Program Structure for Second Year UG Technology (EX)

Semester-III Credit Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		Course Category
		TH – P – TUT	Total (Hrs.)	TH – P – TUT	Credits	
EXC301	Applications of Mathematics in Engineering-I	3– 0 – 1	04	3 – 0 – 1	04	BS
EXC302	Digital Logic Design	3– 0 – 0	03	3 – 0 – 0	03	PC
EXC303	Electronic Devices & Circuits	3– 0 – 0	03	3 – 0 – 0	03	PC
EXC304	Electronic Instrumentation and Control System	3 – 0 – 0	03	3 – 0 – 0	03	PC
EXC305	Electrical Network Theory	2 – 0 – 0	02	2 – 0 – 0	02	PC
EXL302	Digital Logic Design Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	PC
EXL303	Electronic Devices & Circuits Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	PC
EXL304	Electronic Instrumentation and Control System Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	PC
EXPR31	Project Based Learning- Mini Project Lab-I	0 – 2 – 0	02	0 – 1 – 0	01	PBL
EXXS33	Skill Based Learning-III	0 – 2*– 0	02	0 – 1 – 0	01	SAT
EXXA34	Activity Based Learning- IV (Interdisciplinary Informatics)	0 – 2*– 0	02	0 – 1 – 0	01	SAT
Total		**14– 12– 01**	**27**	**14 - 06 - 01**	**21**	--

***SAT Hours are under Practical head but can be taken as Theory or Practical or both as per the need**

PBL - Mini Project Lab - I and II:

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

Program Structure for Second Year UG Technology (EX)

Semester-III Examination Scheme

Course Code	Course Name	Examination Scheme
		Marks

		CA				ESE	Exam Duration In Hrs.	TW	O	P	Total
		T1	T2	Average (T1&T2)	IA						
EXC301	Applications of Mathematics in Engineering-I	30	30	30	10	60	2 ½	25	-	-	125
EXC302	Digital Logic Design	30	30	30	10	60	2 ½	-	-	-	100
EXC303	Electronic Devices & Circuits	30	30	30	10	60	2 ½	-	-	-	100
EXC304	Electronic Instrumentation and Control System	30	30	30	10	60	2 ½	-	-	-	100
EXC305	Electrical Network Theory	20	20	20	10	45	2	-	-	-	75
EXL302	Digital Logic Design Laboratory	-	-	-	-	-	-	25	25	-	50
EXL303	Electronic Devices & Circuits Laboratory	-	-	-	-	-	-	25	-	25	50
EXL304	Electronic Instrumentation and Control System Laboratory	-	-	-	-	-	-	25	-	-	25
EXPR31	Project Based Learning- Mini Project Lab-I	-	-	-	-	-	-	25	-	25	50
EXXS33	Skill Based Learning-III	-	-	-	-	-	-	25	-	-	25
EXXA34	Activity Based Learning-IV (Interdisciplinary Informatics)	-	-	-	-	-	-	25	-	-	25
Total		**140**	**140**	**140**	**50**	**285**	**-**	**175**	**25**	**50**	**725**

Program Structure for Second Year UG Technology (EX)

Semester-IV-Credit Scheme

Course Code	Course Name	Teaching Scheme (Hrs.) TH – P – TUT	Total (Hrs.)	Credits Assigned TH – P – TUT	Total Credits	Course Category
EXC401	Applications of Mathematics in Engineering-II	3– 0 – 1	04	3 – 0 – 1	04	BS
EXC402	Microcontrollers	3– 0 – 0	03	3 – 0 – 0	03	PC
EXC403	Linear Integrated Circuits	3– 0 – 0	03	3 – 0 – 0	03	PC
EXC404	Principles of Communication Engineering	3 – 0 – 0	03	3 – 0 – 0	03	PC

EXC405	Signals and Systems	3 – 0 – 0	03	3 – 0 – 0	03	PC
EXL402	Microcontrollers Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	PC
EXL403	Linear Integrated Circuits Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	PC
EXL404	Principles of Communication Engineering Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	PC
EXPR42	Project Based Learning- Mini Project Laboratory -II	0 – 2 – 0	02*	0 – 1 – 0	01	PBL
EXXS45	Skill Based Learning – V	0 – 2 – 0	02	0 – 1 – 0	01	SAT
EXXS46	Skill Based Learning – VI	0 – 2* - 0	02	0 – 1 – 0	01	SAT
Total		**15– 12– 01**	**28**	**15 - 06 - 01**	**22**	

***SAT Hours are under Practical head but can be taken as Theory or Practical or both as per the need**

Program Structure for Second Year UG Technology (EX)

Semester-IV Examination Scheme

Course Code	Course Name	Examination Scheme									
		Marks									
		CA				ESE	Exam Duration In Hrs.	TW	O	P	Total
		T1	T2	Average (T1&T2)	IA						
EXC401	Applications of Mathematics in Engineering-II	30	30	30	10	60	2 ½	25	-	-	125
EXC402	Microcontrollers	30	30	30	10	60	2 ½	-	-	-	100
EXC403	Linear Integrated Circuits	30	30	30	10	60	2 ½	-	-	-	100
EXC404	Principles of Communication Engineering	30	30	30	10	60	2 ½	-	-	-	100
EXC405	Signals and Systems	30	30	30	10	60	2 ½	-	-	-	100
EXL402	Microcontroller Laboratory	-	-	-	-	-	-	25	25	-	50
EXL403	Linear Integrated Circuits Laboratory	-	-	-	-	-	-	25	-	25	50
EXL404	Principles of Communication Engineering Laboratory	-	-	-	-	-	-	25	-	25	50
EXPR42	Project Based Learning- Mini Project Lab-II	-	-	-	-	-	-	25	-	25	50
EXXS45	Skill Based Learning – V	-	-	-	-	-	-	25	-	-	25

EXXS46	Skill Based Learning – VI	-	-	-	-	-	-	25	-	-	25
Total		**150**	**150**	**150**	**50**	**300**	**-**	**175**	**25**	**75**	**775**

Subject Mapping of Common Courses

Semester	Course Code	Course Name	Course designed for			
			CE	EX	IT	AI-DS
III	EXC301	Applications of Mathematics in Engineering-I	**-**	√	**-**	**-**
IV	EXC401	Applications of Mathematics in Engineering-II	-	√	**-**	**-**

Program Structure for Second Year UG Technology (EX)

Semester-III Credit Scheme

Course Code	Course Name	Teaching Scheme (Hrs.)		Credits Assigned		Course Category
		TH – P – TUT	Total (Hrs.)	TH – P – TUT	Credits	
EXC301	Applications of Mathematics in Engineering-I	3– 0 – 1	04	3 – 0 – 1	04	BS
EXC302	Digital Logic Design	3– 0 – 0	03	3 – 0 – 0	03	PC
EXC303	Electronic Devices & Circuits	3– 0 – 0	03	3 – 0 – 0	03	PC
EXC304	Electronic Instrumentation and Control System	3 – 0 – 0	03	3 – 0 – 0	03	PC
EXC305	Electrical Network Theory	2 – 0 – 0	02	2 – 0 – 0	02	PC
EXL302	Digital Logic Design Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	PC
EXL303	Electronic Devices & Circuits Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	PC
EXL304	Electronic Instrumentation and Control System Laboratory	0 – 2 – 0	02	0 – 1 – 0	01	PC
EXPR31	Project Based Learning- Mini Project Lab-I	0 – 2 – 0	02	0 – 1 – 0	01	PBL

