University of Mumbai

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विद्याविषयक प्राधिकरणे
सभा आणि सेवा विभाग(ए.ए.एम.एस)
रूम नं. १२८ एम.जी.रोड, फोर्ट,
मुंबई – ४०० ०३२
टेलिफोन नं. – ०२२ – ६८३२००३३

(नॅक पुनर्मूल्यांकनाद्वारे ३.६५ (सी.जी.पी.ए.) सह अ++ श्रेणी
विद्यापीठ अनुदान आयोगाद्वारे श्रेणी १ विद्यापीठ दर्जा)

क्र.वि.प्रा.स.से./आयसीडी/२०२५-२६/३७ दिनांक : २७ मे, २०२५

परिपत्रक:-

सर्व प्राचार्य/संचालक, संलग्नित महाविद्यालये/संस्था, विद्यापीठ शैक्षणिक विभागांचे संचालक/ विभाग प्रमुख यांना कळविण्यात येते की, राष्ट्रीय शैक्षणिक धोरण २०२० च्या अमंलबजावणीच्या अनुषंगाने **शैक्षणिक वर्ष २०२५-२६** पासून **पदवी व पदव्युत्तर अभ्यासक्रम** विद्यापरिषदेच्या दिनांक २८ मार्च २०२५ व २० मे, २०२५ च्या बैठकीमध्ये मंजूर झालेले सर्व अभ्यासक्रम मुंबई विद्यापीठाच्या www.mu.ac.in या संकेत स्थळावर NEP २०२० या टॅब वर उपलब्ध करण्यात आलेले आहेत.

मुंबई – ४०० ०३२
२७ मे, २०२५

(डॉ. प्रसाद कारंडे)
कुलसचिव

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AC– 20/5/2025
Item No.– 6.42 (N)

As Per NEP 2020

University of Mumbai

Syllabus for Major Vertical – 1, 4, 5 & 6		
Name of the Programme –B.E. (Electronics and Biomedical Engineering)		
Faculty of Engineering		
Board of Studies in Electronics Engineering		
U.G. Second Year Programme	**Exit Degree**	**U.G. Diploma in Electronics and Biomedical Engineering**
Semester		**III**
From the Academic Year		**2025-26**

University of Mumbai

(As per NEP 2020)

Sr. No.	Heading	Particulars
1	**Title of program** **O:_____**	**B.E. (Electronics and Biomedical Engineering)**
2	**Exit Degree**	**U.G. Diploma in Electronics and Biomedical Engineering**
3	**Scheme of Examination** **R: _____**	NEP 40% Internal 60% External, Semester End Examination Individual Passing in Internal and External Examination
4	**Standards of Passing** **R: _____**	**40%**
5	**Credit Structure** **R. TEU-620C** **R. TEU-620D**	**Attached herewith**
6	**Semesters**	**Sem. III**
7	**Program Academic Level**	**5.00**
8	**Pattern**	**Semester**
9	**Status**	**New**
10	**To be implemented from Academic Year**	**2025-26**

Sd/-	**Sd/-**	**Sd/-**
Dr. R.N.Awale	**Dr. Deven Shah**	**Prof. Shivram S. Garje**
BoS-Chairman-Electronics Engineering	**Associate Dean**	**Dean**
Faculty of Technology	**Faculty of Science & Technology**	**Faculty of Science & Technology**

Preamble

To meet the challenge of ensuring excellence and NEP 2020 policy in engineering education, the issue of quality needs to be addressed, debated, and taken forward systematically. Accreditation is the principal means of quality assurance in higher education. The major emphasis of the accreditation process is to measure the outcomes of the program that is being accredited. In line with this Faculty of Science and Technology (in particular Engineering) of the University of Mumbai has taken the lead in incorporating the philosophy of NEP 2020 education in the process of curriculum development.

The second-year engineering course is a core training program to impart scientific and logical thinking training to learners in general, with a choice of course selection from the program core course, multidisciplinary minor, and vocational skill-enhanced course. Simultaneously, the objectives of NEP 2020 demand nurturing the core program and skills required for the Information Technology Branch of engineering in the learner. Keeping this in view, a pool of courses is offered in Core Courses covering fundamentals required to understand core and modern engineering practices and emerging trends in technology. Considering the shift in pedagogy and the convenience of a stress-free learning process, a choice-based subject pool is offered in the coursework under the heads of Information Technology in Engineering for open electives and multidisciplinary minor courses in the third and fourth semesters. Essentially, to give a glimpse of trends in the industry under vocational and enhanced skill practices, the pool is offered to nurture and develop creative skills in contemporary industrial practices. Criteria met in the structure is the opportunity for learners to choose the course of their interest in all disciplines.

Program Core Course Cover Electronics and Biomedical Engineering core courses. Also, OE and MDM where a pool of subjects are given for selection. Considering the present scenario, diverse choices need to be made available to fulfill the expectation of a learner to aspire for a career in the field of current trends of Technology and interdisciplinary research. Ability enhancement can be achieved in Undergraduate training by giving an objective viewpoint to the learning process and transitioning a learner from a rote learner to a creative professional. for the purpose Design Thinking is introduced in the First Semester to orient a journey learner to become a skilled professional. Considering the NEP-2020 structure of award of Certificate & Diploma at multiple exit-point pools of Vocational skills is arranged for giving exposure to the current Industry practices.

The faculty resolved that course objectives and course outcomes are to be clearly defined for every course so that all faculty members in affiliated higher education institutes understand the depth and approach of the course to be taught, which will enhance the learner‟s learning process. NEP 2020 grading system enables a much-required shift in focus from teacher-centric to continuous-based 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 a 15-week teaching-learning process for NEP 2020, however, the content of courses is to be taught in 12-13 weeks, and the remaining 2-3 weeks are to be utilized for revision, tutorial, guest lectures, coverage of content beyond the syllabus, etc.

There was a concern that in the present system, the second-year syllabus must not be heavily loaded to the learner and it is of utmost importance that the learner entering into the second year of an engineering course should feel at ease by lowering the burden of syllabus and credits. This is necessary for a learner to get accustomed to the new environment of a college and to create a bond between the teacher and the learner. The present curriculum will be implemented for the Second Year of Engineering from the academic year 2054-26. Subsequently, this system will be carried forward for Third Year and Final Year Engineering in the academic years 2026-27, and 2027-28, respectively.

Sd/-Sd/-Sd/-

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BoS-Chairman-Electronics Engineering
Faculty of Technology

Dr. Deven Shah
Associate Dean
Faculty of Science & Technology

Prof. Shivram S. Garje
Dean
Faculty of Science & Technology

Under Graduate Diploma in Engineering- Electronics and Biomedical Engineering

Credit Structure (Sem. III)

	R. TEU-620C								
Level	**Semester**	**Major**		**Minor**	**OE**	**VSC,SEC (VSEC)**	**AEC, VEC, IKS**	**OJT, FP,CEP, CC,RP**	**Cum.Cr. / Sem.**	**Degree/Cum.Cr.**
		Mandatory	**Electives**							
5.0	III	PCC301:3 PCC302:3 PCC303:3 PCC304:3 PCL301: 1 PCL302:1 PCL303:1	--	--	OE:2	--	VEC:2 HSL: 2	CEP:2	22	**UG Diploma45**
	R. TEU-620D									
	IV	PCC401:3 PCC402:3 PCC403:3 PCL401:1 PCL402:1	--	MDM: 4	OE:2	VSEC:2	VEC:2 EEM:2	--	23	
	CumCr.	25	--	4	4	2	*2+2+2+2*	2	45	

Exitoption: Award of UG Diploma in Major and MDM with90credits and additional 4 credits core **one** theory subject with 3 credits and **one** lab with 1 credit from one third year from where they want to take Exit degree. Along with theory and practical course student must compulsory do internship for **one month or 160 hours** which internship is equal to 4 credits.

