University of Mumbai

No. AAMS(UG)/ 16 of 2022-23

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges, Directors of the Recognized Institutions in Faculty of Science & Technology is invited to this office circular No. UG/46 of 2021 dated 21st January, 2021 relating to the Scheme (Sem. III to VIII) and revised syllabus (Rev-2019 'C' Scheme) for the B E. in Electronics Engineering (Sem. III & IV).

They are hereby informed that the recommendations made by the Ad-hoc Board of Studies in Electronics Engineering at its meeting held on 18th November, 2021 and subsequently passed by the Board of Deans at its meeting held on 27th December 2021 vide item No. 6.8 have been accepted by the Academic Council at its meeting held on 28th December, 2021 **vide** item No. 6.8 and that in accordance therewith, the reduced syllabus for B.E. (Electronics Engineering) (Rev-2019 'C' Scheme) for Direct Second Year (Sem.III) as Direct Second Year (DSE) students admission is delayed by the six months due to COVID-19 situation, has been brought into force with effect from the academic year 2021-22 only. (The same is available on the University's website www.mu.ac.in).

(Sudhir S. Puranik)
REGISTRAR

MUMBAI – 400 032
4th May, 2022

To

The Principals of the Affiliated Colleges, and Directors of the Recognized Institutions in Faculty of Science & Technology.

A.C/6.8/28/12/2021

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No. AAMS(UG)/ 16 -A of 2022-23 4th May, 2022

Copy forwarded with Compliments for information to:-

1) The Dean, Faculty of Science & Technology,
2) The Chairman, Board of Studies Electronics Engineering,
3) The Director, Board of Examinations and Evaluation,
4) The Director, Board of Students Development,
5) The Director, Department of Information & Communication Technology,
6) The Co-ordinator, MKCL.

(Sudhir S. Puranik)
REGISTRAR

Copy for information and necessary action :-

1. **The Deputy Registrar, College Affiliations & Development Department (CAD),**
2. **College Teachers Approval Unit (CTA),**
3. **The Deputy Registrar, (Admissions, Enrolment, Eligibility and Migration Department (AEM),**
4. **The Deputy Registrar, Academic Appointments & Quality Assurance (AAQA)**
5. **The Deputy Registrar, Research Administration & Promotion Cell (RAPC),**
6. **The Deputy Registrar, Executive Authorities Section (EA)**
   He is requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to the above circular.
7. **The Deputy Registrar, PRO, Fort, (Publication Section),**
8. **The Deputy Registrar, Special Cell,**
9. **The Deputy Registrar, Fort Administration Department (FAD) Record Section,**
10. **The Deputy Registrar, Vidyanagari Administration Department (VAD),**

Copy for information :-

1. **The Director, Dept. of Information and Communication Technology (DICT), Vidyanagari,**
   He is requested to upload the Circular University Website
2. **The Director of Department of Student Development (DSD),**
3. **The Director, Institute of Distance and Open Learning (IDOL Admin), Vidyanagari,**
4. **All Deputy Registrar, Examination House,**
5. **The Deputy Registrars, Finance & Accounts Section,**
6. **The Assistant Registrar, Administrative sub-Campus Thane,**
7. **The Assistant Registrar, School of Engg. & Applied Sciences, Kalyan,**
8. **The Assistant Registrar, Ratnagiri sub-centre, Ratnagiri,**
9. **P.A to Hon'ble Vice-Chancellor,**
10. **P.A to Pro-Vice-Chancellor,**
11. **P.A to Registrar,**
12. **P.A to All Deans of all Faculties,**
13. **P.A to Finance & Account Officers, (F & A.O),**
14. **P.A to Director, Board of Examinations and Evaluation,**
15. **P.A to Director, Innovation, Incubation and Linkages,**
16. **P.A to Director, Department of Lifelong Learning and Extension (DLLE),**
17. **The Receptionist,**
18. **The Telephone Operator,**

Copy with compliments for information to :-

19. **The Secretary, MUASA**
20. **The Secretary, BUCTU.**

AC – 28/12/2021
Item No. - 6.8

UNIVERSITY OF MUMBAI

Bachelor of Engineering
(Electronics Engineering)

Direct Second Year (Sem. III) Admitted Students for the current Academic Year 2021-22 Only due to Covid Pandemic

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

Under
FACULTY OF SCIENCE & TECHNOLOGY

Program Structure for Second Year Electronics Engineering

UNIVERSITY OF MUMBAI
(With Effect from 2020-2021)

