Bachelor of Technology Automation and Robotics (Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester I (w.e.f. session 2021-22)

S.N.	Course No./ Code	Subject	L:T:P	Hours /Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	BS-135A	Multivariable Calculus and Linear Algebra	3:1:0	4	4	75	25	0	100	3
2	BS-115A	Semiconductor Physics	3:1:0	4	4	75	25	0	100	3
3	ESR-115A	Basic Electrical and Electronics Engineering	3:0:0	3	3	75	25	0	100	3
4	ES-109A	Engineering Graphics & Design	1:2:0	3	3	75	25	0	100	3
5	ES-105A	Programming for Problem Solving	3:0:0	3	3	75	25	0	100	3
6	BS-117LA	Semiconductor Physics Lab	0:0:3	3	1.5	--	20	30	50	3
7	ESR-117LA	Basic Electrical and Electronics Engineering Lab	0:0:2	2	1	--	20	30	50	3
8	ES-113LA	Engineering Graphics & Design Practice	0:0:3	3	1.5	--	20	30	50	3
9	ES-107LA	Programming for Problem Solving	0:0:2	2	1	--	20	30	50	3
		Total	**13:4:10**	**27**	**22**	**375**	**205**	**120**	**700**	

Bachelor of Technology Automation and Robotics (Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester II (w.e.f. session 2021-22)

S.N.	Course No./ Code	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	BS-136A	Calculus and Ordinary Differential Equations	3:1:0	4	4	75	25	0	100	3
2	BS-101A	Chemistry	3:1:0	4	4	75	25	0	100	3
3	ESR-121A	Python Programming	3:0:0	3	3	75	25	0	100	3
4	HM-101 A	English	2:0:0	2	2	75	25	0	100	3
5	BSR-113A	Biology for Engineers	2:0:0	2	2	75	25	0	100	3
6	ESR-119A	Material Science	3:0:0	3	3	75	25	0	100	3
7	BS-103LA	Chemistry Lab	0:0:3	3	1.5	--	20	30	50	3
8	ESR-123LA	Python Programming Lab	0:0:2	2	1	--	20	30	50	3
9	HM-103LA	Language Lab	0:0:2	2	1	--	20	30	50	3
10	ES-111LA	Manufacturing Processes	0:0:3	3	1.5	-	20	30	50	3
		Total	**16:2:10**	**28**	**23**	**450**	**230**	**120**	**800**	

Bachelor of Technology Automation and Robotics (Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester III (w.e.f. session 2022-23)

S.N.	Course No./ Code	Subject	L:T:P	Hours /Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	BS-204A	Higher Engineering Mathematics	3:0:0	3	3	75	25	0	100	3
2	RA -201A	Manufacturing Technology	3:0:0	3	3	75	25	0	100	3
3	RA-203 A	Sensors and Instrumentation	3:0:0	3	3	75	25	0	100	3
4	RA-205 A	Mechanics of Solids	3:0:0	3	3	75	25	0	100	3
5	RA-207 A	Electronic Devices and Circuits	3:0:0	3	3	75	25	0	100	3
6	ES-201A	Engineering Mechanics	3:0:0	3	3	75	25	0	100	3
7	RA-209 LA	Electronic Devices and Circuits Lab	0:0:2	2	1	-	40	60	100	3
8	RA-211 LA	Manufacturing Technology & CNC	0:0:2	2	1	-	40	60	100	3
9	RA-217 LA	Mechanics of Solids Lab	0:0:2	2	1	-	40	60	100	3
		Total	**18:0:6**	**24**	**21**	**450**	**270**	**180**	**900**	
10	*RA-219A	Industrial Training-I	0:0:2	2	-	-	100	-	100	3
11	**MC901 A	Environmental Sciences	3:0:0	3	-	100	-	-	100	3

*** Industrial Training-I** is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 2nd semester and students will be required to get passing marks to qualify.

****MC901A Environmental Sciences:** is a mandatory credit-less course in which the students will be required to get passing marks in the major test.

Bachelor of Technology Automation and Robotics (Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester IV (w.e.f. session 2022-23)

S.N.	Course No./ Code	Subject	L: T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	HTM-901	Universal Human Values - II	3:0:0	3	3	75	25	0	100	3
2	RA-202 A	Automatic Control Systems	3:0:0	3	3	75	25	0	100	3
3	RA-204 A	Computer Aided Design and Analysis	3:0:0	3	3	75	25	0	100	3
4	RA-206 A	Electrical Machines and Power	3:0:0	3	3	75	25	0	100	3
5	RA-208 A	Kinematics and Dynamics of Machines	3:0:0	3	3	75	25	0	100	3
6	RA-210 LA	Computer Aided Design Lab	0:0:2	2	1	-	40	60	100	3
7	RA-212 LA	Electrical Machines and Power Systems Lab	0:0:2	2	1	-	40	60	100	3
8	RA-214 LA	Kinematics and Dynamics of Machines Lab	0:0:2	2	1	-	40	60	100	3
		Total	**15:0:6**	**21**	**18**	**375**	**245**	**180**	**800**	
9	*MC902 A	Constitution of India*	3:0:0	3	-	100	-	-	100	3

MC902 A Constitution of India is a mandatory credit less course in which the student will be required to get passing marks in the major test.

Note: All the students have to undergo 4 to 6 Week Industrial Training after 4th Semester which will be evaluated in 5th Semester.

