

AC- 23/07/2020

Item No. : 122

UNIVERSITY OF MUMBAI



**Program: Bachelor of Engineering
in
Electronics Engineering**

Second Year with Effect from AY 2020-21

Third Year with Effect from AY 2021-22

Final Year with Effect from AY 2022-23

**(REV- 2019 'C' Scheme) from Academic Year 2019 – 20
Under**

FACULTY OF SCIENCE & TECHNOLOGY

(As per AICTE guidelines with effect from the academic year 2019–2020)

AC-23/07/2020

Item No. 122

UNIVERSITY OF MUMBAI



Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of the Course	Second Year B E in Electronics Engineering
2	Eligibility for Admission	First Year Engineering passed in line with the Ordinance 0.6242
3	Passing Marks	40%
4	Ordinances / Regulations (if any)	Ordinance 0.6242
5	No. of Years / Semesters	8 Semesters
6	Level	Certificate/Diploma/UG/PG (Strike out which is not applicable)
7	Pattern	Semester/Yearly (Strike out which is not applicable)
8	Status	New/Revised (Strike out which is not applicable)
9	To be implemented from Academic Year	With effect from Academic Year: 2020-2021

Date:23rd July 2020

Signature:

Dr. S. K. Ukarande
Associate Dean
Faculty of Science and Technology
University of Mumbai

Dr Anuradha Muzumdar
Dean
Faculty of Science and Technology
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Preamble

To meet the challenge of ensuring excellence in engineering education, the issue of quality needs to be addressed, debated and taken forward in a systematic manner. Accreditation is the principal means of quality assurance in higher education. The major emphasis of accreditation process is to measure the outcomes of the program that is being accredited. In line with this, the Faculty of Science and Technology (in particular Engineering), of University of Mumbai, has taken a lead in incorporating the philosophy of outcome based education in the process of curriculum development.

Faculty resolved that course objectives and course outcomes are to be clearly defined for each course, so that all faculty members in affiliated institutes, understand the depth and approach of the course to be taught, which will enhance learner's learning process. Choice based Credit and grading system enables a much-required shift in focus from teacher-centric to learner-centric education since the workload estimated is based on the investment of time in learning and not in teaching. It also focuses on continuous evaluation which will enhance the quality of education. Credit assignment for courses is based on 15 weeks teaching learning process. However, content of courses is to be taught in 12-13 weeks and the remaining 2-3 weeks to be utilized for revision, guest lectures, coverage of content beyond syllabus etc.

There was a concern that the earlier revised curriculum was more focused on providing information and knowledge across various domains of the said program, which led to heavily loading students in terms of direct contact hours. In this regard, faculty of science and technology resolved that to minimize the burden of contact hours, total credits of the entire program will be of 170, wherein focus is not only on providing knowledge but also on building skills, attitude and self learning. Therefore in the present curriculum, skill based laboratories and mini projects are made mandatory across all disciplines of engineering in second and third year of programs, which will definitely facilitate self learning of students. The overall credits and approach of the curriculum proposed in the present revision is in line with the AICTE model curriculum.

The present curriculum will be implemented for Second Year of Engineering from the academic year 2020-21. Subsequently this will be carried forward for Third Year and Final Year Engineering in the academic years 2021-22, 2022-23, respectively.

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Incorporation and implementation of online contents from NPTEL/ SWAYAM Platform

The curriculum revision is mainly focused on knowledge component, skill based activities and project based activities. Self learning opportunities are provided to learners. In the revision process this time, in particular Revised syllabus of 'C' scheme, wherever possible, additional resource links of platforms such as NPTEL, Swayam are appropriately provided. In earlier revisions of the curriculum in the years 2012 and 2016, in Revised scheme 'A' and 'B' respectively, efforts were made to use online contents as additional learning materials to enhance learning of students.

In the current revision based on the recommendation of AICTE model curriculum, overall credits are reduced to 171, to provide opportunity of self learning to learner. Learners are now getting sufficient time for self learning either through online courses or additional projects for enhancing their knowledge and skill sets.

The Principals/ HOD's/ Faculties of all the institutes are required to motivate and encourage learners to use additional online resources available on platforms such as NPTEL/ Swayam. Learners can be advised to take up online courses and on successful completion, they are required to submit certification for the same. This will definitely help learners to facilitate their enhanced learning based on their interest.

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Preface

Technical education in the country is undergoing a paradigm shift in current days. Think tank at national level are deliberating on the issues, which are of utmost importance and posed challenge to all the spheres of technical education. Eventually, impact of these developments was visible and as well adopted on bigger scale by almost all universities across the country. These are primarily an adoption of CBCS (Choice base Credit System) and OBE (Outcome based Education) with student centric and learning centric approach. Education sector in the country, as well, facing critical challenges, such as, the quality of graduates, employability, basic skills, ability to take challenges, work ability in the fields, adoption to the situation, leadership qualities, communication skills and ethical behaviour. On other hand, the aspirants for admission to engineering programs are on decline over the years. An overall admission status across the country is almost 50%; posing threat with more than half the vacancies in various colleges and make their survival difficult. In light of these, an All India Council for Technical Education (AICTE), the national regulator, took initiatives and enforced certain policies for betterment, in timely manner. Few of them are highlighted here, these are design of model curriculum for all prevailing streams, mandatory induction program for new entrants, introduction of skill based and inter/cross discipline courses, mandatory industry internships, creation of digital contents, mandate for use of ICT in teaching learning, virtual laboratory and so on.

To keep the pace with these developments in Technical education, it is mandatory for the Institutes & Universities to adopt these initiatives in phased manner, either partially or in toto. Hence, the ongoing curriculum revision process has a crucial role to play. The BoS of Electronics Engineering under the faculty of Science & Technology, under the gamut of Mumbai University has initiated a step towards adoption of these initiatives. We, the members of Electronics Engineering Board of Studies of Mumbai University feel privileged to present the revised version of curriculum for Electronics Engineering program to be implemented from academic year 2020-21. Some of the highlights of the revision are;

- i. Curriculum has been framed with reduced credits and weekly contact hours, thereby providing free slots to the students to brain storm, debate, explore and apply the engineering principles. The leisure provided through this revision shall favour to inculcate innovation and research attitude amongst the students.
- ii. New skill based courses have been incorporated in curriculum keeping in view AICTE model curriculum.
- iii. Skill based Lab courses have been introduced, which shall change the thought process and enhance the programming skills and logical thinking of the students
- iv. Mini-project with assigned credits shall provide an opportunity to work in a group, balancing the group dynamics, develop leadership qualities, facilitate decision making and enhance problem solving ability with focus towards socio-economic development of the country. In addition, it shall be direct application of theoretical knowledge in practice, thereby, nurture learners to become industry ready and enlighten students for Research, Innovation and Entrepreneurship thereby to nurture start-up ecosystem with better means.
- v. An usage of ICT through NPTEL/SWAYAM and other Digital initiatives of Govt. of India shall be encouraged, facilitating the students for self learning and achieve the Graduate Attribute (GA) specified by National Board of accreditation (NBA) i.e. lifelong learning.