SEMESTER III

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical And Oral	Tutorial	Total
ELC301	**Engineering Mathematics-III**	3	--	1	3	--	1	**4**
ELC302	**Electronics Devices and Circuits -I**	3		--	3		--	**3**
ELC303	**Digital Logic Circuits**	3	--	--	3	--	--	**3**
ELC304	**Electrical Networks Analysis and Synthesis**	3	--	1	3	--	1	**4**
ELC305	**Electronic Instruments and Measurements**	3	--	--	3	--	--	**3**
ELL301	**Electronics Devices and circuits -I Lab**	--	2	--	--	1	--	**1**
ELL302	**Digital Logic Circuits Lab**	--	2	--	--	1	--	**1**
ELL303	**Electronic Instruments and Measurements Lab**	--	2	--	--	1	--	**1**
ELL304	**Skill base Lab OOPM (Java)**	--	4	--	--	2	--	**2**
ELM301	**Mini Project– 1A**	--	$4^{\$}$	--	--	2	--	**2**
Total		**15**	**14**	**2**	**15**	**07**	**2**	**24**

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

Course Code	Course Name	Examination Scheme							
		Theory					Term Work	Practical	Total
		Internal Assessment			End Sem Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg.					
ELC301	Engineering Mathematics-III	20	20	20	80	3	25	--	125
ELC302	Electronics Devices and circuits -I	20	20	20	80	3	--	--	100
ELC303	Digital Logic Circuits	20	20	20	80	3	--	--	100
ELC304	Electrical Networks Analysis and Synthesis	20	20	20	80	3	25	--	125
ELC305	Electronic Instruments and Measurements	20	20	20	80	3	--	--	100
ELL301	Electronics Devices and circuits -I Lab	--	--	--	--	--	25	25	50
ELL302	Digital Logic Circuits Lab	--	--	--	--	--	25	25	50
ELL303	Electronic Instruments and Measurements Lab	--	--	--	--	--	25	25	50
ELL304	Skill base Lab - OOPM (Java)	--	--	--	--	--	50	--	50
ELM301	Mini Project–1 A	--	--	--	--	--	25	25	50
Total		--	--	**100**	**400**	--	**200**	**100**	**800**

Note:

1. Students group and load of faculty per week.

   Mini Project 1 and2: Students can form groups with minimum 2 (Two) and not more than 4 (Four) Faculty Load:1 hour per week per four groups

   Major Project 1 and2: 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 (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tutorial	Theory	TW/Pract.	Tutorial	Total
ELC301	Engineering Mathematics-III	03	-	01	03	-	01	04

Course Code	Course Name	Examination Scheme							
		Theory				Term Work	Pract.	Oral	Total
		Internal Assessment			End Sem Exam				
		Test 1	Test 2	Avg of Test 1 & 2					
ELC301	Engineering Mathematics-III	20	20	20	80	25	-	-	125

Pre-requisite:

Engineering Mathematics-I, Engineering Mathematics-II, Scalar and Vector Product: Scalar and vector product of three and four vectors,

Course Objectives: The course is aimed

1. To familiarize with the Laplace Transform, Inverse Laplace Transform of various functions, and its applications.
2. To acquaint with the concept of Fourier Series, its complex form and enhance the problem solving skills
3. To familiarize the concept of complex variables, C-R equations, harmonic functions, its conjugate and mapping in complex plane.
4. To understand the basics of Linear Algebra and its applications
5. To use concepts of vector calculus to analyze and model engineering problems.

Course Outcomes: On successful completion of course learner will be able to;

1. Apply the concept of Laplace transform to solve the real integrals in engineering problems.
2. Apply the concept of inverse Laplace transform of various functions in engineering problems.
3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems.
4. Find orthogonal trajectories and analytic function by using basic concepts of complex variables.
5. Illustrate the use of matrix algebra to solve the engineering problems.
6. Apply the concepts of vector calculus in real life problems.

Module No	Contents	Hrs.
01	**Module 1: Laplace Transform** 1.1 Definition of Laplace transform, Condition of Existence of Laplace transform. 1.2 Laplace Transform (L) of Standard Functions like $e^{at}, sin(at), cos(at), sinh(at), cosh(at)$ and $t^n, n \geq 0$. 1.3 Properties of Laplace Transform: Linearity, First Shifting theorem, Second Shifting Theorem, change of scale Property, multiplication by *t*, Division by *t*, Laplace Transform of derivatives and integrals (Properties without proof). 1.4 Evaluation of integrals by using Laplace Transformation. **Self-learning Topics:** Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function. **Self-learning Topics:** Heaviside's Unit Step function, Laplace Transform of Periodic functions, Dirac Delta Function.	7
02	**Module 2: Inverse Laplace Transform** 2.1. Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives. 2.2 Partial fractions method to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof). **Self-learning Topics:** Applications to solve initial and boundary value problems involving ordinary differential equations.	6
03	**Module3: Fourier Series** 3.1 Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof). *3.2* Fourier series of periodic function with period 2π and $2l$. 3.3 Fourier series of even and odd functions. 3.4 Half range Sine and Cosine Series. **Self-learning Topics:** Complex form of Fourier Series, Orthogonal and orthonormal set of functions. Fourier Transform.	7