Bachelor of Technology Automation and Robotics (Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester V (w.e.f. session 2023-24)

S.N.	Course No./ Code	Subject	L: T:P	Hours /Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	RA-301A	Design of Machine Elements and Transmission Systems	3:0:0	3	3	75	25	0	100	3
2	RA-303A	Digital Electronics	3:0:0	3	3	75	25	0	100	3
3	RA-305A	Hydraulics and Pneumatics	3:0:0	3	3	75	25	0	100	3
4	RA-307A	Microcontroller and Embedded System Design	3:0:0	3	3	75	25	0	100	3
5	RAP-#	Program Elective -I	3:0:0	3	3	75	25	0	100	3
6	RA-309 LA	Digital Electronics Lab	0:0:2	2	1	-	40	60	100	3
7	RA-311LA	Microcontroller and Embedded System Design Lab	0:0:2	2	1	-	40	60	100	3
8	RA-313LA	Hydraulic Pneumatics Lab	0:0:2	2	1	-	40	60	100	3
9	RA-315LA	Project-I	0:0:4	4	2	-	00	100	100	3
		Total	**15:0:10**	**25**	**20**	**375**	**245**	**280**	**900**	
10	*RA-317A	Industrial Training-II	0:0:2	2	-	-	100	-	100	3
11	**MC903A	Essence of Indian Traditional Knowledge	3:0:0	3	-	100	-	-	100	3

#Program Elective- I	
Course No.	**Course Name**
RAP-301A	Robot Kinematics and Dynamics
RAP-303A	Electrical Drives Control Systems
RAP-305A	Industrial Design and Applied Ergonomics

***Industrial Training-II is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 4th semester and students will be required to get passing marks to qualify.**
**** Essence of Indian Traditional Knowledge is a mandatory credit-less course in which the students will be required to get passing marks in the major test.**
The course of Program Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

Bachelor of Technology Automation and Robotics (Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester VI (w.e.f. session 2023-24)

S.N.	Course No./ Code	Subject	L: T:P	Hours /Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	RA-302 A	PLC & Industrial Automation	3:0:0	3	3	75	25	0	100	3
2	RA-304 A	Principles of Robotics	3:0:0	3	3	75	25	0	100	3
3	RA-306 A	Digital Image Processing & Vision System	3:0:0	3	3	75	25	0	100	3
4	HM-302A	Research Methodology & IPR	3:0:0	3	3	75	25	0	100	3
5	RAP-*	Program Elective -II	3:0:0	3	3	75	25	0	100	3
6	RA-308LA	Robotic Simulation Lab	0:0:2	2	1	-	40	60	100	3
7	RA-310LA	PLC SCADA and HMI Lab	0:0:2	2	1	-	40	60	100	3
8	RA-312LA	Project -II	0:0:6	6	3	-	-	100	100	3
		Total	**15:0:10**	**25**	**20**	**375**	**205**	**220**	**800**	

***Program Elective- II**	
Course No.	**Course Name**
RAP-302A	Neural Network and Fuzzy System
RAP-304A	Sensors Technology
RAP-306A	Industrial Robotics and Material Handling Systems

Note: All the students have to undergo 4 to 6 weeks Industrial Training after 6th semester which will be evaluated in 7th semester.

**** Value Education is a mandatory credit-less course in which the students will be required to get passing marks in the major test.**

The course of Program Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

Bachelor of Technology Automation and Robotics (Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester VII (w.e.f. session 2024-25)

S.N.	Course No./ Code	Subject	L:T:P	Hours /Week	Credits	Examination Schedule (Marks)				Duration of exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	RA-401A	CNC Machine and Metrology	3:0:0	3	3	75	25	0	100	3
2	RA-403A	Automation System Design	3:0:0	3	3	75	25	0	100	3
3	RAO-*	Open Elective- I	3:0:0	3	3	75	25	0	100	3
4	RAP#	Program Elective- III	3:0:0	3	3	75	25	0	100	3
5	RAP##	Program Elective- IV	3:0:0	3	3	75	25	0	100	3
6	RA-405 LA	Advanced Robotics Lab	0:0:2	2	1	-	40	60	100	3
7	RA-407 LA	Automation System Design Lab	0:0:2	2	1	-	40	60	100	3
8	RA-409 LA	Project-III	0:0:6	6	3	-	100	100	200	3
		Total	**15:0:10**	**25**	**20**	**375**	**305**	**220**	**900**	
9	**RA-411 LA	**Industrial Training -III	0:0:2	2	-	-	100	-	100	3

* **Open Elective -I**	
Course No.	**Course Name**
RAO-401A	Fundamentals of IoT and its Applications
RAO-403A	Industry 4.0
RAO-405A	Industrial Safety and Standards

	# **Program Elective -III**
Course No.	**Course Name**
RAP-401A	Industrial Robot Applications
RAP-403A	Mobile Robotics
RAP-405A	Modelling & Simulation

** Industrial Training-III is a mandatory non-credit course in which the students will be evaluated for the industrial training undergone after 6th semester and students will be required to get passing marks to qualify

The course of Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

	## **Program Elective -IV**
Course No.	**Course Name**
RAP-407A	Machine Learning for Robotics
RAP-409A	Robotic Programming
RAP-411A	Artificial Intelligence & Expert System in Automation

Bachelor of Technology Automation and Robotics (Credit Based)
KURUKSHETRA UNIVERSITY, KURUKSHETRA
Scheme of Studies/Examination
Semester VIII (w.e.f. session 2024-25)

S.N.	Course No./ Code	Subject	L: T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hours)
						Major Test	Minor Test	Practical	Total	
1	RA-402 LA	Project-IV	0:0:8	8	4	-	100	100	200	3
2	RAO-*	Open Elective-II	3:0:0	3	3	75	25	0	100	3
3	RAO-**	Open Elective-III	3:0:0	3	3	75	25	0	100	3
4	RAP-#	Program Elective-V	3:0:0	3	3	75	25	0	100	3
5	RAP-##	Program Elective-VI	3:0:0	3	3	75	25	0	100	3
		Total	**12:0: 8**	**20**	**16**	**300**	**200**	**100**	**600**	