[Abbreviation - OE – Open Electives, VSC – Vocation Skill Course, SEC – Skill Enhancement Course, (VSEC), AEC – Ability Enhancement Course, VEC – Value Education Course, IKS – Indian Knowledge System, OJT – on Job Training, FP – Field Project, CEP – Continuing Education Program, CC – Co-Curricular, RP – Research Project]

Sem. -
III and IV

S.E.
Electronics and Biomedical Engineering
Scheme

Program Structure for Second Year of Information Technology

UNIVERSITY OF MUMBAI (With Effect from 2025-2026)

SEMESTER III

Course Code	Course Description	Teaching Scheme (Contact Hours)			Credit Assigned			
		Theory	Practical	Tutorial	Theory	Tutorial	Practical	Total Credits
2253111	Mathematics-III	2	--	1-	2	1	–	3
2253112	Electronic Devices	3	–	--	3	–	–	3
2253113	Data Structures and Algorithms	3	--	--	3	–	–	3
2253114	Electrical Networks Analysis & Synthesis	2	--	--	2	–	–	2
OEC301	Open Elective	2#	--	--	2	–	–	2
2253115	Electronic Devices Lab	--	2	–	–	–	1	1
2253116	Data Structures and Algorithms Lab	--	2	–	–	–	1	1
2253117	Electrical Networks Analysis & Synthesis Lab	--	2	–	–	–	1	1
2253611	Mini Project (group project)	--	2*+2	–	–	–	2	2
2993511	Entrepreneurship Development	--	2*+2	---	–	–	2	2
2993512	Environmental Science for Engineers	--	2*+2	--	–	–	2	2
Total		**12**	**16**	**01**	**12**	**01**	**09**	**22**

* Two hours of practical class to be conducted for full class as demo/discussion.

Theory / Tutorial 1 credit for 1 hour and Practical 1 credit for 2 hours

Institute shall offer a course for Open Elective from Science/Commerce/Management stream bucket provided by the University of Mumbai.

#Institute shall offer a course for MDM from other Engineering Boards.

Course Code	Course Description	Examination scheme							
		Internal Assessment Test (IAT)			End Sem. Exam Marks	End Sem. Exam Duration (Hrs)	Term Work (Tw)	Oral & Pract.	Total
		IAT-I	IAT-II	Total (IAT-I) + IAT-II)					
2253111	Mathematics-III	20	20	40	60	2	25	--	125
2253112	Electronic Devices	20	20	40	60	2	--	--	100
2253113	Data Structures and Algorithms	20	20	40	60	2	--	--	100
2253114	Electrical Networks Analysis & Synthesis	20	20	40	60	2	--	--	100
OEC301	Open Elective	20	20	40	60	2	--	--	100
2253115	Electronic Devices Lab	--	--	--	--	--	25	25	50
2253116	Data Structures and Algorithms Lab	--	--	--	--	--	25	25	50
2253117	Electrical Networks Analysis & Synthesis Lab						25	25	50
2253611	Mini Project (group project)	--	--	--	--	--	25	25	50
2993511	Entrepreneurship Development	--	--	--	--	--	50	--	50
2993512	Environmental Science for Engineers	--	--	--	--	--	50	--	50
Total		**100**	**100**	**200**	**300**	**10**	**225**	**100**	**825**

Vertical –1
Major

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
2253111	**Mathematics-III**	L	T	P	L	T	P	Total
		2	1	--	2	1	-	3
		Examination Scheme						
			IA1	**IA2**	**ESE**		**Total**	
		Theory	20	20	60		100	

Course Objectives:

1. To build a strong foundation in mathematics, provide students with the mathematics fundamentals necessary to formulate, solve and analyse complex engineering problems.
2. To prepare the students to apply reasoning informed by contextual knowledge to engineering practice, and to work as part of teams on multi-disciplinary projects.

Pre-requisite Course Codes	BSC101-Applied Mathematics-I, BSC102-Applied Mathematics-II	
Course Outcomes	After the successful completion, students should be able to	
	CO1	Understand the concept of Laplace transform and its application to solve the real integrals in engineering problems.
	CO2	Understand the concept of inverse Laplace transform of various functions and its applications in engineering problems.
	CO3	Expand the periodic function by using Fourier series for real life problems and complex engineering problems.
	CO4	Apply the concept of vector spaces and orthogonalization process in Engineering Problems
	CO5	Apply the concepts Linear transformations in image processing.
	CO6	Apply the concepts of Eigen values and Eigen vectors to concepts of PCA and image processing.

Module No.	Topics	References	No. of Hours
01	**Laplace Transforms:** 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, 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.	[1], [3]	5
02	**Inverse Laplace Transform:** 2.1 Inverse Laplace Transform, Linearity property, use of standard formulae tofind inverse Laplace Transform, finding Inverse Laplace transform usingderivatives. 2.2 Partial fractions method to find inverse Laplace transform. 2.3 Inverse Laplace transform using Convolution theorem (without proof).	[1], [3]	4
03	**Fourier Series:** 3.1 Dirichlet‟s conditions, Definition of Fourier series and Parseval‟s Identity (without proof). 3.2 Fourier Series on interval (c, c+2l). 3.3 Half range Sine and Cosine Series.	[1], [3]	5
04	**Vectors spaces**: 4.1 Vectors spaces in N dimensional, Finite dimensional Vector spaces, Linear Span, Basis, dimension, Subspace, Cauchy Schwartz Inequality 4.2 Inner Product spaces, Norm, Orthogonal Vectors, Orthogonal Projection and Orthogonal Complements, Gram Schmidt Orthogonalization Process	[2], [4]	4
05	**Linear Transformation:** 5.1 Linear Transformation, types of linear operators (Reflection Projection, Rotation, Contraction, Dialtion, shear), Kernel & Range of Linear Transformation, Rank Nullity Theorem (without proof) 5.2 Matrix of a linear Transformation, Composition of Liner Transformation and Inverse of liner transformation 5.3. Effect of Change of Bases on Linear Operators	[2], [4]	4
06	**Matrix: Eigen values & Eigen vectors:** 6.1 Characteristic equation, Eigen values and Eigen vectors, Example based on properties of Eigen values and Eigen vectors. (Without Proof). 6.2. Similarity of Matrices, Diagonalization of Matrices and Functions of Square matrices	[2], [4]	4
			26

Reference Books:

1: Integral Transforms and their Applications by Lokenath Debnath and Dambaru Bhatta , Chapam& Hall/CRC

2: An introduction to Integral Transforms by BaidyanathPatra , CRC Press.

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. Introduction to Linear Algebra by Gilbert Strang, Wellesly Cambridge Press.
8. Linear Algebra, F. Stephen Friedberg, Arnold Insel, Lawrence Spence, Prentice Hall of India.

Term Work:

General Instructions:

1. Batch wise tutorials are to be conducted. The number of students per batch should be as per University pattern for practicals.
2. Students must be encouraged to write 6 class tutorials on entire syllabus.

Tutorial Guidelines:

Tutorial should be conducted batch wise. Tutorial work will be graded from 20 marks .

Distribution of Term work Marks

1	Attendance	5
2	Class tutorials	20

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
2253112	Electronic Devices	L	T	P	L	T	P	Total
		3	--	--	3	--	1	4
		Examination Scheme						
			IA1	IA2	ESE		Total	
		Theory	20	20	60		100	

Pre-requisite Course Codes	ESC 102,BSC102, BSC202,	
Course Outcomes	After the successful completion students should be able to	
	CO1	Demonstrate semiconductor applications
	CO2	Students will be understand working characteristics of various semiconductor devices
	CO3	Students will be able to perform dc analysis/design electronic Circuits using BJT DC analysis.
	CO4	Students will be able to perform ac analysis of BJT amplifier circuits.
	CO5	Students will be understand the operation and bias circuits of MOSFET.
	CO6	Students will be understand AC analysis of MOSFET circuits.