Thus, this revision of curriculum aimed at creating deep impact on the teaching learning methodology to be adopted by affiliated Institutes, thereby nurturing the students fraternity in a multifaceted directions and create competent technical manpower with legitimate skills. In times to come, these graduates shall shoulder the responsibilities of proliferation of future technologies and support in a big way for 'Make in India' initiative, a reality. In the process, BoS, Electronics Engineering got whole hearted support from all stakeholders including faculty, Heads of department of affiliating institutes, experts faculty who detailed out the course contents, alumni, industry experts and university official providing all procedural support time to time. We put on record their involvement and sincerely thank one and all for contribution and support extended for this noble cause.

Boards of Studies in Electronics Engineering

Sr. No.	Name	Designation	Sr. No.	Name	Designation
1	Dr. R. N. Awale	Chairman	5	Dr. Rajani Mangala	Member
2	Dr. Jyothi Digge	Member	6	Dr. Vikas Gupta	Member
3	Dr. V. A. Vyawahare	Member	7	Dr. D. J. Pete	Member
4	Dr. Srijia Unnikrishnan	Member	8	Dr. Vivek Agarwal	Member

Program Structure for Second Year Electronics Engineering

**UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)**

SEMESTER IV

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELC401	Engineering Mathematics - IV	3	--	1	3	--	1	4
ELC402	Electronics Devices and Circuits - II	3	--	--	3	--	--	3
ELC403	Microcontroller Applications	3	--	--	3	--	--	3
ELC404	Principles of Communication Engg	3	--	1	3	--	1	4
ELC405	Signals and Systems	3	--	--	3	--	--	3
ELL401	Electronics Devices and Circuits - II Lab	--	2	--	--	1	--	1
ELL402	Microcontroller Applications Lab	--	2	--	--	1	--	1
ELL403	Analog Communication Lab	--	2	--	--	1	--	1
ELL404	Skill Base Lab : Python Programming	--	4	--	--	2	--	2
ELM401	Mini Project - 1B	--	4 ^s	--	--	2	--	2
Total		15	14	2	15	07	2	24

s indicates workload of Learner (Not for Faculty), for Mini Project

Programme Structure for Bachelor of Engineering (B.E.) – Electronics Engineering (Rev. 2019 'C' Scheme)

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Practical and oral	Total
		Internal Assessment			End Sem. Exam.	Exam. Duration (inHrs)			
		Test 1	Test 2	Avg.					
ELC401	Engineering Mathematics - IV	20	20	20	80	3	25	--	125
ELC402	Electronics Devices and Circuits -II	20	20	20	80	3	--	--	100
ELC403	Microcontroller Applications	20	20	20	80	3	--	--	100
ELC404	Principles of Communication Engg	20	20	20	80	3	--	--	100
ELC405	Signals and Systems	20	20	20	80	3	25	--	125
ELL401	Electronics Devices and Circuits - II Lab	--	--	--	--	--	25	25	50
ELL402	Microcontroller Applications Lab	--	--	--	--	--	25	25	50
ELL403	Analog Communication Lab	--	--	--	--	--	25	25	50
ELL404	Skill Base Lab : Python Programming	--	--	--	--	--	50	--	50
ELM401	Mini Project - 1B	--	--	--	--	--	25	25	50
Total		--	--	100	400	--	200	100	800

Note:

1. Students group and load of faculty per week.

MiniProject 1 and 2:

Students can form groups with minimum 2 (Two) and not more than 4 (Four)

Faculty Load: 1 hour per week per four groups

MajorProject 1 and 2:

Students can form groups with minimum 2 (Two) and not more than 4 (Four)

Faculty Load: In Semester VII – ½ hour per week per project group

In Semester VIII – 1 hour per week per project group

2. Out of 4 hours/week allotted for the mini-projects 1-A and 1-B, an expert lecture of at least one hour per week from industry/institute or a field visit to nearby domain specific industry should be arranged.
3. Mini-projects 2-A and 2-B should be based on DLOs.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELC401	Engineering Mathematics - IV	03	--	01	03	--	01	04

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELC401	Engineering Mathematics - IV	20	20	20	80	03	25	--	125

Pre-requisite:

Engineering Mathematics - I, Engineering Mathematics - II, Engineering Mathematics - III, Binomial Distribution.

Course Objectives: The course is aimed;

1. To study the line and contour integrals and expansion of complex valued function in a power series.
2. To understand the basic techniques of statistics for data analysis, Machine learning and AI.
3. To study the probability distributions and expectations.
4. To acquaint with the concepts of vector spaces used in the field of machine learning and engineering problems.
5. To familiarize with the concepts of Quadratic forms and Singular value decomposition.
6. To learn the concepts of Calculus of Variations.

Course Outcomes:

On successful completion of course, learner will be able to;

1. Use the concepts of Complex Integration for evaluating integrals, computing residues & evaluate various contour integrals.
2. Demonstrate the use of Correlation and Regression to the engineering problems in data science, machine learning and AI.
3. Illustrate understanding of the concepts of probability and expectation for getting the spread of the data and distribution of probabilities.
4. Apply the concept of vector spaces and orthogonalization process in Engineering Problems.
5. Use the concept of Quadratic forms and Singular value decomposition in various Engineering applications.
6. Find the extremals of the functional using the concept of Calculus of variation.

Module No.	Detailed Contents	Hrs.
01	<p>Complex Integration</p> <p>1.1 Line Integral, Cauchy's Integral theorem for simple connected and multiply connected regions (without proof), Cauchy's Integral formula (without proof).</p> <p>1.2 Taylor's and Laurent's series (without proof).</p> <p>1.3 Definition of Singularity, Zeroes, poles of $f(z)$, Residues, Cauchy's Residue Theorem (without proof).</p> <p>Self-learning Topics: Application of Residue Theorem to evaluate real integrations, Z-Transform.</p>	7
02	<p>Statistical Techniques</p> <p>2.1 Karl Pearson's Coefficient of correlation (r).</p> <p>2.2 Spearman's Rank correlation coefficient (R) (repeated and non-repeated ranks)</p> <p>2.3 Lines of regression.</p> <p>2.4 Fitting of first and second degree curves.</p> <p>Self-learning Topics: Covariance, fitting of exponential curve.</p>	6
03	<p>Probability Distributions</p> <p>3.1. Baye's Theorem, Random variable: Probability distribution for discrete and continuous random variables, Density function and distribution function.</p> <p>3.2 Expectation, mean and variance.</p> <p>3.3 Probability distribution: Poisson & normal distribution.</p> <p>Self-learning Topics: Moments, Moment Generating Function, Applications of Probability Distributions in Engineering.</p>	7
04	<p>Linear Algebra: Vector Spaces</p> <p>4.1 Vectors in n-dimensional vector space, norm, dot product, The Cauchy Schwarz inequality (with proof), Unit vector.</p> <p>4.2 Orthogonal projection, Orthonormal basis, Gram-Schmidt process for vectors.</p> <p>4.3 Vector spaces over real field, subspaces.</p> <p>Self-Learning Topics:- Linear combinations, linear Dependence and Independence, QR decomposition.</p>	6

