practical	2
		ELS-305-MJP	Electronic Science Practical Course VI (Project)	Practical	2
	Major Elective	ELS-306-MJ	A. Fundamentals of Fiber Optic Communication B. Digital Image Processing	Theory	2
		ELS-307-MJP	Electronic Science Practical Course VII A. Practical course on Fundamentals of Fiber Optic Communication B. Practical course on Digital Image Processing	Practical	2
	Minor	ELS-331-MN	C Programming	Theory	2
		ELS-332-MNP	Practicals Course on C Programming	Practical	2
	VSC	ELS-310-VSC	PLC and SCADA	Theory	2
	FP/CEP/OJT	FP-321- ELS	Field Project/Community Enhancement Project	Practical	2
VI	Major Core	ELS-351-MJ	Analog Circuit Design and Applications	Theory	2
		ELS-352-MJ	Advanced Digital System Design	Theory	2
		ELS-353-MJ	Microcontroller based Embedded Systems/ Nanoelectronics and Quantum Computing	Theory	2
		ELS-354-MJP	Electronic Science Practical Course V	Practical	2
		ELS-355-MJP	Electronic Science Practical Course VI (Project)	Practical	2
	Major Elective	ELS-356-MJ	A. Industrial Internet of Things and Applications B. Fundamentals of Artificial Intelligence	Theory	2
		ELS-357-MJP	Electronic Science Practical Course VII A. Practical course based on Industrial Internet of Things and Applications B. Practical course based on Fundamentals of Artificial Intelligence	Practical	2
	Minor	ELS-381-MN	Python Programming	Theory	2
		ELS-382-MNP	Practicals Course on Python Programming	Practical	2
	FP/CEP/OJT	FP-371- ELS	Internship	Practical	4

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science
CBCS NEP(1.0) 2023 Pattern
Discipline Specific Course System: Major

Level: 6	**Year : Third**	**Semester: 5**
Paper: 1	**Compulsory Theory**	**Credits: 2**
Course code: ELS-301-MJ	**Course title: Modern Communication Systems**	
Number of lectures: 30	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

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

CO1: Understand the digital modulation techniques.
CO2: Understand different types of pulse modulation techniques.
CO3: Describe the evolution and importance of Mobile communication and cellular communication
CO4: Know the basics of satellite communication systems.

UNIT 1: Basics of Digital Communication (12 LECTURES)

Introduction, digital trans receiver, Information capacity, bits, bit rate, baud rate and m-ary coding, Amplitude Shift Keying, Frequency Shift Keying, Binary Phase Shift Keying, Quadrature amplitude modulation, Block diagram of MODEM

Digital modulation: Definition of PCM, PCM Sampling, Signal to quantization noise, PCM Methods, Delta modulation and adaptive delta modulation and generation methods

Time Division Multiplexing, Frequency Division Multiplexing

UNIT 2: Mobile and Cellular Communication (18 LECTURES)

Introduction, mobile telephone service, cellular phone, frequency reuse, cell splitting, sectoring, segmentation and dualization, cellular telephone topology, roaming and handoffs, network components and call processing

Comparative study of GSM and CDMA, 2G, 3G and 4G concepts.

Satellite Communication Introduction to satellite, geosynchronous satellites, spacing and frequency allocation, satellite system link models, system parameters, FDM satellite systems: Set-Top Box, channel capacity, satellite radio navigation, FDMA, TDMA, Satellite data communication: VSAT

RECOMMENDED BOOKS:

1. Electronic Communication Systems Fundamentals through advanced, Wayne Tomasi, Pearson Education Press
2. Wirelerss communications, Andrea Goldsmith, Cambridge University Press 3. Fundamentals of Wireless Communication, D. Tse and P. Viswanathan, Cambridge University Press.
4. Modern Wireless Communication, Haykin S. and Moher M., Pearson 5. Wireless and Mobile Network Architectures, Yi-Bing Lin Wiley.
6. WEB resources: http://nptel.ac.in/courses/

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science

CBCS NEP(1.0) 2023 Pattern

Discipline Specific Course System: Major

Level: 6	**Year : Third**	**Semester: 5**
Paper: 2	**Compulsory Theory**	**Credits: 2**
Course code: ELS-302-MJ	**Course title: Process Control Systems**	
Number of lectures: 30	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

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

CO1: Familiar with different types of sensors and related systems
CO2: Know different types of measurement systems.
CO3: Understand control parameters in process automation.
CO4: Understand different types of process control systems and their characteristics.

UNIT 1: Fundamentals of control theory (12 LECTURES)

Definition of Laplace Transform, Laplace Transform using Tables, First Shifiting theorm, Laplace transform of differential equation and integration. Solving different problems to find laplace transform. Definition of inverse Laplace transform, Inverse Laplace transform using tables and by partial fractions**,** zero-order System, First-order System, Second–order System, Dead-Time Element, Specifications and Testing of Dynamic Response. Generalized Data Acquisition system- Elements of a data acquisition system, Single channel Data Acquisition system, Multichannel Data Acquisition system

UNIT 2: Fundamentals of Process Control (18 LECTURES)

Process control principles, Continuous control, discrete state control, composite discrete/continuous control, Process Characteristics, Control system parameters, Architecture of Industrial Automation Systems, Advantages and limitations of Automation Process Control Systems: Two position mode, Multiposition mode, floating control mode, Continuous controller modes: Proportional control, Integral control, Derivative control Composite modes: Proportional-Integral, Proportional derivative, Proportional-integral – derivative (PID)

RECOMMENDED BOOKS:

1. Process Control Instrumentation Technology; Curtis Johnson, Pearson Publication \
2. Instrumentation Devices & Systems, C S Rangan,G R Sarma,V S Mani, TMH
3. Measurement Systems Application and Design, Ernest O Doeblin, Dhanesh N Manik, Tata McGrawHill
4. Elements of Electronic Instrumentation and Measurement, Joseph J. Carr, Pearson Education 5. Modern control technology: components & systems, Kilian, Delmar 6. Process software and digital networks, Bela G Liptak

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science

CBCS NEP(1.0) 2023 Pattern

Discipline Specific Course System: Major

Level: 6	**Year : Third**	**Semester: 5**
Paper: 3	**Compulsory Theory**	**Credits: 2**
Course code: ELS-303-MJ	**Course title: Microcontroller Architecture and Programming**	
Number of lectures: 30	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

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

CO1: Understand the basics of microcontroller.
CO2: Acquire basic programming skills in C language.
CO3: Understand and acquire basic programming skills for AVR microcontroller.

UNIT 1: Basics of C Programming (15 LECTURES)

Types of Programming languages, Algorithm, flowcharts, instructions, syntax, hex files, linkers, compilers, Basic data types, variables, Structure of C program, Operators in C, Arrays concept, one, two-dimensional and multi-dimensional arrays, pointers, Input output statement, Decision making statements, Control loops, Functions: Library functions and user defined functions.