Module No.	Unit No.	Topics	Reference	Hrs.
Module 1	1	**Clippers & Clampers**		6Hrs
	1.1	Theoretical description of basic structure & construction of p n junction diode, symbol, operation under zero bias, forward bias & reverse bias, avalanche breakdown, V-I characteristics & temperature effects (no mathematical analysis or numerical examples).	1,2	
	1.2	Application of P-N junction diode as clippers & clampers (different types of configurations with input-output waveforms & transfer characteristics; theoretical description & analysis of each circuit; numerical examples)		
Module 2	2	**Rectifiers & Filters**		6Hrs
	2.1	Rectifiers: Working & mathematical analysis of full – wave center tapped rectifier & bridge type rectifier (mathematical analysis include expressions for the DC / average & RMS output voltage, DC / average & RMS output current & ripple factor; numerical examples included)	1,2	
	2.2	Filters: Capacitor (C), Inductor (L), Inductor – Capacitor (LC), C-L-C (π) with circuit diagram, waveforms, working / operation & expression for ripple factor (theoretical description only – no analysis or numerical examples to be included)		

Module 3	**3**	**Bipolar Junction Transistor Based Circuits**	1,2 3, 4	8 Hrs
	3.1	DC Circuit Analysis: DC load line and region of operation, common bipolar transistor configurations, biasing circuits, bias stability and compensation, analysis and design of biasing circuits.		
	3.2	AC Analysis of BJT Amplifiers: AC load line, small signal models (h-parameter model, Hybrid-pi model), graphical analysis, ac equivalent circuits and analysis to obtain voltage gain, current gain, input impedance, output impedance of CE, CB and CC amplifiers.		
	3.3	Design of CE Amplifier		
Module 4	**4**	**MOSFET Based Circuits**		8 Hrs
	4.1	DC Circuit Analysis: DC load line and region of operation, common-MOSFETs configurations, analysis and design of biasing circuits	1,2 ,3,4	
	4.2	AC Analysis: AC load line, small-signal model of MOSFET at high and low frequency and its equivalent circuit, small-signal analysis of MOSFET amplifiers, common-source, source follower, common gate.		
	4.3	Design of CS Amplifier using MOSFETS		
Module 5	**5**	**Power Amplifier**		5Hrs
	5.1	Introduction to power amplifiers, difference between voltage and power amplifiers.	2,5,6,7	
	5.2	Classification of Class A, Class-B, Class- AB, Class-C power amplifiers, power amplifier using MOSFET		
Module 6	**6**	**Power Electronic Devices**		6Hrs
	6.1	Introduction to power electronic devices and its needs.	9,10	
	6.2	Introduction, scope and application, construction and characteristics of thyristors, power MOSFET, IGBT, IGCT and GTO,		
	6.3	Applications of power electronic devices		
			Total	**39**

Course Assessment:

Theory:

IA1: 20 Marks written examination for one hour
IA2: 20 Marks written examination for one hour

ESE: 60 Marks written examination for two hours

Recommended Books:

[1] Donald A. Neamen, “Electronic Circuit Analysis and Design”, TATA McGraw Hill, 2nd Edition

[2] Boylestead," Electronic Devices and Circuit Theory", Pearson Education

[3] James Morris & Krzysztof Iniewski, Nano-electronic Device Applications Handbook by CRC Press

[4] David A. Bell, “Electronic Devices and Circuits”, Oxford, Fifth Edition.

[5] Muhammad H. Rashid, “Microelectronics Circuits Analysis and Design”, Cengage

[6] S. Salivahanan, N. Suresh Kumar, “Electronic Devices and Circuits”, Tata McGraw Hill

[7] Millman and Halkies, “Integrated Electronics”, Tata McGraw Hill.

[8] Adel S. Sedra, Kenneth C. Smith and Arun N Chandorkar, “Microelectronic Circuits Theory and Applications”, International Version, OXFORD International Students Edition, Fifth Edition.

[9] Muhammad H. Rashid, “Power Electronics - circuits, devices and applications”, Prentice Hall of India, 2nd edition.

[10] P. S. Bimbhra, "Power Electronics", Khanna Publishers, New Delhi.

Online References:

NPTEL courses on microelectronics: Devices to circuits

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
2253113	Data Structures and Algorithms	L	T	P	L	T	P	Total
		3	--	--	3	--	--	3
		Examination Scheme						
			IA1	IA2	ESE		Total	
		Theory	20	20	60		100	

Pre-requisite Course Codes	C Programming (VSEC102)	
Course Objectives	1. To understand basic linear and non-linear data structures. 2. To implement various operations on Arrays, linked list, stack, queue, binary tree, and graph. 3. To study different sorting and searching techniques. 4. To analyze efficient data structures to solve real world problems.	
Course Outcomes	After the successful completion students should be able to	
	CO1	Implement various linear data structures.
	CO2	Implement various nonlinear data structures.
	CO3	Perform operations on data structures
	CO4	Analyze appropriate sorting and searching techniques for a given problem.
	CO5	Develop solutions for real world problems by selecting appropriate data structure and algorithms.
	CO6	Analyze the complexity of the given algorithms.

Module No.	Unit No.	Topics	Reference	Hrs
1		**Introduction to Data Structures and Algorithms**	3,6,8	3
	1.1	Introduction to Data Structures, Types of Data Structures – Linear and Nonlinear, Operations on Data Structures.		
	1.2	Introduction to Analysis of Algorithms, characteristics of algorithms, Time and Space complexities, Asymptotic notations.		
2		**Stack and Queues**	1,2,3,4	5
	2.1	Introduction,Basic Stack Operations, Representation of a Stack using Array, Applications of Stack: Infix to Postfix Conversion and Postfix Evaluation.		
	2.2	Queue, Operations on Queue, types of queues.		
3		**Linked List**	3,5,7,9	5
	3.1	Introduction, Representation of Linked List, Linked List v/s Array, Types of Linked List - Singly Linked List, Doubly Linked List and		

		Circular Linked List, Operations on Singly Linked List. Implementation of Stack and Queue using Singly Linked List.		
4		**Trees**	3, 5, 6, 8	5
	4.1	Introduction, Tree Terminologies, Binary Tree, Types of Binary Tree, Representation of Binary Trees, Binary Tree Traversals, Binary Search Tree, Operations on Binary Search Tree, Applications of Binary Tree- Huffman Encoding.		
5		**Graphs**	3, 5, 6, 8	3
	5.1	Introduction, Graph Terminologies, Representation of graph (Adjacency matrix and adjacency list), Graph Traversals – Depth First Search (DFS) and Breadth First Search (BFS), Application – Topological Sorting.		
6		**Introduction to Sorting and Searching**	3, 5, 6, 8	5
	6.1	Introduction to Searching: Linear search, Binary search Sorting Techniques: Bubble, Insertion, selection, Quick Sort, Merge Sort, Comparison of sorting Techniques.		
	6.2	Hashing Techniques, Different Hash functions, Collision & Collision resolution techniques: Linear and Quadratic probing.		
			Total	**26**

Course Assessment:

Theory:

IA1: One hours 20 Marks written examination for one hour
IA2: One hours 20 Marks written examination for one hour

ESE: Two hours 60 Marks written examination for two hours

Recommended Books:

[1] Data Structures Using C, Aaron M Tenenbaum, YedidyahLangsam, Moshe J Augenstein, Pearson Education
[2] Introduction to Data Structure and its Applications Jean-Paul Tremblay, P. G.Sorenson
[3] Data Structures using C, Reema Thareja, Oxford
[4] C and Data structures, Prof. P.S.Deshpande, Prof. O.G.Kakde, Dreamtech Press.
[5] Data Structures: A Pseudocode Approach with C, Richard F. Gilberg& Behrouz A. Forouzan, Second Edition, CENGAGE Learning
[6] Balagurusamy, E., "Data Structures Using C", McGraw-Hill Education (India), 2013.
[7] Data Structures using C and C++, Rajesh K Shukla, Wiley - India
[8] ALGORITHMS Design and Analysis, Bhasin, OXFORD
[9] Data Structures Using C, ISRD Group, Second Edition, Tata McGraw-Hill.