05	<p>Linear Algebra: Quadratic Forms</p> <p>5.1 Quadratic forms over real field, Linear Transformation of Quadratic form, Reduction of Quadratic form to diagonal form using congruent transformation.</p> <p>5.2 Rank, Index and Signature of quadratic form, Sylvester’s law of inertia, Value-class of a quadratic form-Definite, Semidefinite and Indefinite.</p> <p>5.3 Reduction of Quadratic form to a canonical form using congruent transformations.</p> <p>5.4 Singular Value Decomposition.</p> <p>Self-learning Topics: Orthogonal Transformations, Applications of Quadratic forms and SVD in Engineering.</p>	7
06	<p>Calculus of Variations:</p> <p>6.1 Euler- Lagrange equation(Without Proof), When F does not contain y, When F does not contain x, When F contains x,y,y’.</p> <p>6.2 Isoperimetric problems-Lagrange Method.</p> <p>6.3 Functions involving higher order derivatives: Rayleigh-Ritz Method.</p> <p>Self-Learning Topics:-Brachistochrone Problem, Variational Problem,Hamilton Principle, Principle of Least action,Several dependent variables.</p>	6
Total		39

Term Work:

General Instructions:

1. Students must be encouraged to write at least 6 class tutorials on entire syllabus.
2. A group of 4-6 students should be assigned a self-learning topic. Students should prepare a presentation/problem solving of 10-15 minutes. This should be considered as mini project in Engineering Mathematics. This project should be graded for 10 marks depending on the performance of the students.

The distribution of Term Work marks will be as follows –

1.	Attendance (Theory and Tutorial)	05 marks
2.	Class Tutorials on entire syllabus	10 marks
3.	Mini project	10 marks

Assessment:

Internal Assessment Test:

Assessment consists of two class tests of 20 marks each. The first-class test (Internal Assessment I) is to be conducted when approx. 40% syllabus is completed and secondclass test (Internal Assessment II) when additional 35% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of total 06 questions, each carrying 20 marks.
2. Total 04 questions need to be solved.
3. Question No: 01 will be compulsory and based on entire syllabus wherein 4 sub-questions of 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.
5. Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

References:

1. Complex Variables and Applications, Brown and Churchill, McGraw-Hill education.
2. Probability, Statistics and Random Processes, T. Veerarajan, McGraw-Hill education.
3. Advanced engineering mathematics H.K. Das, S. Chand, Publications.
4. Higher Engineering Mathematics B. V. Ramana, Tata Mc-Graw Hill Publication
5. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication
6. Advanced Engineering Mathematics Wylie and Barret, Tata Mc-Graw Hill.
7. Beginning Linear Algebra Seymour Lipschutz Schaum's Outline series, Mc-Graw Hill Publication
8. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELC402	Electronic Devices & Circuits - II	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELC402	Electronic Devices & Circuits - II	20	20	20	80	03	--	--	100

Pre-requisite :

- ELC302: Electronic Devices and Circuits - I

Course Objectives:

1. To enhance comprehension capabilities of students through understanding of electronic devices and circuits.
2. To perform DC and AC analysis of single stage and multistage amplifiers.
3. To design electronic circuits using semiconductor devices.

Course Outcomes:

After successful completion of the course students will be able to:

1. Students will be able to understand performance of amplifiers with the help of frequency response.
2. Students will be able to perform DC and AC analysis of single stage and multistage amplifiers, oscillators differential amplifiers and power amplifiers.
3. Students will be able to derive expression for performance parameters in terms of circuit and device parameters.
4. Student will be able to select appropriate circuit for given specifications/applications.

Module No.	Unit No.	Contents	Hrs.
1		Frequency Response of Amplifiers	7
	1.1	Low frequency response and analysis: Effect of coupling, bypass and load capacitances on single stage MOSFET amplifiers.	
	1.2	High frequency response and analysis: Effect of parasitic capacitances on MOSFET amplifiers. High frequency equivalent circuit of MOSFET, Miller's theorem, effect of Miller's capacitance, unity gain bandwidth.	
2		Frequency Response of Multistage Amplifiers	7
	2.1	Types of coupling. Low, mid and high frequency response and analysis of multistage amplifiers (CS-CS, CS-CG).	
3		Feedback Amplifiers	5
	3.1	Types of negative feedback, block diagram representation, Effect of negative feedback on Input impedance, Output impedance, Gain and Bandwidth with derivation, feedback topologies (Introduction only).	
	3.2	Analysis of voltage series negative feedback with appropriate circuits.	
4		Oscillators	4
	4.1	Positive feedback and principle of oscillations, RC oscillators: Phase shift oscillators, Wien bridge oscillators, LC Oscillators: Hartley and Colpitts. Crystal Oscillator (MOSFET circuit analysis).	
5		Differential Amplifiers	8
	5.1	MOSFET current sources, Cascode current mirror, advanced MOSFET active load, small signal analysis: MOSFET active load.	
	5.2	Basic MOSFET differential amplifier, DC characteristics, transfer characteristics, differential and common mode input impedances. MOSFET differential amplifier with active load.	
6		Power Amplifiers	8
	6.1	Power MOSFETs, Heat Sinks, Class A, Class B, Class C and Class AB operation, Power efficiency.	
	6.2	Class AB output stage with diode biasing, VBE multiplier biasing, input buffer transistors, Darlington configuration.	
Total			39

Text Books:

1. Donald A. Neamen, "Electronic Circuit Analysis and Design", TATA McGraw Hill, 2nd Edition.
2. Adel S. Sedra, Kenneth C. Smith and Arun N Chandorkar, "Microelectronic Circuits Theory and Applications", International Version, OXFORD International Students Edition, Fifth Edition.

Reference Books:

1. Robert Boylestad," Electronic Devices and Circuit Theory", Pearson.
2. David A. Bell, "Electronic Devices and Circuits", Oxford, Fifth Edition.
3. Muhammad H. Rashid, "Microelectronics Circuits Analysis and Design", Cengage
4. S. Salivahanan, N. Suresh Kumar, "Electronic Devices and Circuits", Tata McGraw Hill.

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules.
5. Weightage of each module in question paper will be proportional to the number of respective lecture hours mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELC403	Microcontroller Applications	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELC403	Microcontroller Applications	20	20	20	80	03	--	--	100

Course Pre-requisite:

1. ELC302: Electronics Devices and Circuits –I
2. ELC303: Digital Logic Circuits

Course Objectives:

1. To study the Architecture, Memory and hardware features of the 8051 microcontroller.
2. To study Assembly and C language programming for 8051.
3. To study interfacing of various I/O devices.
4. To build a microcontroller-based system.

