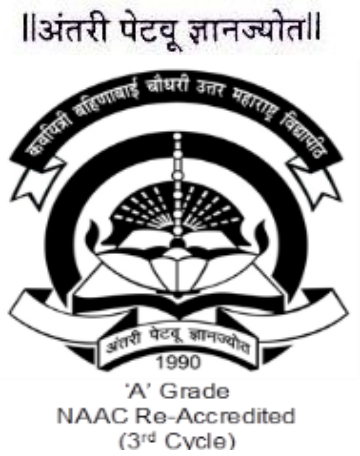
Kavayitri Bahinabai Chaudhari
North Maharashtra University, Jalgaon



SYLLABUS

for

Master of Science (M. Sc.)
Electronics

Choice Based Credit System
(Outcome Based Curriculum)

Department of Electronics, School of Physical Sciences
Kavayitri Bahinabai Chaudhari North Maharashtra University Jalgaon
425 001 (M.S.)

2019 - 2020

Summary of Distribution of Credits under CBCS Scheme
for
M.Sc. Electronics
at
School of Physical Sciences
[at University Campus under Academic Flexibility w.e.f. 2019-20]

Sr.No	Type of course	Sem I	Sem II	Sem III	Sem IV
01	Core (03 T + 01 P)	**16**	**16**	**16**	**16**
02	Skill based	**04**	**04**	**-**	**-**
04	School Elective/ Project	**-**	**-**	**04**	**04**
		-	**-**		
05	Audit	**02**	**02**	**02**	**02**
06	Total Credits	**22**	**22**	**22**	**22**

Subject Type	Core	Skill based	School Elective/ Project	Audit	Practical	Total
Credits	48	08	08	08	16	88

(T, Theory; P, Practical)

Total Credits = 88

M.Sc. (Electronics) Syllabus (with effect from June 2019)

Course credit scheme

Semester	(A) Core Courses			(B) Skill Based / Elective Course			(C) Audit Course (No weightage in CGPA)			Total Credits (A+B+C)
	No. of Courses	Credits (T+P)	Total Credits	No. of Courses	Credits (T+P)	Total Credits	No. of Courses	Credits (Pract.)	Total Credits	
I	4	12 + 4	**16**	1	4 + 0	**4**	1	2	**2**	**22**
II	4	12 + 4	**16**	1	4 + 0	**4**	1	2	**2**	**22**
III	4	12 + 4	**16**	1	0 + 4	**4**	1	2	**2**	**22**
IV	4	12+ 4	**16**	1	0 + 4	**4**	1	2	**2**	**22**
Total Credits	**64**			**16**			**8**			**88**

(T, Theory; P, Practical)

Structure of Curriculum

		First Year				Second Year				Total Credit Value
		Semester I		Semester II		Semester III		Semester IV		
		Credit	Course	Credit	Course	Credit	Course	Credit	Course	
	Prerequisite and Core Courses									
(A)	Theory	12	3	12	3	12	3	12	3	**48**
	Practical	4	1	4	1	4	1	4	1	**16**
(B)	**Skill Based / Subject Elective Courses**									
1	Theory /Practical	4	1	4	1	4	1	4	1	**16**
(C)	**Audit Course (No weightage in CGPA calculations)**									
1	Practicing Cleanliness	2	1							**2**
2	Personality & and Cultural Development Related Course			2	1					**2**
3	Technology Related + Value Added Course					2	1			**2**
4	Professional and Social + Value Added Course							2	1	**2**
	Total Credit Value	**22**	**6**	**22**	**6**	**22**	**6**	**22**	**6**	**88**

List of Audit Courses (Select any ONE course of Choice from Semester II; Semester III and Semester IV)							
Semester I (Compulsory)		**Semester II** (Choose One) **Personality and Cultural Development**		**Semester III** (Choose One) **Technology + Value Added Course**		**Semester IV**(Choose One) **Professional and Social + Value Added Course**	
Course Code	**Course Title**	**Course Code**	**Course Title**	**Course Code**	**Course Title**	**Course Code**	**Course Title**
AC-101	Practicing Cleanliness	AC-201 (A)	Soft Skills	AC-301(A)	Computer Skills	AC-401(A)	Human Rights
		AC-201 (B)	Practicing Sports Activities	AC-301(B)	Cyber Security	AC-401 (B)	Current Affairs
		AC-201 (C)	Practiciing Yoga	AC-301(C)	Python Programming for Electronics	AC-401(C)	Electronics for Internet of Things
		AC-201 (D)	Introduction to Indian Music	AC-301(D)	Robotics and Applications	AC-401(D)	Mechatronics and Applications

M.Sc. (Electronics) Syllabus (with effect from June 2019)

Department of Electronics

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon
Syllabus under CBCS for M.Sc.(Electronics)
Syllabus Structure (with effect from 2019-20)

Semester-I

Course Code	Course Type	Title of the Course	Contact hours/week *For Practical per week per batch			Distribution of Marks for Examination						Credits
						Internal		External		Total		
			Th(L)	Pr	Total	Th	Pr	Th	Pr	Th	Pr	
EL -101	Core	Semiconductor Devices	04	--	04	40	--	60	--	100	--	04
EL-102	Core	VLSI Tools and Techniques	04	--	04	40	--	60	--	100	--	04
EL-103	Core	Analog Circuit Simulation Techniques	04	--	04	40	--	60	--	100	--	04
EL-104	Skill Based	Industrial Automation and Control	04	--	04	40	--	60	--	100	--	04
EL-105	Practical	Practical Laboratory I	--	*04	*04	--	40	--	60	--	100	04
AC-101	Audit Course	Practicing Cleanliness		02	02		100	--	--	--	100	02

Semester-II

Course Code	Course Type	Title of the Course	Contact hours/week *For Practical per week per batch			Distribution of Marks for Examination						Credits
						Internal		External		Total		
			Th(L)	Pr	Total	Th	Pr	Th	Pr	Th	Pr	
EL-201	Core	Optoelectronics	04	--	04	40	--	60	--	100	--	04
EL-202	Skill Based	Java Programming and Web Technology	04	--	04	40	--	60	--	100	--	04
EL-203	Core	Advanced Microcontrollers and Applications	04	--	04	40	--	60	--	100	--	04
EL-204	Core	Advanced Communication Systems	04	--	04	40	--	60	--	100	--	04
EL-205	Practical	Practical Laboratory II	--	*04	*04	--	40		60	--	100	04
AC-201(A)	Audit Course (Personality and Cultural Development Related) (Choose 1)	Soft Skills	--	02	02	100	--	--	--	100	--	02
AC-201(B)		Practicing Sports Activities										
AC_201(C)		Practicing Yoga										
AC-201(D)		Introduction to Indian Music										

Semester-III

Course Code	Course Type	Title of the Course	Contact hours/week *For Project and Practical per week per batch			Distribution of Marks for Examination						Credits
						Internal		External		Total		
			Th(L)	Pr	Total	Th	Pr	Th	Pr	Th	Pr	
EL-301 (A)	Elective (Choose 1)	Digital Signal Processing and Applications	04	--	04	40	--	60	--	100	--	04
EL-301 (B)		CMOS RF Circuits										
EL-302	Core	Semiconductor Processing Technology	04	--	04	40	--	60	--	100	--	04
EL-303	Core	Embedded Systems and Applications	04	--	04	40	--	60	--	100	--	04
EL-304	Practical	Practical Laboratory III	--	*04	*04	--	40	--	60	--	100	04
EL-305	Practical	Special Laboratory (Project I + Report)	--	*04	*04	--	40	--	60	100	--	04
AC-301(A)	Audit Course (Technology + value added course) (Choose 1)	Computer Skills	02	--	02	100	--	--	--	100	--	02
AC-301(B)		Cyber Security										
AC-301(C)		Python Programming for Electronics										
AC-301(D)		Robotics and applications										

Semester-IV

Course Code	Course Type	Title of the Course	Contact hours/week *For Project and Practical per week per batch			Distribution of Marks for Examination						Credits
						Internal		External		Total		
			Th(L)	Pr	Total	Th	Pr	Th	Pr	Th	Pr	
EL-401(A)	Elective (Choose 1)	Modeling and Simulation Techniques	04	--	04	40	--	60	--	100	--	04
EL-401(B)		Micro-electromechanical Systems and Applications										
EL-402	Core	CMOS Technology and Applications	04	--	04	40	--	60	--	100	--	04
EL-403	Core	Digital Image Processing and Applications	04	--	04	40	--	60	--	100	--	04
EL-404	Practical	Practical Laboratory IV	--	*04	*04	--	40	--	60	--	100	04
EL-405	Practical	Special Laboratory (Project + Thesis)	--	*04	*04	40	--	60	--	100	--	04
AC-401(A)	Audit Course (Professional and Social + value added course) (Choose 1)	Human Rights	02	--	02	100	--	--	--	100	--	02
AC-401(B)		Current Affairs										
AC-401(C)		Electronics for Internet of Things										
AC-401(D)		Mechatronics and Applications										

M.Sc. (Electronics) Syllabus (with effect from June 2019)

Program at a Glance

Name of the program (Degree)	: M. Sc. (Electronics)
Faculty	: Science and Technology
Duration of the Program	: Two years (four semesters)
Medium of Instruction and Examination	: English
Exam Pattern	: 60 : 40 (60 marks University exam and 40 marks continuous internal departmental exam/assessment)
Passing standards (separate head of passing)	: 40% in each exam separately
Evaluation mode	: CGPA
Total Credits of the program	: 88 (64 core credits including 16 credit for practical's, 08 credits for skill based, 08 credits for Elective/Project, 08 credits for audit)

M.Sc. (Electronics) Syllabus (with effect from June 2019)

Program Objectives for M.Sc. Program:

1. To impart the profound theoretical and practical knowledge of the specific science discipline along with the fundamental core concepts
2. To train the students to employ modern techniques, tools, methodologies, equipment, hardware/software etc. to perform objective oriented scientific and planned experiments
3. To groom the students for all-round development and mould them in a trained workforce to provide teaching-learning, research, business, professional supports in the various science disciplines
4. To make the student to develop the ability to think analytically, independently and draw logical conclusions to solve real-life problems.
5. To utilize the skills and knowledge gained through the subject to deal with real life situations and problems related to society, environment, research and development etc.

Program Outcomes (PO) for M.Sc. Program:

Upon successful completion of the M.Sc. program, student will be able to:

PO No.	PO	Cognitive level
PO1	understand the basic concepts, fundamental principles, and the scientific theories related to various scientific phenomena and their relevancies in the day-to-day life.	2
PO2	administer the skills in handling scientific instruments, planning and performing in laboratory experiments	3
PO3	analyse the given scientific experimental data critically and systematically and the ability to draw the objective conclusions.	4
PO4	develop various skills such as communication, managerial, leadership, entrepreneurship, teamwork, social, research etc., which will help in expressing ideas and views clearly and effectively	3
PO5	model and formulate the real problems and find solution based-on knowledge acquired	6
PO6	to evaluate how developments in any science subject helps in the development of other science subjects and vice-versa and how interdisciplinary approach helps in providing better solutions and new ideas for the sustainable developments.	5

Program Specific Objectives (PSOs):

- Impart quality education in electronics to the students to become successful professional
- Introduce the students with advances courses like VLSI Embedded systems and Signal processing.
- Develop ability among students to analyze rreal life problem and find te cost-effective solution for te society

Program Specific Outcomes for M. Sc. Electronics program

After completion of the M. Sc. Electronics program, the students should be able to:

PO No.	PSO	Cognitive Level
PSO1	Apply knowledge of electronics to solve problems of the society.	**04**
PSO2	Develop electronics circuits and analyze them properly	**06**
PSO3	Handel advanced software tools for VLSI and embedded systems	**06**

M.Sc. (Electronics) Syllabus (with effect from June 2019)

Department of Electronics

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon
Syllabus under CBCS for M.Sc.(Electronics)
Syllabus Structure (with effect from 2019-20)

Semester-I

Course Code	Course Type	Title of the Course	Contact hours/week *For Practical per week per batch			Distribution of Marks for Examination						Credits
						Internal		External		Total		
			Th(L)	Pr	Total	Th	Pr	Th	Pr	Th	Pr	
EL -101	Core	Semiconductor Devices	04	--	04	40	--	60	--	100	--	04
EL-102	Core	VLSI Tools and Techniques	04	--	04	40	--	60	--	100	--	04
EL-103	Core	Analog Circuit Simulation Techniques	04	--	04	40	--	60	--	100	--	04
EL-104	Skill Based	Industrial Automation and Control	04	--	04	40	--	60	--	100	--	04
EL-105	Practical	Practical Laboratory I	--	*04	*04	--	40	--	60	--	100	04
AC-101	Audit Course	Practicing Cleanliness		02	02		100	--	--	--	100	02

Semester-II

Course Code	Course Type	Title of the Course	Contact hours/week *For Practical per week per batch			Distribution of Marks for Examination						Credits
						Internal		External		Total		
			Th(L)	Pr	Total	Th	Pr	Th	Pr	Th	Pr	
EL-201	Core	Optoelectronics	04	--	04	40	--	60	--	100	--	04
EL-202	Skill Based	Java Programming and Web Technology	04	--	04	40	--	60	--	100	--	04
EL-203	Core	Advanced Microcontrollers and Applications	04	--	04	40	--	60	--	100	--	04
EL-204	Core	Advanced Communication Systems	04	--	04	40	--	60	--	100	--	04
EL-205	Practical	Practical Laboratory II	--	*04	*04	--	40		60	--	100	04
AC-201(A)	Audit Course (Personality and Cultural Development Related) (Choose 1)	Soft Skills	--	02	02	100	--	--	--	100	--	02
AC-201(B)		Practicing Sports Activities										
AC_201(C)		Practicing Yoga										
AC-201(D)		Introduction to Indian Music										