04	**Module 4: Complex Variables** 4.1 Function *f*(z)of complex variable, limit, continuity and differentiability of *f*(z) Analytic function, necessary and sufficient conditions for *f*(z) to be analytic (without proof). 4.2 Cauchy-Riemann equations in cartesian coordinates (without proof). 4.3 Milne-Thomson method to determine analytic function *f*(z)when real part(u) or Imaginary part (v) or its combination (u+v or u-v) is given. 4.4 Harmonic function, Harmonic conjugate and orthogonal trajectories	7

	Self-learning Topics: Conformal mapping, linear, bilinear mapping, cross ratio, fixed points and standard transformations.	
05	**Module 5: Linear Algebra: Matrix Theory** 5.1 Characteristic equation, Eigen values and Eigen vectors, Example based on properties of Eigen values and Eigen vectors.(Without Proof). 5.2 Cayley-Hamilton theorem (Without proof), Examples based on verification of Cayley-Hamilton theorem and compute inverse of Matrix. 5.3 Similarity of matrices, Diagonalization of matrices. Functions of square matrix **Self-learning Topics:** Application of Matrix Theory in machine learning and google page rank algorithms, derogatory and non-derogatory matrices**.**	6
06	**Module 6: Vector Differentiation and Integra**l 6.1 **Vector differentiation**: Basics of Gradient, Divergence and Curl (Without Proof). 6.2 **Properties of vector field:** Solenoidal and irrotational (conservative) vector fields. 6.3 **Vector integral:** Line Integral, Green's theorem in a plane(Without Proof),Stokes' theorem (Without Proof) only evaluation. **Self-learning Topics:** Gauss' divergence Theorem and applications of Vector calculus.	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. Advanced Engineering Mathematics, H.K. Das, S. Chand, Publications
2. Higher Engineering Mathematics, B. V. Ramana, Tata Mc-Graw Hill Publication
3. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Narosa publication
4. Advanced Engineering Mathematics, Wylie and Barret, Tata Mc-Graw Hill.
5. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series
6. Vector Analysis Murry R. Spiegel, Schaum's outline series, Mc-Graw Hill Publication
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	TW/Practical and Oral	Tutorial	Total
ELC302	Electronic Devices & Circuits-I	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		-	-	-	-
ELC 302	Electronic Devices & Circuits-I	20	20	20	80	03	-	-	100

Course Objectives:

1. To deliver the knowledge about physics of basic semiconductor devices and circuits.
2. To enhance comprehension capabilities of students through understanding of electronic devices and circuits
3. To introduce and motivate students to the use of advanced microelectronic devices
4. To analyze and 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 explain working of semiconductor devices.
2. Students will be able to analyze characteristics of semiconductor devices.
3. Students will be able to perform DC and AC analysis of Electronics circuits.
4. Students will be able to compare various biasing circuits as well as various configurations of BJT and MOSFETs.
5. Students will be able to select best circuit for the given specifications/application.
6. Students will be able to design electronics circuits for given specifications.

Module No.	Unit No,	Contents	Hrs
1.	PN Junction Diode		
	1.1	Fermi level concepts, Basic Diode Structure, Energy Band Diagrams, drift and diffusion current, junction capacitance.	**2**
2.	**Bipolar Junction Transistor**		**6**
	2.1	DC Circuit Analysis: biasing circuits, bias stability and Compensation, analysis and design of biasing circuits	
	2.2	AC Analysis of BJT Amplifiers: AC load line, small signal models: h-parameter model, re model, Hybrid-pi model. AC equivalent circuits and analysis to obtain voltage gain, current gain, input impedance, output impedance of CE, CB and CC amplifiers using Hybrid-pi model only.	
3.	**Field Effect Devices**		**8**
	3.1	MOSFET: Construction, operation and characteristics of D-MOSFET and E-MOSFET	
	3.2	DC Circuit Analysis: DC load line and region of operation, Common-MOSFETs configurations, Analysis and Design of Biasing Circuits	
	3.3	AC Analysis: AC load line, Small-Signal model of MOSFET and its equivalent Circuit, Small-Signal Analysis MOSFET Amplifiers (Common-Source, Source Follower, Common Gate)	
4	**Design of Electronic Circuits**		**4**
	4.1	Design of single stage CE amplifier	
	4.2	Design of single stage CS MOSFET amplifier	
	4.2	Design of full wave rectifier with LC and pi filter.	
	Total:		**20**

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. 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
5. Millman and Halkies, “Integrated Electronics”, 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 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	Practical and oral	Tutorial	Total
ELC303	Digital Logic Circuits	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	--	--	--	--	--
ELC303	Digital Logic Circuits	20	20	20	80	03	--	--	100

Course Pre-requisite:
Basic Electrical & Electronics Engineering

Course Objectives:
1. To understand various number system & codes and to introduce the students to various logic gates,SOP, POS form and their minimization techniques.
2. To teach the working of combinational circuits, their applications and implementation of combinational logic circuits using MSI chips.
3. To teach the elements of sequential logic design, analysis and design of sequential circuits.
4. To understand various counters and shift registers and its design using MSI chips.
5. To explain and describe various logic families and Programmable Logic Devices.
6. To train students in writing program with Verilog hardware description languages.