EXXS33	Skill Based Learning-III	0 – 2*– 0	02	0 – 1 – 0	01	SAT
EXXA34	Activity Based Learning- IV (Interdisciplinary Informatics)	0 – 2*– 0	02	0 – 1 – 0	01	SAT
Total		**14– 12– 01**	**27**	**14 - 06 - 01**	**21**	--

***SAT Hours are under Practical head but can be taken as Theory or Practical or both as per the need**

PBL - Mini Project Lab - I and II:

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

Program Structure for Second Year UG Technology (EX)

Semester-III Examination Scheme

Course Code	Course Name	Examination Scheme									
		Marks									
		CA				ESE	Exam Duration In Hrs.	TW	O	P	Total
		T1	T2	Average (T1&T2)	IA						
EXC301	Applications of Mathematics in Engineering-I	30	30	30	10	60	2 ½	25	-	-	125
EXC302	Digital Logic Design	30	30	30	10	60	2 ½	-	-	-	100
EXC303	Electronic Devices & Circuits	30	30	30	10	60	2 ½	-	-	-	100
EXC304	Electronic Instrumentation and Control System	30	30	30	10	60	2 ½	-	-	-	100
EXC305	Electrical Network Theory	20	20	20	10	45	2	-	-	-	75
EXL302	Digital Logic Design Laboratory	-	-	-	-	-	-	25	25	-	50
EXL303	Electronic Devices & Circuits Laboratory	-	-	-	-	-	-	25	-	25	50
EXL304	Electronic Instrumentation and Control System Laboratory	-	-	-	-	-	-	25	-	-	25
EXPR31	Project Based Learning- Mini Project Lab-I	-	-	-	-	-	-	25	-	25	50
EXXS33	Skill Based Learning-III	-	-	-	-	-	-	25	-	-	25

EXXA34	Activity Based Learning-IV (Interdisciplinary Informatics)	-	-	-	-	-	-	25	-	-	25
Total		**140**	**140**	**140**	**50**	**285**	**-**	**175**	**25**	**50**	**725**

Course Code	**Course Name**	**Credits (TH+P+TUT)**
EXC301	**Applications of Mathematics in Engineering-I**	**3 + 0 + 1**
Prerequisite:	1. Engineering Mathematics-I 2. Engineering Mathematics-II 3. Scalar and Vector Product: Scalar and vector product of three and four vectors	
Course Objectives:	1. To learn the Laplace Transform, Inverse Laplace Transform of various functions and its applications. 2. To understand the concept of Fourier Series, its complex form and enhance the problem solving skill. 3. To understand the concept of complex variables, C-R equations, harmonic functions and its conjugate and mapping in the complex plane. 4. To understand the basics of Linear Algebra. 5. To use concepts of vector calculus to analyze and model engineering problems	
Course Outcomes:	Upon completion of the course, the learners will be able to: 1. Solve the real integrals in engineering problems using the concept of Laplace Transform. 2. Analyze engineering problems through the application of inverse Laplace transform of various functions. 3. Expand the periodic function by using Fourier series for real life problems and complex engineering problems. 4. Solve the problems of obtaining orthogonal trajectories and analytic functions by means of complex variable theory and application of harmonic conjugate. 5. Use matrix algebra to solve the engineering problems. 6. Apply the concepts of vector calculus in real life problems.	

Module No. & Name	**Sub Topics**	**CO Mapped**	**Hrs/ Sub Topic**	**Total Hrs/ Module**
. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
. Laplace Transform	Definition of Laplace transform, Condition of Existence of Laplace transform. Laplace Transform (L) of Standard Functions like e^{at}, $sin(at)$, $cos(at)$, $sinh(at)$, $cosh(at)$ and t^n, $n \geq 0$.	1	02	06

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
	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).		02	
	3 Evaluation of integrals by using Laplace Transformation.		02	
2. Inverse Laplace Transform	1. Inverse Laplace Transform, Linearity property, use of standard formulae to find inverse Laplace Transform, finding Inverse Laplace transform using derivatives.	2	02	07
	2. Partial fractions method to find inverse Laplace transform.		03	
	3. Inverse Laplace transform using Convolution theorem (without proof).		02	
. Fourier Series	1. Dirichlet's conditions, Definition of Fourier series and Parseval's Identity (without proof).	3	01	06
	2. Fourier series of periodic function with period 2π and $2l$.		02	
	3. Fourier series of even and odd functions.		01	
	4. Fourier Transform-Fourier sine transform and Fourier cosine transform.		02	
. Complex Variables	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	03	07
	2. Cauchy-Riemann equations in Cartesian coordinates (without proof).		01	
	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		02	
	4. Harmonic function, Harmonic conjugate and orthogonal trajectories.		01	

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
. Linear Algebra: Matrix Theory	1. Characteristic equation, Eigen values and Eigen vectors, Example based on properties of Eigen values and Eigen vectors. (Without Proof).	5	02	06
	2. Cayley-Hamilton theorem (Without proof), Examples based on verification of Cayley- Hamilton theorem and compute inverse of Matrix.		02	
	3. Similarity of matrices, Diagonalization of matrices. Functions of square matrix		02	
. Vector Differentiation and Integral	1. Vector differentiation: Basics of Gradient, Divergence and Curl (Without Proof).	6	02	07
	2. Properties of vector field: Solenoidal and irrotational (conservative) vector fields.		02	
	3. Vector integral: Line Integral, Green's theorem in a plane (Without Proof), Stokes' theorem (Without Proof) only evaluation.		03	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	-	01	01
			Total:	**42**

Books:	
Text Books	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 Barrett, Tata Mc-Graw Hill.
Reference Books	1. Theory and Problems of Fourier Analysis with applications to BVP, Murray Spiegel, Schaum's Outline Series 2. Vector Analysis Murry R. Spiegel, Schaum's outline series, Mc-Graw Hill Publication 3. Beginning Linear Algebra, Seymour Lipschutz, Schaum's outline series, Mc-Graw Hill Publication 4. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publication

Useful links:

1. http://epgp.inflibnet.ac.in/Home/ViewSubject?catid=25
2. https://nptel.ac.in/noc/courses/111/
3. https://www.coursera.org/courses?query=mathematics
4. https://ndl.iitkgp.ac.in/

Continuous Assessment:

General Instructions:

1. Each Student has to write at least 6 class tutorials on the 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 a 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.	Class Tutorials on entire syllabus	15 Marks
2.	Assignment	10 Marks

Continuous Assessment (CA):

The distribution of Continuous Assessment marks will be as follows –

1.	Class Test 1	30 marks
2.	Class Test 2	30 marks
3.	Internal Assessment	10 marks

Class Tests (30 Marks):

Two class tests of 30 marks each should be conducted in a semester. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus (but excluding contents covered in Test I) is completed. Duration of each test shall be one hour and 15 Minutes. Average of the two class tests (T-1 and T-2) will be considered for Continuous Assessment.