	EL - 101: Semiconductor Devices	
	Course Objectives: ➢ Understand basics of semiconductor materials ➢ Various properties of semiconductors ➢ Know different types of semiconductors ➢ Understand the construction, principle of operation and applications of p-n junction devices ➢ Understand the construction, principle of operation and applications of JFET and MOSFET devices ➢ Understand the construction, principle of operation and applications of high frequency solid state devices ➢ Understand the construction, principle of operation and applications of microwave and advance devices ➢ Understand basics of Nano technology and its application.	
Unit 1	**Basics of Semiconductor Electronics** Energy bands and classifications, Bandgap: direct and indirect, Atomic bonds in semiconductors, Commonly used semiconductors, Effect of temperature on semiconductors, Intrinsic and Extrinsic semiconductors, Carrier Concentration Mobility and Resistivity, Carrier Generation and Recombination, compound semiconductors (III-V and II-VI group), properties of degenerate and non-degenerate semiconductors and their applications, measurement of energy gap, Measurement of effective mass of carriers by using cyclotron resonance experiment, measurement of carrier life time, Haynes-Shockley experiment.	**10 L**
Unit 2	**Junction Devices** P-n junction diode, breakdown mechanism in p-n junction diode, junction and diffusion capacitance. P-I-N diode, intrinsic layer, principle of operation, P-I-N diode, applications of P-I-N diode. Zener diode: phenomenon of reverse bias breakdown, principle of operation and applications, Schottky diode, Varactor diode: structure, principle of operation and applications, Tunnel diode: principle of operation, structure and applications, BJT: fabrication, working principles and applications, uni-junction transistor, Hetero-structure transistors and applications.	**14 L**
Unit 3	**FET and MOSFET Devices** JFET: principle of operation, working, applications, MOSFET: accumulation, depletion mode, inversion mode and C-V characteristics of MOS capacitor, constructional details I-V Characteristics, and principle of operation of depletion type and enhancement type MOSFET, equivalent circuit of MOSFET, short channel and narrow width effect, MOSFET scaling and hot electron effect, charged coupled devices (CCD) types of charged coupled device (SCCD and BCCD) application of charged coupled devices.	**10 L**
Unit 4	**High frequency solid state Devices** Frequency dependence of power gain and noise in BJT, Transit time effects in BJT, Transit time effect in FET, Structure, Principle of operation and application of high electron mobility transistor (HEMT), Principle of operation and application of ballistic transistors.	**05 L**
Unit 5	**Microwave and other advanced devices** Construction, Principle of operation and application of impact Avalanche Transit time (IMPATT) Diode, TRAPATT Diode, GUN Diode effect, the transferred electron mechanism, domain formation and various operating modes of GUN diode, TFT and Insulated Gate Bipolar transistor (IGBT).	**08 L**
Unit 6	**Nano Technology**	**05 L**

	Basic concepts of Nano science and technology – Quantum wire – Quantum well – Quantum dot – Properties and technological advantages of Nano materials.	

Suggested readings:

1. **Solid State Electronic Devices**, B. G. Streetman and Sanjay Banerjee, IVth edition, Prentice-Hall of India, Pvt. Ltd., New Delhi.
2. **Solid State and Electron Devices**, Alton M. Ferendci, McGRAW-Hill International Editions, Electrical Engg. Series
3. **Physics of Semiconductor Devices,** S. M. Sze, Willey Eastern Ltd.
4. **Principles of Electronics**, V. K. Mehta, R. Mehta, S. Chand.

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C101.1	Acquire fundamental knowledge of semiconductor materials.	**03**
C101.2	Describe construction, principle of working and applications of various semiconductor devices.	**02**
C101.3	Test and summarize high frequency solid state, microwave and advanced devices.	**05**
C101.4	Explain Nanoscience and Technology.	**03**

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	EL - 102: VLSI Tools and Techniques	
	Course Objectives: ➢ To learn basic CMOS Circuits. ➢ To learn CMOS process technology. ➢ To learn techniques of chip design using programmable devices. ➢ To learn the concepts of designing VLSI Subsystems. ➢ Design Basic Logic Circuits ➢ Design and Evaluate Combinational-Circuit Building Blocks ➢ Design and Test Circuits Employing Flip-Flops, Registers, Counters, and a Simple Processor ➢ Design and Analyze Synchronous Sequential Circuits ➢ VLSI system design verification and testability, and system reliability. ➢ The emphasis of the course is on techniques for system design, testing, system noise and performance analysis.	
Unit 1	**Introduction to MOS Circuits** **Basic concept about VLSI:** Basic MOS Transistors, Enhancement and Depletion Mode Transistor Action, nMOS and CMOS Fabrication Process, **CMOS Inverter:** dc and Transfer Characteristics, Static Load MOS Inverters, Pass Transistor, Transmission Gate, Basic Logic Gates.	**07 L**
Unit 2	**Introduction to Hardware Descriptive Language (HDL)** Importance and Evolution of Hardware Description Languages (HDL), VHDL Capabilities, Hardware Abstraction, Basic Terminology of VHDL Design, Entity Declaration. **Architecture Body:** Structural Style Modeling, Dataflow Style Modeling, Behavioral Style Modeling, Mix Style Modeling, Configuration Declaration, Types of Packages in VHDL and its Declaration.	**08L**
Unit 3	**Basic Language Elements** Identifiers, Keywords, Escaped Identifiers**. Data Objects:** Constants, Variables, Signal, File. **Data Types:** Scalar, Composite, Access, File**, Operators:** Logical, Relational, Shift, Adding, Multiplying, Miscellaneous.	**08 L**

Unit 4	**Modeling** **Behavioral Modelling**: Entity Declaration, Architecture Body, Process Statement, Variable Assignment Statement, Signal Assignment Statement, Wait Statement, If Statement, Case Statement, Null Statement, Loop Statement, Exit Statement, Next Statement, Assertion Statement, Signal Assignment Statement, Inertial Delay Model, Transport Delay Model, Creating Signal Waveforms, Signal Drivers, Sequential Statements, Multiple Processes. **Dataflow Modeling:** Concurrent Signal Assignment Statement, Concurrent versus Sequential Signal Assignment, Delta Delay Revisited, Multiple Drivers, Conditional Signal Assignment Statement, Selected Signal Assignment Statement, Block Statement, Concurrent Assertion Statement. **Structural Modeling:** Component Declaration, Component Instantiation, Resolving Signal Values.	**12 L**
Unit 5	**Packages and Features** **Package:** Package Declaration, Package Body. **Model Simulation:** Test Bench Creation, Converting Real and Integer to Time, Test Bench Example, Initializing a Memory, Variable File Names. **Simulation Examples:** Gates, flip-flops, Multiplexer, de-Multiplexer, Shift Register, Ring Counter, Decade Counter, Synchronous Counter, Adder, Multiplier	**12 L**
Suggested readings: 1. **Digital Design**- Wakerly, PHI. 2. **VHDL, (3/E**) Mcgraw Hill, Perry. 3. **VHDL Primer**- J Bhasker, Pearson Education		

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C102.1	Design an application using VHSIC HDL.	**06**
C102.2	Discriminate between combinatorial and sequential circuits.	**04**
C102.3	Write a VHDL test bench to test VHDL modules.	**04**
C102.4	Analyze code coverage of a VHDL test bench.	**04**
C102.5	Construct a synchronous DSP system in VHDL and verify its performance.	**03**

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	EL - 103: Analog Circuit Simulation Techniques	
	Course Objectives: ➢ To understand the basic operation of BJT, FET and MOSFET and study their characteristics. ➢ To study different biasing techniques for transistors ➢ Analyze the operation of amplifier circuits ➢ To have idea of feedback amplifiers and their applications ➢ To analyze various OPAMP circuits and exploring their applications ➢ Study of PSPICE models	
Unit 1	**Bipolar junction Transistor circuits** Common Emitter configuration, significance of input, output and transfer characteristics, fixed bias or base bias, emitter bias, collector feedback bias, voltage divider bias, load line concept, direct current and alternating current load line, Quiescent point.	**08 L**

Unit 2	**Analysis and applications of transistor amplifier circuit** Analysis of transistor amplifier, trans-conductance, small signal resistances, hybrid parameter analysis, current gain, voltage gain and power gain of an amplifier, switching characteristics and applications, circuits to improve switching time of transistor, applications, multistage amplifiers.	**07L**
Unit 3	**Frequency response of amplifier and applications** Actual mid-band current gain of amplifier, selection criteria for coupling capacitor and bypass capacitors, low frequency response, mid-band frequency response and high frequency response of CE amplifier, effect of source resistance on degradation of gain of an amplifier, reasons for degradation of gain at low and high frequency.	**08 L**
Unit 4	**Field effect transistor circuits and applications** Output and transfer characteristics of FET, its significance, Biasing techniques; self-bias, gate bias and voltage divider bias, FET as an amplifier, MOSFET enhancement mode operation, depletion enhancement mode operation, output and transfer characteristics of MOSFET, its significance, biasing methods for MOSFET.	**07 L**
Unit 5	**Feedback amplifier and oscillators** Concept of feedback, Equation for feedback gain, types of feedback configuration and corresponding analog circuit, effect of negative feedback on gain, input impedance output impedance and bandwidth, frequency response of feedback amplifier, Single pole and double pole response, Oscillators: Classification, phase shift oscillator, analysis, Wein bridge oscillator, analysis.	**07 L**
Unit 6	**Operational amplifier Circuits and applications** Differential amplifier, Instrumentation amplifier, compensated integrator and differentiator, analog computation: OPAMP as a multiplier and divider, Active filters: First and second order low pass and high pass active filter, transfer function, phase shifters, Quadrature oscillator, voltage control oscillator, phase locked loop.	**08L**
Unit 7	**Tools for Analog Circuit Simulation (Actual Practice)** PSPICE models for the components and circuits covered in this course, Analysis of Analog Circuits Using PSPICE.	**05L**

Suggested readings:

1. **Integrated Electronics -** Millman Halkias
2. **Microelectronics -** Millman
3. **Electronics circuits -**Mottershed
4. **Operational amplifier -** Clayton
5. **Electronics for Scientists –**Brophy
6. **SPICE** – A guide to circuit simulation and analysis using PSPICE : Paul W. Tuinenga, PHI

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C103.1	Analyze biasing circuits and know operating condition of transistor	**04**
C103.2	Determine voltage gain and power gain of amplifier circuits	**03**
C103.3	Understand frequency response of amplifier circuits	**04**
C103.4	Understand feedback amplifier configurations and analyze oscillators	**04**
C103.5	Analyze different OPAMP circuits	**04**

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Skilled Based Course

	EL - 104: Industrial Automation and Control	
	Course Objectives: ➢ To understand the fundamental process of automation in industry ➢ To study PLC systems and explore their applications in industry ➢ Determine hardware and software requirements of PLC systems ➢ To study different types of sensors and actuators ➢ To study various drive systems and motors	
Unit 1	**Logic controllers** PLC: Types, Ladder programming and applications, SCADA: Types, Architecture, Monitoring and Applications	**12 L**
Unit 2	**Basics of Mechatronics** Evolution of Mechatronics, An overview of Mechatronics, Scope of Mechatronics, Transducers and Sensors (Mechanical switches, Proximity switches, Photoelectric sensors and switches, Encoders, Temperature sensors, Position / Displacement sensors, Strain gauges, Pressure sensors, Relay, Solid State Relay (SSR), Liquid level detectors), Signal conditioning theory, circuits and systems.	**12L**
Unit 3	**CNC systems** Principle of numerical control, types and features of CNC System, Constituent parts of CNC machines and assembly techniques, configuration, Interfacing, Monitoring and diagnostics.	**08 L**
Unit 4	**Actuators, Mechanism and Industrial drives** Actuator types and application areas- Electromechanical actuators, Fluid power actuators and active material based actuators, Mechanism- Bearings, Belt, Chain, Pulleys, Gears, Rack and Pinion, Slider and Crank, Cams and Followers, Four-bar linkages. Overview of servo control, Servo Hydraulic and Pneumatic Drive: Overview of Servo Hydraulic and Pneumatic Drive, Fundamentals of Hydraulic and Pneumatic Drives, Components of Fluidic Drives Systems, Basic Hydraulic Circuits, Electric Drives: Overview of Electric Drives, Electric Motors, Power Electronics, Sensors.	**12 L**
Unit 5	**Vacuum systems and controls** Overview of vacuum, Classification of vacuum pumps, Types of vacuum pumps: Diaphragm pumps, Rotary (vane pumps and Oil sealed rotary displacement) pumps, Rotary plunger pumps, Roots pumps, Oil Diffusion pumps, Turbo-molecular pumps, Sorption pumps, Sputter-ion pumps, Cryo pumps. Vacuum gauges: Classification of gauges, Penning, Pirani and capacitance gauges.	**12 L**

Suggested readings:

1. Mechatronics, W. Bolton, Addition –Wesley Longman Ltd.
2. Mechatronics, Denny K. Miu, Springer- Verlag
3. Drives and Control for Industrial Automation, Tan Kok KiongAndi Sudjana Putra, Springer.
4. Precision Motion Control Design and Implementation, Tan Kok Kiong, Lee Tong Heng, Huang Sunan, Springer.
5. Vacuum Science and Technology, V. V. Rao, T. B. Ghosh, K. L. Chopra, AlliedPublishers Pvt. Ltd.
6. Electronics Instrumentation, H. S. Kalsi.
7. Industrial Automation using PLC, SCADA & DCS, Rajesh G Jamkar, Global Education Ltd.