UNIT 2: AVR Programming using C (15 LECTURES)

Architecture of AVR, Data types for AVR, Time delay generation, I/O programming, Logic operations, Data conversion, Data serialization, Memory allocation in C, Programming Timers, Counters, serial port, interrupts LCD Interfacing, Keyboard interfacing, ADC interfacing, DAC interfacing, External memory interfacing, Stepper motor interfacing.

RECOMMENDED BOOKS:

1. The AVR microcontroller and embedded systems using Assembly and C, Muhamad ali Mazidi, Sarmad Naimi, Sepehr Naimi, PHI publications
2. Microcontrollers: Architecture, Programming, Interfacing and System Design, Rajkamal, Pearson India, ISBN: 9788131759905
3. Let us C, Yashwant Kanetkar, BPB Publications
4. Embedded Systems: Architecture, Programming & Design, Raj Kamal, Tata McGraw Hill publication

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science
CBCS NEP(1.0) 2023 Pattern
Discipline Specific Course System: Major Practical

Level: 6	**Year : Third**	**Semester: 5**
Paper: 4	**Compulsory Practical Course**	**Credits: 2**
Course code: ELS-304-MJP	**Course title: Electronic Sc. Practical Course V**	
Number of Practicals: 15	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

There are 15 Experiments in Paper ELS-304-MJP Practical Course- V
One activity as directed in practical course which will be equivalent to 2 experiments.

Internal Practical Examination (Out of 25): Continuous Internal Assessment ·
10 Marks for Internal Examination
10 Marks for Activity and Performance
05 Marks for journal and Attendance
University Semester Practical Examination: One experiment of 3 hours duration 25 Marks

---

Course Outcomes: After completing the course, the students will be able to
CO1: Analyze different design and test procedures for analog circuits and systems.
CO2: Measure different parameters of optical fiber communication systems
CO3: Understand importance of product design and entrepreneurship.
CO4: Develop electronic systems for given application.

LABORATORY EXPERIMENTS (Total 10 experiments)

Group A: Modern Communication System (Any 5)

1. To design, build and test PCM encoder.
2. To design, build and test Delta/Adaptive Delta modulation
3. Study of Satellite communication system
4. Comparative study of GSM, CDMA. 2G, 3G and 4G methods
5. Study of architecture of mobile communication system
6. Study QAM /QPSK techniques
7. Study of BPSK MODEM

Group B: Fundamentals of Process Control Systems (Any 4)

1. Simulation of controller modes (P/PI/PD/PID)
2. Design and develop ON/OFF controller using microcontroller.
3. Ladder diagram programming for basic circuits
4. Study of process automation system using ladder diagram (Vending machine/bottle filling plant)
5. Design and Development of ON/OFF temperature control system using Arduino/Raspberry

Group C: Microcontroller Architecture and Programming (Any 6)

1. Simple programs: AVR programming in C using MPLAB or equivalent simulation software for arithmetic, logical operations, memory transfer etc.

2. Code conversions (Decimal to hex, hex to decimal, ASCII to hex , Hex to ASCII, BCD to 7 seg code)
3. Interfacing array of LEDs with AVR board
4. AVR C program to Read Push-button switch and display its status on LED.
5. Interfacing Buzzer with AVR Board.
6. Interfacing 7-Segment LED Display with AVR Board.
7. Interfacing of 16x2 LCD with Arduino board and display message on it.
8. Interfacing 4x4 matrix keyboard with AVR microcontroller.
9. Interfacing temperature sensor LM35 measurement & display on LCD

Group D: ACTIVITY: Any one of the following activities will be considered as equivalent to 2 experiments.

1. Any two additional experiments than specified from any Group.
2. Circuit Design and simulation using LTSPICE/Multisim.
3. Industrial /field Visit
4. Hands on training Workshop
5. Do it Yourself Open ended Project

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science

CBCS NEP(1.0) 2023 Pattern

Discipline Specific Course System: Major Practical (Project)

Level: 6	**Year : Third**	**Semester: 5**
Paper: 4	**Compulsory Practical Course Project**	**Credits: 2**
Course code: ELS-305-MJP	**Course title: Electronic Sc. Practical Course VI (Project)**	
Project	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

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

CO1: Understand basic methodology of selection of topic for project.
CO2: Understand how to do literature review for selected topic for project,
CO3: Apply the knowledge for design and development of the selected project.
CO4: Use different software and hardware for testing, validation and verification of circuits for successful outcome of project
CO5: Understand documentation process in the form of presentation and project report
CO6: Understand process of systematic development of electronic system and Development of skills for successful outcome

Guidelines to conduct Practical Course III (Project)

Practical Course VI is a project Course of 2 Credits.

· Internal Continuous Assessment (25 marks)
· University project Examination (25 marks)

This Course should be conducted using following guidelines:

a) In CBCS Pattern, Student has to perform project in Semester V as well as Semester VI. It can perform
   1. separate project for each semester OR
   2. Can perform continuous project carrying sufficient weightage of marks per semester.
b) There should be internal continuous assessment of Project work in the form of Seminars/presentation and continuous work monitoring
c) After completion of project, student has to submit the Project Report in the following format
   a. Title of Project
   b. Aim and objectives of project
   c. Literature or Reference work
   d. Block diagram and its explanation in brief and/or algorithm of software required if any
   e. Design and development of Circuit/system and Simulation required if any
   f. Circuit Diagram and its working and Program explanation if any
   g. Experimental Work and PCB Design/fabrication required if any
   h. Results and Discussion
   i. Applications
   j. Future Scope
   k. References

d) There must be observations, interpretations, conclusions, results of the project work. d. Algorithm, program strategy, module wise description of parts etc. be provided in case of projects related with development of computer software.

e) Applications, usefulness, student's contribution in it must be clearly specified. Further extension work may be suggested for better outcome of the project. It is recommended to present the projects in competitions / project exhibitions organized by various authorities.

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science

CBCS NEP(1.0) 2023 Pattern

Discipline Specific Course System: Major Elective

Level: 6	**Year : Third**	**Semester: 5**
Paper: 6	**Elective Theory Course**	**Credits: 2**
Course code: ELS-306(A)-MJE	**Course title: Fundamental of Fiber Optic Communication**	
Number of lectures: 30	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

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

CO1: To acquire Knowledge of optical fiber communication system.
CO2: To understand different parameters of optical fibers.
CO3: To learn essential optical components of Fiber Optic Communication. CO4: To analyze and integrate fiber optical network components in variety of networking schemes.

UNIT 1: Overview of Optics and Optical Fiber Communication (15 LECTURES)

History of fiber optic systems, block diagram, Fiber material, fiber cables and fiber fabrication, fiber joints, fiber connectors, splicer, Propagation of light in optical fiber, acceptance angle, numerical aperture, Types and specification of optical fiber, Advantages of optical fiber communication, applications, Attenuation, absorption, linear and nonlinear scattering losses, bending losses, modal dispersion, waveguide dispersion and pulse broadening, Dispersion shifted and dispersion flattened fibers, Measurement of optical parameters, attenuation and dispersion.