Internal Assessment(IA):

Marks will be awarded based on the rubrics designed.

End Semester Theory Examination will be of 60 Marks with Two Hours and 30 Minutes duration.

Course Code	Course Name	Credits (TH+P+TUT)
EXC302	**Digital Logic Design**	**3+0+0**
Prerequisite:	1. Basics of Electrical Engineering(BSC105) 2. Engineering Physics(BSC102)	
Course	. To understand number system representations and their inter-conversions	

Objectives:	used in digital electronic circuits. . To analyse digital logic processes and to implement logical operations using various combinational logic circuits. .To analyse, design and implement logical operations using various sequential logic circuits. . To study the characteristics of memory and their classification. . To learn basic concepts in VHDL and implement combinational and sequential circuits using VHDL.
Course Outcomes:	1. Develop a digital logic and apply it to solve real life problems. 2. Analyse, design and implement combinational logic circuits. 3. Classify different semiconductor memories. 4. Analyse, design and implement sequential logic circuits. 5. Analyse digital system design using PLD. . Simulate and implement combinational and sequential circuits using VHDL.

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
. Number Systems and Codes	Review of Binary, Octal and Hexadecimal Number Systems, their inter-conversion, Binary code, Gray code and BCD code, Binary Arithmetic, Addition, Subtraction using 1's and 2's Complement.	1	--	04
. Logic Family and Logic Gates	1. Difference between Analog and Digital signals, Logic levels, TTL and CMOS Logic families and their characteristics.	1	02	05
	2. Digital logic gates, Universal gates, Realization using NAND and NOR gates, Boolean Algebra, De Morgan's Theorem.		03	
. Combinational Logic Circuits	1. SOP and POS representation, K-Map up to four variables and Quine-McClusky method for minimization of logic expressions.	2	04	12
	2. Arithmetic Circuits: Half adder, Full adder, Half Subtractor, Full Subtractor, Carry Look ahead adder and BCD adder, Magnitude Comparator.		04	
	3. Multiplexer and De-Multiplexer: Multiplexer operations, cascading of Multiplexer, Boolean function implementation using MUX, DEMUX and basic gates, Encoder and Decoder.		04	

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
. **Sequential Logic Circuits**	1. Flip flops: RS, JK, Master slave flip flops; T & D flip flops with various triggering methods, Conversion of flip flops, Registers: SISO, SIPO, PISO, PIPO and Universal Shift Register.	4	04	12
	2. Counters: Asynchronous and Synchronous counters with State transition diagram, Up/Down, MOD N, BCD Counter.		04	
	Applications of Sequential Circuits: Frequency division, Ring counter, Johnson counter, Introduction to design of Moore and Mealy circuits.		04	
5.Different Types of Memories and Programmable Logic Devices	Classification and Characteristics of memory, SRAM, DRAM, ROM, PROM, EPROM and Flash memories	3	01	04
	Introduction: Programmable Logic Devices (PLD), Programmable Logic Array (PLA), Programmable Array Logic (PAL).	5	03	
. **Introduction to VHDL**	Basics of VHDL/Verilog Programming, Design and implementation of Adder, Subtractor, multiplexer and flip flop using VHDL/Verilog.	6	--	02
. **Course Conclusion**	Recap of Modules, Outcomes, Applications, and Summarization.	-	01	01
			Total:	**42**

Books:	
Text Books	. John F. Warkerly, “Digital Design Principles and Practices”, Pearson Education, Fifth Edition (2018). . Morris Mano, Michael D. Ciletti, “Digital Design”, Pearson Education, Fifth Edition (2013). . R. P. Jain, “Modern Digital Electronics", Tata McGraw Hill Education, Fourth Edition (2010). . A. Anand Kumar, “Fundamentals of Digital Circuits”, PHI, Fourth Edition (2016). . Volnei A. Pedroni, “Digital Electronics and Design with VHDL” Morgan Kaufmann Publisher, First Edition (2008). . Stephen Brown & Zvonko Vranesic, “Fundamentals of Digital Logic with Verilog

	Design", Third Edition, MGH (2014). Stochastic Processes", Tata McGraw Hill Education
Reference Books	. Thomas L. Floyd, "Digital Fundamentals", Pearson Prentice Hall, Eleventh Global Edition (2015). . Mandal, "Digital Electronics Principles and Applications", McGraw Hill Education, First Edition (2010). . Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss "Digital Systems Principles and Applications", Ninth Edition, PHI (2009). . Donald P. Leach / Albert Paul Malvino/Gautam Saha, "Digital Principles and Applications", The McGraw Hill, Eight Edition (2015). . Stephen Brown & Zvonko Vranesic, "Fundamentals of Digital Logic Design with VHDL", Second Edition, TMH (2009). . J. Bhasker, "A Verilog HDL Primer", Star Galaxy Press, Third Edition (1997)
Useful Links:	Course: Digital Circuits By Prof. Santanu Chattopadhyay (IIT Kharagpur); https://swayam.gov.in/nd1_noc20_ee70/preview

Continuous Assessment (CA):
The distribution of Continuous Assessment marks will be as follows –

1.	Class Test 1 (T-1)	30 marks
2.	Class Test 2 (T-2)	30 marks
3.	Internal Assessment	10 marks

Class Tests (30 Marks):
Two class tests of 30 marks each should be conducted in a semester. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus (but excluding contents covered in Test I) is completed. Duration of each test shall be one hour and 15 Minutes. Average of the two class tests (T-1 and T-2) will be considered for Continuous Assessment.

nternal Assessment(IA):
Marks will be allotted as per designed rubrics.

End Semester Theory Examination will be of 60 Marks with Two Hours and 30 Minutes duration.

Course Code	Course Name	Credits (TH+P+TUT)
EXC303	**Electronic Devices and Circuits**	**3+0+0**
Prerequisite:	Basic Electrical Circuits	
Course Objectives:	. Analyse Electronic devices using energy band diagrams . Explain electronic circuits for various applications like, switches, regulators and rectifiers . Compare Model of semiconductor devices . Analyse Electronic amplifier Circuits . Design Amplifier circuits for given specification. . Compare various types of amplifiers.	

Course Outcomes:	After successful completion of the course, student will be able to . Evaluate Electrical/physical parameters from energy band diagram of devices. . Define Various parameter, specifications of Electronics circuits . Compare Model of semiconductor devices . Analyse Electronic amplifier Circuits . Design Amplifier circuits for given specification. . Compare various types of amplifiers.