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C104.1	Understand importance of automation in industry	**02**
C104.2	Write ladder programs for sequential control processes	**03**
C104.3	Understand various interface mechanism with PLC	**02**
C104.4	Explain applications of sensors and actuators	**03**
C104.5	Understand various types of drives and their need in industry	**02**

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	EL - 105: Practical Laboratory I	
	Course Objectives: ➢ To characterize basic semiconductors materials ➢ To study characteristics of semiconductor devices ➢ Write VHDL code for digital circuits and simulate them ➢ To simulate various analog circuits using PSPICE ➢ To study PLC system and write ladder program	
	Part-A 1. Determination of Hall coefficient using Hall method. 2. Measurement of Eg of semiconductor. 3. Measurement of resistivity of sample at various temperatures by four probe method. 4. Measurement of threshold voltage in linear and saturation region of MOSFET. 5. Study of I-V characteristics of IGBT. **Part-B (Using Altera/Xilinx tools and FPGA/CPLD kits)** 1. Write VHDL code for full-adder and simulate the waveforms and practically verification using circuit. 2. Write VHDL code for 8:1 Multiplexer/1:8 de-Mux and simulate the waveforms and practically verification using circuit. 3. Write VHDL code for 3-bit binary counter and simulate the waveforms and practically verification using circuit. 4. Write VHDL code for feedback counter and simulate the waveforms and practically verification using circuit. 5. Write VHDL code for RAM and simulate the waveforms. **Part-C** 1. Simulation of voltage divider bias circuit of BJT using PSPICE and Practical verification using circuit. 2. Simulation of I-V and transfer characteristics of BJT/FET/MOSFET using PSPICE and practically verification using circuit. 3. Simulation of I-V and Transfer characteristics of CMOS using PSPICE and practically verification using circuit. 4. Simulation of OPAMP based second order active filters using PSPICE and practically verification using circuit. 5. Simulation of OPAMP based Instrumentation Amplifier using PSPICE and practically verification using circuit.	

	Part-D 1. Develop a test ladder program for pulse counting using limit switch. 2. Develop bottle filling plant using PLC. 3. Develop Car washing automation plant using PLC. 4. Develop Traffic light control system using PLC. 5. Sequential control of DC motor using PLC. 6. Study of CNC and preparing given job using CNC. 7. Develop Object sorting system using PLC. **Note:** *The student has to perform at least 04 practicals from each part.*

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C105.1	Test various electronics devices	**06**
C105.2	Build and test electronic circuits	**06**
C105.3	Simulate analog circuits using PSPICE	**06**
C105.4	Simulate digital circuits using VHDL and verify output using hardware	**06**
C105.5	Write ladder programs for PLC and interface hardware with PLC	**03**

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M.Sc. Part I Semester I Electronics: Audit Courses

AC-101: Practicing Cleanliness **(Compulsory; Campus-level Audit Course; Practical; 2 Credits)**	
Course Objectives (CObs): • To make students aware of Clean India Mission and inculcate cleanliness practices among them.	

	• Awareness program on
	  ○ Swachh Bharat Abhiyan (Clean India Mission)
	  ○ Clean Campus Mission
	  ○ Role of youth in Clean India Mission
	• Cleaning activities inside and surroundings of Department buildings.
	• Tree plantation and further care of planted trees
	• Waste (Liquid/Solid/e-waste) Management, Japanese 5-S practices
	• Planning and execution of collection of Garbage from different sections of University campus
	• Role of youth in power saving, pollution control, control of global warming, preservation of ground water and many more issues of national importance.
	• Cleanest School/Department and Cleanest Hostel contests Painting and Essay writing competitions

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
AC101.1	Identify need at of cleanliness at home/office and other public places.	**2**
AC101.2	Plan and observe cleanliness programs at home and other places.	**4**
AC101.3	Practice Japanese 5-S practices in regular life.	**3**

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	EL - 201: Optoelectronics	
	Course Objectives: ➢ To acquire fundamental understanding of the basic physics behind optoelectronic devices. ➢ To develop basic understanding of light emitting diodes. ➢ Have a detailed knowledge of laser operating principles and structures. ➢ To acquire in depth understanding of photodetectors and displays. ➢ To understand basic principle and applications of optic fibre.	
Unit 1	**Introduction to Optoelectronics** Basic interaction between optics and electronics, Review of P-N junction characteristics , Band Structures, semiconductor hetero junction, principle of LEDs, spontaneous emission, Absorption, stimulated emission, population inversion, LED structure-surface emitting, LED characteristics, opto-isolator, Basics of reflection, refraction, transmission and absorption of light radiation.	**11 L**
Unit 2	**Lasers and properties** LASER as an amplifier of light, necessary condition for amplification, special properties of LASER , Study of three & four level LASERs, study of tunable and semiconductor LASER, applications of LASER, Ruby Laser, He-Ne Laser.	**07L**
Unit 3	**Optical Fiber: Theory and Application** Action of optical fiber as a waveguide, Advantages of optical fiber communications, Necessity condition for waveguide mechanism of optical fiber, Construction of a fiber, Material used for optical fibers, Construction of optical fiber cable, Role of strength materials, Types of optical fibers, step index and graded index ,comparison of waveguiding action, Numerical aperture, Time dispersion, Splicing and fiber connectors, Requirement and practical methods of splicing, Optical fiber connectors, Loss in optical fiber communication, Fiber losses, Intrinsic and extrinsic losses, comparison between losses, Modes of transmission and dispersion in optical fiber, Application of optical fiber.	**18 L**
Unit 4	**Light Detectors** Idea of light detectors, Natural and quantum specialized light detectors, Types of special light detector – thermal and quantum detectors, Types of quantum photo detectors- photo resistive, photovoltaic and photoelectric cell , photo multiplier tube, Important characteristics of light detectors-spectral response, efficiency material used for photodetectors.	**12 L**
Unit 5	**Optical Display Devices.** Necessity of optical displays, Different categories of optical displays-indicators, numeric, alphanumeric and special function displays, characteristics of displays view ability ,response time, power dynamic , static and field effect LCDs,	**12 L**

	Dynamic display—necessity and principle of operation, Contrast improvance ratio, Consideration of displays.	

Suggested readings:

1. An Introduction of Optical Fiber: Cherin A.H, Mc. Graw Hill, Int. Student.
2. Optical Fiber Communication: Keiser G., Mc. Graw Hill.
3. Introduction of Optical Electronics: K.A. Jones, Harper and Row.
4. Optical Communication System: John Grower, Prentice, India.
5. The Laser: Hecth, Mc Graw Hill.

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C201.1	Define the optical properties of semiconductors	**01**
C201.2	explain optical processes in semiconductors	**02**
C201.3	Classify the operation of LEDs and lasers	**02**
C201.4	Evaluate the operation of photodetectors	**05**
C201.5	Create applications of displays	**06**

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Skilled Based

	EL - 202: Java Programming and Web Technology	
	Course Objectives: ➢ Understand Object oriented concepts like data abstraction, encapsulation, etc. ➢ Understand various Java programming constructs. ➢ Do programming in the Java programming language, ➢ Gain knowledge of object-oriented paradigm in the Java programming language, ➢ Use of Java in a variety of technologies and on different platforms.	
Unit 1	**Introduction** **Java Evolution:** Java History, Java Features, Java Support Systems, Java Environment, Java Development Kit, Java Runtime Environment, Classification of Java Statement, Installation and Configuration of Java, Java Virtual Machine. **Overview of Java Language:** Class Declaration, Main Line, Output Line, Simple Java Program. **Java Program Structure:** Documentation Section, Package Statement, Import Statement, Interface Statement, Class Definitions, Main Method Class, Java Keywords.	**11 L**
Unit 2	**Java Components** **Constants, Variables and Data Type:** Declaration and Initialization of Constants and Variables, Scope of Variables, Data Types. **Java Operators and Expression:** Arithmetic, Relational, Logical, Assignment, Increment and Decrement, Conditional, Bitwise, Special. **Decision Making and Branching:** if Statement, if-else Statement, Nesting of if-else Statement, else-if Ladder, switch Statement, "? :" operator. **Decision Making and Looping:** while Statement, do-while Statement, for Statement, jump in Loop, Labeled Loop. **Arrays and String:** One and Multi-dimensional array, Creating an array, Strings.	**12L**
Unit 3	**Object Oriented Programming, Inheritance and Interface** **OOPs:** Defining Class, Fields Declaration, Method Declaration, Creating Object, Accessing Class Members, Invoking Method, Member Variables vs. Local Variables, Passing Arguments to Methods, Returning Multiple Values from Methods, Constructor, Method Overloading, Static Member, Nesting of Method,	**11 L**

	Final Variables and Method, Final Class, Finalizer Method, Abstract Method and Class, Dynamic Method Dispatch, Visibility Control. **Inheritance:** Types of Inheritance, Extending a Class, Super Class, Multilevel Inheritance, Final and Abstract Keyword, Overriding Methods. **Interfaces:** Implementing Interfaces, Accessing Interface Variable.	
Unit 4	**Multithreaded Programming and Java Packages** **Multithreaded Programming**: Creating Threads, Extending the Thread Class, Stopping and Blocking a Thread, Lifecycle of a Thread, Using Thread Methods, Thread Exceptions, Thread Priority Synchronization. **Java Packages:** Java API Packages, Using System Package, Creating Package, Accessing Package, Using Package, Adding a Class to Package, Hiding Classes, Static Import.	**09 L**
Unit 5	**Java in Web Technology** Introduction to World Wide Web (WWW), Development of WWW, Graphical User Interface, Weaving the Web, Introduction to Hyper Text Markup Language (HTML), Preparing Java Applets using the Abstract Windows Toolkit (AWT) Framework, Basic Graphics Features Provided by Java Language.	**07 L**

Suggested readings:

1. **Computing concepts with java 2 essentials,** CAY HORSTMANN 2 Edition WILEY INDIA ISBN 81-265-0931-9.
2. **Big java** by CAY HORSTMANN, 2 Edition, WILEY INDIA ISBN 81-265-0879-5.
3. **Web Design, The complete reference,** Thomas A. Powel, Tata McGraw Hill.
4. **Programming with JAVA primer,** E. Balagurusamy, Tata McGraw Hill.

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C202.1	Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs.	**06**
C202.2	Read and make elementary modifications to Java programs that solve real-world problems.	**06**
C202.3	Validate input in a Java program.	**06**
C202.4	Analyze and fix defects and common security issues in code.	**04**
C202.5	Interprete a version control system to track source code in a project.	**03**

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	EL - 203: Advanced Microcontrollers and Applications	
	Course Objectives: ➢ Understand Object oriented concepts like data abstraction, encapsulation, etc. ➢ Understand various Java programming constructs. ➢ Do programming in the Java programming language, ➢ Gain knowledge of object-oriented paradigm in the Java programming language, ➢ Use of Java in a variety of technologies and on different platforms.	
Unit 1	**Introduction to Advanced Microcontrollers** Architectural features of different types of architectures used in Microcontrollers, like Van Neumann, Harvard, CISC, RISC, SISC architectures. Special features like watchdog timer, digital signal processors, clock monitor, resident program, loader, monitor, General applications of Micro-controllers.	**07 L**

Unit 2	**16 bit MCS-96 Microcontrollers** Architectural block diagram, features, Data types, addressing modes, Instruction set, Arithmetic, data transfer, logical and other types of instructions, Programming, simple programs and loop programs.	**17L**
Unit 3	**32 bit Arm Microcontrollers** Architectural block diagram, features, Data types, addressing modes, Instruction set and programming, simple programs and loop programs.	**08 L**
Unit 4	**Interfacing Applications** Interfacing Light Emitting Diodes, 7-segment display, keypad, stepper motor and Analog to Digital Converter to arm processor.	**07 L**
Unit 5	**Robotics and Applications** Introduction, physical configurations, Cartesian co-ordinate, polar co-ordinate, cylindrical and body and arm configuration, technical features, robotics motion, body and arm motions, wrist motions, programming languages, victors assembly language and machine control language, work cell control and interlocks, robotics sensors – vision sensors, touch sensors and voice sensors, Need of robotics in industries, material transfer, machine loading, spray painting, welding, processing operation, assembly and inspection.	**11 L**

Suggested readings:

1. The 16 bit Intel 8096 Programming, Interfacing, applications by Ron Katz and Howard Boyet.
2. CAD/CAM-computer Aided Design and Manufacturing, M. P. Grover and E. W. Zimmers, Jr, PHI, New Delhi
3. Microcontroller: Architecture, implementation and Programming by Kenneth Hintz and Daniel Tabak, Tata McGraw Hill
4. www.intel.com

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C203.1	Explain advanced features of microcontrollers	**02**
C203.2	Write assembly language programs for microcontrollers	**03**
C203.3	Develop Interface hardware with microcontrollers	**03**
C203.4	Write embedded programs	**06**
C203.5	Extend applications of robotics in industry	**02**