Course Outcomes:

After successful completion of the course students will be able to:

1. To explain fundamental concepts of microcontrollers.
2. To develop programming skills for microcontrollers using Assembly and C concepts
3. To interface various devices to the microcontroller
4. To design and implement microcontroller-based systems.

Module No.	Unit No.	Contents	Hrs.
1		8051 Microcontroller Architecture	06
	1.1	Introduction to the concepts of Microprocessors and Microcontrollers	
	1.2	Prerequisites: Concept of Buses, Read/write operations, T state, Machine cycle and Instruction cycle	
	1.3	8051 Architecture	
	1.4	8051 Memory organisation	
	1.5	RISC and CISC Concepts, Harvard and Von Neumann Architectures	
	1.6	Overview of various available Microcontrollers	
	1.7	Applications of Microcontrollers	
2		8051 Assembly language programming	06
	2.1	Addressing modes of 8051.	
	2.2	Assembler Directives	
	2.3	Instruction Set: Data transfer instructions, Arithmetic instructions, Logical instructions, Branching instructions.	
3		8051 Internal Hardware	07
	3.1	I/O ports and programming	
	3.2	Timers/Counters and programming	
	3.3	Serial port and programming	
	3.4	Interrupts and programming	
	3.5	Low power modes of the 8051	
4		8051 programming in Embedded C	06
	4.1	Embedded C-programming concepts: Data types, Modifiers, Qualifiers, Functions, Macros, Interrupt service routines.	
	4.2	Embedded C programming for 8051 (including programming I/O ports, Timers/Counters, Serial port and Interrupts)	
5		8051 Interfacing –Part 1	07
	5.1	Interfacing external memory to 8051	
	5.2	Display interfacing: 7-segment LED display, 16x2 generic alphanumeric LCD display.	
	5.3	Keyboard interfacing: 4x4 matrix keyboard	
		<i>(Interfacing examples must be done using Assembly language & Embedded C)</i>	
6		8051 Interfacing –Part 2	07
	6.1	Analog devices interfacing: 8-bit ADC, 8-bit DAC, temperature sensor (LM35)	
	6.2	Motor interfacing: Relay, DC motor (speed control using PWM), Stepper motor and Servo motor.	
	6.3	8051 Microcontroller based system design (including Sensors and Actuators)	
		<i>(Interfacing examples must be done using Assembly language & Embedded C)</i>	
Total			39

Text Books:

1. M.A.Mazidi, J.C.Mazidi, Rolin D. McKinlay, “The 8051 Microcontroller and Embedded Systems Using Assembly and C”, Pearson Education, Second Edition, 2007.
2. Kenneth J. Ayala, “The 8051 Microcontroller”, Cengage Learning India Pvt. Ltd, Third Edition, 2005.

Reference Books:

1. Raj Kamal, “Microcontrollers: Architecture, Programming, Interfacing and System Design”, Pearson Education, 2009.
2. Manish K Patel, “The 8051 Microcontroller Based Embedded Systems”, McGraw Hill, 2014.
3. Ajay V Deshmukh, “Microcontroller Theory And Applications “, Tata Mcgraw Hill, 2017

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No.1 will be compulsory and based on entire syllabus wherein sub questions of 2 to 5 marks will be asked.
4. Remaining questions will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Term Work	Practical or Oral	Total
ELC404	Principles of Communication Engineering	03	--	--	03	--	--	03

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELC404	Principles of Communication Engineering	20	20	20	80	3	--	--	100

Prerequisite:

- Engineering Mathematics - III
- Engineering Mathematics - IV

Course Objectives:

1. Understand the need for various analog modulation techniques
2. Analyze the characteristics of the receivers
3. Understand pulse modulation methods
4. Identify the necessity of multiplexing

Course Outcomes:

After successful completion of the course students will be able to:

1. describe the various elements of communication system.
2. recognize the need for multiplexing techniques.
3. analyze the performance of different analog modulation methods.
4. illustrate generation and detection of amplitude and frequency modulated systems.
5. characterize pulse modulation techniques.

Module No.	Unit No.	Topics	Hrs
1		Introduction to Electronic Communication	04
	1.1	Introduction: Electromagnetic frequency spectrum, concepts of wave propagation-ground wave, sky wave and space wave	
	1.2	Elements of communication systems: Information sources, communication channels, noise, sources of noises, need for modulation, bandwidth and power trade-off.	
2		Amplitude Modulation and demodulation	10
	2.1	Amplitude Modulation: Types of Analog Modulation, Principles of Amplitude Modulation, AM for a Complex Modulating Signal, AM Power Distribution, AM Current Distribution, Limitations of AM, AM modulators and Demodulator	
	2.2	Types of AM: Modulation & Demodulation Techniques: DSB-SC, SSB-SC, Comparison of AM, DSBSC and SSB	
	2.3	Applications of AM: AM Radio broadcasting, TV broadcasting of video	
3		Angle modulation and demodulation	09
	3.1	Frequency Modulation: Principles of Angle Modulation, Theory of FM— Basic Concepts, Spectrum Analysis of FM Wave, Narrowband and Wideband FM, Noise triangle, Pre-emphasis, de-emphasis FM Generation: Direct methods and Indirect method, FM Detection: Frequency discriminator and Phase discriminator methods	
	3.2	Phase Modulation: Theory of Phase Modulation, Relationship between FM and PM, Advantages and Disadvantages of Angle Modulation, Comparison of AM, FM and PM	
	3.3	Applications of FM: FM Radio broadcasting, TV broadcasting of sound	
4		Radio Transmitters and Receivers	06
	4.1	Radio receivers: Receiver Characteristics: Sensitivity, Selectivity, Fidelity, Image frequency rejection ratio, TRF Receivers and its characteristics, Concept of Heterodyning, Superheterodyne Receiver, choice of Intermediate frequency	
	4.2	AM and FM Transmitters and Receivers: AM and FM Radio Transmitters, AM and FM Radio Receivers, Practical diode detector, Automatic Gain Control (AGC), Types of AGC, Automatic Frequency Control (AFC) and Importance of Limiter	
5		Pulse-Modulation and Multiplexing	10
	5.1	Introduction to digital transmission of signals: comparison of Digital Analog Transmissions, Concept of regenerative Repeater	
	5.2	Sampling and quantization: Sampling Theorem, Aliasing error, Natural Sampling, Flat top sampling, Quantization of Signals	
	5.3	Pulse Modulation Techniques: Generation and detection of Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM)	
	5.4	PCM and Multiplexing: Pulse-Code Modulation (PCM), Significance of Companding for voice signals, Delta Modulation, Time Division Multiplexing (TDM) and Frequency Division Multiplexing (FDM)	
Total			39