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Introduction of Electronic Devices	Review of Energy Band Diagram, Carrier statistics and Thermal Equilibrium, Carrier transport: drift diffusion , Generation and Recombination	1	02	04
	2 PN Junction diodes , current equation, Zener diode, Voltage regulator, BJT and MOSFET construction, Band diagram of these devices	1, 2	02	
2. Biasing Circuits of BJTs and MOSFETs	Concept of DC load line, DC models, Q point and regions of operations, Analysis and design of biasing circuits for BJT (Fixed bias & Voltage divider Bias) DC load line and region of operation for MOSFETs.	2, 3	02	06
	Analysis and design of biasing circuits for JFET (self-bias and voltage divider bias), E-MOSFET (Drain to Gate bias & voltage divider bias).	3, 4	04	
3. Small Signal Amplifiers	Concept of AC load line and Amplification, Small signal analysis (Zi, Zo, Av and Ai) of CE amplifier using hybrid pi model	3	03	09
	Small signal analysis (Zi, Zo, Av) of CS (for EMOSFET) amplifiers. Introduction to multistage amplifiers. (Concept, advantages & disadvantages).	3, 4, 6	06	
4. Frequency response of Small signal Amplifiers	1 Effects of coupling, bypass capacitors and parasitic capacitors on frequency response of single stage amplifier, Miller effect and Miller capacitance	4	05	09
	2 High and low frequency analysis of CS,	3, 4, 6	04	

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
	CE amplifier.			
5. Large Signal Amplifiers	Classification and working of Power amplifier	6	02	05
	Analysis of Class A power amplifier (Series fed and transformer coupled).	4	01	
	Transformerless Amplifier: Class B power amplifier. Class AB output stage with diode biasing	6	02	
6. MOSFET amplifiers	1 Introduction of Differential Amplifier and its configurations(EMOSFET), Small signal Analysis	4	02	06
	2 Differential and common mode gain, CMRR, differential and common mode Input impedance, Current sources using 2 transistor	2	04	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	-	01	01
			Total:	**42**

Books:	
Text Books	1. D. A. Neamen, "Electronic Circuit Analysis and Design," Tata McGraw Hill, 2nd Edition. 2. A. S. Sedra, K. C. Smith, and A. N. Chandorkar, "Microelectronic Circuits Theory and Applications," International Version, OXFORD International Students, 6th Edition
Reference Books	1. Boylestad and Nashelesky, "Electronic Devices and Circuits Theory," Pearson Education, 11th Edition. 2. A. K. Maini, "Electronic Devices and Circuits," Wiley. 3. T. L. Floyd, "Electronic Devices, "Prentice Hall, 9th Edition, 2012
Useful Links:	
1. https://www.falstad.com/circuit/ 2. https://youtu.be/sKmSqjNvGH8	

Term Work:

The distribution of Continuous Assessment marks will be as follows –

1.	Class Test 1 (T-1)	30 marks
2.	Class Test 2 (T-2)	30 marks
3.	Internal Assessment	10 marks

Class Tests (30 Marks):
Two class tests of 30 marks each should be conducted in a semester. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus (but excluding contents covered in Test I) is completed. Duration of each test shall be one hour and 15 Minutes. Average of the two class tests (T-1 and T-2) will be considered for Continuous Assessment.

Internal Assessment(IA):
Marks will be allotted as per designed rubrics.

End Semester Theory Examination will be of 60 Marks with Two Hours and 30 Minutes duration.

Course Code	Course Name	Credits (TH+P+TUT)
EXC304	**Electronic Instrumentation & Control Systems**	**3+0+0**
Prerequisite:	1. Basic Electrical Engineering 2. Applied Physics	
Course Objectives:	1. To provide basic knowledge about the various sensors and transducers . To provide fundamental concepts of control system such as mathematical modelling, time response and Frequency response 3. To develop concepts of stability and its assessment criteria.	
Course Outcomes:	. Identify various sensors, transducers and their brief performance specification . Explain the principle of working of various transducers used to measure temperature, displacement level, pressure and their applications in industry . Determine the models of physical systems in forms suitable for use in the analysis and design of control systems . Obtain the transfer functions for a given Control system . Apply the analysis of systems in the time domain and frequency domain. . Predict stability of a given system using appropriate criteria.	

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02	02
1. Principle of Measurement, Testing and Measuring instruments	1 Introduction to Basic instruments: Components of generalized measurement system Concept of accuracy, precision, linearity, sensitivity, resolution, hysteresis, calibration	1	02	04

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
	2 Measurement of Resistance: Kelvin's double bridge, Wheatstone bridge and Megohm bridge. Measurement of Inductance: Maxwell bridge and Hey bridge Measurement of Capacitance: Schering bridge		02	
2. Sensors and Transducers	1 Basics of sensors and Transducers- Active and passive transducers, characteristics and selection criteria of transducers	2	02	06
	Displacement and pressure- Potentiometers, pressure gauges, Linear Variable Differential Transformers (LVDT) for measurement of pressure and displacement strain gauges		02	
	Temperature Transducers- Resistance Temperature Detectors (RTD). Thermistors and thermocouples, their ranges and applications		02	
3. Introduction to control system Analysis	1 Introduction: Open and closed loop systems, example of control systems, Introduction of Adaptive Control System	3	01	08
	2 Modelling: Modelling of Electrical System, Transfer function model		02	
	Block diagram reduction techniques and Signal flow graph		05	
4. Response of control system	Dynamic Response: Standard test signals, transient and steady state behaviour of first and second order systems, steady state errors in feedback control systems and their types.	4	02	04
	.2 Concept of lag and lead compensator		02	
5. Stability Analysis in Time Domain	Concept of stability: Routh and Hurwitz stability criterion.	5	02	08
	Root locus Analysis: Root locus concept, general rules for constructing root-locus, root locus analysis of control system		06	

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
6. Stability Analysis in frequency domain	1 Introduction: Frequency domain specification, Relationship between time and frequency domain specification of system, stability margins	6	03	09
	Bode Plot: Magnitude and phase plot, Method of plotting Bode plot, Stability margins and analysis using bode plot. Frequency response analysis of RC, RL, RLC circuits		04	
	3 Nyquist Criterion: Concept of Polar plot and Nyquist plot, Nyquist stability criterion, gain and phase margin		02	
ii. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	-	01	01
			Total:	**42**

Books:	
Text Books	. A.K. Sawhney, "*Electrical & Electronic Measurement & Instrumentation"* – DRS. India . B.C Nakra, K.K. Chaudhary, Instrumentation Measurement and Analysis, Tata Mc Graw Hill. . W.D. Cooper, "*Electronic Instrumentation and Measuring Techniques"* –PHI . Nagrath, M. Gopal, "*Control System Engineering*", Tata McGraw-Hill
Reference Books	1. Helfrick & Cooper, "*Modern Electronic Instrumentation & Measuring Techniques"* – PHI 2. M.M.S. Anand, "*Electronic Instruments and Instrumentation Technology"*. 3. Gopal M., "*Control Systems Principles and Design*", Tata McGraw Hill Publishing Co. Ltd. New Delhi, 1998 4. Benjamin C. Kuo, "*Automatic Control Systems*, Pearson Education", VIIth edition
Useful Links:	
NPTEL/ Swayam Course: Course: Control Systems by Prof. C. S. Shankar Ram (IIT Madras); https://swayam.gov.in/nd1_noc20_ee90/preview	

Continuous Assessment (CA):
The distribution of Continuous Assessment marks will be as follows –

1.	Class Test 1 (T-1)	30 marks
2.	Class Test 2 (T-2)	30 marks
3.	Internal Assessment	10 marks

Class Tests (30 Marks):
Two class tests of 30 marks each should be conducted in a semester. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus (but excluding contents covered in Test I) is completed. Duration of each test shall be one hour and 15 Minutes. Average of the two class tests (T-1 and T-2) will be considered for Continuous Assessment.

nternal Assessment(IA):
Marks will be allotted as per designed rubrics.