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	EL - 204: Advanced Communication Systems	
	Course Objectives: ➢ Recognize different communication systems ➢ Understand concept of mobile communication system ➢ Understand concept of telecommunication switching ➢ Understand concept of telecommunication networks ➢ Understand the difference between analog and digital communication system ➢ Understand the construction, principle of operation and applications of advanced optical components ➢ Know the different types of optical sensors ➢ Know the concept, working and application of satellite communication system ➢ Know the concept, working and application of internet communication system	

Unit 1	**Mobile Communication** **Cellular concept:** Introduction to basic cellular system, Cellular coverage planning, Mobile radio propagation, frequency reuse, Co-channel interference, Diversity, fading channels, spreading codes, power control, handoff, types of handoff, Multiple access. **Wireless networking:** Wireless systems and standards, WAP and other protocols for internet access. Blue-tooth and other wireless networks, system comparison. Spread spectrum concept. Basics of CDMA. Applications of CDMA to cellular communication systems. Second and third generation CDMA systems/ standards. Multicarrier CDMA. Synchronization and demodulation. Diversity techniques and rake receiver.	**13 L**
Unit 2	**Mobile Unit** Block diagram and operation of mobile unit, block diagram of cellular network, GSM architecture, making a call, receiving a call, GSM and CDMA technology and their applications.	**07L**
Unit 3	**Telecommunication Switching and Networks** Principles of circuit switching and signaling schemes, space time and space time division switching, single stage and multistage switching network. Traffic engineering and tele-traffic theory. Markov processes representing traffic, calculation of blocking probability.	**07 L**
Unit 4	**Advanced Optical communication** Analog and Digital communication link design. WDM, DWDM, optical couplers, Mach-Zehnder interferometer multiplexer, optical add/drop multiplexers, isolators, circulators, optical filters, tunable sources and tunable filters, arrayed waveguide grating, diffraction grating, optical amplifiers, optical integrated circuits, OTDR, SONET: frame format, overhead channels, payload pointer, multiplexing hierarchy. SDH: Standards, frame structure and features. Optical switching, WDM networks, Classification of optical sensors. Intensity modulated, phase modulated and spectrally modulated sensors.	**13 L**
Unit 5	**Satellite communication** Introduction to satellite communication system, Importance of satellite communication system, concept of orbit and its types, Kepler's law, orbit tracking, satellite launching, attitude control, main and auxiliary propulsion subsystem, earth station and satellite sub systems, satellite link: uplink and downlink frequency, satellite link design and analysis, multiplexing techniques, multiple accesses for satellite links: FDMA, TDMA CDMA and DAMA, propagation effects, DBS-TV, GPS. VSAT: Network architecture, access control protocol and link analysis.	**07 L**
Unit 6	**Internet Communication** Modem, Modem-computer interfacing, modulation schemes, computer networks and different topologies, OSI7-layer protocol, application layer protocols, transport layer protocols, network layer and routing, link layer and local area networks, security in computer networks.	**06 L**

Suggested readings:

1. **An introduction to fiber optic systems (IInd edition)** By John Powers, Irwin Publications, Chicago (1993 & 1997)
2. **Understanding fiber optics (IInd edition)** By Jeff Hecht (BPB publications) 1997
3. **Principles and Applications of Optical Communications**, By Max Ming-Kang Liu, Irwin Publications, Chicago
4. **Mobile cellular Telecommunications: Analog and Digital Systems (IInd edition)** By William C.Y. Lee, McGraw-Hill, Inc. New York, 1995
5. **Optical Communication System**, John Gower, Prentice Hall, India

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C204.1	Practically apply the knowledge of communication system to real life problems.	**03**
C204.2	Apply the concept of telecommunication switching to practical implementation.	**03**
C204.3	Apply knowledge of optical devices to develop circuits.	**03**
C204.4	Explian to society about digital communication.	**03**
C204.5	Review, prepare and explain technological developments.	**03**

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	EL - 205: Practical Laboratory II	
	Course Objectives: ➢ To handle optoelectronics components ➢ To study characteristics of optoelectronics devices ➢ Have acquaintance with Java programs ➢ To interface hardware with microcontrollers ➢ To write embedded C programs ➢ Handle communication kits	
Unit 1	**Part-A** 1. Characterization of Photodiode and phototransistor. 2. Measurement of NA and attenuation in optical fiber. 3. Study of losses in Optic Fiber. 4. Study of V-I and P-I characteristics of Laser diode using fiber optic platform. 5. Study of various types of 7-segment display and their application for displaying message using electronic circuit. 6. Determination of efficiency of given solar cell. 7. Study of solar grid for power analysis. **Part-B** 1. Write Java program for performing arithmetic operations 2. Write Java program for performing string operations. 3. Write Java program for performing operations over file. 4. Write Java program to perform Multi-threaded Programming and Exceptions. 5. Write Java program for handling Packages. 6. Write Java program for writing static web page. 7. Write Java program for writing web page with animation. (**Note:** Exp. No 1 to 2 using Methods, Array, Inheritance and so on). **Part-C** 1. Writing arithmetic programs using MCS-96. 2. Writing code conversion programs using MCS-96. 3. Interfacing of LED display/7-segment display to arm processor. 4. Interfacing of stepper motor to ARM processor. 5. Interfacing of DC Motor to ARM processor and display its speed on LCD. 6. Use of microcontroller for robotics applications.	

	Part-D 1. Study of intensity modulation and demodulation using fiber optic kit. 2. Study of free space communication using fiber optic kit. 3. Study of TDM and de-multiplexing using fiber optic kit. 4. PC to PC data communication using WDM. 5. Setting of fiber optic analog and digital link. 6. Study of mobile communication. **Note:** *The student has to perform at least 04 practicals from each part.*

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C205.1	Explain characteristics of optoelectronics devices	**02**
C205.2	Write Java programs for various applications	**06**
C205.3	Adapt Interface hardware with advanced microcontrollers	**06**
C205.4	Write embedded programs	**03**
C205.5	Operate communication kits	**03**

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M.Sc. Part I Semester II (Electronics): Audit Courses

	AC-201(A): Soft Skills **(Personality and Cultural Development Related Audit course; Practical; 2 Credits)** **(Optional: Campus-level)**	
	Course Objectives (CObs): • To inculcate different soft skills among students.	
Unit 1	**Introduction to soft skills** Formal definition, Elements of soft skills, Soft vs. Hard skills, Emotional quotient, Goal setting, life skills, Need for soft skills, Communication skills, Etiquettes& Mannerism.	**2 hrs.**
Unit 2	**Self-Assessment** Goal setting, SWOT analysis, attitude, moral values, self-confidence, etiquettes, non-verbal skills, achievements, positive attitude, positive thinking and self-esteem. Activity: The teacher should prepare a questionnaire which evaluate students in all the above areas and make them aware about these aspects.	**4 hrs.**
Unit 3	**Communication Skills** Types of communication: Verbal, Non-verbal, body language, gestures, postures, gait, dressing sense, facial expressions, peculiarity of speaker (habits). Rhetoric speech: Prepared speech (topics are given in advance, students get 10 minutes to prepare the speech and 5 minutes to deliver, Extempore speech (students deliver speeches spontaneously for 5 minutes each on a given topic), Storytelling (Each student narrates a fictional or real-life story for 5 minutes each),	**8 hrs.**

	Oral review (Each student orally presents a review on a story or a book read by them) Drafting skills: Letter, Report & Resume writing, business letters, reading & listening skills Activity: The teacher should teach the students how to write the letter, report and build resume. The teacher should give proper format and layouts. Each student will write one formal letter, one report and a resume.	
Unit 4	**Formal Group Discussion, Personal Interview & Presentation skills** Topic comprehension, Content organization, Group speaking etiquettes, driving the discussion & skills. Preparation for personal interview: dress code, greeting the panel, crisp self-introduction, neatness, etiquettes, language tone, handling embarrassing & tricky questions, graceful closing. Activity: Each batch is divided into two groups of 12 to 14 students each. Two rounds of a GD for each group should be conducted and teacher should give them feedback. Mock interview are to be conducted.	**4 hrs.**
Unit 5	**Aptitude and analytical skills** Quantitative aptitude, Numerical reasoning, verbal reasoning, diagrammatic test, situational tests, logical thinking. Analytical skills: Definition, Types, problem solving	**8 hrs.**
Unit 6	**Life skills** Time management, critical thinking, sound and practical decision making by dealing with conflicts, stress management, leadership qualities Activity: The teacher can conduct a case study activity to train students for decision making skills. The teacher should conduct a session on stress management and guide students on how to manage stress. The teacher may conduct a stress relieving activity in the class. He/she may counsel students individually to know their problems and guide them on dealing with them effectively.	**4 hrs.**

Suggested readings:

1. Basics of Communication In English: Francis Sounderaj, MacMillan India Ltd.
2. English for Business Communication: Simon Sweeney, Cambridge University Press
3. An Introduction to Professional English and Soft Skills: Das, Cambridge University Press
4. Quantitative Aptitude: R.S. Agrawal

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
AC201A.1	Identify their lacunas about some soft skills and try to overcome the same.	**2**
AC201A.2	Practice learned soft skills in real life and do their jobs more effectively.	**3**

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AC-201(B): Practicing Sports Activities

(Personality and Cultural Development Related Audit course; Practical; 2 Credits)

(Optional: Campus-level)

Course Objectives (CObs):

- To motivate students towards sports and provide them required training.

SR NO.	NAME OF THE SPORT/GAME (Select ONE of the Following)	SYLLABUS OF THE COURSE	TIMING (02 Hours in a Week)	SEMESTER
1	Volleyball	• General Fitness • Basic Fitness • Specific Fitness • History of the Game • Basic Skill of the Game • Major Skill of the Game • Technique & Tactics of the Game • Game Practice	Morning : 07 to 09 AM OR Evening : 05 to 07 PM	Total 30 Hours in Each Semester
2	Athletics			
3	Badminton			
4	Cricket			
5	Basketball			
6	Handball			
7	Kabaddi			
8	Kho-Kho			
9	Table-Tennis			
10	Swimming			

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
AC201B.1	Identify one or more sports of their choice and develop more interest to participate at University/National level sport events.	**2**
AC201B.2	Practice the learned sports activities regularly in real life.	**3**

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AC-201(C): Practicing Yoga (Personality and Cultural Development Related Audit course; Practical; 2 Credits) (Optional: Campus-level)	
	Course Objectives: • To motivate students towards yoga and provide them required training.
	• Yog: Meaning, Definition & Introduction, Objectives • Primary Introduction of Ashtanga Yoga • Preparation of Yogabhyas • Omkar Sadhana, Prayer, Guru Vandana • Sukshma Vyayamas • Suryanamaskar (12 Postures) • Asanas : ▪ Sitting (Baithaksthiti) - Vajrasana, Padmasan, Vakrasan, Ardha-Pashchimotanasanan ▪ Supine (Shayansthiti) - Uttan Padaasan(Ekpad/Dwipad), Pavanmuktasana, Viparitakarani Aasan, Khandarasan, Shavasana ▪ Prone (Viparitshayansthiti) - Vakrahasta, Bhujangasana, Saralhasta Bhujangasana, Shalabhasana(Ekpad/Dwipad), Makarasana ▪ Standing (Dhandsthiti) - Tadasana , TiryakTadasana, Virasana, Ardh Chakrasana • Primary Study of Swasana: Dirghaswasana, Santhaswasana, JaladSwasana - 6 Types • Pranayama : Anuloma-viloma, Bhramari

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
AC201C.1	Identify and practice some Yoga asanas regularly in their life to remain healthy.	**2**
AC201C.2	Provide guidance and practice about Yoga to their friends, parents and relatives.	**3**

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AC-201(D): Introduction to Indian Music (Personality and Cultural Development Related Audit course; Practical; 2 Credits) (Optional: Campus-level)	
	Course Objectives: • To motivate students towards Indian music and provide them minimum required training. .
	• Definition and brief about generation of Swar, Saptak, Thaat, Raag, Aavartan, Meend, Khatka, Murkee, Taal, Aalaap etc. • Taal and its uses - Treetaal, Daadraa, Zaptaal, Kervaa. • Information of Badaakhyaal, Chhotaakhyaal (one), Sargam, Lakshangeet (information) • Detailed information of Tambora • Detailed information of Harmonium and Tablaa. • Five filmy songs based on Indian Classical Music (Theory and Presentation) • Sound Management - Basic information of Sound Recording (including Practicals) • Composition of Music as per the Story • Preparing news write-ups of the Seminars, Library Musical Programmes held at the nearest Akashwani, by personal visits.