#Program Elective- V		**##Program Elective- VI**	
Course No.	**Course Name**	**Course No.**	**Course Name**
RAP-402 A	Artificial Intelligence for Robotics	RAP-408 A	Object Oriented Programming and Data Structures
RAP-404 A	Modern Robotics	RAP-410 A	Totally Integrated Automation
RAP-406 A	Maintenance and Safety Engineering	RAP-412 A	Flexible Manufacturing Systems

***Open Elective- II**		****Open Elective-III**	
Course No.	**Course Name**	**Course No.**	**Course Name**
RAO-402A	Total Quality Management	RAO-408A	Entrepreneurship
RAO-404A	Quality and Reliability Engineering	RAO-410A	Computer Integrated Manufacturing Systems
RAO-406A	Field and Service Robotics	RAO-412A	Industrial Drives for Automation

The course of Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.

	Credits
Basic Sciences	24
Open Elective	9
Program Elective	18
HUM	9
Engineering Sciences	24
Project	13
Engg. Core	63
Total	160

Semester-1

BS-135A	Multivariable Calculus and Linear Algebra						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 Hr
Purpose	To familiarize the prospective engineers with techniques in calculus, sequence & series, multivariable calculus, and linear algebra.						
Course Outcomes							
CO1	To introduce the idea of applying differential and integral calculus to notions of improper integrals. Apart from some applications it gives a basic introduction on Beta and Gamma functions.						
CO 2	To introduce the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.						
CO 3	To develop the tool of power series and Fourier series for learning advanced Engineering Mathematics.						
CO 4	To familiarize the student with functions of several variables that is essential in most branches of engineering.						
CO 5	To develop the essential tool of matrices and linear algebra in a comprehensive manner.						

UNIT-I **(**12 hrs)

Calculus: Evaluation of definite and improper integrals: Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions. Rolle's Theorem, Mean value theorems, Indeterminate forms and L'Hospital's rule.

UNIT-II **(**12 hrs)

Sequence and Series: Convergence of sequence and series, tests for convergence (Comparison test, D'Alembert's Ratio test, Logarithmic test, Cauchy root test, Raabe's test); Power series.

Fourier series: Introduction, Fourier-Euler Formula, Dirichlet's conditions, Change of intervals, Fourier series for even and odd functions, Half range sine and cosine series.

UNIT-III (09 hrs)

Multivariable Calculus (differentiation): Taylor's series (for one and more variables), series for exponential, trigonometric and logarithm functions.

Partial derivatives, Total differential, Chain rule for differentiation, Homogeneous functions, Euler's theorem, Jacobian, Maxima, minima and saddle points; Method of Lagrange multipliers.

UNIT-IV (07 hrs)

Matrices: Rank of a matrix, elementary transformations, elementary matrices, Gauss Jordon method to find inverse using elementary transformations, normal form of a matrix, linear dependence and independence of vectors, consistency of linear system of equations, linear and orthogonal transformations, eigenvalues and eigenvectors, properties of eigenvalues, Cayley – Hamilton theorem and its applications.

Suggested Books:

1.ErwinKreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. Erwin Kreyszig and Sanjeev Ahuja, Applied Mathematics- I, Wiley India Publication, Reprint 2015.
3. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
4. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
6. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
7. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
8. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

BS-115A	Semiconductor Physics						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3H

Purpose	To introduce the fundamentals of solid-state physics and its applications to the students.
Course Outcomes	
CO1	To make the students aware of basic terminology of crystal structure.
CO 2	Introduce the elementary quantum mechanics, which will be useful in understanding the concepts of solid-state physics.
CO 3	Discussion of classical free electron theory, quantum theory and Band theory of solids.
CO 4	Basics and applications of semiconductors.

Unit - I

Crystal Structure: Crystalline and Amorphous solids, Crystal Structure: lattice translation vector, symmetry operations, space lattice, basis; Unit cell and Primitive cell, Fundamental types of lattices: two-dimensional and three dimensional Bravais lattices; Characteristics of Unit cells: Simple Cubic (SC), Body Centred Cubic (BCC), Face Centred Cubic (FCC), Hexagonal Close Packed (HCP) structure; Simple crystal structures: Sodium Chloride, Cesium Chloride, Diamond, Cubic Zinc Sulfide; Miller Indices, Bonding in Solids, Point defects in crystals: Schottky and Frenkel defects.

Unit – II

Quantum Theory: Need and origin of Quantum concept, Wave-particle duality, Phase velocity and group velocity, Uncertainty Principle and Applications; Schrodinger's wave equation: time-dependent and time –independent; Physical Significance of wave function ψ.

Unit – III

Free Electron Theory: Classical free electron theory: electrical conductivity in metals, thermal conductivity in metals, Wiedemann-Franz law, success and drawbacks of free electron theory; Quantum free electron theory: wave function, eigen values; Fermi-Dirac distribution function, Density of states, Fermi energy and its importance, Thermionic Emission (qualitative).

Band theory of Solids: Bloch theorem, Kronig-Penney Model (qualitative), E versus k diagram, Brillouin Zones, Concept of effective mass of electron, Energy levels and energy bands, Distinction between metals, insulators and semiconductors, Hall effect and its Applications.

Unit –IV

Semiconductors: Conduction in Semiconductors, Intrinsic Semiconductors: Conductivity of charge carriers, Carrier concentration in intrinsic semiconductors; Extrinsic Semiconductors: n-type semiconductors, p-type semiconductors, charge carrier concentration in extrinsic semiconductors.