End Semester Theory Examination will be of 60 Marks with Two Hours and 30 Minutes duration.

Course Code	Course Name	Credits (TH+P+TUT)
EXC305	**Electrical Network Theory**	**2+0+0**

Prerequisite:	. Basic Electrical Engineering . Matrix (Engineering Mathematics-I), Solutions to Differential Equation, Integration (Engineering Mathematics- II), Laplace Transform (Applications of Mathematics in Engineering -I)
Course Objectives:	1. To explain the basic concepts and Theorems of electrical networks with Dependent Source and solve them using mesh and nodal analysis techniques 2. To introduce students with the fundamental concepts in graph theory 3. To analyse the Circuits in Time and Frequency domain 4. To introduce open circuit, short circuit, transmission, hybrid parameters. 5. To study concepts of driving point and transfer functions, poles and zeros, Hurwitz polynomial of Network Functions. 6. To study positive real functions from given functions.
Course Outcomes:	After successful completion of the course, student will be able to . Articulate knowledge in analysing Circuits by using Network theorems with Dependent source. . Illustrate the complex electric circuits by converting them into Graph Theory. . Apply Time domain and frequency domain analysis of RLC Circuits . Synthesize the various parameters of two port network . Recognize Hurwitz polynomials from a given function. . Integrate positive real function from given function

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	01	01
1. Analysis of DC circuits	1 Analysis of DC circuits: Analysis of circuits with dependent sources using generalized Mesh, Node, Super mesh, Super node analysis.	1	02	07
	Circuit Theorems: Superposition Theorem, Thevenin Theorem, Norton Theorem, Maximum Power Transfer Theorem. (Use only DC source).	1	04	
	Magnetic Circuits: Concept of Self and mutual inductances, Coefficient of Coupling, dot convention, equivalent circuit.	1	01	
2. Graph Theory	Concept of Node and Loop, Tree, Co-tree, Incidence matrix: Complete Incidence matrix, Reduced Incidence matrix, number of possible trees of graph	2	02	04
	2.2 Cut Set Matrix and Tie Set Matrix	2	02	
3. Time domain and frequency domain analysis of R-L-C Circuits	Time domain analysis of R-L and R-C Circuits: Forced and natural response, initial and final values. Solution using first order and second order differential equations with step signals.	3	03	06
	Frequency domain analysis of R-L-C Circuits: Forced and natural response, Solution using second order equation for step signal (One Loop or Node), Effect of damping factor (No Numerical)	3	03	
4. Two port Networks	Open Circuit, Short Circuit, and Transmission and Hybrid parameters.	4	03	04
	Relationships among parameters (No Derivations), reciprocity and symmetry conditions	4	01	
5. Network Function	Driving point and Transfer function, Poles and Zeros of Network functions, Properties of Hurwitz Polynomials, Testing for Hurwitz polynomials.	5	--	03

Module No. & Name	Sub Topics	CO Mapped	Hrs/ Sub Topic	Total Hrs/ Module
6. Positive Real Functions	Properties of Positive Real Functions, Necessary and sufficient conditions for positive real functions. Testing for positive real functions.	6	--	02
. Course Conclusion	Recap of Modules, Outcomes, Applications, and Summarization.	--	01	01
			Total:	**28**

Books:	
Text Books	. Franklin F Kuo, "Network Analysis and Synthesis", Wiley Toppan, 2nd edition, 1966. . M E Van Valkenburg, "Network Analysis", Prentice-Hall of India Pvt Ltd, New Delhi, 26th Indian Reprint, 2000
Reference Books	. A. Sudhakar, Shyam mohan S. Palli "Circuits and Networks", Tata McGraw-Hill education, 2010 . Smarajit Ghosh "Network Theory Analysis & Synthesis", PHI learning . K.S. Suresh Kumar, "Electric Circuit Analysis" Pearson, 2013. . D. Roy Choudhury, "Networks and Systems", New Age International, 1998 . C. K. Alexander and M. N. O. Sadiku," Fundamental of Electric Circuit" McGraw Hill Education, India, 2013
Useful Links:	
1. Analog signals, Network and measurement Virtual Laboratory: vlabs.iitkgp.ac.in/asnm/#	

Continuous Assessment (CA):

The distribution of Continuous Assessment marks will be as follows –

1.	Class Test 1	20 marks
2.	Class Test 2	20 marks
3.	Internal Assessment	10 marks

Class Tests (20-Marks): Test-1 and Test-2 consists of two class tests of 20 marks each. Test-1 is to be conducted on approximately 40% of the syllabus completed and Test-2 will be based on remaining contents (approximately 40% syllabus but excluding contents covered in Test-1). Duration of each test shall be 1 Hour. Average of the two class tests (T-1 and T-2) will be considered for Continuous Assessment.

Internal Assessment(IA):

Marks will be allotted as per designed rubrics.

End Semester Theory Examination will be of 45 Marks with Two hour duration.

Lab Code	**Lab Name**	**Credits (P+TUT)**
EXL302	**Digital Logic Design Laboratory**	**1+0**
Lab Prerequisite:	1. Basics of Electrical Engineering(BSC105) 2. Engineering Physics(BSC102)	
Lab Objectives:	. To understand number system representations and their inter-conversions used in digital electronic circuits. . To analyse digital logic processes and to implement logical operations using various combinational logic circuits. . To analyse, design and implement logical operations using various sequential logic circuits. . To study the characteristics of memory and their classification. 5. To learn basic concepts in VHDL and implement combinational and sequential circuits using VHDL.	
Lab Outcomes:	1. Verify logic gates. 2. Implement combinational logic circuits. 3. Implement sequential logic circuits. 4. Simulate basic logic gates using VHDL. 5. Write accurate documentation for experiments performed. 6. Apply ethical principles like timeliness and adhere to the rules of the laboratory.	

Lab No.	**Experiment Title**	**LO Mapped**	**Hrs/Lab**
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02
	Verify operations of logic gates and Boolean function.	1, 5, 6	02
	Verify operations of universal gates NAND and NOR.	1, 5, 6	02
	Implement and design Binary to Gray and Gray to Binary.	1, 5, 6	02
	Implement and design half adder & subtractor and full adder & subtractor circuits.	2, 5, 6	02
	Implement and design BCD Adder.	2, 5, 6	02

Lab No.	Experiment Title	LO Mapped	Hrs/Lab
	Design and Implement logic equation using multiplexer.	2, 5, 6	02
	Implement and Design digital Encoder circuit.	1, 5, 6	02
	Design and verify the truth table of various flip flops (FF) like SR, JK, D and T flip-flops.	3, 5, 6	02
	Simulate AND, OR and NAND logic gate operation using Verilog Hardware Description Language.	4, 5, 6	02
	Simulate Decoder using VHDL code.	5, 6	02
	Simulate positive edge triggered D flip flop with asynchronous active low preset and clear using VHDL code.	5, 6	02
	Simulate the counter using VHDL code.	5, 6	02
	Case Study / Mini Project	1 to 6	02
		Total	**28**