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
AC201D.1	Identify different types of Indian music.	**3**
AC201D.2	Develop more interest to learn and practice Indian music.	**4**

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M.Sc. (Electronics) Syllabus (with effect from June 2019)

Department of Electronics

Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon
Syllabus under CBCS for M.Sc.(Electronics)
Syllabus Structure (with effect from 2019-20)

Semester-III

Course Code	Course Type	Title of the Course	Contact hours/week *For Project and Practical per week per batch			Distribution of Marks for Examination						Credits
						Internal		External		Total		
			Th(L)	Pr	Total	Th	Pr	Th	Pr	Th	Pr	
EL-301 (A)	Elective (Choose 1)	Digital Signal Processing and Applications	04	--	04	40	--	60	--	100	--	04
EL-301 (B)		CMOS RF Circuits										
EL-302	Core	Semiconductor Processing Technology	04	--	04	40	--	60	--	100	--	04
EL-303	Core	Embedded Systems and Applications	04	--	04	40	--	60	--	100	--	04
EL-304	Practical	Practical Laboratory III	--	*04	*04	--	40	--	60	--	100	04
EL-305	Practical	**Special Laboratory (Project I + Report)**	--	*04	*04	--	40	--	60	100	--	04
AC-301(A)	Audit Course (Technology + value added course) (Choose 1)	Computer Skills	02	--	02	100	--	--	--	100	--	02
AC-301(B)		Cyber Security										
AC-301(C)		Python Programming for Electronics										
AC-301(D)		Robotics and applications										

Semester-IV

Course Code	Course Type	Title of the Course	Contact hours/week *For Project and Practical per week per batch			Distribution of Marks for Examination						Credits
						Internal		External		Total		
			Th(L)	Pr	Total	Th	Pr	Th	Pr	Th	Pr	
EL-401(A)	Elective (Choose 1)	Modeling and Simulation Techniques	04	--	04	40	--	60	--	100	--	04
EL-401(B)		Micro-electromechanical Systems and Applications										
EL-402	Core	CMOS Technology and Applications	04	--	04	40	--	60	--	100	--	04
EL-403	Core	Digital Image Processing and Applications	04	--	04	40	--	60	--	100	--	04
EL-404	Practical	Practical Laboratory IV	--	*04	*04	--	40	--	60	--	100	04
EL-405	Practical	**Special Laboratory (Project + Thesis)**	--	*04	*04	40	--	60	--	100	--	04
AC-401(A)	Audit Course (Professional and Social + value added course) (Choose 1)	Human Rights	02	--	02	100	--	--	--	100	--	02
AC-401(B)		Current Affairs										
AC-401(C)		Electronics for Internet of Things										
AC-401(D)		Mechatronics and Applications										

Elective Course

	EL – 301 (A) : Digital Signal Processing and Applications	
	Course Objectives: ➢ Understand and working knowledge of design, implementation and analysis DSP systems. ➢ Make students familiar with the essential methods in DSP, including digital filter design, transform-domain processing and the importance of Signal Processors. ➢ Make students aware of the meaning and implications of the properties of systems and signals.	
Unit 1	**Basics of Digital Signal Processing** Analog Vs. Digital Signal Processing, Block diagram of digital signal processor, Sampling Theorem, Sampling, Quantization, Aliasing.	**05 L**
Unit 2	**Signals and Systems** Basic signals, representation of signals in various ways, types of signals, systems: classification of systems, properties of systems, LSI system, delta function, impulse response, linear convolution, properties of convolution, correlation, its type and applications.	**12 L**
Unit 3	**Mathematical Transforms** Z-transform, definition, the region of convergence, properties of Z-transform, inverse Z-transform: various methods, DTFT, properties, DFT, properties, circular convolution, graphical method and matrix method, FFT.	**17 L**
Unit 4	**Filters** Types of filters, Infinite impulse response filters, Finite impulse response filters, various window functions, implementation of these filters, Analog filters	**12 L**
Unit 5	**DSP Applications** Audio compression and decompression, audio equalization, audio noise cancellation, audio echo cancellation, video compression, video stabilization, image compression, face finding, image resizing, data modulation and demodulation, speech synthesis, mobile telephone, set-top box and ECG monitoring.	**05 L**

Suggested readings:

1. **Digital Signal Processors**- Kuo and Gan, Pearson Education
2. **Digital Signal Processing**: D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, J Wile and sons, Singapore.
3. **Digital Signal Processing**: Principle, Algorithms and Applications, John G. Proakis and D.G. Manolakis, Prentice-Hall.
4. **Theory and Application of Digital Signal Processing**: L. R. Rabiner and B. Gold, Prentice-Hall**.**
5. **Introduction to Digital Signal Processing**: J.R. Johnson, Prentice Hall
6. **Industrial Control Electronics** – Applications and Design, Michael Jacob Prentice Hall.

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C301A.1	Use concepts of trigonometry, complex algebra, Fourier transform, z-transform to analyze the operations on signals and acquire knowledge about Systems	**03**
C301A.2	Design, implementation, analysis and comparison of digital filters for processing of discrete time signals	**04**

C301A.3	Integrate computer-based tools for engineering applications	**06**
C301A.4	Employ signal processing strategies at multidisciplinary team activities.	**03**
C301A.5	Develop creative and innovative designs that achieve desired performance criteria within specified objectives and constraints, understand the need for lifelong learning and continuing professional education	**06**

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Elective Course

	EL – 301 (B) : CMOS RF Circuits	
	Course Objectives: ➢ Familiarize the basic concepts in RF design on the characterization of nonlinearity, noise, scattering parameters. ➢ Acquaint the student will knowledge of wireless standards and their specifications ➢ Impart the knowledge of different transceiver architectures and their trade-offs ➢ Introduce the design of low noise amplifiers, mixers and passive devices ➢ Expose the design issues in oscillators, frequency synthesizers and RF power amplifiers	
Unit 1	**Introduction to RF design and Wireless Technology:** Design and Applications, Complexity and Choice of Technology. Basic concepts in RF design: Nonlinearly and Time Variance, Intersymbol interference, random processes and noise. Sensitivity and dynamic range, conversion of gains and distortion.	**07 L**
Unit 2	**RF Modulation** Analog and digital modulation of RF circuits, comparison of various techniques for power efficiency, Coherent and non-coherent detection, Mobile RF communication and basics of Multiple Access Techniques. Receiver and Transmitter architectures. Direct conversion and two-step transmitters.	**11 L**
Unit 3	**RF Testing** RF testing for heterodyne, Homodyne, Image reject, Direct IF and sub-sampled receivers.	**07 L**
Unit 4	**BJT and MOSFET Behavior at RF Frequencies** BJT and MOSFET behavior at RF frequencies, Modeling of the transistors and SPICE model, Noise performance and limitations of devices, integrated parasitic elements at high frequencies and their monolithic implementation.	**07 L**
Unit 5	**RF Circuits Design** Overview of RF Filter design, Active RF components & modeling, Matching and Biasing Networks. Basic blocks in RF systems and their VLSI implementation, Low noise Amplifier Design in various technologies, Design of Mixers at GHz frequency range, Various mixers working and implementation. Oscillators- Basic topologies VCO and definition of phase noise, Noise power and trade-off. Resonator VCO designs, Quadrature and single sideband generators. Radiofrequency Synthesizers- PLLS, Various RF synthesizer architectures and frequency dividers, Power Amplifier Design, Liberalization techniques, Design issues in integrated RF filters.	**18 L**

Suggested readings:

Text:

1. Thomas H. Lee “Design of CMOS RF Integrated Circuits” Cambridge University press 1998.
2. R. Jacob Baker, HW Li, D.E. Boyce “ CMOS Circuit Design, Layout and Simulation.” PHI 1998.

References:

1. B. Razavi "RF Microelectronics" PHI 1998.
2. Y.P. Tsividis "Mixed Analog and Digital Devices and Technology" TMH 1996.

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C301B.1	Define and compute the various parameters characterizing the nonlinearity Including gain compression, intermodulation and harmonic distortion	**01**
C301B.2	Enumerate the different specifications of a wireless standard	**01**
C301B.3	Analyze a given receiver circuit by its noise figure, sensitivity and dynamic range	**04**
C301B.4	Design input and output matching networks for impedance transformation	**06**
C301B.5	Categorize the different requirements of RF receivers including bandwidth, channel selection, band selection and Tx-Rx feedthrough	**04**

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	EL – 302 : Semiconductor Processing Technology	
	Course Objectives: ➢ Have a working knowledge of all the main process areas in a FAB, including Photolithography; Diffusion; Etch, & etc. ➢ Have knowledge of the key process capital equipment in each area. ➢ Know about the advent of electronics manufacturing at the nanoscale and the advantages and implications encountered. ➢ Students should know how to operate, process all of the equipment and meters in the cleanroom and function successfully as a team in order to complete the lab objectives.	
Unit 1	**Environment and Crystal Growth for VLSI Technology** **Environment:** What is a cleanroom?, the need for cleanroom, types of clean rooms, basics of cleanroom standards, different sections I cleanroom, vertical and horizontal flow unidirectional flow cleanrooms, operating a cleanroom: contamination control **Crystal Growth:** Why single crystal? Crystal structures of semiconducting materials, use of silicon as a semiconductor, Different Techniques for Growing Single-Crystal Silicon: CZ and Bridgeman techniques, Float zone, Zone refining, Ingot shaping, Polishing, Cutting, Wagering, Scribe lines, Cleavage, Silicon, Insulators, sapphire and amorphous substrates.	**08 L**
Unit 2	**Fabrication processes** **Diffusion:** Nature of diffusion, the diffusion concentration, Field aided motion, Impurity behavior in silicon, substitution diffusers, ion implantation, **Epitaxy:** Molecular Beam Epitaxy, Vapor Phase Epitaxy, reaction at the substrate, Elements of nucleation and growth, Doping and auto-doping, Formation of GaAs (reaction involved), Liquid Phase Epitaxy, tilt-type growth furnace, slider boat arrangement, Evaluation of epitaxial layers, **Ion Implantation:** Penetration range, ion implantation systems, process considerations, implantation damage and annealing, **Deposition:** Evaporation, Sputtering and Chemical Vapor Deposition (CVD,	**16 L**

	PECVD, APECVD, ALD), **Etching:** Wet chemical etching, dry physical etching, dry chemical etching, reactive ion etching, ion beam techniques	
Unit 3	**Lithography** What is photoresist? Photoresist composition, Positive and negative resists, photoresist performance factors, photomask and its preparation, scaling, patterning, reticle masks, master mask, production mask, alignment mask. Optical lithography: photolithography requirements, basic steps of photolithography, contact printing, projection printing, proximity printing, edge bead removal, Proximity effect and its corrections, vary figures, variable exposure, standing wave effect, critical dimension, depth of focus, phase shift mask, Electron beam lithography (EBL) step and repeat method, electron-beam mask fabricator (EBMF), EUV lithography, (Telecentric effect) laser beam, ion beam lithography, X-ray lithography, future trends.	**08 L**
Unit 4	**Oxidation** Thermal oxidation process of silicon, Kinetics of oxide growth, Properties of Silicon Dioxide, Oxide Quality, **Thermal Oxidation:** Dry, Wet, Rapid thermal, pyrogenic oxidation, Halogenic low-pressure oxidations, Techniques of oxidation (chlorine enhanced oxidation), Oxidation furnaces, high and low-pressure oxidations. Techniques and difficulties in growing good quality thin oxide layers, oxidation induced stacking faults, Deal grove model assumptions, segregation coefficient, impurity redistribution during oxidation, failure of Deal grove model in initial stages, Properties of thermal, anodic and plasma oxides Evaluation of oxide layers.	**09 L**
Unit 5	**Characterization Techniques** **Physical Characterizations:** Refractive Index and thickness measurement, XRD, SEM, TEM, Elliposometry, Talley step, AFM **Electrical Characterization:** I-V, C-V measurement, impurity profile measurement, Hall probe technique, resistivity measurement, Four probe technique, Hall Measurement, Sheet resistance, Mobility and carrier concentration and impurity profile measurements, Vander Pau method, breakdown strength measurement, **Chemical Characterizations:** Spectroscopic Techniques U-V, RHEED, ESCA.	**09 L**

Suggested readings:

1. **Cleanroom Technology: Fundamentals of Design, Testing and Operation** by W. Whyte, John Wiley & Sons Ltd
2. **VLSI Fabrication principles**, S. K. Gandhi, John Willey and Sons.
3. **VLSI technology**, S, M. Sze, Mc Graw Hill Int. Book Co.
4. **Integrated Circuit Engineering**, B. Glasser and S. Sharpe
5. **Semiconductor Integrated Circuit fabrication techniques:** P. E. Gise and R. Blanchard
6. T**he Science and Engineering of Microelectronic Fabrication** by Stephen A. Campbell (Oxford University Press)
7. **Silicon Processing for the VLSI Era** (Volume 1- Process Technology, Volume 2 – Process Integration and Volume 3 – The Submicron MOSFET) by S. Wolf and R. N. Tauber, Lattice Press, Sunset Beach, California
8. **Semiconductor Manufacturing and Process Control** by Gary S. May and Costas J. Spanos (IEEE, Wiley-Interscience)
9. **Integrated Circuit Manufacturability – The Art of Process and Design Integration**, edited by Jose Pineda de Gyvez and Dhiraj K. Pradhan (IEEE Press)

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C302.1	Established in-depth knowledge in ✓ Wafer preparation. ✓ Lithography and Etching. ✓ Diffusion process. Characterization techniques.	**03**
C302.2	Analyze IC fabrication methodologies for VLSI and ULSI domain.	**04**
C302.3	Solve engineering problems by proposing potential solutions leading to better IC chip designs.	**06**

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	EL – 303: Embedded Systems and Applications	
	Course Objectives: ➢ Have knowledge about the basic functions, structure, concepts and applications of embedded systems. ➢ Develop familiarity with 8051 Microcontrollers and their applications in an embedded environment. ➢ Learn the method of designing and program an Embedded Systems for real-time applications. ➢ Understand operating system concepts, types and choosing RTOS. ➢ Have knowledge about the development of embedded software using RTOS and implement small programs to solve well-defined problems on an embedded platform. ➢ Develop familiarity with tools used to develop in an embedded environment.	
Unit 1	**Introduction** Embedded system, components of embedded system, processor, memory, microcontroller, DSP, Application-specific system processor, power supply management, clock oscillator, reset circuit, Input/output ports, buses and interfaces, DAC and ADC, LCD and LED displays, keypad/keyboard, Types of interrupts, interrupt priorities.	**10 L**
Unit 2	**Embedded on-chip Hardware** Memory, memory interface unit, programming the memory, embedded system input/output devices, timers, 8253, different operating modes, parallel ports, memory-mapped Input/output, serial ports, UART.	**07 L**
Unit 3	**Embedded Communication** Parallel data communication, GPIB and HPIB standards, serial data communication, Asynchronous communication and standards, PC-PC communication, modem, computer-modem interfacing, network communication, I2C bus standard, wireless communication.	**07 L**
Unit 4	**Embedded System Software and testing of systems** Real-time systems, the model of real-time systems, Characteristics of real-time systems, Features of the real-time operating system, Unix as a RTOS, windows as a RTOS, Task scheduling in embedded systems: task scheduler, first in first out, the shortest job first, round-robin, priority-based scheduling, Programming languages: assembly languages, high-level languages, verification vs. testing,	**20 L**

	faults in embedded systems, hardware fault models, software-hardware covalidation fault models, embedded software testing.	
Unit 5	**Applications of Embedded Systems** Mobile phones, home appliances, microwave oven, washing machine, laser printer, Automated Teller Machines, Bluetooth communication, automated car assembly plant, chemical plant control.	**06 L**
Suggested readings: **1) Fundamentals of Embedded Software**- Daniel W Lewis, Pearson Education **2) An embedded software primer**, David E Simon, Pearson education **3) Embedded Micro-computer System: Real-Time Interfacing**, J.W. Valvano.		