Semiconductor Devices: The p-n junction, Current-voltage characteristics of p-n junction; The Transistor: Bipolar Junction Transistor (BJT), Field Effect Transistor (FET), Metal-Semiconductor Junction (Ohmic and Schottky); Semiconductor Laser.

Suggested Books:

1. Applied Physics for Engineers, Wiley India Pvt. Ltd.
2. Introduction to Solid State Physics, John Wiley & Sons. .
3. Concepts of Modern Physics (5th edition), Tata McGraw-Hill Publishing Company Limited.
4. Solid State Physics, New Age International (P) Limited.
5. A Textbook of Quantum Mechanics, McGraw Hill Education (India) Private Limited.
   Introduction to Nanotechnology, John Wiley & Sons.

Note: The paper setter will set the paper as per the question paper templates provided.

BS-117LA	Semiconductor Physics Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3H
Purpose	To give the practical knowledge of handling the sophisticated instruments.						
Course Outcomes							
CO	To make the students familiar with the experiments related with Semiconductor Physics.						

Note: Student will be required to perform at least 10 experiments out of the following list.

1. To study the V-I characteristics of a p-n diode.
2. To find the flashing and quenching potential of Argon and to find the capacitance of unknown capacitor.
3. To find the value of Planck's constant by using photoelectric cell.
4. To find the temperature coefficient of resistance by using Pt resistance thermometer by post office box.
5. To find the ionization potential of Argon/Mercury using a thyratron tube.
6. To study the variation of magnetic field with distance and to find the radius of coil by Stewart and Gee's apparatus.
7. To study the characteristics of (Cu-Fe, Cu-Constantan) thermocouple.
8. To find the value of Hall Coefficient of semiconductor.
9. To find the value of e/m for electrons by Helical method.
10. To find the band gap of intrinsic semiconductor using four probe method.
11. To calculate the hysteresis loss by tracing a B-H curve.
12. To find the frequency of ultrasonic waves by piezoelectric methods.
13. To verify Richerdson thermionic equation.

Suggested Books:

C. L. Arora, B. Sc. Practical Physics, S. Chand. B.L. Worshnop and H, T, Flint, Advanced Practical Physics, KPH. S.L. Gupta & V. Kumar, Practical Physics, Pragati Prakashan.

ESR-115A	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING						
L	T	P	Credit	Major Test	Minor Test	Total	Time (Hrs)
3	0	-	3	75	25	100	3
Purpose	1. Understand Electrical & Electronics Engineering Fundamentals. 2. Acquire specific knowledge and skills so as to comprehend how electric, magnetic and electronic circuits are applied in practice.						
Course Outcomes							
CO 1	Describe the performance of an electric circuit as well as solving both single phase and three-phase AC circuits in sinusoidal steady state.						
CO 2	Predict about electrical safety and implementation of electric wiring.						
CO 3	Illustrate various rotating electric machines, with application of motors in particular, transducers and electric batteries						
CO 4	Identify and explain various types of operational amplifier.						

Unit-I

(DC & AC Circuits): Introduction to DC and AC circuits, Active and passive two terminal elements, Ohms law, Voltage-Current relations for resistor, inductor, capacitor, Kirchhoff's laws, Ideal sources – equivalent resistor, current division, voltage division, Sinusoids, Generation of AC, Average and RMS values, Form and peak factors, Analysis of R-L, R-C and R-L-C series circuits.

(Magnetic Circuits and Transformers): Magnetic effects of electric current, Law of Electromagnetic Induction, Self-Inductance, Mutual Inductance, Single Phase Transformer: Construction, Working principle, Efficiency.

Unit-II

(Electrical Safety and Wiring): Safety measures in electrical system, types of wiring, Difference between grounding and earthing, Basic principles of earthing, components of earthing system.

(Single Phase Transformer) (qualitative analysis only): Concept of magnetic circuits. Relation between MMF & Reluctance. Hysteresis & Eddy current phenomenon. Principle, construction & emf equation Phasor diagram at ideal, no load and on load conditions. Losses & Efficiency, regulation. OC & SC test, equivalent circuit, concept of auto transformer.

Unit-III

(Rotating Electrical Machines): Operating characteristics of DC motor, working principle, construction and applications of Induction motor, Brushed DC motor, Geared DC motor, Brushless DC motors, Servo Motors, Stepper motors, Linear DC motor.

(Transducers): Principle of sensing, Basic requirements of transducers, classification of transducers, passive transducers: capacitive, inductive, LVDT, potentiometric, strain gauge, thermistor, Hall-Effect, Active transducers: piezoelectric, photoelectric and thermocouple, Tri-axial Sensors: Gyroscopes, Accelerometers, Magnetometers.

Unit-IV

(Batteries): Selecting Battery: Basic Battery Specifications, common parameters of battery/applications, Different types of Batteries used in different applications, Power Supplies: Linear and SMPS.

(Operational Amplifiers): Op-amp and its characteristics: Input Impedance, Output Impedance, Gain, Bandwidth, Open loop & closed loop configurations. Basic op-amp circuits: Inverting & Non-inverting voltage amplifiers, Comparator, adder, subtractor, integrator, differentiator.

Text Books:

T1: Basic Electrical Engineering by D. P. Kothari and I. J. Nagrath, 2nd Edition, McGraw-Hill Education (India) Pvt Limited.

T2: Basic Electrical and Electronics Engineering by S. K. Bhattacharya, 2nd Edition, Pearson.

T3: Electronic Devices and Circuit Theory by R. L. Boylestad and L. Nashelsky, 11th Edition, Pearson.

T4: Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad, 4th Edition, PHI.