Online References:

1. https://nptel.ac.in/courses/106/102/106102064/
2. https://www.coursera.org/specializations/data-structures-algorithms
3. https://www.edx.org/course/data-structures-fundamentals
4. https://swayam.gov.in/nd1_noc19_cs67/preview

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
2253114	Electrical Networks Analysis & Synthesis	L	T	P	L	T	P	Total
		2	--	--	2	--	1	3
		Examination Scheme						
			IA1	IA2	ESE		Total	
		Theory	20	20	60		100	

Pre-requisite Course Codes	ESC102: Basic Electrical & Electronics Engineering	
Course Objectives	Course Objectives: 1. To evaluate electrical networks using various techniques, including nodal, mesh analysis and network theorems. 2. To analyze circuits in time and frequency domain using tools for network analysis and mathematical approaches. 3. To apply network synthesis techniques for two port parameters and network functions, including Foster and Cauer forms. 4. To apply the realizability concept and synthesize passive networks.	
	After the successful completion students should be able to	
Course Outcomes	CO1	Apply the basic concepts, laws, and methods of analyzing DC networks and solve complex electric circuits using network theorems.
	CO2	Apply the fundamental concepts of coupled circuits, including self and mutual inductance, coupling coefficient and analyze the behavior of coupled circuits.
	CO3	Analyze electrical circuits in time domain, including R-C, R-L and R-L-C circuits using differential equations and identify and describe the characteristics of circuit responses, including transient and steady-state response.
	CO4	Apply the fundamental concepts of frequency domain and its application in solving electrical networks.
	CO5	Evaluate transfer function model of system using two port network parameters.
	CO6	Synthesize electrical networks using passive elements.

Module No.	Unit No.	Topics	Reference	Hrs.
1		**Analysis of DC Circuits**		4
	1.1	**Analysis of DC circuits with dependent sources using:** Kirchhoff‟s Laws, Mesh Analysis, Supermesh Analysis, Node Analysis, Supernode Analysis.		
	1.2	**Application of Network Theorems to DC Circuits:** Thevenin‟s Theorem, Norton‟s Theorem, Maximum Power Transfer Theorem.		
2		**Magnetic Circuits**		3
	2.1	**Analysis of Coupled Circuits:** Self and mutual inductances, coefficient of coupling, dot convention, equivalent circuit, solution using loop analysis.		
3		**Time Domain Analysis of Electrical Networks**		4
	3.1	**Time Domain Analysis of RLC Circuits:** 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.		
4		**Frequency Domain Analysis of Electrical Networks**		3
	4.1	**Frequency Domain Analysis of RLC Circuits:** S-domain representation, Applications of Laplace Transform in solving electrical networks.		
5		**Two Port Networks**		6
	5.1	**Network Functions:** Driving point and Transfer Function, Poles and Zeros, Analysis of ladder networks		
	5.2	**Two Port Parameters:** Open circuit, Short circuit, Transmission and Hybrid parameters, relationships among parameters, reciprocity and symmetry conditions.		
6		**Synthesis of Electrical Networks**		6
	6.1	**Realizability Concept:** Hurwitz polynomial, Concept of positive real function, testing for necessary and sufficient conditions for positive real functions.		
	6.2	**Synthesis of RC, RL, LC circuits:** Concepts of synthesis of RC, RL, LC driving point functions, Foster and Cauer forms.		
			Total	**26**

Course Assessment:

Theory:

IA1: One hours 20 Marks written examination for one hour
IA2: One hours 20 Marks written examination for one hour

ESE: Two hours 60 Marks written examination for two hours

Recommended Books:-

Text Books:

[1] William Hayt, Jack Kemmerly, Jamie Phillips and Steven Durbin ―Engineering Circuit Analysis, McGraw Hill Education, 2024.
[2] Circuits and Networks: Analysis and Synthesis, A. Sudhakar and S.P. Shyammohan McGraw Hill Education (India) Private Limited; 5th edition (2015).
[3] Ravish R. Singh, "Network Theory: Analysis and Synthesis" - S.Chand Publishing, 2023
[4] M. E. Van Valkenburg, ―Network Analysis, Prentice Hall, 2006.
[5] Franklin F Kuo, "Network Analysis and Synthesis", Wiley Toppan, 2nd edition ,1966.

Reference Books:

[1] Circuit Theory Analysis and Synthesis, A. Chakrabarti, Dhanpat Rai & Co., Seventh - Revised edition (2018).
[2] Mahmood Nahvi 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).

Online References:

[1] Network Analysis - Prof. Tapas Kumar Bhattacharya, IIT Kharagpur (NPTEL Archive): https://archive.nptel.ac.in/courses/108/105/108105159/

[2] Basic Electric Circuits - Prof. Ankush Sharma, IIT Kanpur (NPTEL Archive): https://archive.nptel.ac.in/courses/108/104/108104139/

[3] Circuit Theory - Prof. S. C. Dutta Roy , IIT Delhi (NPTEL Archive): https://archive.nptel.ac.in/courses/108/102/108102042/#

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
2253115	Electronic Devices and Circuits Lab	L	T	P	L	T	P	Total
		--	--	2	--	--	1	1
		Examination Scheme						
		Term work		Orals			Total	
		25		25			50	

Pre-requisite Course Codes	ESL 102 BEEE Lab, BSL2012 Semiconductor Physics Lab	
Laboratory Objectives	1.	To deliver a hands-on approach for studying electronic devices
	2	To comprehend characteristics of electronic devices; thereby understanding their behavior
	3.	To analyze & calculate inherent parameters of electronic devices through experimental approach
	4.	To introduce modern software simulation tools for modeling & simulation of electronic devices
Laboratory Outcomes	After the successful completion students should be able to	
	LO1	Understand and analyze the operation of clippers and clampers in shaping and modifying waveforms.
	LO2	Simulate basic electronic circuits through software simulation
	LO3	Analyze electronic circuits using BJT and FET (DC & AC analysis)
	LO4	Verify the performance of the designed amplifier through theoretical analysis, simulation, and practical implementation
	LO 5	Study of static characteristic of power devices through software simulation

Laboratory Experiments:

Sr. No.	Title of experiment	Hardware /Software	Module	Reference
1.	To perform Clippers and Clampers.	Hardware	1	1,3
2.	To perform Full wave/Bridge rectifier with LC/pi filter.	Hardware	2	1,3
3.	SPICE simulation of Full wave/Bridge rectifier with LC/pi filter.	Software	2	2
4.	Compare different Biasing Circuits of BJT	Hardware/Software	3	1,3

5.	To perform AC, DC, Transient and frequency response of single stage CE amplifiers.	Hardware/Software	3	1,2,3
6	Design CE amplifier for a given specification	Hardware/Software	3	1,2,3
7	Compare different Biasing Circuits of MOSFETS	Hardware/Software	4	1,2,3
8.	To perform AC, DC, Transient and frequency response of single stage CS MOSFET amplifiers.	Hardware/Software	4	1,2,3
9.	Design of CS Amplifier for a given specification	Hardware/Software	4	1,2,3
10.	Study of Power Amplifier	Software	5	1,2
11.	Study of static characteristics of SCR	Software	6	1,2
12.	Study of static characteristic of Triac and Diac	Software	6	1,2

Laboratory Assessment:

Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical/ Oral Exam: An Oral examination will be held based on the above syllabus.