UNIT 2: Optical Sources and Detectors (15 LECTURES)

Sources: Coherent and non-coherent sources, quantum efficiency, modulation capability of optical sources, Working principle and characteristics of - LEDs, Laser diodes, Modulation in laser diodes, Detectors: PIN and APD, Noise analysis in optical detectors, Architecture of optical transport networks (OTNs), network topologies, Introduction to Synchronous optical networking (SONET) and synchronous digital hierarchy (SDH).

RECOMMENDED BOOKS:

1. Optical fiber communication – Principles and practice, J.M. Senior, PHI 2. Fiber optics and Optoelectronics, R.P. Khare, Oxford University Press
3. Optical fiber communication, G. Kaiser McGraw Hill

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science

CBCS NEP(1.0) 2023 Pattern

Discipline Specific Course System: Major Elective

Level: 6	**Year : Third**	**Semester: 5**
Paper: 6	**Elective Theory Course**	**Credits: 2**
Course code: ELS-306(B)-MJE	**Course title: Digital Image Processing**	
Number of lectures: 30	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

Course Outcome:

1. To make the students aware of basic mathematics required for image processing
2. To make students familiar with different image processing algorithms
3. To provide the students with the knowledge of practically implementing the algorithms for various applications

Unit-1: Introduction to Digital Image Processing (18 Lecture)

Light and electromagnetic spectrum, elements of visual perception, luminance, brightness, contrast, hue, saturation, mach band effect, color image fundamentals-RGB, HIS models, basic concepts of sampling and quantization and companding in imaging, two dimensional sampling theory, practical limitations in sampling (aliasing effect), digital image representation, spatial and intensity resolution, image interpolation, relationship between image pixels- neighbours, logical and arithmetic operation on images.

Some basic intensity transformation function, histogram processing, fundamentals of spatial filtering, spatial operations like smoothing and sharpening spatial filters, multispectral image enhancement, false color and pseudo color, color image processing, typical example for image enhancement and spatial filtering.

Basic concepts of Fourier transform and Fourier series, 2D Fourier transform and 2D discrete fourier transform, basics of filtering in frequency domain, image smoothing (LP), sharpening (HP), selective filtering (BP and BR) in frequency domain & their implementation(Using Image processing Tools.

Unit-2: Image compression, MATLAB implementation and case studies (12 Lecture)

Pixel and data redundancy, fidelity criteria, information theory, error free coding,
lossy compression, transform coding (DCT and wavelet)
Image file formats, TGA, GIF, TIFF, BMP, JPEG, CDR
Applications and case studies: feature enhancement using equalization methods, salt and pepper noise removal using spatial as well as frequency domain filters, study of a biometric system for finger print reading covering the points like the sensor device, data quality assessment, comparison and matching, database etc, applications of digital image processing in medical spectroscopy

Text / Reference Books:

1. Rafel.C.Gonzalez, Richard .E.Woods, “Digital Image Processing”, Pearson Third Edition, 2008.
2. Rafel.C.Gonzalez, Richard .E.Woods and Steven L. Eddins “Digital Image Processing usind MATLAB”, Pearson 2004.
3. Anil.K.Jain, “ Fundamentals of Digital Image Processing”, Pearson, 2002.
4. Keenneth R Castleman, "Digital Image Processing", Pearson Education, 1995.

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science

CBCS NEP(1.0) 2023 Pattern

Discipline Specific Course System: Major Elective Practical

Level: 6	**Year : Third**	**Semester: 5**
Paper: 7	**Elective Practical Course**	**Credits: 2**
Course code: ELS-307(A)-MJPE	**Course title: Practical course on fundamental of fiber optic communication**	
Number of Practicals: 15	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

There are 15 Experiments in Paper ELS-307(A)-MJPE Practical Course on fundamental of fiber optic Communication

One activity as directed in practical course which will be equivalent to 2 experiments.

- Internal Practical Examination (Out of 25): Continuous Internal Assessment ·
  - 10 Marks for Internal Examination
  - 10 Marks for Activity and Performance
  - 05 Marks for journal and Attendance
- University Semester Practical Examination: One experiment of 3 hours duration 25 Marks

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

CO1: Analyze different design and test procedures for analog circuits and systems.

CO2: Measure different parameters of optical fiber communication systems

CO3: Understand importance of product design and entrepreneurship.

CO4: Develop electronic systems for given application.

LABORATORY EXPERIMENTS (Total 08 experiments)

Group A: Fundamental of Fiber Optic Communication (any 7)

1. To measure propagation loss in optical fibers
2. To measure bending loss in optical fibers
3. To set up fiber optic voice link
4. To measure Numerical Aperture of given optical fiber.
5. To study different methods of optical fiber terminations and polishing
6. To study fiber optic sensors and their applications
7. To design, build and test fiber optic Transmitter
8. To design, build and test of fiber optic Receiver
9. Visit to telecom facility for observing splicing, alignment, fusing, OTDR operation, types of connectors, couplers and cables

Group B: ACTIVITY: Any one of the following activities (Any 8)

1. Any two additional experiments than specified from any Group. - **equivalent to 2 experiments.**
2. Circuit Design and simulation using LTSPICE/Multisim. - **equivalent to 2 experiments.**
3. Industrial /field Visit - **equivalent to 2 experiments.**
4. Hands on training Workshop - **equivalent to 2 experiments.**
5. Do it Yourself Open ended Project - **equivalent to 4 experiments.**

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science

CBCS NEP(1.0) 2023 Pattern

Discipline Specific Course System: Major Elective Practical

Level: 6	**Year : Third**	**Semester: 5**
Paper: 7	**Elective Practical Course**	**Credits: 2**
Course code: ELS-307(B)-MJPE	**Course title: Practical course on Digital Image Processing**	
Number of Practicals: 15	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

There are 15 Experiments in Paper ELS-307(B)-MJPE Practical Course on fundamental of fiber optic Communication

One activity as directed in practical course which will be equivalent to 2 experiments.

- Internal Practical Examination (Out of 25): Continuous Internal Assessment ·
  - 10 Marks for Internal Examination
  - 10 Marks for Activity and Performance
  - 05 Marks for journal and Attendance
- University Semester Practical Examination: One experiment of 3 hours duration 25 Marks

Group A: Digital Image Processing (Any 7)

1. Basic Exercises of MATLAB software (Any 3)
2. Basic Exercises of MATLAB software on Image processing module.
3. Implementation of image enhancement techniques in MATLAB
4. Implementation of histogram processing techniques in MATLAB
5. Build a GUI in MATLAB for image noise filtering &
6. Build a GUI in MATLAB for edge detection technique in MATLAB
7. Study & implementation of a segmentation algorithm in MATLAB
8. Development of Photoshop type application for image processing

Group B: ACTIVITY: Any one of the following activities (Any 8)

1. Any two additional experiments than specified from any Group. - **equivalent to 2 experiments.**
2. Circuit Design and simulation using LTSPICE/Multisim. - **equivalent to 2 experiments.**
3. Industrial /field Visit - **equivalent to 2 experiments.**
4. Hands on training Workshop - **equivalent to 2 experiments.**
5. Do it Yourself Open ended Project - **equivalent to 4 experiments.**

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science

CBCS NEP(1.0) 2023 Pattern

Discipline Specific Course System: Minor

Level: 6	**Year : Third**	**Semester: 5**
Paper: Minor	**Minor Theory Course**	**Credits: 2**
Course code: ELS-331-MN	**Course title: C Programming**	
Number of lectures: 30	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

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

CO1: Understand the basics of C language Programming.
CO2: Acquire basic programming skills in C language.
CO3: Understand and acquire basic programming skills for C language

UNIT 1: Basics of C Programming (12 LECTURES)

Types of Programming languages, Algorithm, flowcharts, instructions, syntax, hex files, linkers, compilers, Basic data types, variables, Structure of C program, Operators in C, Input output statement, Decision making statements, Control loops, Case control instructions.