T5: A course in Electrical & Electronics Measurement & Instrumentation by A. K. Sawhney, 4th Edition, Dhanpat Rai and Co.

T6: Battery Reference Book by Newnes, 3rd Edition, Thomas Crompton. Download Here

Reference Books:

R1: Electric Circuits by Charles K. Alexander & Matthew N. O. Sadiku, 4th Edition, McGraw-Hill Publication.

R2: Electrical Engineering Fundamentals by Vincent Del Toro, 2nd Edition, PHI.

R3: Electronic Principles by Albert Paul Malvino, 6th Edition, Tata McGraw Hill.

R4: Digital Design by M. Mano, 3rd Edition, Pearson.

R5: Electric Machines by Ashfaq Hussain, 3rd Edition, Dhanpat Rai and Co.

Note: The paper setter will set the paper as per the question paper templates provided.

ESR-117LA	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB						
L	**T**	**Practical**	**Credit**	**Minor Test**	**(Practical)**	**Total**	**Time (Hrs)**
-	**-**	**2**	**1**	**20**	**30**	**50**	**3**

Purpose	1. To understand and verify kirchhoff's laws. 2. To design led based circuit using arduino and analyze the result. 3. To Interface inverting and non-inverting operational amplifier and determine the gain of both amplifiers.
Course Outcomes	
CO 1	Students will be able to understand and verify kirchhoff's laws.
CO 2	Students will be able to establish relationship between voltage and current in series R-L circuit.
CO 3	Students will be able to demonstrate the working of LVDT.
CO 4	Students will be able to design LED based circuit using arduino and analyze the results.

LIST OF EXPERIMENTS

1. To verify kirchhoff's current law.
2. To verify kirchhoff's voltage law.
3. To study voltage-current relationship in an R-L series circuit and to determine the power factor of the circuit.
4.To verify and demonstrate the working of LVDT.
5. To design a LED flasher.
6. To design Christmas dual led chaser lights.
7. To design a door bell using push button.
8. To design automatic street light using LDR.
9.. To measure gain of inverting operational amplifier.
10. To measure gain of non- inverting operational amplifier.

Note: At least 9 out of the listed experiments to be performed during the semester.

Course code	ES-109A							
Course title	Engineering Graphics & Design							
Scheme and Credits	L	T	P	Credits	Major Test	Minor Test	Total	Time
	1	0	2	3	75	25	100	3Hr

Course Outcomes

Objective- To expose students to the basics of Engineering Drawing, graphics and Projections.	
CO-1	To learn about construction of various types of curves and scales.
CO-2	To learn about orthographic projections of points, lines and planes.
CO-3	To Learn about the sectional views and development of Right regular solids
CO-4	To Learn about the construction of Isometric Projections and conversion of Isometric views to Orthographic views and vice-versa.

UNIT - I

Introduction to Engineering Drawing:

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

UNIT - II

Orthographic Projections:

Principles of Orthographic Projections-Conventions-Projections of Points and lines inclined to both planes; Projections of planes inclined to one principal Plane.

Projections of Regular Solids:

Solid with axis inclined to both the Planes;

UNIT - III

Sections and Sectional Views of Right Regular Solids:

Sectional views of simple right regular solids like prism, pyramid, Cylinder and Cone. Development of surfaces of Right Regular Solids-Prism, Pyramid, Cylinder and Cone;

UNIT - IV

Isometric Projections:

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;

Suggested Books:

1. Engineering Graphics using AUTOCAD 2000: T. Jeyapoovan, Vikas Publishing House.
2. Engineering Drawing: Plane and Solid Geometry: N.D. Bhatt and V. M. Panchal, Charotar Publishing House.
3. Engineering Drawing: Amar Pathak, Dreamtech Press, New Delhi.
4. Thomas E. French, Charles J. Vierck, Robert J. Foster, “Engineering drawing and graphic technology”, McGraw Hill International Editions.
5. Engineering Graphics and Drafting: P.S. Gill, Millennium Edition, S.K. Kataria and Sons.
6. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
7. A. Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
8. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann, 1999.
9. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
10. Corresponding’s to CAD Software Theory and User Manuals.

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ES-113LA							
Course title	Engineering Graphics & Design Practice							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	-	-	3	1.5	30	20	50	3Hr
Pre-requisites (if any)	-							

Aim: To make student practice on engineering graphics and design softwares and provide exposure to the visual aspects of engineering design.	
CO-1	To give an overview of the user interface and toolboxes in a CAD software.
CO-2	To understand to customize settings of CAD software and produce CAD drawing.
CO-3	To practice performing various functions in CAD softwares.
CO-4	To Learn about solid modelling and demonstration of a simple team design project.

Module 1: Overview of Computer Graphics:
Listing the computer technologies that impact on graphical communication, Demonstrating Knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus(Button Bars),The Command Line(where applicable),The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

Module2: Customization & CAD Drawing:
Setup of the drawing page and the printer ,including scale settings, Setting up of units and drawing limits ;ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

Module3: Annotations, layering & other functions:
Applying dimensions to objects ,applying annotations to drawings ;Setting up and use of Layers ,layers to create drawings ,Create ,edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen);Printing documents to paper using the print command ;orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation ,Computer-aided design(CAD) software modeling of parts and assemblies .Parametric and non-parametric solid, surface, and wire frame models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises .Dimensioning guidelines , tolerancing techniques; dimensioning and scale multi views of dwelling;

Module4: Demonstration of a simple team design project:
Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blue print form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows ,doors ,and fixtures such as WC, bath ,sink ,shower ,etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modeling (BIM).