Text Books:

1. Kennedy and Davis, “Electronics Communication System”, Tata McGrawHill, Fourth Edition
2. T L Singal, “Analog and Digital Communication”, Tata McGrawHill
3. B.P. Lathi, “Modern Digital and analog Communication System”, OXFORD, Fourth Edition

Reference Books:

1. Wayne Tomasi, “Electronics Communication Systems”, Pearson Education, Fifth Edition
2. Taub and Schilling, “Principles of Communication Systems”, Tata McGraw Hill, Fourth Edition
3. Roy Blake, “Electronics Communication System”, Thomson learning, Second Edition
4. R P Singh & Sapre, “Analog and Digital communication”, Tata McGraw Hill, Third Edition
5. Robert J. Schoenbeck, “Electronics communications modulation and transmission”, Second Edition
6. Lean W Couch, “Digital and Analog communication system”, Pearson Education, Sixth Edition
7. Roddy Coolen, “Electronic Communications”, PHI, Fourth Edition

Internal Assessment (IA):

Two tests must be conducted which should cover at least 80% of syllabus. The average marks of both the test will be considered as final IA marks.

End Semester Examination:

1. Question paper will comprise of 6 questions, each carrying 20marks.
2. The students need to solve total 4 questions.
3. Question No. 1 will be compulsory and based on entire syllabus.
4. Remaining questions (Q2 to Q6) will be set from all modules.
5. Weightage of each module in question paper will be proportional to the number of respective lecture hours mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELC405	Signals and Systems	03	--	01	03	--	01	04

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal Assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELC405	Signals and Systems	20	20	20	80	03	25	--	125

Course Pre-requisites:

- Basic knowledge of - Integration, Differentiation, Complex Numbers, Partial Fractions
- Basics of Laplace transform, Fourier transform and Z transform (Engineering Mathematics - I, II & III)

Course Objectives:

1. To introduce the mathematical concepts of continuous and discrete time signals and systems.
2. To acquaint the students with various time domain and frequency domain methods for analysis of signals and systems.

Course Outcomes:

After successful completion of the course students will be able to:

1. Identify and differentiate between continuous and discrete time signals and systems.
2. Develop input output relationship for LTI systems.
3. Apply the concept of Laplace transform and understand conversion from time domain to frequency domain for continuous time systems.
4. Apply the concept of Z transform and comprehend conversion from time domain to frequency domain for discrete time systems.
5. Analyse continuous time signals using Fourier series.
6. Analyse discrete time signals using Fourier Transform.

Module No.	Unit No.	CONTENTS	Hrs.
1		Continuous and Discrete Time Signals and Systems	8
	1.1	Mathematical Representation and Classification of Continuous Time (CT) and Discrete Time (DT) Signals Arithmetic Operations on Signals, Time Shifting, Time Scaling, Time Reversal of Signals, Sampling Theorem and Aliasing	
	1.2	Mathematical Representation and Classification of CT systems	
	1.3	Mathematical Representation and Classification of DT systems	
2		Time Domain Analysis of Continuous And Discrete Signals and Systems	7
	2.1	Properties of Linear Time Invariant (LTI) systems, Impulse and Step Response	
	2.2	Use of Convolution Integral and Convolution Sum and Correlation for Analysis of LTI Systems	
	2.3	Properties of Convolution Integral/Sum	
3		Frequency Domain Analysis of Continuous Time System using Laplace Transform	6
	3.1	Need of Laplace Transform, Review of Laplace Transform, Concept of ROC, Properties, Inverse Laplace Transform, Poles and Zeros	
	3.2	Analysis and characterization of LTI system using Laplace transform: impulse and step response, causality, stability, stability of causal system	
4		Frequency Domain Analysis of Discrete Time System using Z Transform	6
	4.1	Need for Z Transform, Definition, Properties of Unilateral and Bilateral Z Transform, Mapping with s Plane, Relationship with Laplace Transform	
	4.2	Z Transform of Standard Signals, ROC, Poles and Zeros of Transfer Function, Inverse Z Transform	
	4.3	Analysis and Characterization of LTI System Using Z Transform: Impulse and Step Response, Causality, Stability in z-Domain.	
5		Frequency Domain Analysis of Continuous Time Signals	6
	5.1	Fourier Series of Continuous Time Signals, Properties of Fourier series	
	5.2	Fourier Transform, Properties of Fourier Transform, Fourier Transform of Standard Signals, Relationship Between Fourier and Laplace Transform	
6		Frequency Domain Analysis of Discrete Time Signals	6
	6.1	Concept of Discrete Time Fourier Series, Properties of DTFS, Discrete Time Fourier Transform and Determination of Magnitude and Phase Functions using DTFT	
	6.2	Relation between Z transform and DTFT	
Total			39

Text Books:

1. Tarun Kumar Rawat, “Signals and Systems”, Oxford University Press, 2016.
2. A. Nagoor Kani, “Signals and Systems”, Tata McGraw-Hill Education, 2014.

Reference Books:

1. John Proakis and Dimitris Monolakis, “Digital Signal Processing”, Pearson Publications, 4th Edition, 2006.
2. Alan V. Oppenheim, Alan S. Willsky, and S. Hamid Nawab, “Signals and Systems”, 2nd Edition, PHI learning, 2010
3. B. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2nd Edition, 2006.

Internal Assessment (IA):

Two tests must be conducted, which should cover at least 80% of the syllabus. The average marks of both the tests will be considered as final IA marks.

End Semester Examination:

1. Question paper will comprise of 6 questions, each of 20 marks.
2. Total 4 questions need to be solved.
3. Question No. 1 will be compulsory and based on entire syllabus, wherein sub questions of 2 to 5 marks will be asked.
4. The remaining questions will be selected from all the modules.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELL401	Electronic Devices & Circuits - II Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme								
		Theory Marks				End Sem. Exam	Exam duration Hours	Term Work	Practical / Oral	Total
		Internal assessment			Test 1					
		Test 1	Test 2	Avg of Test 1 and Test 2						
ELL401	Electronic Devices & Circuits - II Lab	--	--	--	--	--	25	25	50	

Term Work:

At least 10 experiments covering entire syllabus of **ELC 402** (Electronic Devices and Circuits-II) should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiment must be graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Suggested List of Experiments

Sr. No.	Hardware Experiment Name
1	To implement single stage MOSFET amplifier (CS) and study its frequency response
2	To implement Cascode amplifier and study its frequency response.
3	To determine input and output impedance of amplifier with and without feedback.
4	To Implement two stage RC coupled CE amplifier and plot frequency response.
5	To perform an experiment to study performance of RC phase shift oscillator.

6	To perform an experiment to study performance of Hartley oscillator.
7	To perform an experiment to study performance of Colpitts oscillator.
8	To perform an experiment to study performance of Crystal oscillator.
9	To perform an experiment to study Class B push pull amplifier.
10	To perform an experiment to study Class AB amplifier.