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C303.1	Apply and analyze the applications in various processors and domains of an embedded system.	**03**
C303.2	Analyze and develop embedded hardware and software development cycles and tools.	**04**
C303.3	Analyze to understand what a microcomputer, core of the embedded system.	**04**
C303.4	Analyze to understand different concepts of a RTOS, sensors, memory interface, communication interface.	**04**
C303.5	Remember the definitions of ASICs, PLDs, memory, memory interface.	**01**

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	EL – 304: Practical Laboratory III	
	Course Objectives: ➢ Understand significance of DSP processor ➢ Use MATLAB tools for DSP and perform using CMOS RF ➢ Independently work in clean room ➢ Process the semiconductor samples ➢ Interface hardware with ARM processor	
	Part-A 1. Implement a moving average filter using MATLAB. 2. Write a MATLAB program for the magnitude and phase response of the signal. 3. Study of Auto-correlation using MATLAB. 4. Study of Linear and Circular convolution techniques using MATLAB. 5. Study of low pass filter using DSP kit. **Part-B** 1. Study of wafer handling and cleaning. 2. Growth of Silicon dioxide layer for microelectronics applications. 3. Photolithography using photoresist. 4. Studies on dry and wet etching processes for semiconductor thin films. 5. Studies on optical characterization techniques ellipsometry.	

	6. Studies on optical characterization techniques FTIR. 7. I-V characteristics of BJT / MOSFET devices. **Part-C** 1. Write a program for Arithmetic operations using the ARM processor. 2. Write a code conversion program using the ARM processor. 3. Interface Relay to the ARM processor. 4. Interface DC motor to the ARM processor. 5. Interface DAC to the ARM processor.

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C304.1	Use MATLAB and develop applications of DSP	**03**
C304.2	Create CMOS RF circuit and its applications	**06**
C304.3	Prepeare semiconductor processing steps	**06**
C304.4	Develop hardware and write software for ARM	**06**
C304.5	Examine independently in practical laboratory and think new applications	**03**

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	EL – 305: Special Laboratory (Project I + Report)	
	Course Objectives: ➢ Advanced Research ➢ Industrial Automation Using embedded system ➢ Industrial Automation using PLC	

Assessment Scheme

Sr. No.	Criterial	Marks out of	
		Internal	External
1	**Performance of the student in the presentation of the project**	**10**	**10**
2	**Experimental Work carried out by the student**	**20**	**30**
3	**Project Report**	**-**	**10**
4	**Viva-Voce**	**10**	**10**
	Total	**40**	**60**

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C305.1	Develop ability for problem-based surveys and their solution, analysis of result and drawing conclusions.	**06**
C305.2	Develop technical skills for any kind of automation platform.	**06**

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M.Sc. Part II Semester III Electronics: Audit Courses

AC-301(A): Computer Skills

(Technology + Value added Audit course; Practical; 2 Credits)

(Optional: Campus + Program level)

Course Objectives (CObs):

- To inculcate different daily useful computer skills among students.

Unit 1	**Elements of Information Technology** 1.1 Information Types: Text, Audio, Video, and Image, storage formats 1.2 Components: Operating System, Hardware and Software, firmware 1.3 Devices: Computer, Mobile Phones, Tablet, Touch Screen, Scanner, Printer, Projector,smart boards 1.4 Processor & Memory: Processor functions, speed, Memory types: RAM /ROM /HDD /DVD-ROM/Flash drives, memory measurement metrics	**2 hrs**
Unit 2	**Office Automation-Text Processing** 2.1 Views: Normal View, Web Layout View, Print Layout View, Outline View, ReadingLayout View 2.2 Working with Files: Create New Documents, Open Existing Documents, SaveDocuments to different formats, Rename Documents, Close Documents 2.3 Working with Text: Type and Insert Text, Highlight Text, Formatting Text, Delete Text,Spelling and Grammar, paragraphs, indentation, margins 2.4 Lists: Bulleted and Numbered Lists, 2.5 Tables: Insert Tables, Draw Tables, Nested Tables, Insert Rows and Columns, Moveand Resize Tables, Moving the order of the column and/or rows inside a table, TableProperties 2.6 Page Margins, Gutter Margins, Indentations, Columns, Graphics, Print Documents, 2.7 Paragraph Formatting, Paragraph Attributes, Non-printing characters 2.8 Types of document files: RTF, PDF, DOCX etc.	**5 hrs**
Unit 3	**Office Automation-Worksheet Data Processing** 3.1 Spreadsheet Basics: Adding and Renaming Worksheets, Modifying Worksheets, 3.2 Moving Through Cells, Adding Rows, Columns, and Cells, Resizing Rows and Columns, Selecting Cells, Moving and Copying Cells 3.3 Formulas and Functions: Formulas, Linking Worksheets, Basic Functions, AutoSum, Sorting and Filtering: Basic Sorts, Complex Sorts, Auto-fill, Deleting Rows, Columns, and Cells 3.4 Charting: Chart Types, drawing charts, Ranges, formatting charts	**5 hrs**
Unit 4	**Office Automation- Presentation Techniques and slide shows** 4.1 Create a new presentation, AutoContent Wizard, Design Template, Blank Presentation,Open an Existing Presentation, PowerPoint screen, Screen Layout 4.2 Working with slides: Insert a new slide, Notes, Slide layout, Apply a design template,Reorder Slides, Hide Slides, Hide Slide text, Add content, resize a placeholder or textbox, Move a placeholder or text box, Delete a placeholder or text box, Placeholder orText box properties, Bulleted and numbered lists, Adding notes 4.3 Work with text: Add text and edit options, Format text, Copy text formatting, Replacefonts, Line spacing, Change case, Spelling check, Spelling options	**6 hrs**

	4.4 Working with tables: Adding a table, Entering text, Deleting a table, Changing rowwidth, Adding a row/column, Deleting a row/column, Combining cells ,Splitting a cell,Adding color to cells, To align text vertically in cells, To change table borders,Graphics, Add clip art, Add an image from a file, Save & Print, slide shows, slideanimation/transitions.	
Unit 5	**Internet & Applications:** 5.1 Computer Network Types: LAN, PAN, MAN, CAN, WAN, Defining and describing theInternet, Brief history, Browsing the Web, Hypertext and hyperlinks, browsers,Uniform resource locator 5.2 Internet Resources: Email, Parts of email, 5.3 Protecting the computer: Password protection, Viruses, Virus protection software,Updating the software, Scanning files, Net banking precautions. 5.4 Social Networking: Features, Social impact, emerging trends, issues, Social Networking sites: Facebook, Twitter, linkedin, orkut, online booking services 5.5 Online Resources: Wikipedia, Blog, Job portals, C.V. writing 5.6 e-learning: e-Books, e-Magazines, e-News papers, OCW(open course wares): Sakshat(NPTEL) portal, MIT courseware	**4 hrs**
Unit 6	**Cloud Computing Basics** 6.1 Introduction to cloud computing 6.2 Cloud computing models: SAS, AAS, PAS 6.3 Examples of SAS, AAS, PAS (DropBox, Google Drive, Google Docs, Office 365 Prezi, etc.)	**3 hrs**

Suggested readings:

1. TCI, "Introduction to Computers and Application Software", Publisher: Jones & Bartlett Learning, 2010, ISBN: 1449609821, 9781449609825
2. Laura Story, Dawna Walls, "Microsoft Office 2010 Fundamentals", Publisher: Cengage Learning, 2010, ISBN: 0538472464, 9780538472463
3. June Jamrich Parsons, Dan Oja, "Computer Concepts Illustrated series", Edition 5, Publisher Course Technology, 2005, ISBN 0619273550, 9780619273552
4. Cloud computing online resources

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
AC301A.1	Identify their lacunas about some computer skills and try to overcome the same.	**2**
AC301A.2	Practice the learned computer skills in real life and do their jobs more effectively.	**3**

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AC-301(B): Cyber Security

(Technology + Value added Audit course; Practical; 2 Credits)
(Optional: Campus + Program level)

Course Objectives (CObs):

- To make students aware of different daily useful cyber security skills/rules.

Unit 1	**Networking Concepts Overview** Basics of Communication Systems, Transmission Media, ISO/OSI and TCP/IP models, Network types: Local Area Networks, Wide Area Networks, Internetworking, Packet Formats, Wireless Networks: Wireless concepts, Advantages of Wireless, Wireless network architecture, Reasons to use wireless, Internet	**3 hrs**
Unit 2	**Security Concepts** Information Security Overview, Information Security Services, Types of Attacks, Goals for Security, E-commerce Security, Computer Forensics, Steganography. Importance of Physical Security, Biometric security & its types, Risk associated with improper physical access, Physical Security equipments. Passwords: Define passwords, Types of passwords, Passwords Storage – Windows & Linux.	**7 hrs**
Unit 3	**Security Threats and vulnerabilities** Overview of Security threats, Hacking Techniques, Password Cracking, Types of password attacks, Insecure Network connections, Wi-Fi attacks & countermeasures, Information Warfare and Surveillance. Cyber crime: e-mail related cyber crimes, Social network related cyber crimes, Desktop related cyber crimes, Social Engineering related cyber crimes, Network related cyber crimes, Cyber terrorism, Banking crimes	**7 hrs**
Unit 4	**Cryptography** Understanding cryptography, Goals of cryptography, Types of cryptography, Applications of Cryptography, Use of Hash function in cryptography, Digital signature in cryptography, Public Key infrastructure	**5 hrs**
Unit 5	**System & Network Security** System Security: Desktop Security, email security: PGP and SMIME, Web Security: web authentication, Security certificates, SSL and SET, Network Security: Overview of IDS, Intrusion Detection Systems and Intrusion Prevention Systems, Overview of Firewalls, Types of Firewalls, VPN Security, Security in Multimedia Networks, Fax Security.	**3 hrs**
Unit 6	**OS Security** OS Security Vulnerabilities updates and patches, OS integrity checks, Anti-virus software, Design of secure OS and OS hardening, configuring the OS for security, Trusted OS.	**2 hrs**
Unit 7	**Security Laws and Standards** Security laws genesis, International Scenario, Security Audit, IT Act 2000 and its amendments.	**3 hrs**

Suggested readings:

1. Skills Factory, Certificate in Cyber Security, Text Book Special edition, Specially published for KBC NMU, Jalgaon
2. BPB Publication, "Fundamentals of Cyber Security", Mayank Bhushan, Rajkumar Singh Rathore , Aatif Jamshed

3. CreateSpace Independent Publishing Platform, "Cyber Security Basics", Don Franke, ISBN-13: 978-1522952190ISBN-10: 1522952195
4. Online references

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
AC301B.1	Practice learned cyber security skills/rules in real life.	**3**
AC301B.2	Provide guidance about cyber security skills/rules to their friends, parents and relatives.	**2**

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	AC – 301 (C) : Python Programming for Electronics	
	Course Objectives: ➢ Understand basic concepts in Python ➢ Understand different control structures in Python ➢ Explore file handling in Python ➢ Explore lists, strings, and tuples ➢ Develop an electronics application independently using Python	
	Practical Han-on: The students should undertake one topic of the following and must prepare detailed presentation, practical implementation, and report submission. • **Introduction to Python** History, features, variables, data types, numbers, identifiers, keywords, basic operators, lists, strings, tuples, dictionaries, printing to screen, reading from the input • **Control statements and loops:** If statement, if-else statement, elif statement, while loop, infinite loop, using else statement with loops, for-loop, nested loops, loop control statements, break statement, continue statement, pass statement • **Python functions and modules:** Defining a function, calling a function, passing by reference vs passing by value, function arguments, required arguments, keyword arguments, default arguments, variable length arguments, the return statement, lambda function, python modules, directory function • **File handling and exceptions:** Opening and closing files, file object attributes, reading and writing files, renaming and deleting files, directories in Python, directory functions, Assert statement in Python, handling an exception, except clause with no and multiple exceptions, try-finally clause, an argument of an exception, user-defined exceptions, classes and objects	

- **Developing an electronics application using Python**
  It includes hardware and/or software application related to electronics e.g. Python programming for Raspberry Pi

Grades:
Successful completion of course is dependent upon two forms of assessment:

1. Quizzes/presentations to test student knowledge in **Learning Activity Packet (LAP)** (20 marks)
2. Hands-on assessment given by the instructor. (80 marks)

Sr. No.	Activity	Marks
1	Preparation of experimental setup	20
2	Observations and recording	10
3	Interpretation of result and conclusion	10
4	Answer to sample questions	10
5	Submission of report in time	30
	Total	**80**

a. Combined with your hands-on assessments will be a hands-on final for each section which has a scheduled date. You must take the final on the schedule date or you may be disqualified.