Recommended Books:

[1] David A Bell, "Laboratory Manual for Electronic Devices and Circuits", 4th edition, PHI, 2001.

[2] Muhammed H Rashid, "SPICE for circuits and electronics using PSPICE", 2nd edition, PHI, 1995

[3] Mithal. G.K, "Practicals in Basic Electronics", G K Publishers Private Limited, 1997.

Term Work:

At least 10 experiments covering the entire syllabus of PCL 302 (Electronic Devices and circuits Lab) should be set to have well predefined inference and conclusion. This must include **50%** Hardware and **50%** Simulation experiments. The experiments should be student centric and attempts should be made to make the experiments meaningful and interesting. 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.

Note:

Suggested List of Experiments is indicative. However, flexibility lies with individual course instructors 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 (Hrs/week)			Credits Assigned			
2253116	Data Structures and Algorithms Laboratory	L	T	P	L	T	P	Total
		--	--	2	--	--	1	1
		Examination Scheme						
		Term work		Oral			Total	
		25		25			50	

Pre-requisite Course Codes	PCL201X	
Laboratory Outcomes	After the successful completion students should be able to:-	
	LO 1	To Implement and analyze time and space complexity in sorting
	LO 2	To find minimum and maximum element of an array using divide and conquer strategy
	LO 3	To identify and implement an algorithm to be used in the construction of communication networks
	LO4	Identify and implement an algorithm to be used in disaster management

Module. No.	Exp. No	Name of the experiment
1	**1**	**Sorting:** Implement and analyze time and space complexity of Modified bubble, Insertion and Selection sort to display exam result of students based on their total marks scored.
2	2	**Divide and Conquer:** Implement and analyze time and space complexity of Quick and Merge sort to display records of an employee working in any organization based on their work experience.
	3	**Divide and Conquer: (Any one)** I. Implement and Analyze time and space complexity of multiplying long Integers using divide and conquer strategy. I. Implement and Analyze time and space complexity of finding minimum and maximum element of an array using divide and conquer strategy
3	**4** **5**	**Greedy Strategy**: **(Any 2)** I. Identify and implement an algorithm to be used to solve the challenge faced by airline and shipping companies of maximizing revenue while adhering to weight and space constraints when loading cargo onto airplanes or ships.determine the optimal selection and allocation of cargo items based on their values (revenue) and weights, ensuring efficient use of cargo space. I. Identify and implement an algorithm to be used in the construction of communication networks (telephone or internet networks) where a telecommunication company needs to lay down cables to connect several cities to establish a reliable network infrastructure. The company wants to minimize the cost of laying down cables while ensuring that all cities are connected and there is no redundancy in the network. . Identify and implement an algorithm to be used by vending machines to determine the optimal combination of coins to give as change to customers.

4	6 7	**Dynamic Programming: (Any 2)** I. Identify and implement an algorithm to be used in disaster management and emergency response systems to find the shortest path for emergency vehicles, such as ambulances or fire trucks, to reach affected areas or victims. I. Identify and implement an algorithm to be used to compare DNA /RNA sequences to identify similarities and evolutionary relationships between organisms. . Identify and implement an algorithm to be used by city planners and urban developers to determine the shortest paths between all pairs of locations, such as residential areas, commercial centers, and public facilities, to improve accessibility, reduce traffic congestion, and enhance urban mobility.
5	**8**	**Backtracking: (Any 1)** I. Implement N queen problem I. Identify and implement an algorithm to be used for coloring regions on a map such that adjacent regions do not have same color.
6	**9**	**String Matching:** Identify and implement an algorithm to be used by search engines to quickly locate documents containing specific keywords or phrases, improving search efficiency and response time.

Laboratory Assessment:

Term Work: Term Work shall consist of at least 10 to 12 practicals based on the above list. Also, Term work Journal must include at least 2 assignments.

Term Work Marks: **25 Marks** (Total marks) = 15 Marks (Experiments) + 5 Marks (Assignments) + 5 Marks (Attendance)

Practical/ Oral Exam: An Oral examination will be held based on the above syllabus

Recommended Books:

1 T. H. Cormen, C.E. Leiserson, R. L. Rivest, and C. Stein, "Introduction to algorithms", 2nd Edition, PHI Publication 2005.
2 Ellis Horowitz, Sartaj Sahni, S. Rajsekaran. "Fundamentals of computer algorithms" University Press.
3 "Algorithm Design Manual" by Steven S. Skiena
4 Sanjoy Dasgupta, Christos Papadimitriou, Umesh Vazirani, "Algorithms", Tata McGraw-Hill Edition.
5 S. K. Basu, "Design Methods and Analysis of Algorithm", PHI

Online resources

2. https://nptel.ac.in/courses/106/106/106106131/
3. https://www.coursera.org/specializations/algorithms
4. https://www.mooc-list.com/tags/algorithms
5. https://www.youtube.com/watch?v=aGjL7YXI31Q&list=PLEbnTDJUr_IeHYw_sfBOJ6gk5pie0yP-0
6. https://www.geeksforgeeks.org/design-and-analysis-of-algorithms/
7. Algorithm visualization tool https://visualgo.net/
8. Electrode/ Hacker Rank platform to solve challenging problems

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
2253117	Electrical Networks Analysis & Synthesis Laboratory	L	T	P	L	T	P	Total
		--	--	2	--	--	1	1
		Examination Scheme						
		Term work		Practicals			Total	
		50		25			75	

Pre-requisite Course Codes	ESC102: Basic Electrical & Electronics Engineering	
Laboratory Objectives	1.	To analyze and solve electrical networks using nodal, mesh analysis and network theorems.
	2	To develop an ability to apply various methods of analysis of electrical circuits under transient and steady state conditions.
	3.	To design and implement simple electrical networks using synthesis techniques.
Laboratory Outcomes	After the successful completion students should be able to	
	LO 1	Apply basic concepts of electrical networks for analyzing DC Networks and theorems
	LO 2	Apply knowledge of various parameters to synthesize filter circuits
	LO 3	Apply knowledge of first order and second order system to solve time domain analysis of RLC circuits
	LO 4	Synthesize RLC circuits using frequency domain analysis
	LO 5	Evaluate various parameters of two port networks
	LO 6	Analyze the stability criteria and synthesize RC, RL & LC circuits

Laboratory Experiments:

Sr. No.	Title of experiment	Module	Reference
1.	Simulation of Nodal Analysis for DC Circuits / To verify Maximum Power Transfer Theorem.	1	
2.	Simulation of DC Circuit for determining Thevenin's Equivalent / To verify Thevenin‟s and Norton‟s Theorem.	1	
3.	To design Low pass, high pass, band pass and band stop filters and evaluate various parameters.	2	
4.	To plot the step response of the first order system and observe the effect of changing time constant in the first order system. (SCILAB / MATLAB)	3	
5.	To plot the step response of the second order system and evaluate time domain specifications. (SCILAB / MATLAB)	3	
6.	Simulation of R-L-C series Circuit.	4	
7.	To find pole zero plot of given transfer functions. (SCILAB / MATLAB)	5	

8.	Determination of Z and Y parameters of two port network	5	
9.	To determine the stability of a given system using Routh‟s criteria. (SCILAB / MATLAB)	6	
10.	Verification of Maximum Power Transfer Theorem (Virtual Laboratory): https://asnm-iitkgp.vlabs.ac.in/exp/maximum-power-transfer-theorem/	1	
11.	To study the behaviour of a series R-L-C circuit (Virtual Laboratory): https://asnm-iitkgp.vlabs.ac.in/exp/rlc-circuit-analysis/index.html	3	
12.	Experimental verification of frequency response of R-L-C series Circuit (Virtual Laboratory): https://asnm-iitkgp.vlabs.ac.in/exp/rlc-series-circuit/index.html	4	
13.	To determine Y, Z, h and ABCD parameters of single and cascaded two-Port networks experimentally and verify their interrelationships (Virtual Laboratory): https://asnm-iitkgp.vlabs.ac.in/exp/two-port-network/	5	

Please Note: The list of experiments is merely meant to serve as a guide and is not limited to, the instructors are free to add innovative and creative lab experiments, and the use of open-source software, simulation platforms, and virtual laboratories is encouraged.