Useful Links:
1. http://vlabs.iitkgp.ac.in/dec/#
Term work: Term work should consist of a minimum of 8 experiments. Journal must include assignments on content of theory and practical of the course. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work. Total 25 Marks (Experiments: 15-marks, Assignments/Case study/Project/demo/presentation: 10-marks)
Oral/Practical/P&O: **Oral** examination will be based on the experiment list and content of the entire theory syllabus and carries 25-Marks

Lab Code	Lab Name	Credits (P+TUT)
EXL303	**Electronic Devices & Circuits Laboratory**	**1+0**
Hardware Requirements:	PC with following Configuration 1. Intel Dual Core Processor or higher 2. Minimum 4 GB RAM 3. Minimum 40 GB Hard disk	

Software Requirements:	1. Windows / Linux Desktop OS 2. NGSpice Software 3. LTspice Circuit Simulation Software
Lab Prerequisite:	1. Basic Electrical Engineering Lab
Lab Objectives:	1. To physical Implementation of given circuit 2. To introduce simulation of Electronic circuits 3. To troubleshoot the Electronic circuit 4. To create new circuits for given application
Lab Outcomes :	Student Will be able to 1. Assemble components and measuring devices using bread board as per the circuit diagram for experiment to be performed. 2. Perform experiment to gather appropriate data 3. Analyse data obtained from experiment to relate theory with experiment results 4. Explain functionality of various equipments, electronics devices and components and instruments used to perform laboratory work 5. Write accurate documentation for experiments performed. **6.** Apply ethical principles like timeliness and adhere to the rules of the laboratory.

Lab No.	Experiment Title	LO Mapped	Hrs/Lab
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02
	Introduction to Lab equipment and Simulation tools	1, 5, 6	02
	Draw P-N junction diode characteristics.	2, 3, 4, 5, 6	02
	To study Zener as a voltage regulator	2, 3, 4, 5, 6	02
	Plot characteristics of CE configuration	2, 3, 4, 5, 6	02
	Analyse BJT biasing circuits	2, 3, 4, 5, 6	02
	Understand BJT as CE amplifier	2, 3, 4, 5, 6	02
	Plot frequency response of CE amplifier	2, 3, 4, 5, 6	02
	Analyse E-MOSFET biasing circuits	2, 3, 4, 5, 6	02
	Simulation experiment on study of CS amplifier	2, 3, 4, 5, 6	02
	Simulation experiment on study frequency response of CS amplifier	2, 3, 4, 5, 6	02

Lab No.	Experiment Title	LO Mapped	Hrs/Lab
	Simulation experiment on study of differential amplifier	2, 3, 4, 5, 6	02
	Implementation of application based on BJT	2, 3, 4, 5, 6	02
	Implementation of application on MOSFET	2, 3, 4, 5, 6	02
		Total:	**28**

Useful Links:

1. http://vlabs.iitkgp.ernet.in/be/
2. https://www.falstad.com/circuit/

Term work:

1. Term work should consist of a minimum of 8 experiments.
2. Journal must include assignments on content of theory and practical of the course.
3. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.
4.Total 25 Marks (Experiments: 15-marks, Assignments/Case study/Project/demo/presentation: 10-marks)

Oral/Practical/P&O :

Practical examination will be based on the experiment list and content of the entire theory syllabus and carries 25-Marks

Lab Code	Lab Name	Credits (P+TUT)
EXL304	**Electronic Instrumentation and Control System Lab**	**1+0**
Lab Prerequisite:	1. Basic Electrical Engineering 2. Applied Physics	
Lab Objectives:	. To experimentally verify the principle and characteristics of various transducers and measurement of resistance and inductance . To make students understand the construction and the working principle of various transducers used for Displacement measurement, Temperature measurement and Level measurement. . To examine steady-state and frequency response of the Type 0, 1, and 2 systems . To examine steady-state and frequency response of first and second order electrical systems. . To inspect stability analysis of a system using Root locus, Bode plot, polar plot and Nyquist plot.	
Lab Outcomes:	. Analyse Plot and validate the performance characteristics of transducers. . Validate the characteristics of various temperature, pressure and level transducers.	

	. Analyse Plot frequency response of first-order electrical system. . Analyse Plot time response of second-order electrical systems and calculate the steady-state error. . Write accurate documentation for experiments performed. . Apply ethical principles like timeliness and adhere to the rules of the laboratory.

Lab No.	Experiment Title	LO Mapped	Hrs./ Lab
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02
	Designing DC bridge for Resistance Measurement (Quarter, Half and Full bridge)	1, 5, 6	02
	Designing AC bridge Circuit for capacitance measurement.	1, 5, 6	02
	Study and characteristics of Resistive Temperature Detector (RTD).	2, 5, 6	02
	Study of Linear Variable Differential Transformer (LVDT)	2, 5, 6	02
	To plot the effect of time constant on first-order systems response.	3, 5, 6	02
	To plot the frequency response of first-order System	3, 5, 6	02
	To plot the time response of second-order systems	3, 5, 6	02
	To plot the frequency response of second-order System	3, 5, 6	02
	To Examine Steady State Error for Type 0, 1, 2 System	4, 5, 6	02
	To study the performance of Lead and Lag Compensator	4, 5, 6	02
	To inspect the relative stability of systems by Root-Locus using Simulation Software	3, 5, 6	02
	To determine the frequency specification from Polar plot of system	4, 5, 6	02
	To inspect the stability of system by Nyquist plot using Simulation software	4, 5, 6	02
	To inspect the stability of the system by Bode plot using Simulation software.	3, 5, 6	02
15.	Any other experiment based on syllabus which will help students to understand the topic/concept.		02
		Total	**32***
***Minimum 28 Hrs. Lab / Mini Project to be conducted**			

Useful Links:

1. http://slcoep.vlabs.ac.in/List%20of%20experiments.html?domain=Electrical%20Engineering
2. http://vlabs.iitkgp.ernet.in/asnm/#

Term work:

1. Term work should consist of a minimum of 8 experiments.

2. Journal must include assignments on content of theory and practical of the course.

. The final certification and acceptance of term work ensures satisfactory performance of laboratory work and minimum passing marks in term work.

. Total 25 Marks (Experiments: 15-marks, Assignments/Case study/Project/demo/presentation: 10-marks)

Course code	Project Based Learning	Credits (TH+P+TUT)
EXPR31	**PBL Mini Project Lab-I**	**0+1+0**

Objectives:

1. To acquaint yourself 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 yourself 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 inference from available results through theoretical/ experimental/simulations
5. Analyze 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 lifelong learning.
9. Demonstrate project management principles during project work.