Unit-2: Advance in C (18 LECTURES)

Introduction of high-level programming language, operators and its precedence, various data types in C, storage classes in C. Functions: user defined function, pointer to functions, Functions: Library functions and user defined functions, pointers, Recursion, Arrays concept, one, two-dimensional and multi-dimensional arrays, String, Handling strings, Structure.

Text / Reference Books:

1. Computer programming in C, V. Rajaraman, Pearson Education, 2nd edition, 2003.
2. The C programming language, Dennis Ritchie, Pearson Education, 2nd edition, 2003.
3. Programming with C, Byron S. Gottfried, Schaum Outline Series, Tata McGraw Hill.
4. Programming in C, Stephen G. Kochan. CBS
5. Let us C by Yashwant Kanitkar

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science

CBCS NEP(1.0) 2023 Pattern

Discipline Specific Course System: Minor Practical

Level: 6	**Year : Third**	**Semester: 5**
Paper: Minor	**Minor Practical Course**	**Credits: 2**
Course code: ELS-332-MNP	**Course title: Practical course on C Programming**	
Number of Practicals: 15	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

Group A: C Programming (Any 9)

Write C Programs for following:

1. Simple C Programs (5)
2. Generate the Fibonacci series up to the given limit N and also print the number of elements in the series
3. Find minimum and maximum of N numbers.
4. Find the GCD of two integer numbers.
5. Calculate factorial of a given number.
6. Find all the roots of a quadratic equation $Ax^2 + Bx + C = 0$ for non -zero coefficients A, B and C
7. Calculate the value of sin (x) and cos (x) using the Fourier series. Also print sin (x) and cos (x) value using library function.
8. Generate and print prime numbers up to an integer N
9. Sort given N numbers in ascending order using bubble sort.
10. Find the sum & difference of two matrices of order MxN and PxQ
11. Find the product of two matrices of order MxN and PxQ

Group B: ACTIVITY: Any one of the following activities (Any 6)

1. Any two additional experiments than specified from any Group. - **equivalent to 2 experiments.**
2. Circuit Design and simulation using LTSPICE/Multisim. - **equivalent to 2 experiments.**
3. Industrial /field Visit - **equivalent to 2 experiments.**
4. Hands on training Workshop - **equivalent to 2 experiments.**
5. Do it Yourself Open ended Project - **equivalent to 4 experiments.**

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science

CBCS NEP(1.0) 2023 Pattern

Discipline Specific Course System: Vocational Skill Course

Level: 6	**Year : Third**	**Semester: 5**
Paper: VSC	**VSC Theory + Practical**	**Credits: 2 (1T+1P)**
Course code: ELS-310-VSC	**Course title: PLC and SCADA**	
Number of lectures: 15 **Number of Practicals : 8**	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

Course Outcomes: After completing the course, the students will be able to
CO1: Know about the basics of programmable logic controllers and their components.
CO2: Demonstrate PLC programming using ladder programming.
CO3: Develop PLC based systems by programming different components in PLC.

UNIT 1: Programmable Logic Controller (PLC) (18 LECTURES) Introduction, Brief History, PLC Configurations, Typical system components, System block diagram, Introduction, Basic components and their symbols: control transformers, fuses, Switches, Relays, Time delay relays, Indicator lamps, Fundamentals of Ladder diagrams: Basic diagram, Wiring, Boolean and relay logic, single cycle circuit, combined circuit. Machine control terminology, Physical components Vs Program components, Ladder program execution sequence, Mnemonic programming Wiring Techniques: PLC power connection, Input wiring, output wiring, Relay outputs, Solid state outputs

UNIT 2: Introduction to SCADA (18 LECTURES)
Fundamentals of SCADA system, SCADA Hardware, SCADA software, SCADA and LAN, Comparative study of SCADA, DCS and PLC, Block diagram of SCADA system, Advantages, Remote terminal Units (RTU), Typical requirements of RTU, SCADA Key features, Introduction to protocols, Case Study of SCADA applications

Practical's based on PLC and SCADA

1. Ladder Programming for basic logic gates
2. Basic ladder diagram programming
3. Use of timers
4. Use of counters
5. Simulation of PLC SCADA system for bottle filling plant, traffic signal control systems
6. Comparative study of different PLC SCADA systems
7. Study of different components of PLC SCADA system
8. Creation of wiring diagram of basic PLC SCADA system using wiring diagram tool
9. Industrial visit

RECOMMENDED BOOKS:

1.Programmable Logic Controllers Programming Methods and Applications, John R. Hackworth and Fredrick D. Hackworth, Jr., Pearson Education
2. Practical SCADA for Industry, David Bailey BEng, Bailey and Associates, Perth, Australia
3. Programmable Logic Controllers, W. Bolton.
4. Programmable Logic Controllers, Frank D. Petruzella, Third Edition, Tata McGraw Hill

Education Private Limited
5. Learning Programmable Logic Controllers with Applications, PK Srivastava, BPB Publications.

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science
CBCS NEP(1.0) 2023 Pattern
Discipline Specific Course System: Field Project

Level: 6	**Year : Third**	**Semester: 5**
Paper: Field Project	**Compulsory Field Project**	**Credits: 2**
Course code: ELS- 321-FP	**Course title: Field Project**	
Training /Workshop/ Project	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

All Students should do on field project or training four hours a week.
Assessment will be done on their performance and final presentation.

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science
CBCS NEP(1.0) 2023 Pattern
Discipline Specific Course System: Major

Level: 6	**Year : Third**	**Semester: 6**
Paper: 1	**Compulsory Theory**	**Credits: 2**
Course code: ELS-351-MJ	**Course title: Analog circuit Design and Applications**	
Number of lectures: 30	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

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

CO1: Understand basics of analog circuit design.
CO2: Analyze waveform generators required for testing different circuits.
CO3: Build application circuits using specialized ICs.
CO4: Design analog systems using available ICs.