Course Outcome:
After successful completion of the course students will be able to;
1. Perform code conversion and able to apply Boolean algebra for the implementation and minimization of logic functions.
2. Analyse, design and implement Combinational logic circuits.
3. Analyse, design and implement Sequential logic circuits.
4. Design and implement various counter using flip flops and MSI chips.
5. Understand TTL & CMOS logic families, PLDs, CPLD and FPGA.
6. Understand basics of Verilog Hardware Description Language and its programming with combinational and sequential Logic circuit.

Module No.	Unit No,	Contents	Hrs
1.	**Fundamentals of Digital Design**		
	1.1	Review of Number System, Weighted code, Parity Code: Hamming Code	**2**
2.	**Combinational Circuits using basic gates as well as MSI devices**		**2**
	2.1	Arithmetic Ripple carry adder, Carry Look ahead adder,	
	2.2	MSI devices: IC7483, IC74151, IC74138, IC7485.	
3.	**Sequential Logic Design**		**6**
	3.1	Sequential Logic Design: Mealy and Moore Machines, Clocked synchronous state machine analysis, State reduction techniques (inspection, partition and implication chart method) and state assignment, sequence detector, Clocked synchronous state machine design	
	3.2	Sequential logic design practices: MSI counters (7490, 7492, ,7493,74163, 74169) and applications, MSI Shift registers (74194) and their applications.	
4.	**Logic Families and Programmable Logic Devices**		**4**
	4.1	CMOS Logic:- CMOS inverter, CMOS NAND and CMOS NOR, Interfacing CMOS to TTL and TTL to CMOS.	
	4.2	Introduction to CPLD and FPGA architectures, Numerical based on PLA and PAL.	
5.	**Introduction to Verilog HDL**		**6**
	5.1	Basics: Introduction to Hardware Description Language and its core features, synthesis in digital design, logic value system, data types, constants, parameters, wires and registers. Verilog Constructs: Continuous & procedural assignment statements, logical, arithmetic, relational, shift operator, always, if, case, loop statements, Gate level modelling, Module instantiation statements.	
	5.2	**Modelling Examples**: Combinational logic eg. Arithmetic circuits, Multiplexer, Demultiplexer, decoder, Sequential logic e.g. flip flop, counters.	
	Total		**20**

Text Books:

1. R. P. Jain, Modern Digital Electronics, Tata McGraw Hill Education, Third Edition 2003.
2. Morris Mano, Digital Design, Pearson Education, Asia 2002.
3. J. Bhaskar, A Verilog HDL Primer, Third Edition, Star Galaxy Publishing, 2018.

Reference Books:

1. Digital Logic Applications and Design – John M. Yarbrough, Thomson Publications, 2006
2. John F. Warkerly, Digital Design Principles and Practices, Pearson Education, Fourth Edition, 2008.
3. Stephen Brown and Zvonko Vranesic, Fundamentals of digital logic design with Verilog design, McGraw Hill, 3rd Edition.
4. Digital Circuits and Logic Design – Samuel C. Lee , PHI
5. William I. Flectcher, "An Engineering Approach to Digital Design", Prentice Hall of India.
6. Parag K Lala, "Digital System design using PLD", BS Publications, 2003.
7. Charles H. Roth Jr., "Fundamentals of Logic design", Thomson Learning, 2004.

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 second class test (Internal Assessment II) when additional 40% 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-questionsof 5 marks each will be asked.
4. Remaining questions will be randomly selected from all the modules.

Weightage of each module will be proportional to number of respective lecture hours as mentioned in the syllabus.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and oral	Tutorial	Total
ELC304	Electrical Network Analysis & Synthesis	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					
ELC304	Electrical Network Analysis & Synthesis	20	20	20	80	03	25	--	125

Course Pre-requisite:

1.Basic Electrical Engineering
2.Engineering Mathematics I and II

Course Objectives:

1. To learn electrical networks and its analysis in time and frequency domain.
2. To understand synthesis of electrical networks.
3. To understand various types of filters.

Course Outcomes:

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

1. Explain basic electrical circuits with nodal and mesh analysis and apply network theorems.
2. Apply Laplace Transform for steady state and transient analysis.
3. Determine different network functions and solve complex circuits using network parameters.
4. Realize electrical networks for given network functions using synthesis concepts.
5. Design various types of filters.