Suggested Simulation Experiments:

Sr. No.	Simulation Experiment Name
1	SPICE simulation of frequency response of single stage CS MOSFET amplifier.
2	SPICE simulation of frequency response of Cascade amplifier.
3	SPICE simulation of frequency response of two stage RC coupled CS amplifier.
4	SPICE simulation of RC phase shift oscillator.
5	SPICE simulation of Wein Bridge oscillator.
6	SPICE simulation of Hartley oscillator.
7	SPICE simulation of Colpitts oscillator.
8	SPICE simulation of Crystal oscillator.
9	SPICE simulation of Class B push pull amplifier.
10	SPICE simulation of Class AB amplifier.

Note:

Suggested List of Experiments is indicative. However, flexibilities lies with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELL402	Microcontroller Applications Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELL402	Microcontroller Applications Lab	--	--	--	--	--	25	25	50

Prerequisite: C Programming

Course Objectives:

1. To study Assembly and C language programming for 8051.
2. To study interfacing of various I/O devices.

Course Outcomes:

After successful completion of the course students will be able to:

1. To develop programming skills for microcontrollers using Assembly and C concepts
2. To interface various devices to the Microcontroller

Term Work:

At least 10 experiments covering entire syllabus of **Microcontroller Applications (ELC403)** should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiment must be graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Suggested List of Experiments

Sr. No.	Experiment title
1	Arithmetic Operations
2	Logical Operations
3	Branching operations
4	I/O port programming
5	Applications of Timers
6	Serial port programming
7	Interrupts programming
8	Seven Segment Display Interfacing
9	LCD Interfacing
10	Interfacing a Matrix keyboard
11	Interfacing a Relay
12	Sensor interfacing using an ADC
13	Generation of different waveforms using DAC
14	Speed Control of DC Motor (using PWM)
15	Stepper Motor Interfacing

Atleast 05 experiments must be performed using Embedded C and experiments should have mix i.e. Hardware and simulation ones.

Note:

Suggested List of Experiments is indicative. However, flexibilities lies with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELL403	Principles of Communication Engineering Lab	--	02	--	--	01	--	01

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg of Test 1 and Test 2					
ELL403	Principles of Communication Engineering Lab	--	--	--	--	--	25	25	50

Term Work:

At least 10 experiments covering entire syllabus of *ELC 404* (Principles of Communication Engg.) should be set to have well predefined inference and conclusion. The experiments should be student centric and attempt should be made to make experiments more meaningful, interesting. Simulation experiments are also encouraged. Experiment must be graded from time to time. The grades should be converted into marks as per the Credit and Grading System manual and should be added and averaged. The grading and term work assessment should be done based on this scheme. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Practical and Oral exam will be based on the entire syllabus.

Suggested List of experiments/Tutorials:

Sr. No.	Tutorial/Experiment Title
1	Tutorial on Signal Representations- Fourier Series
2	Tutorial on Signal Representations- Fourier Transforms
3	Amplitude Modulation and demodulation
4	DSB-SC Balanced Modulator
5	Frequency Modulation and Demodulation

6	Super-heterodyne radio receiver
7	Pulse Amplitude Modulation, Pulse Width Modulation and Pulse Position Modulation
8	Verification of Sampling Theorem
9	Pulse Code Modulation
10	Delta Modulation and Adaptive Delta Modulation

List of Simulation/Software Experiments

Sr. No.	Simulation Experiments Name
1	Simulation of Generation of Signals
2	Simulation of Fourier Transform
3	Simulation of PSD of a Signal
4	Simulation of Multiplexing (TDM/FDM)
5	Simulation of Amplitude Modulation and Demodulation
6	Simulation of Frequency Modulation and Demodulation
7	Simulation of Phase Modulation and Demodulation

Note:

Suggested List of Experiments is indicative. However, flexibility lies with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELL 404	Skill-Base Lab: Python Programming	--	01 ^s + 03	--	--	02	--	02

§ One-hour theory per week for the complete class. (For simplifying its implementation, 2hrs. theory on alternate weeks can be conducted)

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical and Oral	Total
		Internal Assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ELL404	Skill-Base Lab: Python Programming	--	--	--	--	--	50	--	50

Course pre-requisite:

ECL 304 – Skill Lab: C++ and Java Programming

Course Objectives:

1. Describe the core syntax and semantics of Python programming language.
2. Explore file handling in Python
3. Infer the Object-oriented Programming concepts in Python
4. Formulate GUI Programming and Databases operations in Python
5. Develop applications using variety of libraries and functions

Course Outcomes:

After successful completion of the course student will be able to;

1. Describe syntax and semantics in Python
2. Illustrate different file handling operations
3. Interpret object-oriented programming in Python
4. Design GUI Applications in Python
5. Express proficiency in the handling Python libraries for data science
6. Develop machine learning applications using Python.

Module No.	Unit No.	Content	Hrs.
1		Introduction to Python	06
	1.1	Introduction to Python, Installation and resources, Identifiers and Keywords, Comments, Indentation and Multi-lining, Variables (Local and Global), data types, Arithmetic, Comparative, Logical and Identity Operators, Bitwise Operators, Expressions, Print statement and Formats, Input Statements in python.	
	1.2	Strings, Lists, Tuples, Dictionaries, Sets, Accessing Elements, Properties, Operations and methods on these data structures.	
	1.3	Decision Flow Control Statement: if and else statement, Nested If statement, Loop Statement: While Loop, do and while loop, for loop statement, Continue, Break and pass Statement, Conditional Statements.	
2		Functions and File I/O Handling	06
	2.1	Functions: Built-in-functions, library functions, Defining and calling the functions, Return statements, Passing the arguments, Lambda Functions, Recursive functions, Modules and importing packages in python code.	
	2.2	File Input/Output: Files I/O operations, Read / Write Operations, File Opening Modes, with keywords, Moving within a file, Manipulating files and directories, OS and SYS modules.	
3		Object Oriented Programming	08
	3.1	Classes and Objects, Public and Private Members, Class Declaration and Object Creation, Object Initialization, Class Variables and methods, Accessing Object and Class Attributes.	
	3.2	Intricacies of Classes and Objects, Inheritance, Constructor in Inheritance, Exception Handling, Link list, Stack, Queues.	
4		Graphical User Interface and Image processing	08
	4.1	Graphical User Interface using Tkinter Library module, creating simple GUI; Buttons, Labels, entry fields, widget attributes.	
	4.2	Database: Sqlite database connection, Create, Append, update, delete records from database using GUI.	
	4.3	Basic Image Processing using OpenCV library, simple image manipulation using image module.	
5		Numpy, Pandas, Matplotlib, Seaborn, Scipy	10
	5.1	Introduction to Numpy, Creating and Printing Ndarray, Class and Attributes of Ndarray, Basic operation, Copy and view, Mathematical Functions of Numpy.	
	5.2	Introduction to Pandas, Understanding Dataframe, View and Select Data, Missing Values, Data Operations, File read and write operation.	
	5.3	Introduction to Matplotlib library, Line properties, Plots and subplots, Types of Plots, Introduction to Seaborn.	
	5.4	Introduction to Scipy, Scipy Sub packages – Integration and Optimization, Eigen	

		values and Eigen Vectors, Statistic, Weave and IO.	
6		Python Applications	10
	6.1	GUI based applications	
	6.2	Applications in Image Processing, Networking	
	6.3	Machine Learning, Linear Regression, Logistic Regression	
	6.4	Classification using K nearest neighbor	
	6.5	Support Vector Machines	
Total			48