These assessments are considered for a final LAP grade

Suggested readings:

1) **A practical introduction to Python Programming**- Brian Heinold
2) **A Python Book**: Dave Kuhlman
3) **Core Python Programming**, Dr. R. Nageswara Rao, Dreamtech Press

Course Outcomes (COts):
On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
AC301C.1	Identify the Importance of Python	**02**
AC301C.2	Explain use of control structures in Python	**02**
AC301C.3	Test file functions in Python	**04**
AC301C.4	Explain lists, strings, and tuples for different applications	**04**
AC301C.5	Develop independently python-based application for electronics	**06**

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	AC – 301 (D) : Robotics and Applications	
	Course Objectives: • To develop the student's knowledge in various robot structures and their workspace. To develop student's skills in performing spatial transformations associated with rigid body motions. • To develop student's skills in perform kinematics analysis of robot systems. • To provide the student with knowledge of the singularity issues associated with the operation of robotic systems.	

- To provide the student with some knowledge and analysis skills associated with trajectory planning.
- To provide the student with some knowledge and skills associated with robot control.

Practical hands-on:

The students should undertake one topic of the following and must prepare detailed presentations, practical implementation, and report submission.

- **End Effectors**
  Gripper force analysis and gripper design, design of multiple degrees of freedom, active and passive grippers. SELECTION OF ROBOT: Factors influencing the choice of a robot, robot performance testing, economics of robotization, Impact of robot on industry and society.

- **Sensors in Flexible Manufacturing Systems:**
  Vision sensors, image transformations, robot visual sensing tasks, detecting partially visible objects, sensors in flexible manufacturing

- **Material Handling**
  Concepts of material handling, principles and considerations in material handling systems design, conventional material handling systems - industrial trucks, monorails, rail guided vehicles, conveyor systems, cranes and hoists, advanced material handling systems, automated guided vehicle systems, automated storage and retrieval systems(ASRS), bar code technology, radio frequency identification technology.

- **Robot for inspection:**
  Robotic vision systems, image representation, object recognition and categorization, depth measurement, image data compression, visual inspection, software considerations.

- **Industrial Robotics**
  Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability.

- **Industrial Application of Robot:**
  Application of Robots in continuous arc welding, Spot welding, Spray painting, assembly operation, cleaning, robot for underwater applications.

Grades:

Successful completion of course is dependent upon two forms of assessment:

1. Quizzes/presentations to test student knowledge in **Learning Activity Packet (LAP)** (20 marks)
2. Hands-on assessment given by the instructor. (80 marks)

Sr. No.	Activity	Marks
1	Preparation of experimental setup	20
2	Observations and recording	10

3	Interpretation of result and conclusion	10
4	Answer to sample questions	10
5	Submission of report in time	30
	Total	**80**

a. Combined with your hands-on assessments will be a hands-on final for each section which has a scheduled date. You must take the final on the schedule date or you may be disqualified.
b. These assessments are considered for a final LAP grade.

Suggested readings:

TEXT BOOKS:

1. Richaerd D Klafter, Thomas Achmielewski and Mickael Negin, "Robotic Engineering – A integrated Approach" Prentice HallIndia, New Delhi, 2001.
2. Mikell P. Groover,"Automation, Production Systems, and Computer Integrat Manufacturing", 2nd Edition, John Wiley & sons, Inc, 2007.

REFERENCES:

1. James A Rehg, "Introduction to Robotics in CIM Systems", Prentice Hall of India, 2002.
2. Deb S R, "Robotics Technology and Flexible Automation", Tata McGraw Hill, New Del 1994
3. Nagrath and Mittal, "Robotics and Control", Tata McGraw-Hill, 2003.
4. Spong and Vidhyasagar, "Robot Dynamics and Control", John Wiley and sons, 2008.
5. Fu. K.S, Gonzalez, R.C., Lee, C.S.G, Robotics, control, sensing, Vision and Intelligenc McGraw Hill International, 1987
6. Harry Asada & Slottine "Robot Analysis& Control" , Wiley Publications, 2014
7. S K Saha, "introduction to Robotics ", 2nd edition, TMH, 2013.

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
AC301D.1	Apply knowledge of mathematics, sciences and engineering	**03**
AC301D.2	Explain basic concepts, parts of robots and types of robots.	**02**
AC301D.3	Design automatic manufacturing cells with robotic control.	**06**
AC301D.4	Modify the electronic control system in manufacturing process.	**06**
AC301D.5	Explain effectively and work in interdisciplinary groups	**02**

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Elective Course

	EL – 401 (A) : Modeling and Simulation Techniques	
	Course Objectives: ➢ Define the basics of simulation modeling and replicating the practical situations related with electronics ➢ Generate random numbers and random variates using different techniques. ➢ Develop a simulation model for electronics devices.	

	➢ Analysis of Simulation models using input analyzer, and output analyzer ➢ Analysis of device models using simulation tools	
Unit 1	**Introduction** Models and their types need of modeling, physical models, analog models, probabilistic and deterministic models, static and dynamic models, Common types of mathematical models used for engineering systems, Model determination from input-output observation, Basic Principle of simulation, Analog and digital simulation techniques, material level simulation, physical level simulation, logic level simulation and behavioral level simulation, mixed-level simulation.	**10 L**
Unit 2	**Semiconductor device simulation** Materials used for light-emitting devices, heterostructure, a double heterostructure, quantum-well, different recombination mechanisms, Maxwell's equations, derivation of Poisson's and Laplace's equation, the continuity equation for electrons and holes, current density expressions, simplification of these equations, drift-diffusion approximation, limitations of drift-diffusions, wave equations for TE and TM modes, modeling of the semiconductor laser diode, self-consistent analysis.	**17 L**
Unit 3	**Computational Techniques for device simulation** Finite difference methods, first order and second order derivatives obtained from Taylor's series, comparison with finite element method, solution of poison's equation, solution of the steady-state continuity equation for electrons and holes, discretization of these equations, analysis of simulation results, random number generation and testing, Monte Carlo integration, basic concepts.	**10 L**
Unit 4	**Modeling of diodes and Transistors** P-n junction: contact potential, depletion width and current models, BJT: small signal and large signal models, Eber-Moll's model, JFET: the model of pinch-off voltage and drain current of MOSFET: small signal and large signal models	**07 L**
Unit 5	**Nano-scale Electronics device modeling** Schrödinger's equation, quantum transport, Nanoscale devices: quantum well, quantum wire and quantum dots, transfer matrix formation for multiple quantum wells.	**06 L**

Suggested readings:

4) **System Simulation**, G. Gordon, Prentice Hall
5) **Modeling and Simulation**, R. Leigh, Peter Peregrims Ltd.
6) **Simulation Modelling and Analysis**, M. Law, W. D. Kelton, McGraw Hill.

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C401A.1	Describe the role of important elements of the electronic system, devices and process	**02**
C401A.2	Hypothesize real-world situations related to systems development decisions, originating from source requirements and goals.	**06**
C401A.3	Develop skills to apply simulation software to construct and execute goal-driven system models.	**06**
C401A.4	Expain the model and apply the results to resolve critical issues in a real-world environment.	**02**

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Elective Course

	EL – 401 (B) : Micro-electromechanical Systems and Applications	
	Course Objectives: ➢ Various MEMS fabrication technologies ➢ MEMS-specific design issues and constraints ➢ Dynamics and modeling of microsystems ➢ Applications of microsensors and microactuators ➢ Getting access to fabrication and testing in academia and industry	
Unit 1	**Introduction to Micro-electromechanical systems and MEMS design** What is MEMS? MEMS technology, a brief history of MEMS, MEMS design tools, bulk-micromachining based MEMS design, surface-micromachining based MEMS design.	**10 L**
Unit 2	**Material issues for microsystems** Failure mechanisms of materials used in Microsystems, methods for measuring mechanical properties of materials used in Microsystems structure materials for Microsystems, materials for the microtribological application.	**11 L**
Unit 3	**MEMS processing and fabrication techniques and technology** Silicon-based micromachining, surface micromachining technology: standard surface micromachining technology and multilayer polysilicon, metallization, isolation, monolithic integrated surface micromachining technology, 3D surface machining, other materials, bulk micromachining.	**12 L**
Unit 4	**Micro-electromechanical sensors** Physical sensors, chemical sensors, biological sensors, resonant pressure sensors, resonant accelerometers, resonant gas flow sensors, silicon-based electrostatic field sensors, MEMS-based micro gas sensors**,** micro-hotplate Gas sensor, micro-gas sensor array, nanofiber-based gas sensing materials.	**14 L**
Unit 5	**MEMS Packaging** MEMS packaging fundamentals, contemporary MEMS packaging approaches, bonding processes for MEMS packaging: fusion bonding, anodic bonding, epoxy bonding, eutectic bonding, solder bonding, localized heating and bonding, Vacuum packaging: integrated micromachining, post packaging, hybrid approach**.**	**11 L**
Suggested readings: 1) Microsystems and nanotechnology, Zhaoying Zhou, Zhonglin Wang, Liwei Lin, Springer. 2) MEMS AND Microsystems: Design And Manufacture 1st Edition, Tai-Ran Hsu, Mcgraw Hill Education. 3) Mems and Nems, Lyshevski, CRC press. 4) Advanced Mechatronics and MEMS Devices 1st Edition, Dan Zhang, Springer New York. 5) MEMS, MAHALIK N P, Mcgraw Hill Education.		

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C401B.1	Explain the operation of microdevices, microsystems and their applications	**02**
C401B.2	Design the microdevices, microsystems using the MEMS fabrication process.	**06**
C401B.3	Established the basic approaches for various sensor and actuator design	**03**
C401B.4	Develop experience in micro/nanosystems for photonics.	**06**

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	EL – 402 : CMOS Technology and Applications	
	Course Objectives: ➢ Handle VLSI components ➢ Study characteristics of MOS devices ➢ Draw the MOS layouts of using lambda-based rules ➢ Interface FPGA kit with VHDL program ➢ Design the circuits using VHDL programs on the Xilinx tool. ➢ Handle communication kits	
Unit 1	**Basic Electrical Properties of MOS Transistor** **MOS:** I-V Characteristic of MOS Transistor, Threshold Voltage (Vth), Transconductance (g_m) for MOS, MOS Transistor Figure of Merit (ω_0), MOS Transistor Circuit Model, Inverter Principle, Depletion and Enhancement Load Inverters, **CMOS**: The Basic CMOS Inverter, IV and Transfer Characteristics, Latch-up in CMOS Circuits, Noise Margins, Dynamic Behavior, Power Dissipation, Determination of pull-up to pull-down Ratio for nMOS Inverter Driven by another nMOS Inverter, **BiCMOS:** Inverters.	**15L**
Unit 2	**MOS Circuit Layout Design** **MOS Layers**, **Stick Diagrams:** nMOS Design Style, CMOS Design Style. **Scalable Design Rules**: Lambda Based Design Rules, Contact Cuts, Double Metal MOS Process Rules, CMOS Lambda Based Design Rules. **MOS Device Layout**: Transistor Layout, Inverter Layout, CMOS Digital Circuit Layouts and Simulation.	**10L**
Unit 3	**Sub System Design, Layouts and Process** **Switch Logic**: Pass Transistor and Transmission gate, **Gate Logic**: The Inverter, Nand Gates, Nor Gate, Other forms of CMOS Logic. **Structured Design**: A Parity Generator, Multiplexer, Shifter, Adder, Multiplier.	**12 L**
Unit 4	**Basic Circuit Concepts** Sheet Resistance, Sheet Resistance for MOS Transistor and Inverters, Area Capacitance of Layers, Standard Unit of Capacitance, Area Capacitance Calculation, The Delay Unit, Inverter Delay, Propagation Delay.	**06 L**
Unit 5	**Sequential Circuits** Static Latches, Flip Flops and Registers, Dynamic Latches and Registers, CMOS Schmitt Trigger, Monostable Sequential Circuits, Astable Circuits. Memory Design: RAM Cells.	**07L**
Suggested readings: **1. Basic VLSI Design,** Douglas A. Pucknell and Kamran Eshraghian **2. Essentials of VLSI Circuits and Systems,** K. Eshraghian **3. Digital Integrated Circuits,** Rabey, Pearson Education **4. CMOS Digital IC Circuit Analysis and Design,** Kang and Leblebigi		