Module No.	Unit No,	Contents	Hrs
1.	**Analysis of Circuits**		**2**
	1.1	Analysis of coupled circuits: Solution using loop analysis.	
2.	**Time and Frequency Domain Analysis of Electrical Networks**		**6**
	2.1	Time Domain Analysis of Electrical Networks: Forced and natural response, Initial and final conditions in network elements, Solution of first and second order differential equations for series and parallel R-L, R-C, R-L-C circuits, Transient and steady state response.	
	2.2	Frequency Domain Analysis of Electrical Networks: S-domain representation, Concept of complex frequency, Applications of Laplace Transform in solving electrical networks.	
3.	**Two Port Networks**		**4**
	3.1	Two Port Parameters: Transmission and Hybrid parameters, relationships among parameters, reciprocity and symmetry conditions	
4	**Synthesis of Electrical Networks**		**6**
	4.1	Realizability Concept: Hurwitz polynomial, Concept of positive real function, testing for necessary and sufficient conditions for positive real functions.	
	4.2	Synthesis of RC, RL, LC circuits: Concepts of synthesis of RC, RL, LC driving point functions, Foster and Cauer forms.	
5	**Introduction to Filters**		**2**
	5-1	Basic Filters and Design and analysis of Constant K filters	
	Total:		**20**

Text Books:

1. Network Analysis, M. E. Van Valkenburg/T.S. Rathore, Pearson Education, 3rd Edition (2019).
2. Engineering Circuit Analysis, William H. Hayt, Jack Kemmerly, Jamie Phillips, Steven Durbin McGraw Hill, 9th Edition (2018).
3. Networks and Systems, Ashfaq Husain, Khanna Book Publishing Co. (P) Ltd.; 2nd Edition (2019).
4. Circuits and Networks: Analysis and Synthesis, A. Sudhakar and S.P. Shyammohan McGraw Hill Education (India) Private Limited; 5th edition (2015).

Reference Books:

1. Circuit Theory Analysis and Synthesis, A. Chakrabarti, Dhanpat Rai& Co., Seventh - Revised edition (2018)
2. MahmoodNahvi and Joseph A. Edminister, "Schaum's Outline of Electrical Circuits", .McGraw-Hill Education, 7th Edition (2017).
3. Problems and Solutions of Electrical Circuit Analysis, R.K. Mehta & A.K. Mal, CBS Publishers and Distributors Pvt. Ltd (2015).
4. Networks and systems, D. Roy Choudhary, New Age International Publishers, 2nd Edition (2013).

Term Work:

This shall consist of at least 10 tutorials based on the entire syllabus.Each tutorial shall have a minimum of four numerical problems solved and duly graded.

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	Practical and Oral	Tutorial	Total
ELC305	Electronic Instruments and Measurements	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					
ELC305	Electronic Instruments and Measurements	20	20	20	80	03		--	100

Course Pre-requisite:

1. FEC105-Basic Electrical Engineering
2. FEC101-Engineering Mathematics-I
3. FEC201-Engineering Mathematics-II

Course Objectives:

1. To develop understanding of fundamental principles of electronic measurements.
2. To disseminate basic methods for measurements of electrical quantities.
3. Toimpart knowledge of analog and digital instrumentation.

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

1. Recall and define instrument characteristics as well as interpret errors in measurements.
2. Understand and Measure various variables or value of unknown element.
3. Illustrate digital instruments like digital voltmeter, signal generator, wave analyzer.
4. Explain various components of oscilloscopes.
5. Choose appropriate transducer for measurement of distance, temperature and pressure.
6. Develop a calibration scheme for given instrument

Module No.	Unit No,	Contents	Hrs
1.	**Fundamental Principles of Measurement**		**3**
	1.1	Instrument characteristics: Static (accuracy, precision, linearity, drift, sensitivity, resolution, hysteresis, dead band). Dynamic (Speed of response, fidelity, lag and dynamic error)	
	1.2	Instrument characteristics: Static (accuracy, precision, linearity, drift, sensitivity, resolution, hysteresis, dead band). Dynamic (Speed of response, fidelity, lag and dynamic error)	
2.	**Measurement of Resistance, Inductance and Capacitance**		**7**
	2.1	The concept of measurement with bridge, measurement of low, medium and high resistances using Wheatstone bridge, Kelvin double bridge and mega-ohm bridge (Megger). Numerical problems (computation of sensitivity, resolution, range, errors)	
	2.2	Measurement of Inductance, Capacitance and Frequency: Maxwell bridge, Anderson bridge, Hay's bridge, Schering bridge, Wien's bridge. LCR-Q meter. Numerical problems(computation of sensitivity, resolution, range, errors)	
3.	**Electronic Instruments**		
	3.1	3.1 Digital DC Voltmeters (DVM): Ramp, dual slope, integrating, successive approximation. AC Voltmeters: Rectifier, average responding, peak responding, true RMS meter. Digital multimeter (DMM), Digital phase meter.	**7**
	3.2	3.2 Signal Generators: Low frequency signal generator, function generator, pulse generator, sweep frequency generator.	
	3.3	3.3 Wave analyzer: Basic wave analyzer, frequency selective and heterodyne. Harmonic distortion analyzer, spectrum analyzer.	
4	**Instrument Calibration**		**3**
	4.1	Principles and characteristics of calibration. Need of calibration	
	4.2	Calibration of potentiometer. Use of potentiometer for calibration of voltmeter. DMM as standard instrument for calibration.	
	Total:		**20**