Laboratory Assessment:

Assessment:

Term Work: Term Work shall consist of at least 8 practicals‟ based on the above list and not limited to. Also, Term work Journal must include at least 2 assignments or 2 Virtual Laboratories or 1 Mini Project / 1 Circuit development on the topics from the subject.

Term Work Marks: 25 Marks (Total marks) = 15 Marks (Experiment) + 5 Marks (Assignments / Virtual Laboratory / Mini Project / Circuit development on the topics from the subject) + 5 Marks (Attendance)

Practical/ Oral Exam: An Practical examination will be held based on the above syllabus.

Recommended Books:

[1] Circuit Theory Analysis and Synthesis, A. Chakrabarti, Dhanpat Rai & Co., Seventh - Revised edition (2018).

[2] Mahmood Nahvi 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).

SEC

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
2253611	Mini Project	L	T	P	L	T	P	Total
		--	--	4	--	--	2	2
		Examination Scheme						
		Term work		Orals			Total	
		25		25			50	

Pre-requisite Course Codes		
Course Outcomes	After the successful completion students should be able to	
	CO1	Identify and address community needs and challenges which help learners to develop problem-solving skills and creativity in finding innovative solutions.
	CO2	Enhance their cultural competence and ability to work effectively in multicultural settings
	CO3	Critically think on complex issues considering multiple view points
	CO4	Demonstrate collaboration, team work, civic engagement, empathy, and compassion while engaging directly with community
	CO5	Develop a lifelong commitment to social justice and making a positive impact in the world

This course requires students to participate in field-based learning/projects generally under the supervision of faculty. The curricular component of „community engagement and service" involve activities that would expose students to the socio-economic issues in society so that the theoretical learnings can be supplemented by actual life experiences to generate solutions to real-life problems. At the end of the course, it is expected that students will have valuable learnings in terms of enhanced communication skills, increased cultural competence, improved critical thinking, leadership skills, collaboration skills, empathy & compassion, civic engagement, problem-solving skills, self-reflection & personal growth, and long-term commitment to social justice. It is expected that 26-30 hours of contact time per credit in a semester (52 to 60 hours in a semester for 2 credits) along with 13-15 hours of activities such as preparation for community engagement and service, preparation of reports, etc., and independent reading and study.

Other Guidelines to students for successful Community Engagement:

Community engagement is the process of working collaboratively with and through groups of people affiliated by geographic proximity, special interest, or similar situations to address issues affecting the well-being of those people It is a powerful vehicle for bringing about environmental and behavioural changes that will improve the health of the community and its members. It often involves partnerships and coalitions that help mobilize resources and influence systems, change relationships among partners, and serve as catalysts for changing policies, programs, and practices. Community engagement project is different as compared to traditional consultation. It is a regular engagement of community for achieving an identified goal or vision. It recognizes the role of community engagement in its broadest sense in the development of local democracy, while noting that the focus of the report is on the practice of community engagement as it relates to local authority activity. Communication, diplomacy, patience, and flexibility are essential to engage with a community.

For successful engagement conditions include: Shared and defined purpose. Willingness to collaborate. Commitment to contributing. Participation of the right people. Open and credible process. Involvement of a champion with credibility and clout. Ensure that the engagement process is complex but manageable. Initially the team will: Discuss and define the initiative and its potential impact. Set the purpose and goals for community engagement. Define the community. Know and respect the community‟s characteristics. Develop a relationship with the community, build trust, work with formal and informal leadership, find the community gatekeeper, identify the project champion, meet with the local organizations, and learn the assets and challenges for that community keeping in mind the 17 sustainable development goals. Find the common interests. The following four phases provide broad outline for the community engagement process:

Phase-I: **Outreach**

Go to the community instead of having the community come to you. Invite the stakeholders to a conversation. Create a constructive environment for dialogue allowing time to get to know the participants remembering that the community‟s time is valuable and must be respected. Identify the person or the organization that has convened the group and will provide initial leadership and organizational management. Outline the purpose and process for the conversation. Use a facilitator when appropriate. Define the issue and why it is important. Outline what is broken and focus on what is working. Is the issue a people problem or a situation problem? Can the problem be solved with technical expertise or will it require something else? Determine the interest and merit in hosting future discussions.

Phase-II: **Gather Facts, Brainstorm and Select**

Create an environment for discussion where people are comfortable asking questions, expressing doubts, and brainstorming new ideas. Gather the facts related to the issue and its impact. Use a SWOT, appreciative inquire, asset mapping, and other tools during the factfinding stage. Clarify the issue‟s alignment with the community‟s values and ethics. Establish the common ground on which conversations will be based. Brainstorm and gather alternative solutions. Ask the “what if” questions. Spend time discussing the options and the potential impact. Allow the process to equip the participants to see the change, feel the change, and then be prepared to change. Select the best practice/solution. If required use decision-making tools to reduce the number of options.

Phase-III: **Plan and Review**

Write the implementation action plan. Include the evaluation procedure that will answer the question “What will it look like when the change has happened?”. Discuss the proposal with the appropriate stakeholders searching for insight and response. Use the feedback to assess and revise the plan. Stay focused on the solution.

Phase-IV: **Implement and Evaluate**

Implement the plan. Remember, groups want a rapid success. Identify an action that will provide a “meaningful win” within the “immediate reach.” Evaluate the impact. Report the status to the community and gather feedback. Revise the plan and evaluate again. Keep the participants informed through discussion agendas, written summaries of previous discussions, goals/assignments for the next discussion, and progress reports providing accountability for delivering what was promised.

Vertical – 5

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2993511	Entrepreneurship Development	2*	2	-	-	-	-	2

Course Code	Course Name	Examination Scheme						
		Theory Marks				Term Work	Practical/ Oral	Total
		Internal assessment			End Sem. Exam			
		IAT-I	IAT-II	IAT-I + IAT-II				
2993511	Entrepreneurship Development	--	--	--	--	50	--	50

Note: * Two hours of practical class to be conducted for full class as demo/discussion/theory.

Lab Objectives:

1. To introduce students to entrepreneurship concepts and startup development.
2. To develop business idea generation, validation, and business model preparation.
3. To provide hands-on experience in market research, financial planning, and business pitching.
4. To enhance problem-solving and decision-making skills in entrepreneurial ventures.
5. To familiarize students with government schemes and support systems for entrepreneurs.
6. To develop communication and presentation skills required for business pitching.

Lab Outcomes:

Upon successful completion of this course, students will be able to:

1. Understand the fundamental concepts of entrepreneurship and business models.
2. Conduct market research and develop business plans.
3. Utilize financial planning and cost analysis for startups.
4. Apply entrepreneurial skills to identify and solve business challenges.
5. Develop prototypes using open-source software for business operations.
6. Pitch business ideas effectively with structured presentations.