UNIT 1: Fundamentals of Analog Circuit Design (15 LECTURES)
Design specifications, selection of amplifier, unwanted signals, avoiding fault conditions, offset nullifying techniques, enhancing output capabilities. Logarithmic Amplifiers, Log/Antilog Modules, Precision Rectifier, Peak Detector, Sample and Hold Circuits. OP-AMP as Comparator, Schmitt Trigger, Monostable Multivibrator, Analog Multiplier applications

UNIT 2: Waveform Generators and Voltage Regulators (15 LECTURES)
Wien-bridge and twin-T oscillators, Square wave generators, Ramp Generator, Triangular wave generator, Sawtooth wave generator, Sine wave generator, Crystal Oscillator, Function Generators: Multi op-amp function generators, function generator IC's. Phase Locked Loops: Block diagram and operation, Applications as Frequency Multiplier and Frequency Shift Keying, Design of Power Supply: Voltage Regulator, Three terminal voltage regulators, Fixed and adjustable voltage regulators (78XX, LM317), Dual power supply (LM320, LM317), Basic switching regulator and its characteristics

RECOMMENDED BOOKS:

1. OP-AMP and Linear ICs, Ramakant A. Gayakwad, Prentice Hall / Pearson Education
2. Operational Amplifiers and Linear Integrated Circuits, Robert F. Coughlin, Frederick F. Driscoll, PHI
3. Operational Amplifiers, G. B. Clayton, Elsevier

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science

CBCS NEP(1.0) 2023 Pattern

Discipline Specific Course System: Major

Level: 6	**Year : Third**	**Semester: 6**
Paper: 2	**Compulsory Theory**	**Credits: 2**
Course code: ELS-352-MJ	**Course title: Advanced Digital System Design using Verilog**	
Number of lectures: 30	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

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

CO1: Work on various IC technology options

CO2: Demonstrate Logic simulation, Design verification, Verilog.

CO3: Demonstrate behavioral modeling, Boolean-Equation, Flip-Flops and Latches; multiplexers, encoders, and decoders, synchronizers for asynchronous signals.

CO4: Work on combinational logic; three-state devices and bus interfaces; Registered logic; registers and counters; Resets; Divide and conquer: Partitioning a design.

CO5: Understand and analyze basics of PLA; PAL; Programmability of PLDs; CPLDs; FPGAs

UNIT 1: Modeling of Combination Circuits (15 LECTURES)

Introduction: Design methodology – An introduction; IC technology options Logic Design with Verilog:

Structural models of combinational logic; Logic simulation, Design verification, and Test methodology; Propagation delay; Truth-Table models of Combinational and sequential logic with Verilog Logic Design with Behavioral Models:

Behavioral modeling; A brief look at data types for behavioral modeling; Boolean-Equation – Based behavioral models of combinational logic;

A comparison of styles for behavioral modeling; Behavioral models of multiplexers, encoders, and decoders; Dataflow models of a Linear- Feedback Shift Register; Modeling digital machines with repetitive algorithms. Machines with multicycle operations; Design documentation with functions and tasks; Algorithmic state machine charts for behavioral modeling; ASMD charts;

Behavioral models of counters, shift registers and register files; Switch debounce, meta-stability and synchronizers for asynchronous signals; Design example

UNIT 2: Modeling of Sequential ciruits and PLA (15 LECTURES)

Synthesis of Combinational and Sequential Logic: Introduction to synthesis; Synthesis of combinational logic; Synthesis of sequential logic with latches; Synthesis of threestate devices and bus interfaces; Synthesis of sequential logic with flip-flops; Synthesis of explicit state machines; Registered logic; State encoding; Synthesis of implicit state machines, registers and counters; Resets; Synthesis of gated clocks and clock enables; Anticipating the results of synthesis; Synthesis of loops; Design traps to avoid; Divide and conquer: Partitioning a design.

Programmable Logic and Storage Devices: Programmable logic devices; storage devices; PLA; PAL; Programmability of PLDs; CPLDs; FPGAs; Verlog-Based design flows for FPGAs; Synthesis with FPGAs.

RECOMMENDED BOOKS:

1. **Michael D. Celetti: Advanced Digital Design with the Verilog HDL, PHI, 2013**
2. PeterJ. Asheden: Degital Design –An Embedded Systems Approach Using VERILOG, ELSEVIER 2013. 2.
3. Stephen Brown, Zvonko Vranesic: Fundamentals of Digital Logic with Verilog Design, Tata Mc-Graw Hill 2009

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science
CBCS NEP(1.0) 2023 Pattern
Discipline Specific Course System: Major

Level: 6	**Year : Third**	**Semester: 6**
Paper: 3	**Compulsory Theory**	**Credits: 2**
Course code: ELS-353-MJ	**Course title: Nanoelectronics and Quantum Computing**	
Number of lectures: 30	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

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

CO1: Understand basic concepts of nano electronic devices and nano technology.
CO2: Understand the electron transport mechanism in nanostructures.
CO3: Understand techniques of characterization of nanostructures.
CO4: Understand different devices constructed using nanotechnology.
CO5: Understand the basic principles of quantum computing
CO6: Gain knowledge of the fundamental differences between conventional computing and quantum computing.
CO7: Simulate and analyze the characteristics of Quantum Computing Systems

UNIT 1: Introduction to Nanotechnology and Nanoelectronics (18 LECTURES)

Overview of basic Nano electronics, Limitations of conventional microelectronics, Top down approach, Bottom up approach, Flash Memory, Applications of nanotechnology in nanoelectronics. Introduction to metamaterials, Resonant-tunneling diode, electrons in square quantum wells of finite depth, electrons in quantum wire, electrons in quantum dots, Density of states of electrons in nanostructures Introduction to characterization of nanostructures: Principle of operation of Scanning electron microscope (SEM), Transmission Electron Microscope (TEM), Scanning Tunneling Microscope (STM), X-Ray Diffraction analysis (XRD), UV-Vis absorption Spectrum, Materials: Semiconductors nanoparticles, Organic semiconductors, Lattice-matched and pseudomorphic heterostructures, Inorganic nanowires, Carbon nanomaterials: nanotubes and fullerenes, Devices: Coulomb Blockade, The Single-Electron Transistor (SET), Carbon Nanotube Transistors (CNT), Semiconductor Nanowire, Quantum well laser, quantum dot LED, quantum dot laser, MOSFETS

UNIT 2: Characterization of Nanostructures (12 LECTURES)

The Quantum Mechanics of Photon Polarization, Single-Qubit Quantum Systems, Quantum State Spaces, Entangled States, Multiple-Qubit Systems, Measurement of Multiple-Qubit States, EPR Paradox and Bell's Theorem, Bloch sphere. Unitary Transformations, Quantum Gates, Unitary Transformations as Quantum Circuits, Reversible Classical Computations to Quantum Computations, Language for Quantum Implementations. Limitations of Quantum Computing, Alternatives to the Circuit Model of Quantum Computation, Quantum Protocols, Building Quantum, Computers, Simulating Quantum Systems, Bell states. Quantum teleportation. Quantum Cryptography, no cloning theorem

RECOMMENDED BOOKS:

1. Nanotechnology: Principles and Practices, Sulbha K. Kulkarni, Springer 2008
2. Introduction to Nanoelectronics Science, nanotechnology, Engineering and Applications, V. Mitin ,Viatcheslav A. Kochelap , Michael A. Stroscio Vladimir, Cambridge University Press 2008
3. John Gribbin, Computing with Quantum Cats: From Colossus to Qubits, 2021
4. William (Chuck) Easttom, Quantum Computing Fundamentals, 2021
5. Parag Lala, Quantum Computing, 2019 4. Eleanor Rieffel and Wolfgang Polak,