Suggested Books(ES-113L):

1. Chris McMahon and Jimmie Browne, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. Chougule N.K.; CAD/CAM /CAE, Scitech Publications India Pvt. Ltd.
3. Vikram Sharma; Computer Aided Design and Manufacturing, S.K. Kataria and Sons.
4. Rogers, D.F. and Adams, A., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
5. Ibrahim Zeid, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
6. M.P. Groover, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall.
7. A Primer on Computer aided Engineering Drawing-2006, published by VTU, Belgaum.
8. A.Yarwood, Introduction to AutoCAD 2017, Published by CRC Press.
9. O. Ostrowsky, Engineering Drawing with CAD applications, Butterworth Heinemann,1999.
10. BSI, Technical production documentation (TPD) – specification for defining, specifying and graphically reporting products, BS8888, 2002.
11. (Corresponding set of)CAD Software Theory and User Manuals
12. Ibrahim Zeid, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
13. P. Radhakrishnan, S. Subramanayan and V.Raju, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
14. Groover M.P. and Zimmers E. W., CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
15. Dr. Sadhu Singh, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
16. Thomas E.French, Charles J.Vierck, Robert J.Foster, “Engineering drawing and graphic technology”, McGraw Hill International Editions.

Note: The paper setter will set the paper as per the question paper templates provided.

ES-105A	Programming for Problem Solving						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3Hr
Purpose	To familiarize the students with the basics of Computer System and C Programming						
Course Outcomes							
CO 1	Describe the overview of Computer System and Levels of Programming Languages.						
CO 2	Learn to translate the algorithms to programs (in C language).						
CO 3	Learn description and applications of conditional branching, iteration and recursion.						
CO 4	To use arrays, pointers and structures to formulate algorithms and programs.						

UNIT – I

Overview of Computers: Block diagram and its description, Number systems, Arithmetic of number systems, Computer Hardware: Printers, Keyboard and Mouse, Storage Devices.

Introduction to programming language: Different levels of PL: High Level language, Assembly language, Machine language; Introduction to Compiler, Interpreter, Debugger, Linker, Loader, Assembler.

Problem Analysis: Problem solving techniques, Algorithms and Flowchart representation.

UNIT – II

Overview of C: Elements of C, Data types; Storage classes in C; Operators: Arithmetic, relational, logical, bitwise, unary, assignment and conditional operators, precedence & associativity of operators.

Input/output: Unformatted & formatted I/O function in C.

Control statements: if statement, switch statement; Repetition: for, while, and do-while loop; break, continue, goto statements.

UNIT – III

Arrays: Definition, types, initialization, processing an array, String handling.

Functions: Definition, prototype, parameters passing techniques, recursion, built-in functions, passing arrays to functions, returning arrays from functions.

UNIT – IV

Pointers: Declaration, operations on pointers, pointers and arrays, dynamic memory allocation, pointers and functions, pointers and strings.

Structure & Union: Definition, processing, passing structures to functions, use of union.

Data files: Opening and closing a file, I/O operations on files.

Suggested Books:

1. Brian W. Kernighan Dennis Ritchie, “C Programming Language” Pearson Education India.
2. Subrata Saha, Subhodip Mukherjee: Basic Computation & Programming with ‘C’-Cambridge University Press.
3. Ajay Mittal, “Programming in C - A Practical Approach”, Pearson.
4. E Balagurusamy :Programming in ANSI C,TMH Education.
5. Pradip Dey and ManasGhose, “Computer Fundamental and Programming in C”, Oxford Pub.
6. Forouzan Behrouz, “Computer Science: A Structured Programming Approach Using C”, Cengage Learning.
7. Ashok Kamthane, “Programming in C, 3e”, Pearson Education India..
8. Yashwant Kanetker, “Let us C”, BPB Publications.
9. A K Sharma, “ Fundamentals of Computers & Programming” Dhanpat Rai Publications
10. Rajaraman V., “Computer Basic and C Programming”, Prentice Hall of India Learning.

Note: The paper setter will set the paper as per the question paper templates provided.

ES-107LA	Programming for Problem Solving Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3Hr
Purpose	To Introduce students with problem solving using C Programming language						
Course Outcomes							
CO 1	To formulate the algorithms for simple problems						
CO 2	Implementation of arrays and functions.						
CO 3	Implementation of pointers and user defined data types.						
CO 4	Write individual and group reports: present objectives, describe test procedures and results.						

LIST OF PROGRAMS

1. Write a program to find the sum of individual digits of a positive integer.
2. Write a program to generate the first n terms of the Fibonacci sequence.
3. Write a program to generate all the prime numbers between 1 and n, where n is the input value given by the user.
4. Write a program to find the roots of a quadratic equation.
5. Write a function to generate Pascal's triangle.
6. Write a program for addition of Two Matrices
7. Write a program for calculating transpose of a matrix.
8. Write a program for Matrix multiplication by checking compatibility
9. Write programs to find the factorial of a given integer by using both recursive and non-recursive functions.
10. Write a function that uses functions to perform the count the lines, words and characters in a given text.
11. Write a program to explores the use of structures, union and other user defined variables
12. Write a program to print the element of array using pointers
13. Write a program to implement call by reference
14. Write a program to print the elements of a structure using pointers
15. Write a program to read a string and write it in reverse order
16. Write a program to concatenate two strings
17. Write a program to check that the input string is a palindrome or not.
18. Write a program which copies one file to another.
19. Write a program to reverse the first n characters in a file.

Note: At least 10 programs are to be performed & executed from the above list.

Semester-2

BS-136A	Calculus and Ordinary Differential Equations						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 Hr
Purpose	To familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables.						
Course Outcomes							
CO1	To introduce effective mathematical tools for the solutions of differential equations that model physical processes.						
CO 2	To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.						
CO 3	To introduce the tools of differentiation and integration of functions of complex variable that are used in various techniques dealing engineering problems.						