Text Books:

1. David Bell, “Electronic Instrumentation and Measurements”, Oxford Publishing, 2nd edition, 2003.
2. A. D. Helfrick, W. D. Cooper, “Modern Electronics Instrumentation and Measurement Techniques”, NJ.: Prentice Hall, 2002.
3. H. S. Kalsi, “Electronic Instrumentation”, Tata McGraw Hill, 2nd edition, 2004.

Reference Books:

1. C. S. Rangan, G. R. Sarma, V. S. V. Mani, “Instrumentation: Devices and Systems”, Tata McGraw Hill, 2nd edition, 2004.
2. A. K. Sawhney, “Electrical and Electronic Instruments and Measurements”, DhanpatRai& Sons, Delhi, 2015.
3. D. Prensky, “Electronic Instrumentation”, Prentice Hall Publication.
4. S. K. Singh, “Industrial Instrumentation and Control”, Tata McGraw Hill, 3rd Edition, 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 module

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELL301	Electronic Devices & Circuits - I 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					
ELL301	Electronic Devices & Circuits-I Lab	--	--	--	--	--	25	25	50

Term Work:

At least 06 experiments covering entire syllabus of ELC302 (Electronic Devices and Circuits I)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. Experiments 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	To study passive(R,L,C) and active (BJT,MOSFTET) components.
2	To study equipment (CRO, Function Generator, Power supply).
3	To perform characteristics of PN junction diode.
4	To perform Clippers and Clampers.

5	To perform analysis and design Fixed bias, voltage divider bias for CE amplifier.
6	To perform CE amplifier as voltage amplifier (Calculate Av, Ai, Ri, Ro).
7	To perform CS MOSFET amplifier as voltage amplifier and measurement of its performance parameters.
8	To perform Full wave/Bridge rectifier with LC/pi filter.
9	To perform Zener as a shunt voltage regulator.
10	To design Full wave/Bridge rectifier with LC/pi filter.
11	To design single stage CE Amplifier.
12	To design single stage CS Amplifier.

Suggested Simulation Experiments:

Sr. No.	Experiment Title
1	SPICE/NGSPICE simulation of and implementation for junction analysis
2	SPICE/NGSPICE simulation of and implementation for BJT characteristics
3	SPICE/NGSPICE simulation of and implementation for JFET characteristics
4	SPICE/NGSPICE simulation of for MOSFET characteristics
5	SPICE/NGSPICE simulation of Full wave/Bridge rectifier with LC/pi filters.
6	SPICE/NGSPICE simulation of CE amplifier
7	SPICE/NGSPICE simulation of CS MOSFET amplifier.

(Expected percentage of H/w and software experiments should be 60% & 40% respectively)

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 can be explored to the students with greater clarity, ease and motivate to think differently.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical	Tutorial	Theory	Practical	Tutorial	Total
ELL302	Digital Logic Circuits Lab	--	02	--	--	01	--	01

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					
ELL302	Digital Logic Circuits Lab	--	--	--	--	--	25	25	50

Term Work:
At least 06 experiments covering entire syllabus of ELC 303 (Digital Logic Circuits) 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.

Course Objective:-

1. To learn the functionality of basic logic gates.
2. To Construct combinational circuits and verify their functionalities.
3. To learn the functionality of flip flops and their conversion.
4. To Design and implement synchronous and asynchronous counters, Shift registers using MSI.
5. To simulate various combinational and sequential circuits and analyze the results using Verilog HDL.

Suggested List of Experiments:

Sr. No.	Hardware Experiment Title
1	To verify different logic gates and implement basic gates using universal gates
2	To implement Boolean function in SOP and POS form
3	To implement half adder, full adder, half Subtractor, full Subtractor

4	To implement BCD adder using binary adder IC 7483
5	To implement logic equations using Multiplexer IC 74151
6	To verify truth table of SR,JK,T and D flip flops
7	To perform Flip flop conversion JK to D, JK to T and D to T flip flop
8	To implement MOD N counter using IC 7490/7492/7493
9	To implement Synchronous counter using IC 74163/74169 **OR** To implement universal shift register using IC 74194

Simulation/Software Experiments

Sr. No.	Software Experiment Title
1	To design and simulate Full adder/full subtractor using Verilog HDL
2	To design and simulate Multiplexer/Demultiplexer using Verilog HDL
3	To design and simulate decoder 74138 using Verilog HDL
4	To simulate basic flip flops using Verilog HDL
5	To design and simulate 4 bit counter / up-down counter using Verilog HDL
6	To design and simulate Shift register using Verilog HDL

(Additional suggested experiments (optional) *Implementation of any of above using* ***FPGA/CPLD)***

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 can be explored to the students with greater clarity, ease and motivate to think differently.