QUANTUM COMPUTING A Gentle Introduction, 2011
6. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge UniversityPress.2002
7. . Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information,Vol. I: Basic Concepts, Vol II: Basic Tools and Special Topics, World Scientific. 2004
8. . Pittenger A. O., An Introduction to Quantum Computing Algorithms 2000

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science

CBCS NEP(1.0) 2023 Pattern

Discipline Specific Course System: Major Practical

Level: 6	**Year : Third**	**Semester: 6**
Paper: 5	**Compulsory Major Practical Course**	**Credits: 2**
Course code: ELS-354-MJP	**Course title: Electronic Sc. Practical Course V**	
Number of Practicals: 15	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

List of Experiments:

Group A: Analog circuit Design and Applications(Any 6)
Design, build and test following circuits and analyze them:

1. Logarithmic Amplifiers using non linear components in feedback(Diode and BJT).
2. Precision Rectifier
3. Peak Detector
4. Sample and Hold Circuits.
5. OP-AMP as Comparator, Schmitt Trigger
6. Opamp as astable and Monostable Multivibrator
7. Analog Multiplier applications
8. Function generator using Opamp/8038
9. Sinusoidal oscillators using opamp/ICs
10. Regulated power supply/SMPS
11. PLL characteristics and its use as frequency multiplier

Group B: : Advanced Digital System Design using Verilog(any 6)
Note: Use appropriate tools/language to implement the following experiment:

1. Design, develop, and verify a Verilog module that implements Logic gates (All logic gates)
2. Design, develop, and verify a Verilog module that implements Half adder and full adder.
3. Design, develop, and verify a Verilog module that implements 2:1 MUX and 1:2 DEMUX
4. Design, develop, and verify a Verilog module that implements a SR Flip-Flop
5. Design, develop, and verify a Verilog module that implements a JK Edge-Triggered Flip-Flop Design, develop, and verify a Verilog module that produces a 4-bit output indicating the number of 1s in an 8-bit input word.
6. Design, develop, and verify a Verilog module that implements a Universal Shift Register and then implement a bidirectional ring counter capable of counting in either direction, beginning with first active clock edge after reset.
7. Design, develop, and verify a Verilog module that implements a counter whose modulus value $n \leq 10$.

Group C: Nanoelectronics and Quantum Computing(Any one equivalent to 3 expts)
Self learning experiments

- MOOC courses
- Literature Survey
- Seminar

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science

CBCS NEP(1.0) 2023 Pattern

Discipline Specific Course System: Major

Level: 6	**Year : Third**	**Semester: 6**
Paper: Major Practical	**Compulsory Project**	**Credits: 2**
Course code: ELS-355-MJP	**Course title: Electronic Sc. Practical Course VI(Project)**	
Project	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

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

CO1: Understand basic methodology of selection of topic for project.

CO2: Understand how to do literature review for selected topic for project,

CO3: Apply the knowledge for design and development of the selected project.

CO4: Use different software and hardware for testing, validation and verification of circuits for successful outcome of project

CO5: Understand documentation process in the form of presentation and project report

CO6: Understand process of systematic development of electronic system and Development of skills for successful outcome

Guidelines to conduct Practical Course III (Project)

Practical Course III is a project Course of 2 Credits.

· Internal Continuous Assessment (25 marks)

· University project Examination (25 marks)

This Course should be conducted using following guidelines:

In CBCS Pattern, Student has to perform project in Semester V as well as Semester VI. It can perform separate project for each semester OR Can perform continuous project carrying sufficient weightage of marks per semester. There should be internal continuous assessment of Project work in the form of Seminars/presentation and continuous work monitoring After completion of project, student has to submit the Project Report in the following format

- Title of Project
- Aim and objectives of project
- Literature or Reference work
- Block diagram and its explanation in brief and/or algorithm of software required if any
- Design and development of Circuit/system and Simulation required
- Circuit Diagram and its working and Program explanation if any
  Experimental Work and PCB Design/fabrication
- Results and Discussion
  Applications
- Future Scope and References

There must be observations, interpretations, conclusions, results of the project work. d. Algorithm, program strategy, module wise description of parts etc. be provided in case of projects related with development of computer software. Applications, usefulness, student's contribution in it must be clearly specified. Further extension work may be suggested for better outcome of the project. It is recommended to present the projects in competitions / project exhibitions organized by various authorities.

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science

CBCS NEP(1.0) 2023 Pattern

Discipline Specific Course System: Major Elective

Level: 6	**Year : Third**	**Semester: 6**
Paper: 6	**Elective Theory Course**	**Credits: 2**
Course code: ELS-356(A)-MJE	**Course title: Internet of Things and Applications**	
Number of lectures: 30	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

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

CO1: Know the basic building blocks of IoT
CO2: Know IoT protocols
CO3: Understand how to Design and Develop IoT based system through case studies..

UNIT 1: Introduction of IoT (12 LECTURES)

Definition and characteristics of IoT, Technical Building blocks of IoT, Devices, Communication Technologies, Physical design of IoT, IoT enabling technologies, IoT Issues and Challenges-Planning, Costs and Quality, Security and Privacy, Risks **IoT Protocols:** MQTT, CoAP, XMPP and AMQT, IoT communication models, IoT Communication technologies: Bluetooth, BLE, Zigbee, Zwave, NFC, RFID, Zigbee etc.

UNIT 2: Health Care and Smart City applications of IoT (18 LECTURES)

Smart Healthcare: Characteristics of e-health and applications: monitoring of health parameters, smart medicine box, elderly people monitoring, challenges, Smart City: Characteristics and applications–Smart Economy, Smart People, Smart Goverence, Smart Mobility, Smart Environment, Smart Living, Smart Grid, Transport and Traffic Management Smart Home: Characteristics of Smart Home, Smart Home Energy Management, Smart Appliances, Communication Technologies for Smart Homes, maintenance, security, challenges

Smart Agricultural: Characteristics and Applications, Scarecrow, Smart Irrigation System, Crop Water Management, Integrated Pest Management, Sensor-based field and resource mapping, Remote equipment monitoring

RECOMMENDED BOOKS:

1. Internet of Things –A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515.

2. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for the Internet of Things, David Hanes, Cisco Press, ISBN-13: 978-1-58714-456-1, ISBN-10: 1-58714-456-5, 20173

3.The Internet of Things: Applications to the Smart Grid and Building Automation, Olivier Hersent, Omar Elloumi and David Boswarthick, Wiley, 97811199583453. 4.The Internet of Things –Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi ,Wiley,ISBN:978-1-119-99435-0

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science

CBCS NEP(1.0) 2023 Pattern

Discipline Specific Course System: Major Elective

Level: 6	**Year : Third**	**Semester: 6**
Paper: 7	**Elective Practical Course**	**Credits: 2**
Course code: ELS-357(A)-MJPE	**Course title: Practical course based on internet of things and applications**	
Number of Practicals: 15	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

List of Experiments:

1 To interface LED/buzzer to Arduino/Raspberry pi and write a program to make it ON or OFF

2. To interface digital sensor/push button to Arduino/Raspberry pi and write a program to make LED ON when button pressed or sensor detection

3. To interface motor to Arduino/Raspberry pi and write a program to turn ON motor when push button is pressed

4. To interface DHT 11/any temperature sensor to Arduino/Raspberry pi and write a program to print temperature and/ or humidity.