UNIT-I (10 hrs)

First order ordinary differential equations: Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Ordinary differential equations of higher orders: Second order linear differential equations with constant coefficients, method of variation of parameters, Cauchy and Legendre's linear differential equations.

UNIT-II **(**10 hrs)

Multivariable Calculus (Integration): Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar)

Applications: areas and volumes; Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds.

UNIT-III (10hrs)

Vector Calculus: Introduction, Scalar and Vector point functions, Gradient, divergence & Curl and their properties, Directional derivative.

Line integrals, surface integrals, volume integrals, Theorems of Green, Gauss and Stokes (without proof).

UNIT-IV (10 hrs)

Complex Variable – Differentiation: Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties;

Complex Variable – Integration: Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof).

Suggested Books:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Erwin kreyszig and Sanjeev Ahuja, Applied Mathematics- II, Wiley India Publication, 2015.
4. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India, 2009.
5. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
6. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
7. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
8. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Ed., Mc-Graw Hill,2004.
9. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
10. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Note: The paper setter will set the paper as per the question paper templates provided.

BS-101A	Chemistry						
L	T	P	Credit	Major Test	Minor Test	Total	Time
3	1	-	4	75	25	100	3 Hr
Purpose	To familiarize the students with basic and applied concept in chemistry						
CO1	An insight into the atomic and molecular structure						
CO2	Analytical techniques used in identification of molecules						
CO3	To understand Periodic properties						
CO4	To understand the spatial arrangement of molecules						

UNIT - I

Atomic and molecular structure

Molecular orbitals of diatomic molecules (N_2, O_2, CO) Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and energy level diagrams of $[Co(NH_3)_6]$, $[Ni(CO)_4]$, $[PtCl_2(NH_3)_2]$ and magnetic properties of metal complexes. Band structure of solids and the role of doping on band structures.

UNIT - II

Spectroscopic techniques and applications

Principles of spectroscopy and selection rules. Electronic spectroscopy (basic concept). Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Basic concepts of Nuclear magnetic resonance and magnetic resonance imaging, Diffraction and scattering.

UNIT - III

Use of free energy in chemical equilibria

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications.

Periodic properties

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries (H_2O, NH_3, PCl_5, SF_6, CCl4, $Pt(NH_3)_2Cl_2$

UNIT - IV

Stereochemistry

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations and symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis.

Organic reactions and synthesis of a drug molecule

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule (paracetamol and Aspirin)

Suggested Books:

1) University chemistry, by B. M. Mahan, Pearson Education
2) Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
3) Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4) Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S.Krishnan
5) Physical Chemistry, by P. W. Atkins
6)Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore,5th Edition http://bcs.whfreeman.com/vollhardtschore5e/default.asp

Note: The paper setter will set the paper as per the question paper templates provided.

BS-103LA	Chemistry Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	3	1.5	30	20	50	3Hr

Aim: To impart scientific approach and to familiarize with the experiments in chemistry relevant for research projects in higher semesters	
CO-1	Understand and practice different techniques of quantitative chemical analysis to generate experimental skills and apply these skills to various analyses
CO-2	Learn to design and carry out scientific experiments as well as accurately record and analyze the results of such experiments
CO-3	Develop the ability to understand and explain the use of modern spectroscopic techniques for analysing and interpreting the IR spectra and NMR spectra of some organic compounds
CO-4	Understand and practice different techniques of quantitative chemical analysis to generate experimental skills and apply these skills to various analyses

LIST OF EXPERIMENTS

1. To Determine the surface tension of a given liquid
2. To determine the relative viscosity of a given liquid using Ostwald's viscometer
3. To identify the number of components, present in a given organic mixture by thin layer chromatography
4. To determine the alkalinity of a given water sample
5. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using conductometer
6. Synthesis of a drug (paracetamol/Aspirin)
7. Determination of chloride content of a given water sample
8. To determine the calcium & magnesium or temporary & permanent hardness of a given water sample by EDTA method
9. To determine the total iron content present in a given iron ore solution by redox titration
10. Determination of the partition coefficient of a substance between two immiscible liquids
11. To find out the content of sodium, potassium in a given salt solution by Flame Photometer
12. To find out the λmax and concentration of unknown solution by a spectrophotometer
13. To find out the flash point and fire point of the given oil sample by Pensky Martin apparatus
14. To determine the amount of dissolved oxygen present in a given water sample
15. To find out the pour point and cloud point of a lubricating oil
16. Determination of the strength of a given HCl solution by titrating it with standard NaOH solution using pH meter
17. Using Redwood Viscometer find out the viscosity of an oil sample

Note: At least 9 experiments to be performed from the list.

ESR-121A	Python Programming						
L	**T**	**P**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3HR**
Purpose	**Learn Python, Design and program Python applications**						
CO1	**Configure the python, pip and jupyter notebook to solve machine learning problems.**						
CO2	**Find solution of various problems through python programs like data structure of python.**						
CO3	**Illustrate of data storage in secondary memory through programming approach like flat file, RDBMS and NoSQL.**						
CO4	**Implementation of hypothesis testing and classes of scikit-learn using proper dataset.** **Develop an application using concept of supervised and unsupervised learning.**						

UNIT - I

Introduction to Python: Software, Development Tools, Learning Programing with Python, Writing a Python Program, The Python Interactive Shell, Values and Variables, Expression and Arithmetic's.