Course Code	Course Name	Teaching Scheme			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELL303	Electronic Instruments and Measurements Lab	--	02	--	--	01	--	01

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					
ELL303	Electronic Instruments and Measurements Lab	--	--	--	--	--	25	25	50

Course Outcomes:

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

1. Demonstrate the instrument characteristics as well as interpret errors in measurements.
2. Measure various variables or value (R, L and C) of unknown element.
3. Illustrate digital instruments like digital voltmeter, signal generator, wave analyzer.
4. Explain various functions of oscilloscopes.
5. Choose appropriate transducer for measurement of distance, temperature and pressure.
6. Develop a calibration scheme for given instrument.

Term Work:

At least 06 experiments covering entire syllabus of ELC303 (**Electronic Instruments and Measurements**) 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 Title
1	Study of DSO for measurements of voltage, frequency and phase.
2	Measurement of resistance using wheat-stone /kelvin bridge.
3	Measurement of inductance and Q-factor using Hay's bridge.
4	Measurement of capacitance using Schering bridge.
5	Measurement of frequency using Wien bridge.
6	Study characteristics and use of LVDT.
7	Measurement of temperature using RTD/Thermister.
8	Measurement of displacement using strain gauge.
9	Calibration of potentiometer.
10	Calibration of voltmeter using potentiometer/DMM.

Simulation/Software Experiments

Sr. No.	Software Experiment Title
1	Simulation of the zeroth, first order and second order Instrument to understand its dynamic characteristics.
2	Simulation of measurement of rms , average with error indication
3	Simulation of the Working of multichannel oscilloscope and demonstrate the different modes
4	Simulation of measurement of various physical parameters such as Temperature, distance or pressure.
5	Simulation of DAS
6	Simulation of the calibration method and its performance evaluation

Preferably open source software should be used for implementation.

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 can be explored to the students with greater clarity, ease and motivate to think differently.

Course Code	Course Name	Teaching Scheme (Hrs.)			Credits Assigned			
		Theory	Practical and Oral	Tutorial	Theory	Practical and Oral	Tutorial	Total
ELL304	Skill based Lab OOPM (Java)	--	02* + 02	--	--	02	--	02
* *Theory class to be conducted for full class*								

Course Code	Course Name	Examination Scheme							
		Theory Marks					Term Work	Practical And Oral	Total
		Internal assessment			End Sem. Exam	Exam. Duration (in Hrs)			
		Test 1	Test 2	Avg. Of Test 1 and Test 2					
ELL304	Skill based Lab OOPM (Java)	--	--	--	--	--	50	--	50

Course Pre-requisites:

- Fundamentals of C-Programming

Course Objectives:

1. To understand Object Oriented Programming basics and its features.
2. To understand and apply Object Oriented Programming (OOP) principles using Java
3. Able to implement Methods, Constructors, Arrays, Multithreading and Applet in java
4. Able to use a programming language to resolve problems.

Course Outcomes:

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

1. Understand fundamental features of an object-oriented language: object classes and interfaces, exceptions and libraries of object collections.
2. Understand Java Programming.
3. To develop a program that efficiently implements the features and packaging concept of java in laboratory.
4. To implement Exception Handling and Applets using Java.

Module No.	Unit No,	Contents	Hrs
1.	**Introduction to Java**		**6**
	1.1	Programming paradigms- Introduction to programming paradigms, Introduction to four main Programming paradigms like procedural, object oriented, functional, and logic & rule based. Difference between C++ and Java.	
	1.2	Java History, Java Features, Java Virtual Machine, Data Types and Size (Signed vs. Unsigned, User Defined vs. Primitive Data Types, Explicit Pointer type), Programming Language JDK Environment and Tools.	
2.	**Inheritance, Polymorphism, Encapsulation using Java**		**10**
	2.1	Classes and Methods: class fundamentals, declaring objects, assigning object reference variables, adding methods to a class, returning a value, constructors, this keyword, garbage collection, finalize() method, overloading methods, argument passing, object as parameter, returning objects, access control, static, final, nested and inner classes, command line arguments, variable-length Arguments. String: String Class and Methods in Java	
	2.2	Inheritances: Member access and inheritance, super class references, Using super, multilevel hierarchy, constructor call sequence, method overriding, dynamic method dispatch, abstract classes, Object class. Packages and Interfaces: defining a package, finding packages and CLASSPATH, access protection, importing packages, interfaces (defining, implementation, nesting, applying), variables in interfaces, extending interfaces, instance of operator.	
3.	**Exception Handling and Applets in Java**		
	3.1	Exception Handling: fundamental, exception types, uncaught exceptions, try, catch, throw, throws, finally, multiple catch clauses, nested try statements, built-in exceptions, custom exceptions (creating your own exception subclasses). Managing I/O: Streams, Byte Streams and Character Streams, Predefined Streams, Reading console Input, Writing Console Output, and Print Writer class. Threading: Introduction, thread life cycle, Thread States: new, runnable, Running, Blocked and terminated, Thread naming, thread join method, Daemon thread.	**8**
	3.2	Applet: Applet Fundamental, Applet Architecture, Applet Life Cycle, Applet Skeleton, Requesting Repainting, status window, HTML Applet tag, passing parameters to Applets, Applet and Application Program.	
	Total:		**24**