5. To interface Bluetooth to Arduino/Raspberry pi and write a program to send sensor data to smartphone using Bluetooth

6. Write a program on Arduino/Raspberry pi to upload temperature and humidity data to Thingsspeak cloud.

7. Design and develop temperature control system using temperature sensor (LM 35/PT 100/AD 590)

8. Design and develop mobile app for attendance of students using RFID/biometric sensor and ESP8266 module

9 to 10: Any project of student's choice

11 and 12. Activity: Workshop/seminar/2 additional expts not in above list

13 to 15: Industry visit,/ Seminar on **any one** Advanced topics from the list below(Self Learning)

a. Use of IoT in space technology

b. Use of IoT for smart farming

c. Use of IoT in smart city

d. Use of IoT in industry

e. Use of IoT in health monitoring of patient

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science

CBCS NEP(1.0) 2023 Pattern

Discipline Specific Course System: Major Elective

Level: 6	**Year : Third**	**Semester: 6**
Paper: 6	**Major Elective Theory**	**Credits: 2**
Course code: ELS-356(B)-MJE	**Course title: Introduction to Artificial Intelligence**	
Number of lectures: 30	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

Course Outcomes

CO1: Explore basic concepts of AI and understand the importance of agents.
CO2: Understand various search strategies.
CO3: Analyze knowledge representation and reasoning approaches.
CO4: Understand the importance of planning in real world scenarios.
CO5: Evaluate the architecture of expert systems.

Unit I Introduction AI

Foundations of AI, Intelligent Agents – Agents and Environments – Good Behavior –Nature of Environments – Structure of Agents. Problem Solving Agents – Searching for solutions Uninformed Search Strategies – Informed Search Strategies, Heuristic functions - Adversarial search - Local search algorithms and optimization problems – Searching with nondeterministic actions, Constraint satisfaction problems. Knowledge and reasoning Logical Agents: Wumpus world - Propositional logic - First order logic: Inference, forward and backward chaining, Resolution.
Classical planning – Algorithms – Approaches - Planning and acting in real world – Hierarchical planning – Multiagent planning

Unit II: Expert systems

Expert systems – Introduction – Difference between expert system and conventional programs– Expert system organization – Architecture of Expert system – Knowledge representation techniques- Knowledge acquisition techniques - Inference Engine- Explanation systems.

Recommended Books:

TEXT BOOKS:
1. Stuart J Russell and Peter Norvig, Artificial Intelligence – A Modern Approach, PHI Learning, Fourth Edition, 2022.
2. Patterson W D, Introduction to Artificial Intelligence and Expert Systems, PHI Learning, First Edition, 1995.
REFERENCE BOOKS: 1. Elaine Rich and Kelvin Knight, Artificial Intelligence, TMH, Third Edition, 2009.

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science

CBCS NEP(1.0) 2023 Pattern

Discipline Specific Course System: Major Elective Practical

Level: 6	**Year : Third**	**Semester: 6**
Paper: 7	**Elective Practical Course**	**Credits: 2**
Course code: ELS-357(B)-MJPE	**Course title: Practical course based on Artificial Intelligence**	
Number of Practicals: 15	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

List of Experiments:

1. Solve the Water Jug Problem using DFS, BFS blind search algorithms

2. Implement Mini-max adversarial search algorithm.

3. Find the optimal path between two cities using best first search and A* heuristic algorithms

4. Implement the Missionaries and cannibals problem using constraint satisfaction method.

5. Represent knowledge using Propositional Logic and perform inference.

6. Represent knowledge using Predicate Logic and perform inference.

7. Case study: Autonomous Vehicles

8. Case Study: Travelling Salesman Problem.

9. Case Study: Planning Delivery of packages

10. Develop an Expert System.
11 and 12. Activity: Workshop/seminar/2 additional expts not in above list

13 to 15: Industry visit,/ Seminar on **any one** Advanced topics from the list below(Self Learning)

a. Machine Learning
b. Deep Learning
c. NLP
d. Artificial Neural Networks
e. AI ethics

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science

CBCS NEP(1.0) 2023 Pattern

Discipline Specific Course System: Minor

Level: 6	**Year : Third**	**Semester: 6**
Paper: Minor	**Compulsory Theory**	**Credits: 2**
Course code: ELS-381-MN	**Course title: Python Programming**	
Number of lectures: 30	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

Course Outcomes:

CO1: Understand the basics of writing Python code
CO2: Implement programs using lists, tuples, and dictionaries
CO3: Understand the use of control structures
CO4: Implement programs using packages
CO5: Analyze the need for file manipulation and develop programs to implement it.

Unit I Introduction

Data types Introduction to Python – Advantages of using Python – Executing Python Programs – Python's Core data types – Numeric Types – String Fundamentals.
Lists, Tuples, Dictionaries Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension.
Control Flow, Functions, Modules Python Statements: Assignments – Expressions – If condition – While and for loops. Functions: Definition, Calls – Scopes – Arguments – Recursive Functions– Functional Programming tools. Classes and Object Oriented programming with Python - Modules and Packages: Purpose, using packages– Exception Handling with Python.

Unit II: Packages and File handling

Packages: NumPy, Pandas, Scikit learn - Machine learning with Python – Cleaning up, Wrangling, Analysis, Visualization - Matplotlib package – Plotting Graphs.
File Handling Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions

Recommended Books:

TEXT BOOKS: 1. Mark Lutz, "Learning Python", Fifth Edition, O'Reilly, 2013.
2. Daniel Liang, "Introduction to programming using Python", Pearson, First edition, 2021. 3. Wes Mc Kinney, "Python for Data Analysis", O'Reilly Media, 2012.
REFERENCE BOOKS: 1. Tim Hall and J-P Stacey, "Python 3 for Absolute Beginners", Apress, First Edition, 2009.
2. Magnus Lie Hetland, "Beginning Python: From Novice to Professional", Apress, Second Edition, 2005

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science

CBCS NEP(1.0) 2023 Pattern

Discipline Specific Course System: Minor

Level: 6	**Year : Third**	**Semester: 6**
Paper: Minor	**Minor Practical Course**	**Credits: 2**
Course code: ELS-382-MNP	**Course title: Electronic Sc. Practical Course (Minor) Sem VI**	
Number of Practicals: 15	**Internal assessment: 25 marks**	**Semester assessment: 25 marks**

List of Programs:

Write python program to solve the following problems:

1. Exchange the values of two variables
2. Finding minimum among n variables
3. Perform Simple sorting
4. Generate Students' marks statement
5. Find square root, GCD, exponentiation
6. Perform linear search, binary search
7. Perform Matrix operations using NumPy
8. Perform Dataframe operations using Pandas
9. Use Matplotlib on dataset and visualize
10. Perform Word count, copy file operations