General Guidelines for Mini Project I and II:

General Guidelines for Mini Project I and II:	
1	Students shall form a group of 2 to 4 students, while forming a group shall not be allowed less than two or more than four students, as it is a group activity.
2	Students should do surveys and identify needs, which shall be converted into problem statements for mini projects in consultation with faculty supervisor/internal committee of faculties.
3	Students shall submit an implementation plan in the form of Gantt/PERT/CPM chart, which will cover weekly activity of mini projects.
4	A logbook to be prepared by each group, wherein the group can record weekly work progress, guide/supervisor can verify and record notes/comments.
5	Faculty supervisor may give inputs to students during mini project activity; however, focus shall be on self-learning.
6	Students in a group shall understand problems effectively, propose multiple solutions and select the best possible solution in consultation with the guide/ supervisor.
7	Students shall convert the best solution into a working model using various components of their domain areas and demonstrate.
8	The solution to be validated with proper justification and report to be compiled in standard format of the college.
9	With the focus on self-learning, innovation, addressing societal problems and entrepreneurship quality development within the students through the Mini Projects, it is preferable that a single project of appropriate level and quality be carried out in two semesters by all the groups of the students. i.e. Mini Project 1 in semester III and IV.
10	However, based on the individual students or group capability, with the mentor's recommendations, if the proposed Mini Project adhering to the qualitative aspects mentioned above gets completed in odd semester, then that group can be allowed to work on the extension of the Mini Project with suitable improvements/modifications or a completely new project idea in even semester. This policy can be adopted on a case by case basis. **Note: Project Should More Towards Societal Based And Health Care Based.**

Term Work:		
The review/ progress monitoring committee shall be constituted by senior faculty members. The progress of mini project to be evaluated on continuous basis, minimum two reviews in each semester. Assessment also considers peer review and ethics observed by faculties and participation involvement.		
In continuous assessment focus shall also be on each individual student, log book maintained and weekly meeting based on the same.		
Distribution of Term work marks for both semesters shall be as below:		**Practical Marks**
1	Marks awarded by guide/supervisor based on implementation	10
2	Peer assessment by team members	05

3	Marks awarded by review committee	05
4	Quality of Project report	05

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

One-year project:

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

Half-year project:

1	In this case in one semester students' group shall complete project in all aspects including, • Identification of need/problem • Proposed final solution • Procurement of components/systems • Building prototype and testing
2	Continuous assessment will be weekly based on a logbook. Two presentations will be conducted for review before a panel. • First shall be for finalization of problem and proposed solution • Second shall be for implementation and testing of solutions.

Assessment criteria of Mini Project

Mini Project shall be assessed based on following criteria;

1	Quality of survey/ need identification
2	Clarity of Problem definition based on need.
3	Innovativeness in solutions
4	Feasibility of proposed problem solutions and selection of best solution

5	Cost effectiveness
6	Societal impact
7	Innovativeness
8	Cost effectiveness and Societal impact
9	Full functioning of working model as per stated requirements
10	Effective use of skill sets
11	Effective use of standard engineering norms
12	Contribution of an individuals as member or leader
13	Clarity in written and oral communication
In **one year, project**, first semester evaluation may be based on the first six criteria and the remaining may be used for the second semester evaluation of performance of students in the mini project.	
In the case of a half **year project** all criteria's in generic may be considered for evaluation of performance of students in a mini project.	
Guidelines for Assessment of Mini Project Practical/Oral Examination:	
1	Report should be prepared as per the guidelines issued by the University of Mumbai.
2	Mini Project shall be assessed through a presentation and demonstration of working model by the student project group to a panel of Internal and External Examiners preferably from industry or research organizations having experience of more than five years approved by head of Institution.
3	Students shall be motivated to participate in poster, project competition on the work in students' competitions.
Mini Project shall be assessed based on 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 individuals as member or leader
8	Clarity in written and oral communication

Project Based Learning Code	Project Based Learning Course Name	Credits (TH+P+TUT)
EXPR31	**Mini Project Lab-I**	**0+1+0**

Mini Project Prerequisite:	1. Mini-Project 1- PBL 2. C++ and Java Programming 3. 3. Electronic Devices and Circuit	
Mini Project Objectives:	To make students familiar with the basics of Electronics, Microcontroller, Arduino board. To familiarize the students with the programming and interfacing of different devices with Arduino Board. To increase students critical thinking ability and provide solutions to some real time problems.	
Mini Project Outcomes:	After successful completion of the course student will be able to: Write basic codes for the Arduino board using the IDE for utilizing the onboard resources. Apply the knowledge of interfacing different devices to the Arduino board to accomplish a given task. Design Arduino based projects for a given problem Write code using python language using IDE for utilizing the onboard resources. Apply the knowledge of interfacing different devices to Arduino board to accomplish a given task. Design Arduino based projects for a given problem.	

periment No.	**Unit No.**	**Arduino Board**	**Hrs.**	**PRO mapped**
EX.1.0		**Introduction to Arduino Board**	**02**	**1**
	1.1	Introduction to Arduino Uno board and integrated development environment (IDE)		
	1	Write the code for blinking the on board led with a specified delay Apparatus Requirement: Hardware: Arduino Board LED, Software: Arduino IDE Software.		
EX.2.0		**GPIO (along with Analog pin) Programming**	**04**	**1**
	2.1	Introduction to programming GPIO, Analog and PWM PINS.		
	1	Interface any Digital Sensors to the Arduino board and display sensor values on serial Monitor.		
	2	Interface any Analog sensor to the Arduino board and display sensor values on serial Monitor.		
	3.	Generate varying duty cycle PWM using Arduino.		
EX.3.0		**Controlling output devices/Displaying**	**04**	**2**
	3.1	Introduction to different sensor (Analog and Digital), Relays, Motors and display.		
	1	Interface an Analog Sensors to the Arduino board and		

		display sensor values on LCD/TFT/Seven segment Display.		
	2	Interface a temperature sensor to Arduino and switch on a relay to operate a fan if temperature exceeds given threshold. Also display the temperature on any of the display device		
EX.4.0		**Interfacing Communication Devices and Cloud Networking**	**04**	**2**
	4.1	Introduction to Bluetooth, Zigbee, RFID and WIFI, specifications and interfacing methods.		
	1	Interface Wi-Fi /Bluetooth/GSM/Zigbee/RF module to Arduino and program it to transfer sensor data wirelessly between two devices. Any two techniques from the above-mentioned modules needs to be interfaced.		
5.0		**Sample Projects**	**10**	**2**
	1.	Waste Management System		
	2.	Smart City Solutions		
	3.	Energy Monitoring Systems		
	4.	Smart Classrooms and learning Solutions		
	5.	Home security systems		
	6.	Smart Agriculture solutions		
	7.	Healthcare solutions.		
	8.	Industrial Applications		
	9.	IoT Applications		
	10.	Robotics		
		Total Hrs.	**24**	
*** Preferably the Project should be based on Arduino Boards**				

Reference Books:

1. Simon Monk, "Hacking Electronic: Learning Arduino and Raspberry Pi", McGraw-Hill Education TAB; 2 edition (September 28, 2017).
2. Programming Arduino: Getting Started with Sketches (second edition).
3. Arduino Workshop: A Hands-On Introduction with 65 Projects 1st Edition.
4. Arduino Cookbook.
5. Arduino Programming in 24 Hours, Sams Teach Yourself.