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C402.1	Explain the characteristics of MOS devices	**02**
C402.2	Analyze signal flowing through the MOS circuits	**04**
C402.3	Write VHDL programs for given circuits	**06**
C402.4	Construct mask and stick layouts of CMOS devices	**03**
C402.5	Explain basic circuit concepts	**02**

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	EL – 403 : Digital Image Processing and Applications	
	Course Objectives: ➢ Make students understand image fundamentals and how digital images can be processed, ➢ Know Image enhancement techniques and its application, ➢ Know Image compression and its applicability, ➢ Know the fundamentals of computer vision, ➢ Know the geometrical features of images, object recognition and application of real-time image processing.	
Unit 1	**Introduction** Components of an; Image Processing system and Applications, Human Eye and Image Formation Sampling and Quantization, Basic Relationship among pixels neighbor, connectivity, regions, boundaries, distance measures	**10L**
Unit 2	**Image processing operations** Image Enhancement: Spatial Domain-Gray Level transformations, Histogram, Arithmetic/Logical Operations, Spatial filtering, Smoothing and Sharpening Spatial Filters, Frequency domain filtering and smoothening operation.	**13L**
Unit 3	**Image segmentation and Thresholding** Image Segmentation: Discontinuities, Edge Linking and boundary detection, Thresholding, Region-Based Segmentation, Watersheds; Introduction to morphological operations; binary morphology - erosion, dilation, opening and closing operations, applications; basic gray-scale morphology operations; Feature extraction; Classification; Object recognition.	**12 L**
Unit 4	**Image Restoration and compression:** Inverse filtering, Wiener filtering; Wavelets- Discrete and Continuous Wavelet Transform, WaveletTransform in 2-D, Redundancies- Coding, Interpixel, Psycho visual; Fidelity, Source and Channel Encoding, Image Compression Standards- JPEG, JPEG 2000, MPEG; Video compression.	**08 L**
Unit 5	**Color image processing:** Color fundamentals, color models, Pseudocolor image processing, basics of full-color image processing, color transformation, Colorimage filtering: smoothening and sharpening, color segmentation: segmentation in HSI color space, segmentation in RGB color space, color edge detection.	**07L**

Suggested readings:

1. **Digital Image Processing,** R. C. Gonzalez and R. E. Woods, Pearson Education
2. **Digital Image Processing using MATLAB,** R. C. Gonzalez, R. E. Woods and S. L. Eddi Pearson Education
3. **Fundamentals of Digital Image processing,** A. K. Jain, Pearson Education
4. **Digital Image Processing**, Kenneth & Castleman (PHI)
5. **Digital Image Processing & Analysis,** Chanda & Mazumdar (PHI)

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C403.1	Adapt skills to enhancing images.	**06**
C403.2	Describe image processing in spatial and frequency domain.	**02**
C403.3	Correlate the fundamental and state of the art image compression standards.	**04**
C403.4	Produce image segmentation for separating the objects in an image.	**06**
C403.5	Develop the conversion of image for computer vision.	**03**

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	EL – 404: Practical Laboratory IV	
	Course Objectives: ➢ Learn Hardware Descriptive Language (Verilog/VHDL) ➢ Learn the fundamental principles of VLSI circuit design in the digital and analog domain ➢ Perform various operations over digital image ➢ Study different MEM based actuators ➢ Simulate electronics devices	
	Part-A (Using MATLAB) 1. Finite difference discretization and solution of Poisson's equation. 2. Analysis of simple p-n junction diode using the static model. 3. Random number generation and Monte Carlo integration. 4. Simulation of Eber-Moll model for the BJT. 5. Simulation of large signal model for MOSFET. 6. Solution of wave equation for the field intensity distribution. **OR** **Part-A** 1. Study the Principle and working of electromechanical actuators. 2. Study the Principle and working of electromechanical sensors. 3. Study the Principle and working of bimetal actuators. 4. Study the Principle and working of hydraulic actuators. 5. Study the Principle and working of Pneumatic actuators. **Part-B** 1. Sketch layout and study CMOS inverter using tools. 2. Draw transistor schematic for two/three input logic gates and sketch layouts using tools. 3. Draw transistor schematic for parity generator and sketch layout using tools. 4. Draw sticks diagram and layout for different flip flops. 5. Sketch layout and study multiplexer using tools. 6. Sketch layout and study S-RAM using tools. **Part-C (Using MATLAB)** 1. Read an image and perform edge modification operations using MATLAB. 2. Perform erosion, dilation, opening and closing operation over the image. 3. Perform skeletonization operation over fingerprint. 4. Color image filtering using MATLAB 5. Perform histogram operation on images having different contrast levels. 6. Study the basic grey level transformations. 7. Perform image compression using MATLAB.	

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C404.1	Write HDL code for basic as well as the advanced digital integrated circuit	**03**
C404.2	Design, Simulate and Extract the layouts	**06**
C404.3	Use MATLAB tools for device simulation	**06**
C404.4	Modify the digital image using DIP	**06**
C404.5	Integrate the logic modules into FPGA Boards	**06**

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	EL – 405: Special Laboratory (Project + Thesis)	
	Course Objectives: ➢ Advanced Research ➢ Industrial Automation Using embedded system ➢ Industrial Automation using PLC	
	Assessment Scheme **Sr. No. / Criterial / Marks out of: Internal / External** **1** — **Performance of the student in the presentation of the project** — **10** / **10** **2** — **Experimental Work carried out by the student** — **20** / **30** **3** — **Project Report** — **-** / **10** **4** — **Viva-Voce** — **10** / **10** **Total** — **40** / **60**	

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
C405.1	Develop ability for problem-based surveys and their solution, analysis of result and drawing conclusions.	**06**
C405.2	Develop technical skills for any kind of automation platform.	**06**

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M.Sc. Part II Semester IV (Electronics): Audit Courses

	AC-401(A): Human Rights **(Professional and Social + Value Added Audit course; Practical; 2 Credits)** **(Optional: Campus-level)**	
	Course Objectives (CObs): • To make students aware about human rights and human values.	
Unit 1	**Introduction to Human Rights** 1.1 Concept of Human Rights 1.2 Nature and Scope of Human Rights	**6 hrs.**

	1.3 Fundamental Rights and Fundamental Duties 1.4 Interrelation of Rights and Duties	
Unit 2	**Human Rights in India** 2.1 Meaning and Significance of **:** 1) Right to Equality 2) Right to Freedom, 3) Right against Exploitation, 4) Right to Freedom of Religion, 5) Cultural and Educational Rights, and 6) Right to Constitutional Remedies. 2.2 Constitutional Provisions for Human Rights 2.3 Declaration of Human Rights 2.4: National Human Rights Commission	**8 hrs.**
Unit 3	**Human Values** 3.1: Meaning and Definitions of Values 3.2: Importance of values in the life of Individual 3.3: Types of Values 3.4: Programmes for conservation of Values	**8 hrs.**
Unit 4	**Status of Social and Economically Disadvantaged people and their rights** 4.1: Rights of women and children in the context of Social status 4.2: The Minorities and Human Rights 4.3: Status of SC/ST and other Indigenous People in the Indian Scenario 4.4: Human rights of economically disadvantaged Society	**8 hrs.**
Suggested readings: 1. Human rights education – YCMOU, Nasik 2. Value education – SCERT, Pune 3. Human rights reference handbook – Lucille whare		

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
AC401A.1	Practice the learned issues under human rights and human values in real life.	**3**
AC401A.2	Provide social justices to people around them and provide guidance about human rights to their friends, parents and relatives.	**5**

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	AC-401(B): Current Affairs **(Professional and Social + Value Added Audit course; Practical; 2 Credits)** **(Optional: Campus-level)**		
	Course Objectives (CObs): • To make students updated about current affairs of India and world.		
	Title	**Content**	**Hours**
Unit 1	Politics & Economy	• National & International Political Activity, Organization. • Economy & Business, Corporate world	08
Unit 2	Awards and recognitions	• National & International Awards and recognitions • Books and authors	07
Unit 3	Science & Technology	• Software, Automobile, Space Research • New inventions and discoveries	07

Unit 4	Environment & Sports	• Summit & conference, Ecology & Climate, Organization. • National & International Games, Olympics, commonwealth etc.	08

Suggested readings (Use recent years' data and current literature):

1. India 2019, by Publications Division Government of India
2. Manorama Year Book by Philip Mathew,
3. India 2019, Rajiv Maharshi
4. Quick General Knowledge 2018 with Current Affairs Update, Disha Experts
5. General Knowledge 2018: Latest Who's Who & Current Affairs by RPH Editorial Board.

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
AC401B.1	Identify important issues currently/ recently happening in India or world.	**5**
AC401B.2	Summarize current affairs regularly.	**6**

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	AC-401(C) : Electronics for Internet of Things	
	Course Objectives: ➢ To understand the basics of Internet of things and protocols ➢ To study characteristics of IoT based Components ➢ To get an idea of some of the application areas where Internet of Things can be applied ➢ To understand the concepts of Web of Things	
	Practical Hands-on: The students should undertake one topic of the following and must prepare detailed presentation, practical implementation, and report submission. • **IoT** What is the IoT and why is it important? Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security Issues. • **IoT Protocols** Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4–BAC Net Protocol– Modbus – KNX – Zigbee– Network layer – APS Layer – Security • **IoT Architecture** IoT Open source architecture (OIC)- OIC Architecture & Design principles- IoT Devices and deployment models- IoTivity: An Open-source IoT stack - Overview- IoTivity stack architecture- Resource model and Abstraction. • **Web of Things** Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence	

- **IoT Applications**
  IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, IoT-A, Hydra etc.

Grades:

Successful completion of course is dependent upon two forms of assessment:

1. Quizzes/presentations to test student knowledge in **Learning Activity Packet (LAP)** (20 marks)
2. Hands-on assessment given by the instructor. (80 marks)

Sr. No.	Activity	Marks
1	Preparation of experimental setup	20
2	Observations and recording	10
3	Interpretation of result and conclusion	10
4	Answer to sample questions	10
5	Submission of report in time	30
	Total	**80**

a. Combined with your hands-on assessments will be a hands-on final for each section which has a scheduled date. You must take the final on the schedule date or you may be disqualified.
b. These assessments are considered for a final LAP grade.

Suggested readings

Textbook:

1. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press,2012.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
3. David Easley and Jon Kleinberg, "Networks, Crowds, and Markets: Reasoning About a HighlyConnected World", Cambridge University Press, 2010.
4. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.

References:

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)",1st Edition, VPT, 2014
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to ConnectingEverything", 1st Edition, Apress Publications, 2013
3. CunoPfister, Getting Started with the Internet of Things, O "Reilly Media, 2011, ISBN: 978-1- 4493-9357-1

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
AC401C.1	Explain the Architecture and various protocol of IoT	**02**
AC401C.2	Identify and design the new models for strategic market interaction	**01**
AC401C.3	Estabilshed the interface the IoT based system	**03**
AC401C.4	Design business intelligence and information security for Wot.	**06**
AC401C.5	Apply the IoT based system for automation in industry.	**03**

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	AC-401(D) : Mechatronics and Applications	
	Course Objectives: • Mechatronics is the combination of computer science, electronics, and mechanics (engineering) and is applied to most industries through automation enhancements. • Experience practical applications of automation control. • Transform their theoretical knowledge into the practical implementation of the topics which include: ✓ basic electricity and controller devices, ✓ sensors and actuators controlling motion and motors, ✓ using and troubleshooting hydraulics and pneumatics, ✓ Application of measurement techniques, ✓ remote control applications, ✓ mechanical systems ✓ Programmable Logic Controllers (PLC).	
	Practical Outcomes: 1. Identify different types of proximity and position sensors 2. Chose the appropriate sensors for the given applications 3. Use relevant transducer for velocity, motion, acceleration and torque sensors for the specified applications 4. Measure the speed of the given motor using a stroboscope sensor 5. Identify various components of translational mechanical system 6. Identify various components of rational mechanical system 7. Identify various components of the electrical system 8. Troubleshoot pneumatic system of mechatronic system 9. Troubleshoot hydraulic system of mechatronic system 10. Troubleshoot different mechanical actuators of the mechatronic system 11. Identify different types of PLC 12. Use of PLC for running one practical industrial application **Grades:** Successful completion of the course is dependent upon two forms of assessment: 1. Quizzes/presentations to test student knowledge in **Learning Activity Packet (LAP)** (20 marks) 2. The instructor will give a hands-on assessment. (80 marks)	

Sr. No.	Activity	Marks
1	Preparation of experimental setup	20
2	Observations and recording	10
3	Interpretation of result and conclusion	10
4	Answer to sample questions	10
5	Submission of the report in time	30
	Total	**80**

a. Combined with hands-on assessments will be a hands-on final for each section, which has a scheduled date. Students must take the final on the scheduled date, or may be disqualified.
b. These assessments are considered for a final LAP grade.

Course Outcomes (COts):

On completion of this course, the student will be able to:

CO No.	CO	Cognitive level
AC401D.1	Distinguish an understanding of fundamental Mechatronics characteristics, systems, and concepts.	**02**
AC401D.2	Apply basic mathematical, critical reading, electronic, and engineering concepts to design and evaluate Mechatronics systems pertaining to electrical systems (AC/DC, motors, and industrial wiring), mechanical systems (hydraulics, pneumatics, piping, electro-fluid power, and chain drives), and programmable logic controller	**03**
AC401D.3	Work effectively, both individually and interactively, to express hands-on applications in the laboratory.	**02**

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