11 and 12. Activity: Workshop/seminar/2 additional expts not in above list

13 to 15: Industry visit,/ Develop a billing system using python

---

MES ABASAHEB GARWARE COLLEGE (Autonomous)
KARVE ROAD, PUNE 411 004
Department of Electronic Science
CBCS NEP(1.0) 2023 Pattern
Discipline Specific Course System: Internship

Level: 6	**Year : Third**	**Semester: 6**
Paper: Minor	**CompulsoryPractical/Internship**	**Credits: 4**
Course code: ELS-371-FP	**Course title: Internship**	

Course Objectives and Outcomes:

An internship is gaining first-hand experience by an individual besides comprehending the way of working in an organisation, leading to improve the skill aptitude for a specific job or job role and building research capabilities with learning opportunities. Internships should be such organized that benefits the research intern as well as the internship providing organization. Following are the intended objectives of engaging undergraduate students in internship for employability and research internship programmes:

1. Integration of workshop with workplace
2. Understanding of the world of work:
3. Phygital and hybrid model learning:
4. Developing research aptitude:
5. Exposure in emerging technologies:
6. Enhance entrepreneurial capabilities:
7. Development of decision-making and teamwork skills
8. Cultivate a sense of Social Imagery and Citizenship Responsibility:
9. Stimulate collaborative influence.
10. Enhancing professional competency

INTERNSHIP CATEGORIES

The undergraduate internships would be classified into two types:

i. Internship for enhancing the employability
ii. Internship for developing the research aptitude

The internship programs should be well conceptualized and interactive for building research capabilities/aptitude/skills of our under-graduates/researchers/faculties for

1. Development of project and its execution
2. Decision-making
3. Confidence development
4. Working/coordinating in a team
5. Creative and critical thinking and problem-solving
6. Ethical values
7. Professional development
8. Understand government/local bodies world of work
9. Reference of resource persons in the field
10. Development of online/ simulation-based module for a virtual research internship
11. Understanding the nuances of building a deep-technology start-up
12. Study certain entrepreneurs,
13. Study of the enterprises, farmers, artisans, etc.

Apart from gaining relevant research experience, the interns would learn the following, through research professionals/mentors:

- Ideation and conceptualization of a research question/problem
- Learning about new tools and handling of equipment
- Experimentation and collection of data
- Simulations and development of models
- Preparation and presentation of reports

Further, there are certain verticals that HEIs may incorporate as options while choosing a sector by a student while making registration and undergoing an internship/research internship. The list is indicative only.

1. Trade and Agriculture Area
2. Economy & Banking Financial Services and Insurance Area
3. Logistics, Automotive & Capital Goods Area
4. Fast Moving Consumer Goods & Retail Area
5. Information Technology/Information Technology enabled Services & Electronics Area
6. Handcraft, Art, Design & Music Area
7. Healthcare & Life Science Area
8. Sports, Wellness and Physical Education Area
9. Tourism & Hospitality Area
10. Digitisation & Emerging Technologies (Internet of Things/Artificial Intelligence/Machine Learning/Deep Learning/Augmented Reality/Virtual Reality, etc.) Area
11. Humanitarian, Public Policy and Legal Service Area
12. Communication Area
13. Education Area
14. Sustainable development Area
15. Environment Area
16. Commerce, Medium and Small-Scale Industries Area

ACADEMIC CREDENTIALS & MONITORING OF INTERNSHIP

A. Internship

A minimum of 2-4 credits, out of the required minimum 120/160 credits, of a 3-year UG degree/4-year UG degree (Honours)/4-year UG degree (Honours with Research) can be assigned for Internship as per the National Higher Education Qualifications Framework (NHEQF) and Curriculum and Credit Framework for Undergraduate Programme (CCFUP). An internship of 60 to 120 hours duration after the 4th semester will be mandatory for the students enrolled in UG degree programmes.

For an internship, one credit of Internship means two-hour engagement per week. Accordingly, in a semester of 15 weeks' duration, one credit in this course is equivalent to 30 hours of engagement in a semester.

B. Research Project/Dissertations/Thesis/Project work

For the 4-year UG degree programme (Honours with Research), engagement of students in the dissertations/research project during the entire 8th semester of 12 credits will be considered as a mandatory component for the award of the degree. The students need to essentially submit the research project/dissertations/thesis/project work to the allotted mentor. The submission of the report with the conduction of viva will also be a component for the successful evaluation of the dissertation/research project/thesis/Project work.

The dissertation/research project/thesis work should involve 360 hours' duration during the 8th semester and it will be mandatory for the students enrolled in UG degree programmes (Honours with Research).

Competencies to be developed during Research Internships

3-year UG degree, 4-year UG degree (Honours) and 4-year degree (Honours with Research) programme will be operating strictly adhering to NEP-2020, NHEQF and CCFUP provisions. Based on the higher education qualification level descriptors for Level-5.5 and Level-6 some of the competencies with research orientation should be attained by the students by studying the courses under the Research Ability Enhancement Courses (RAEC) and by undertaking the research internship project.

- The students should be well-versed with the techniques and methods of research that would support knowledge creation.

● The students should have an understanding of complex problem statements and the ability to develop solutions for real-life problems.
● The students will possess a good comprehension ability to interpret the oral and written communications in research papers, and present own interpretations.
● The students will be able to communicate technical information, research findings to the peers.
● The students will be made aware of the research ethics, professional accountability, conduct and will be able to practice the research ethics and appropriate skills in in his/her own research work.
● The student will be able to enhance academic productivity by developing writing and reading skills and can make contributions towards social and economic issues from their research in future.
● The research intern can possess an attitude and skill of adaptability and flexibility for new challenges at organisational and individual level with a mind-set of teamwork and collaborations.

5.2 Duration and Slots for Internship in Curriculum

Each undergraduate student may complete an internship of 2-4 credits during after the 4th semester of the UG degree programme focussing on Hands-on Training/Short Research Project. However, the student who has to go for a 4-year UG degree (Honours with Research) programme will be required to choose courses as given Table 1 during the 8th semester.

Table 1: Activities, Suggested Duration along with a corresponding number of credits of Internship Programme:

S. No.	Courses	Suggested Schedule	Duration	Suggested Activities	Credits
1	● 3-year UG degree ● 4-year UG degree (Honours) ● 4-year UG degree (Honours with Research)	After (4th) Semester	60 -120 hours	Hands-on Training/Short Research Project Seminar attendance Read assigned journals to prepare for seminars Study certain entrepreneurs Social projects Study of the enterprises/ farmers	02-04
2	4-year UG Degree (Honours with Research)	8th Semester	One Semester	(i) HEI may adopt Research Methodology, Research Tools and Techniques, Research Ability Enhancement and Policy Framework Courses (ii)Dissertation/Thesis/Project Work/Research project	08 12

Note: In a 4-year UG degree (Honours) students not undertaking research may do 3 courses for 12 credits in lieu of a research project/dissertation as specified in CCFUP Document.