DETAILED SYLLABUS

Sr. No.	Module	Detailed Content	Hours	LO Mapping
0	**Prerequisite**	Fundamentals of communication and leadership skills.	01	--
I	**Introduction to Entrepreneurship**	Definition, Characteristics, and Types of Entrepreneurs. Entrepreneurial Motivation and Traits. Start-up Ecosystem in India. Challenges in Entrepreneurship	**02**	**LO1**
II	**Business Idea Generation & Validation**	Ideation Techniques: Design Thinking, Brainstorming, Mind Mapping. Business Model Canvas (BMC). Market Research & Customer Validation. Minimum Viable Product (MVP) Concept.	**04**	**LO2**

III	**Business Planning & Strategy**	Writing a Business Plan. SWOT Analysis and Competitive Analysis. Financial Planning and Budgeting. Risk Assessment and Management	**04**	**LO3**
IV	**Funding and Legal Framework**	Sources of Funding: Bootstrapping, Angel Investors, Venture Capital Government Schemes & Start-up India Initiatives. Business Registration & Legal Formalities. Intellectual Property Rights (IPR) & Patents	**05**	**LO4**
V	**Marketing & Digital Presence**	Branding and Digital Marketing. Social Media Marketing & SEO. Customer Relationship Management (CRM). E-commerce & Online Business Models	**05**	**LO5**
VI	**Business Pitching & Prototype Development**	Pitch Deck Preparation & Presentation Techniques. Prototyping with Open-source Tools. Elevator Pitch & Investor Pitch. Case Studies of Successful Start-ups	**05**	**LO6**

Text Books:

1. "Entrepreneurship Development and Small Business Enterprises" – Poornima M. Charantimath, Pearson, 3rd Edition, 2021.
2. "Innovation and Entrepreneurship" – Peter F. Drucker, Harper Business, Reprint Edition, 2019.
3. "Startup and Entrepreneurship: A Practical Guide" – Rajeev Roy, Oxford University Press, 2022.
4. "Essentials of Entrepreneurship and Small Business Management" – Norman Scarborough, Pearson, 9th Edition, 2021.
5. "The Lean Startup" – Eric Ries, Crown Publishing, 2018.

References:

1. "Disciplined Entrepreneurship: 24 Steps to a Successful Startup" – Bill Aulet, MIT Press, 2017.
2. "Zero to One: Notes on Startups, or How to Build the Future" – Peter Thiel, 2014.
3. "The $100 Startup" – Chris Guillebeau, Crown Business, 2019.
4. "Business Model Generation" – Alexander Osterwalder & Yves Pigneur, Wiley, 2020.
5. "Blue Ocean Strategy" – W. Chan Kim & Renée Mauborgne, Harvard Business Review Press, 2019.

Online Resources:

Website Name
1. Startup India Portal – https://www.startupindia.gov.in 2. MIT OpenCourseWare – Entrepreneurship – https://ocw.mit.edu/courses/sloan-school-of-management/ 3. Coursera – Entrepreneurship Specialization – https://www.coursera.org/specializations/entrepreneurship 4. Harvard Business Review – Entrepreneurship Articles – https://hbr.org/topic/entrepreneurship 5. Udemy – Startup & Business Courses – https://www.udemy.com/courses/business/entrepreneurship/

List of Experiments.

Sr No	List of Experiments	Hrs
01	Business Idea Generation using Mind Mapping.	02
02	Conducting Market Research & Customer Validation.	02
03	Preparing a Business Model Canvas for a Startup Idea.	02
04	Developing a Financial Plan & Break-even Analysis.	02
05	Creating a Website using WordPress/Wix.	02
06	Social Media Marketing Campaign using Open-source Tools.	02
07	Digital Prototyping using Figma/Inkscape.	02
08	Business Pitch Deck Preparation & Presentation.	02
09	Exploring Government Schemes for Startups.	02
10	Legal Compliance & IPR Basics (Case Study).	02

Sr No	List of Assignments / Tutorials	Hrs
01	a. Write a report on any successful entrepreneur and their startup journey. b. Conduct SWOT analysis for a real-life startup.	02
02	Develop a business idea and create a one-page business plan.	02
03	Conduct market research using surveys & present findings.	02
04	Design a simple logo and branding strategy for a startup.	02
05	Create a financial model and cost estimation for a startup.	02
06	Make a case study report on startup failure analysis.	02

List of Open-Source Software
1. Canva – Designing pitch decks, social media posts, and branding materials. 2. Trello / Asana – Project management for startups. 3. GIMP / Inkscape – Graphic design and logo creation. 4. WordPress / Wix – Website development for startups. 5. OpenCart / PrestaShop – E-commerce website setup. 6. Figma – UI/UX design and prototyping. 7. LibreOffice Calc – Financial planning and budgeting. 8. Google Suite (Docs, Sheets, Slides) – Documentation and presentations. 9. Python (Pandas, Flask, Django) – Data analytics and web application development. 10. MailChimp – Email marketing and customer engagement.

Assessment :

Term Work: Term Work shall consist of at least 10 practicals" based on the above list. Also, Term work Journal must include at least 6 assignments.

Term Work Marks: 50 Marks (Total marks) = 15 Marks (Experiment) + 15 Marks (Assignments) + 5 Marks (Attendance)+ 10 Marks (Report)

Course Code	Course Name	Teaching Scheme (Contact Hours)			Credits Assigned			
		Theory	Pract.	Tut.	Theory	Pract.	Tut.	Total
2993512	**Environmental Science**	**1**	**-**	**-**	**1**	**-**	**-**	**3**

		Theory					Term work	Pract / Oral	Total
		Internal Assessment			End Sem Exam	Exam Duration (in Hrs)			
		Test 1	Test 2	Avg.					
2993512	**Environmental Science**	20	20	40	60	2	--	--	100

Rationale:

Most of the engineering branches are offspring of applied sciences, and their practices have a significant impact on the environment. Understanding environmental studies is essential for engineers to develop sustainable solutions, minimize ecological footprints, and promote responsible resource management. This course equips students with the knowledge of ecosystems, biodiversity, pollution control, and environmental laws, enabling them to integrate sustainability into engineering practices.

Course Objectives:

1. To understand the scope, importance, and role of environmental studies in public awareness and health.
2. To study different natural resources, their issues, and sustainable conservation.
3. To understand ecosystem types, structures, and functions.
4. To explore biodiversity, its importance, threats, and conservation.
5. To learn about pollution types, causes, effects, and control measures.
6. To understand environmental challenges, sustainability, and ethics.

Course Outcomes:

1. Explain the significance of environmental studies and the role of IT in environment and health.
2. Describe resource types, associated problems, and conservation methods.
3. Classify ecosystems and explain their role in ecological balance
4. Analyze biodiversity levels and conservation strategies, especially in India.
5. Explain pollution impacts and suggest preventive measures.
6. Discuss environmental issues and propose sustainable solutions.