Useful learning Links:

Suggested Software tools:

1. Win32 Disk Imager: https://sourceforge.net/projects/win32diskimager/
2. SD Card Formatter: https://www.sdcard.org/downloads/formatter/
3. Arduino IDE: https://www.arduino.cc/en/main/software

Online Repository:

1. GitHub
2. NPTEL Videos on Arduino Programming.
3. Spoken Tutorial Project-IIT Bombay: https://spoken-tutorial.org/tutorial- search/?search_foss=Arduino&search_language=English
4. Teachers are recommended to use a free online simulation platform "Tinkercad" for the simulation of Arduino based circuits before the students implement it in the hardware: ht://www.tinkercad.com

Term Work (25 Marks):

The review/ progress monitoring committee shall be constituted by senior faculty members. The progress of the mini project to be evaluated on a continuous basis, minimum two reviews in each semester. Assessment also considers peer review and ethics observed by faculties and participation involvement.

In continuous assessment focus shall also be on each individual student, log book maintained and weekly meeting based on the same.

Distribution of Term work marks for both semesters shall be as below:		**Practical Marks**
1	Marks awarded by guide/supervisor based on implementation	10
2	Peer assessment by team members	05
3	Marks awarded by review committee	05
4	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

Skill Based Learning Code	**Skill Based Learning - III**	**Credits (TH+P+TUT)**
EXXS33	**C++ and Java Programming**	**0+1+0**
Skill Prerequisite:	1. C-Programming (Structured Programming Approach)	
Skill Objectives:	. To describe the principles of Object Oriented Programming (OOP) . To describe and understand decision making, looping structure for effective programming . To understand and apply concept of classes and objects, inheritance and interfaces . To understand and develop program using multithreading and Applet	
Skill Outcomes:	Apply the basic principles of OOP. Apply decision making, looping structure for effective programming. Implement the concept of classes and objects, inheritance and interfaces Apply the concept of multithreading in object oriented programming and Using Applet solve real world problems. Write accurate documentation for experiments performed. Apply ethical principles like timeliness and adhere to the rules of the	

	laboratory.

Module No.	Module Title	SO Mapped	Hrs/ Module
i. Prerequisites and Course Outline	Prerequisite Concepts and Course Introduction.	-	02
Write C++ Program to			
1.	Print Number Entered by User	1	02
2.	Swap Two Numbers	1	02
3.	Check Whether Number is Even or Odd	2	02
4.	Find Largest Number Among Three Numbers	2	02
5.	Create a Simple class and Object	3	02
	Create an object of a class and access class attributes	3	02
	Create class methods	3	02
	Create a class to read and add two distance	3	02
	Create a class for student to get and print details of a student	3	02
	Demonstrate an example of friend function with class.	3	02
11.	Implement inheritance.	3	02
Write JAVA Program to			
1.	Display addition of number using command line Argument	1	02
2	Accept marks from user, if Marks greater than 40,declare the student as “Pass” else “Fail”	1	02
3	Write a program to demonstrate call by value and call by reference.	3	02
4	Display sum of first 10 even numbers using do-while loop.	2	02
5	Display Multiplication table of 15 using while loop	2	02
6	Display basic calculator using Switch Statement.	2	02
7	Write a program to find the factorial of a number, using a recursive function.	3	02
8	Illustrate method of overloading	3	02
9	Demonstrate Parameterized Constructor	3	02
10	Write a program to find the area of a circle using	3	02

Module No.	Module Title	SO Mapped	Hrs/ Module
	Single Inheritance such that the base class method accepts the radius and the derived class method calculates and displays area.		
11	Create thread by implementing 'runnable' interface or creating 'Thread Class	4	02
12	Write an applet to draw different shapes using colors (Applet)	4	02
		Total	**48***

***Minimum 28 Hrs. Lab / Mini Project to be conducted**

Text Books:

1. Bjarne Stroustrup, "The C++ Programming language", Third edition, Pearson Education.
2. Yashwant Kanitkar, "Let Us Java", 2nd Edition, BPB Publications.
. D.T. Editorial Services, "Java 8 Programming Black Book", Dreamtech Press, Edition: 2015
4. Deitel, "C++ How to Program", 4th Edition, Pearson Education.

Reference Books:

. Herbert Schidt, "The Complete Reference", Tata McGraw-Hill Publishing Company Limited, Ninth Edition.
2. Java: How to Program, 8/e, Dietal, PHI
. Grady Booch, James Rumbaugh, Ivar Jacobson, "The Unified Modeling Languageser Guide", Pearson Education
. Sachin Malhotra, Saurabh Chaudhary "Programming in Java", Oxford University Press, 2010.

Useful Links:

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

Term Work (25 Marks):

Term Work shall be awarded based on Assessment Rubrics.

Exposure Course Code	Exposure Course Name	Credits			
		TH	P	TUT	Total
EXXA34	**SAT – IV: Activity Based Learning (Interdisciplinary Informatics)**	**-**	**01**	**-**	**01**

ABL Objectives (AOBs):	1. To expose learners to the opportunities, effectiveness and benefits of integrating informatics with diverse disciplines such as biotechnology, healthcare, agriculture, nanotechnology, earth sciences, etc. 2. To introduce the approaches for integrating informatics with different disciplines. 3. To explore real-world applications of interdisciplinary informatics,

	relevant data and tools for its development. 4. To acquaint learners with recent trends and research in interdisciplinary informatics. 5. To enhance critical thinking, research, communication and presentation skills. 6. To promote interdisciplinary research and development.
ABL Outcomes (AOs):	Upon completion of the course, the learners will be able to: 1. Understand the fundamental concepts and interdisciplinary nature of informatics. 2. Analyze literature, case studies and successful solutions related to interdisciplinary informatics applications. 3. Analyze and interpret the data for interdisciplinary informatics. 4. Identify real-world problems that can be addressed through interdisciplinary informatics. 5. Demonstrate effective communication skills to bridge the gap between disciplinary jargons and develop interdisciplinary collaborations. 6. Demonstrate a life-long motivation to engage in hands-on projects, research and practices in sustainable interdisciplinary informatics.
Guidelines for Activity-Based Learning (ABL):	1. Students shall work in team of 03-04 members, which shall remain for this entire course. 2. Student teams shall choose, survey and study any 01 of the following informatics using the Internet / Library Resources / Research Articles / Case Study Reports / etc.: . Bioinformatics . Agro Informatics . Health Informatics . Weather Informatics . Nano Informatics . Geo Informatics 3. Students are also required to study the recent Research and Development in the interdisciplinary informatics, focusing on need-based real-world applications. 4. During the contact hours, each student team is required to provide a weekly report of their progress — orally and as written summaries of approximately 01-02 pages, accompanied by a list of references. 5. During the contact hours across the entire semester, each student team is also required to deliver 02 Seminars (Power Point Presentations) of 15-20 minutes each, which reflect their learning outcomes. 6. At the end of the term, each student team has to present a synthesis of their work in a final documented report of approximately 10-15 pages. 7. Faculties shall act as facilitators: Observe students as they work on the activity and provide guidance as well as support wherever required.
Term Work (TW):	Term Work evaluation shall be for Total 25 Marks based on the 02 Seminars (50%), Final Report (20%), Weekly Participation and Reporting (30%) and contents covered therein.