Text Books:

1. Yashvant Kanetkar, “Let us Python: Python is Future, Embrace it fast”, BPB Publications; 1st edition (8 July 2019).
2. Dusty Phillips, “Python 3 object-oriented Programming”, Second Edition PACKT Publisher, August 2015.
3. John Grayson, “Python and Tkinter Programming”, Manning Publications (1 March 1999).
4. Core Python Programming, Dr. R. Nageswara Rao, Dreamtech Press
5. Beginning Python: Using Python 2.6 and Python 3.1. James Payne, Wrox publication
6. Introduction to computing and problem solving using python, E Balagurusamy, McGraw Hill Education

Reference books:

1. Eric Matthes, “Python Crash Course A hands-on, Project Based Introduction to programming” No Starch Press; 1st edition (8 December 2015).
2. Paul Barry, “Head First Python” O’Reilly; 2nd edition (16 December 2016)
3. Zed A. Shaw, “Learn Python the Hard Way: A Very Simple Introduction to the Terrifyingly
4. Beautiful World of Computers and Code”, Addison Wesley; 3rd edition (1 October 2013).
5. Andreas C. Mueller, “Introduction to Machine Learning with Python”, O’Reilly; 1st edition (7 October 2016)
6. David Beazley, Brian K. Jones, “Python Cookbook: Recipes for Mastering Python 3”, O’Reilly Media; 3rd edition (10 May 2013).
7. Bhaskar Chaudhary, “Tkinter GUI Application Development Blueprints: Master GUI
8. Programming in Tkinter as you design, implement, and deliver 10 real world application”, Packt Publishing (November 30, 2015)

Software Tools:

- Python IDE: <https://www.python.org/downloads/>
- Anaconda Environment: <https://www.anaconda.com/distribution/>

Online Repository:

1. Github
2. Python 3 Documentation: <https://docs.python.org/3/>
3. "The Python Tutorial", <http://docs.python.org/release/3.0.1/tutorial/>
4. <http://spoken-tutorial.org>
5. Python 3 Tkinter library Documentation: <https://docs.python.org/3/library/tk.html>
6. Numpy Documentation: <https://numpy.org/doc/>
7. Pandas Documentation: <https://pandas.pydata.org/docs/>
8. Matplotlib Documentation: <https://matplotlib.org/3.2.1/contents.html>
9. Scipy Documentation: <https://www.scipy.org/docs.html>
10. Machine Learning Algorithm Documentation: <https://scikit-learn.org/stable/>
11. <https://nptel.ac.in/courses/106/106/106106182/>

Sr. No.	Problem Statement	Module No.
1	<ol style="list-style-type: none"> 1. Write python programs to understand expressions, variables, quotes, basic math operations, list, tuples, dictionaries, arrays etc. 2. Write Python program to implement byte array, range, set and different STRING Functions (len, count, lower, sorted etc) 3. Write Python program to implement control structures. 4. Assume a suitable value for distance between two cities (in km). 5. Write a program to convert and print this distance in meters, feet, inches and centimeter. 6. Write a program to carry out the following operations on the given set 7. $s = \{10, 2, -3, 4, 5, 88\}$ <ol style="list-style-type: none"> a) Number of items in sets s b) Maximum element in sets s c) Minimum element in sets s d) Sum of all elements in sets s e) Obtain a new sorted set from s, set s remaining unchanged f) Report whether 100 is an element of sets s g) Report whether -3 is not an element of sets s. 	Module 1
2	<ol style="list-style-type: none"> 1. Write python program to understand different File handling operations 2. Create 3 lists – a list of names, a list of ages and a list of salaries. 3. Generate and print a list of tuples containing name, age and salary from the 3 lists. From this list generate 3 tuples – one containing all names, another containing all ages and third containing all salaries. 	Module 2
3	<ol style="list-style-type: none"> 1. Write Python program to implement classes, object, Static method and inner class 2. If any integer is given as in input through the keyboard, write a program to find whether it is odd or even number. 3. If ages of Ram, Shyam, and Ajay are given as an input through the keyboard, write a program to determine the youngest of the three. 4. Write a program that prints square root and cube root of numbers from 1 to 10, up to 4 	Module 3

	<p>decimal places. Ensure that the output is displayed in separate lines, with number center-justified and square and cube roots right-justified.</p> <ol style="list-style-type: none"> 5. Write a program to find the factorial value of any number entered through the keyboard. 6. Write a program that defines a function <code>count_lower_upper()</code> that accepts a string and calculates the number of uppercase and lowercase alphabets in it. It should return these values as a dictionary. Call this function for some sample strings. 7. A 5-digit positive integer is entered through the keyboard, write a recursive function to calculate sum of digits of 5-digit number. 	
4	<ol style="list-style-type: none"> 1. Write Python program to create, append, update, delete records from database using GUI. 2. Write Python program to obtain histogram of any image 3. Write Python Program to split color image in R,G,B and obtain <ol style="list-style-type: none"> a. individual histograms. 4. Write Python program for histogram equalization 5. Write Python Program for edge detection 6. Write Python Program for image segmentation 7. Write Python program to implement GUI Canvas application using Tkinter 8. Write Python program to implement GUI Frame application using Tkinter 	Module 4
5	<ol style="list-style-type: none"> 1. Write Python program to study define, edit arrays and perform arithmetic operations. 2. Write python program to study selection, indexing, merging, joining, concatenation in data frames 3. Evaluate the dataset containing the GDPs of different countries to: <ol style="list-style-type: none"> a) Find and print the name of the country with the highest GDP b) Find and print the name of the country with the lowest GDP c) Print text and input values iteratively d) Print the entire list of the countries with their GDPs e) Print the highest GDP value, lowest GDP value, mean GDP value, standardized GDP value, and the sum of all the GDPs 4. Analyze the Federal Aviation Authority (FAA) dataset using Pandas to do the following: <ol style="list-style-type: none"> a) View: aircraft make name, state name, aircraft model name, text information, flight phase, event description type, fatal flag b) Clean the dataset and replace the fatal flag NaN with “No”. c) Find the aircraft types and their occurrences in the dataset d) Remove all the observations where aircraft names are not available e) Display the observations where fatal flag is “Yes” 5. Analyze the “auto mpg data” and draw a pair plot using seaborn library for mpg, weight, and origin. <ol style="list-style-type: none"> (a) Origin: This dataset was taken from the StatLib library maintained at Carnegie Mellon University. <ul style="list-style-type: none"> • Number of Instances: 398 • Number of Attributes: 9 including the class attribute • Attribute Information: <ul style="list-style-type: none"> • mpg: continuous • cylinders: multi-valued discrete • displacement: continuous 	Module 5