DETAILED SYLLABUS:

Unit Name	Topic Name	Topic Description	No of Lecture

Module-I	The Multidisciplinary Nature of Environmental Studies	Definition, scope and importance. Need for public awareness, Role of information technology in environment and human health. Human population and the environment: Population growth, variation among nations. Population Explosion-family welfare program. Environment and human health Women and child welfare	2
Module-II	Natural Resources	Renewable and non-renewable resources. Natural resources & associated problems: a) Forest resources: b) Water resources: Natural resources & associated problems c) Mineral resources: d) Food resources: e) Energy resources: Role of an individual in conservation of natural resources: f) Equitable use of resources for sustainable lifestyles.	2
Module-III	Ecosystems	Concepts of an ecosystem. Introduction, types, characteristic features, structure and function of the following ecosystem: a. Forest ecosystem b. Grassland ecosystem c. Desert ecosystem d. Aquatic ecosystem (ponds, streams, lakes, rivers, oceans, estuaries). Case study on various ecosystems in India.	2
Module-IV	Biodiversity and its Conservation	Introduction-Definition: genetic species and ecosystem diversity. Bio-geographical classification of India Value of biodiversity: Consumptive use, productive use, social, ethical, aesthetic and option values, Bio-diversity at global, national, local levels India as a mega diversity nation Case study on Bio diversity in India.	3
Module-V	Environmental Pollution Definition	Causes, effects and control measures of: a) Air pollution b) Water pollution c) Soil pollution. Solid waste management: Causes, effect and control measures of urban and industrial wastes. Role of an individual in prevention of pollution, Case study on Pollution Disaster management: floods, earthquake, cyclone and landslides. Carbon Credits for pollution prevention	3
Module-VI	Social Issues and Environment	From unsustainable to sustainable development Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Environmental ethics: issues and possible solution. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies. Consumerism and waste products. Environment protection act. Public awareness Case study on Environmental Ethics	3

Textbooks

1. Environmental Science: Towards a Sustainable Future, G. Tyler Miller and Scott Spoolman, 13th Edition, Cengage Learning 2021
2. Environmental Management: Text and Cases, Bala Krishnamoorthy, 3rd Edition, PHI Learning, Publication Year: 2016

3. Green IT: Concepts, Technologies, and Best Practices, Markus Allemann, Springer 2008
4. Sustainable IT: Slimming Down and Greening Up Your IT Infrastructure, David F. Linthicum, IBM Press 2009
5. Environmental Modelling: Finding Solutions to Environmental Problems, David L. Murray, Cambridge University Press 2016
6. Remote Sensing and Image Interpretation, Thomas M. Lillesand, Ralph W. Kiefer, and

Jonathan W. Chipman, 9th Edition, John Wiley & Sons 2020
7. Business Ethics: Concepts and Cases, Manuel Velasquez, Pearson 2012

Reference Books

1. Environmental Law and Policy in India, Shyam Divan and Armin Rosencranz, 2nd Edition, Oxford University Press 2018
2. The International Handbook of Environmental Laws, David Freestone and Jonathon L. Rubin, Edward Elgar Publishing 2000
3. E-Waste Management: Challenges and Opportunities in Developing Countries, Ruediger Kuehr and Ram K. Jain, Springer 2008
4. The E-Waste Handbook: Managing Electronic Waste, Klaus Hieronymi, Ruediger Kuehr, and Ram K. Jain, Earthscan 2009
5. Environmental Ethics: An Introduction, J. Baird Callicott, University of Georgia Press1999

Online References:

Sr. No.	Website Name
1.	Centre for Science and Environment (CSE), Website: cseindia.org
2.	Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India
3.	CSIR-National Environmental Engineering Research Institute (NEERI)

Assessment:
Internal Assessment (IA) for 20 marks:

- IA will consist of Two Compulsory Internal Assessment Tests. Approximately 40% to 50% of syllabus content must be covered in First IA Test and remaining 40% to 50% of syllabus content must be covered in Second IA Test

➢ **Question paper format**

- Question Paper will comprise of a total of **six questions each carrying 20 marksQ.1** will be **compulsory** and should **cover maximum contents of the syllabus**
- **Remaining questions** will be **mixed in nature** (part (a) and part (b) of each question must be from different modules. For example, if Q.2 has part (a) from Module 3 then part (b) must be from any other Module randomly selected from all the modules)
- A total of **Three questions** needs to be answered

Vertical – 6

(Open Electives and MDM Courses)

Course Code	Course Name	Teaching Scheme (Hrs/week)			Credits Assigned			
		L	T	P	L	T	P	Total
		2	--	--	2	--	--	2
OE301	**Introduction to IoT and Applications**	**Examination Scheme**						
			IA1	**IA2**	**ESE**		**Total**	
		Theory	20	20	60		100	

Course Objectives:

1. Define the Internet of Things (IoT) and its key characteristics.
2. Explore the conceptual framework and architectural views of IoT systems.
3. Identify the technologies and components that enable IoT implementations.
4. Understand communication protocols and design principles for connected devices.
5. Examine various sensor and actuator technologies used in IoT applications.
6. Apply IoT design methodologies through case studies in smart living and connected commerce.

Course Outcomes	After the successful completion students should be able to	
	CO1	Articulate the fundamental concepts and significance of IoT.
	CO2	Analyze and differentiate between various IoT technologies and protocols.
	CO3	Design and implement basic IoT applications using appropriate sensors and actuators.
	CO4	Evaluate the effectiveness of IoT solutions in real-world scenarios.
	CO5	Conduct case studies to assess the impact of IoT on smart living and commerce.
	CO6	Collaborate on innovative IoT projects, demonstrating practical application of learned concepts.

Module No.	Unit No.	Topics	Reference	Hrs.
1	**Introduction to Internet of Things**		1,2	6
	1.1	Definition and characteristics, IoT conceptual framework		
	1.2	IoT architectural View		
	1.3	Technology behind IoT – server end technology, Major components of IoT system, Development too, ls and Open-source Framework for IoT implementation, APIs and device Interfacing Components, platforms, and Integration tools, M2M		
2	**Design Principles for Connected Devices and Web Connectivity**		1,2	6
	2.1	Overview of NFC, RFID, Bluetooth, Bluetooth LE, Zigbee, Wi-Fi, GSM		
	2.2	Constrained RESTful Environment (CoRE), CoAP, REST, HTTP, HTTPS, and web-sockets		
	2.3	Internet connectivity		
3	**Sensors and Actuators**		1,2	4
	3.1	Sensor technology – Analog and digital sensors, temperature sensor, humidity sensor, distance sensor, light sensor, acceleration sensor		
	3.2	Participatory sensing, Industrial IoT		
	3.3	Actuators – LED, Piezoelectric vibrator , piezoelectric speaker, motor, relay switch		

4	**IoT Platforms Design Methodology**		1,2	4
	4.1	10 step IoT design Methodology		
	4.2	Case study: IoT system for Weather Monitoring		
5	**Case Studies Based on Smart Living**		1,2	4
	5.1	Smart lighting, gas/smoke detection		
	5.2	Smart parking, emergency response		
	5.3	Smart irrigation, wearable electronics for health and fitness monitoring		
6	**Case studies based on Connected Commerce**		1,2	4
	6.1	Inventory management, smart payment		
	6.2	Fleet tracking		
Total				**26**

Course Assessment:

Theory: IA1: One hours 20 Marks written examination for one hour
IA2: One hours 20 Marks written examination for one hour
ESE: Two hours 60 Marks written examination for two hours

Reference text books:

1. Internet of Things – Architecture and Design Principles – Raj Kamal
2. Internet of Things – A Hands on Approach – Arshdeep Bahga and Viajy Madisetti

Letter Grades and Grade Points:

Semester GPA/ Programme CGPA Semester/ Programme	% of Marks	Alpha-Sign/ Letter Grade Result	Grading Point
9.00 - 10.00	90.0 – 100	O (Outstanding)	10
8.00 - < 9.00	80.0 - < 90.0	A+ (Excellent)	9
7.00 - < 8.00	70.0 - < 80.0	A (Very Good)	8
6.00 - < 7.00	60.0 - < 70.0	B+ (Good)	7
5.50 - < 6.00	55.0 - < 60.0	B (Above Average)	6
5.00 - < 5.50	50.0 - < 55.0	C (Average)	5
4.00 - < 5.00	40.0 - < 50.0	P (Pass)	4
Below 4.00	Below 40.0	F (Fail)	0
Ab (Absent)	-	Ab (Absent)	0

Sd/-

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BoS-Chairman-Electronics Engineering
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Dr. Deven Shah
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