Textbooks:

1. D. T. Editorial Services, "Java 8 Programming Black Book", Dreamtech Press, Edition, 2015.
2. Yashwant Kanitkar, "Let Us Java", BPB Publications, 4nd Edition, 2019.

Reference Books:

1. Herbert Schidt, "The Complete Reference", Tata McGraw-Hill Publishing Company Limited, 10th Edition, 2017.
2. Harvey M. Deitel, Paul J. Deitel, Java: How to Program, 8th Edition, PHI , 2009.
3. Grady Booch, James Rumbaugh, Ivar Jacobson, "The Unified ModelingLanguageser Guide", Pearson Education.
4. Sachin Malhotra, Saurabh Chaudhary "Programming in Java", Oxford University Press, 2010

Software Tools:

1. Raptor-Flowchart Simulation:http://raptor.martincarlisle.com/
2. Eclipse: https://eclipse.org/
3. Netbeans:https://netbeans.org/downloads/
4. CodeBlock:http://www.codeblocks.org/
5. J-Edit/J-Editor/Blue J

Online Repository:

1. Google Drive
2. GitHub
3. Code Guru

Suggested list of Experiments:

Sr. No.	Write JAVA Program to
1	Display addition of number
2	Accept marks from user, if Marks greater than 40,declare the student as "Pass" else "Fail""
3	Accept 3 numbers from user. Compare them and declare the largest number (Using if-else statement).
4	Display sum of first 10 even numbers using do-while loop.
5	Display Multiplication table of 15 using while loop.
6	Display basic calculator using Switch Statement.
7	Display the sum of elements of arrays.
8	Accept and display the string entered and execute at least 5 different string functions on it.
9	Read and display the numbers as command line Arguments and display the addition of them
10	Define a class, describe its constructor, overload the Constructors and instantiate its object.

11	Illustrate method of overloading
12	Demonstrate Parameterized Constructor
13	Implement Multiple Inheritance using interface
14	Create thread by implementing 'runnable' interface or creating 'Thread Class.
15	Demonstrate Hello World Applet Example

Note:
Suggested List of Experiments is indicative. However, flexibilities lies with individual course instructor to design and introduce new, innovative and challenging experiments ,from within the curriculum, so that, the fundamentals can be explored to the students with greater clarity, ease and motivate to think differently.

Term Work:

At least **10**experiments covering entire syllabus should be set to have well predefined inference and conclusion. Teacher should refer the suggested experiments and can design additional experiment to maintain better understanding and quality.

The experiments should be students centric and attempt should be made to make experiments more meaningful, interesting and innovative. Term work assessment must be based on the overall performance of the student with every experiments and are graded from time to time.

The grades will be converted to marks as per "**Choice Based Credit and Grading System**" manual and should be added and averaged. Based on above scheme grading and term work assessment should be done.

The practical and oral examination will be based on entire syllabus. Students are encourages to share their experiments codes on online repository. Practical exam slip should cover all 16 experiments for examination.

Course code	Course Name	Credits
ELM 301	Mini Project -1A	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 301	Mini Project- 1A	--	--	--	--	--	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-1A (Especially for DSE Admitted Students in A.Y. 2020-21 only)

- Students from among the **DSE admitted 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.
- **As a special case for DSE Admitted Students in AY 2020-21 only, a single project of appropriate level and quality need to be carried out in two semesters by all the groups of the students. i.e. Mini Project 1A in semester III and Mini Project 1B in semester IV.**
- **Since the two semesters i.e. sem-III and IV would be progressing simultaneously for these students as a special case, Mini Project-1A shall cover only the detailed survey, Problem definition and report writing for the same for the chosen project which shall constitute the term work of Mini Project-1A.**
- **The detailed implementation, presentation and final report writing shall be covered in Mini Project 1B which shall also constitute the term work of Mini Project 1B in sem-IV**.
- The report to be compiled in standard format of University of Mumbai.

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.

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. Effective use of skill sets
10. Effective use of standard engineering norms
11. Contribution of an individual's as member or leader
12. Clarity in written and oral communication

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 of the detailed survey carried out, Problem identification and proposal of the best solution being showcased to a panel of Internal and External Examiners preferably from industry or research organizations 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