	<ul style="list-style-type: none"> • horsepower: continuous • weight: continuous • acceleration: continuous • model year: multi-valued discrete • origin: multi-valued discrete • car name: string (unique for each instance) <p>6. Write python program to use SciPy to solve a linear algebra problem.</p> <p>7. There is a test with 30 questions worth 150 marks. The test has two types of questions:</p> <ol style="list-style-type: none"> 1. True or false – carries 4 marks each 2. Multiple-choice – carries 9 marks each. <p>Find the number of true or false and multiple-choice questions.</p>	
6	<ol style="list-style-type: none"> 1. Write python program to study linear regression 2. Write python program to study multiple linear regression 3. Write python program to study logistic regression 4. Write python program to study Support Vector Machine 5. Write python program to study decision tree algorithm 6. Write python program to study two-way communication between client and server. 	Module 6

Suggested list of course projects:

- Speed typing Test using Python
- Music player in Python
- Calculator app using tkinter
- Train announcement system using python
- Dice rolling simulator
- Expense tracker
- Contact book using python
- Develop classification model using freely available datasets
- Develop python application for sentiment analysis

Note:

Suggested List of Experiments and problem statements are indicative. However, flexibility lies with individual course instructor to design and introduce new, innovative and challenging experiments, (limited to maximum 30% variation to the suggested list) from within the curriculum, so that, the fundamentals and applications can be explored to give greater clarity to the students and they can be motivated to think differently.

Term Work:

At least 12 experiments and 1 course project should be performed. Term work assessment must be based on the overall performance of the student with every experiment graded from time to time. The grades will be converted to marks as per “Credit and Grading System” manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

Course Code	Course Name	Credits
ELM 401	Mini Project - 1B	02

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical/ Oral	Total
		Internal Assessment			End Sem. Exam	Exam duration Hours			
		Test 1	Test 2	Avg. of Test 1 and Test 2					
ELM 401	Mini Project - 1B	--	--	--	--	--	25	25	50

Objectives

1. To acquaint with the process of identifying the needs and converting it into the problem.
2. To familiarize the process of solving the problem in a group.
3. To acquaint with the process of applying basic engineering fundamentals to attempt solutions to the problems.
4. To inculcate the process of self-learning and research.

Outcomes:

Learner will be able to...

1. Identify problems based on societal /research needs.
2. Apply Knowledge and skill to solve societal problems in a group.
3. Develop interpersonal skills to work as member of a group or leader.
4. Draw the proper inferences from available results through theoretical/ experimental/simulations.
5. Analyse the impact of solutions in societal and environmental context for sustainable development.
6. Use standard norms of engineering practices
7. Excel in written and oral communication.
8. Demonstrate capabilities of self-learning in a group, which leads to life long learning.
9. Demonstrate project management principles during project work.

Guidelines for Mini Project

- Students shall form a group of 3 to 4 students, while forming a group shall not be allowed less than three or more than four students, as it is a group activity.
- Students should do survey and identify needs, which shall be converted into problem statement for mini project in consultation with faculty supervisor/head of department/internal committee of faculties.

- Students shall submit implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini project.
- A log book to be prepared by each group, wherein group can record weekly work progress, guide/supervisor can verify and record notes/comments.
- Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
- Students in a group shall understand problem effectively, propose multiple solution and select best possible solution in consultation with guide/ supervisor.
- Students shall convert the best solution into working model using various components of their domain areas and demonstrate.
- The solution to be validated with proper justification and report to be compiled in standard format of University of Mumbai.
- With the focus on the self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV. Similarly, Mini Project 2 in semesters V and VI.
- However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on case by case basis.

Guidelines for Assessment of Mini Project:

Term Work

- The review/ progress monitoring committee shall be constituted by head of departments of each institute. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester.
- In continuous assessment focus shall also be on each individual student, assessment based on individual's contribution in group activity, their understanding and response to questions.
- Distribution of Term work marks for both semesters shall be as below;
 - Marks awarded by guide/supervisor based on log book: 10
 - Marks awarded by review committee : 10
 - Quality of Project report : 05

Review/progress monitoring committee may consider following points for assessment based on either one year or half year project as mentioned in general guidelines.

One-year project:

- In first semester entire theoretical solution shall be ready, including components/system selection and cost analysis. Two reviews will be conducted based on presentation given by students group.
 - First shall be for finalisation of problem
 - Second shall be on finalisation of proposed solution of problem.
- In second semester expected work shall be procurement of components/systems, building of working prototype, testing and validation of results based on work completed in an earlier semester.
 - First review is based on readiness of building working prototype to be conducted.
 - Second review shall be based on poster presentation cum demonstration of working model in last month of the said semester.

Half-year project:

- In this case in one semester students' group shall complete project in all aspects including,
 - Identification of need/problem
 - Proposed final solution
 - Procurement of components/systems
 - Building prototype and testing
- Two reviews will be conducted for continuous assessment,
 - First shall be for finalisation of problem and proposed solution
 - Second shall be for implementation and testing of solution.

Assessment criteria of Mini Project:

Mini Project shall be assessed based on following criteria;

1. Quality of survey/ need identification
 2. Clarity of Problem definition based on need.
 3. Innovativeness in solutions
 4. Feasibility of proposed problem solutions and selection of best solution
 5. Cost effectiveness
 6. Societal impact
 7. Innovativeness
 8. Cost effectiveness and Societal impact
 9. Full functioning of working model as per stated requirements
 10. Effective use of skill sets
 11. Effective use of standard engineering norms
 12. Contribution of an individual's as member or leader
 13. Clarity in written and oral communication
- In **one year, project**, first semester evaluation may be based on first six criteria's and remaining may be used for second semester evaluation of performance of students in mini project.
 - In case of **half year project** all criteria's in generic may be considered for evaluation of performance of students in mini project.

Guidelines for Assessment of Mini Project Practical/Oral Examination:

- Report should be prepared as per the guidelines issued by the University of Mumbai.
- Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organisations having experience of more than five years approved by head of Institution.
- Students shall be motivated to publish a paper based on the work in Conferences/students competitions.

Mini Project shall be assessed based on the following points;

1. Quality of problem and Clarity
2. Innovativeness in solutions
3. Cost effectiveness and Societal impact
4. Full functioning of working model as per stated requirements
5. Effective use of skill sets
6. Effective use of standard engineering norms
7. Contribution of an individual's as member or leader
8. Clarity in written and oral communication