Python Flow Controls: Conditional Executions: Boolean Expressions, if Statement, if-else statement, Compound Boolean Expression, pass statement, Nested Conditionals, Iterators: The While Statement, Definite Loops vs Indefinite Loops, The for Statement, Nest Loops, Abnormal Loop Termination, While/else and for/else

UNIT – II

Python Collections: Lists: Using Lists, List Traversal, List Membership, List Assignments and Equivalence, List Bounds, Slicing, List Element Removal, List Methods, Tuples, Dictionaries and Sets, Handling Exceptions

UNIT - III

Functions, Classes and Objects: Functions: Writing Functions That Accept Any Number of Arguments, Writing Functions That Only Accept Keyword Arguments, Attaching Informational Metadata to Function Arguments, Returning Multiple Values from a Function, Defining Functions with Default Arguments, Defining Anonymous or Inline Functions, Capturing Variables in Anonymous Functions, Making an N-Argument Callable Work as a Callable with Fewer

UNIT – IV

Files and I/O: Reading and Writing Text Data, Printing to a File, Printing with a Different Separator or Line Ending, Reading and Writing Binary Data, Writing to a File That Doesn't Already Exist, Performing I/O Operations on a String, Reading and Writing Compressed Datafiles, Iterating Over Fixed-Sized Records, Reading Binary Data into a Mutable Buffer, Memory Mapping Binary Files, Manipulating Pathnames, Testing for the Existence of a File, Getting a Directory Listing, Bypassing Filename Encoding, Printing Bad Filenames, Adding or Changing the Encoding of an Already Open File, Writing Bytes to a Text File, Wrapping an Existing File Descriptor As a File Object, Making Temporary Files and Directories, Communicating with Serial Ports, Serializing Python Objects, Reading and Writing CSV Data, Reading and Writing JSON Data, Parsing Simple XML Data

Suggested Books:

Text Books:
1. Fundamentals of Python Programming by Richard L. Halterman
2. Python Cookbook by David Beazley and Brian K. Jones

Reference Books:
1. Guido Van Rossum, Fred. L. Drake 'Introduction to Python' – Network Theory Limited – March 2011
2. Alex Martelli 'Python in a Nutshell' - O'Reilly - 2nd Edition, 2006

E-Resources: -

1. Python Programming Tutorials: https://www.tutorialspoint.com/python/index.htm
2. Video tutorials of Signal & Signal: https://nptel.ac.in/courses/106/106/106106145/

Note: The paper setter will set the paper as per the question paper templates provided.

Course code	ESR-123 LA							
Course title	Python Programming Lab							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	-	-	2	1	30	20	50	3Hr
Pre-requisites(if any)	-							

Aim: To make student will be developing adequate skills in programming and will be known to understand the implementation of various applications using python	
CO-1	Write, Test and Debug Python Programs
CO-2	Implement Conditionals and Loops for Python Programs
CO-3	Use functions and represent Compound data using Lists, Tuples and Dictionaries
CO-4	Read and write data from & to files in Python and develop Application using Pygame

LIST of EXPERIMENTS

Write and run a Python program that outputs the value of each of the following expressions:

5.0/9.0
5.0/9
5/9.0
5/9
9.0/5.0
9.0/5
9/5.0
9/5

Based on your results, what is the rule for arithmetic operators when integers and floating point numbers are used?

- Write and run a Python program that asks the user for a temperature in Celsius and converts and outputs the temperature in Fahrenheit. (Use the formula given in the example above and solve for temp Fin terms of temp C.)
- Here is an algorithm to print out n! (n factorial) from 0! to 19!:

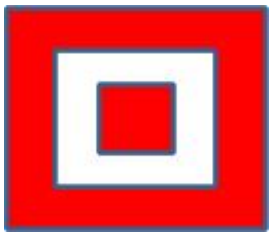
1. Set f = 1
2. Set n = 0
3. Repeat the following 20 times:

a. Output n, "! = ", f
b. Add 1 to n
c. Multiply f by n

Using a for loop, write and run a Python program for this algorithm.

- Modify the program above using a while loop so it prints out all of the factorial values that are less than 1 billion.
- Modify the first program so it finds the minimum in the array instead of the maximum.
- (Harder) Modify the first program so that it finds the **index** of the maximum in the array rather than the maximum itself.
- Modify the bubble sort program so it implements the improvements discussed in class. (HINT: To exit the main loop if the array is already sorted, simply change the loop variable to equal the last value so the loop ends early.)

Draw the Target symbol (a set of concentric Squares, alternating red and white) in a graphics window that is 200 pixels wide by 200 pixels high. Hint: Draw the largest circle first in red, then draw the next smaller circle in white, then draw the next smaller circle in red. Graphical objects drawn later appear "on top of" graphical objects drawn earlier.



- Try entering the following literal values at the prompt. (Hit ENTER after each)

-5
-4.2
4.5
4.14
0.90

Something odd should occur. *Describe it on paper.*

- Reading from a CSV file of the given data using pandas library.

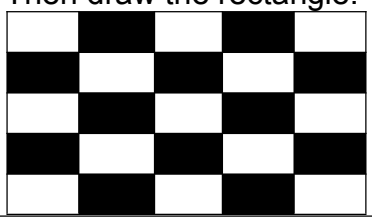
- For the given data, plot the scatter matrix for males only, and for females only. Do you think that the 2 sub-populations correspond to gender?
- For the given data, using python environment, apply, 1-sample t-test: testing the value of a population mean.
- For the given data, using python environment, apply, 2-sample t-test: testing for difference across populations

- Generate simulated data from python, apply simple linear and multiple linear regression analysis.
- Retrieve the estimated parameters from the model above. Hint: use tab-completion to find the relevant attribute.

- Going back to the brain size + IQ data, test if the VIQ of male and female are different after removing the effect of brain size, height and weight.

- Using matplotlib, visualize the simulated data with suitable statistical measures.

- Create a 5 X 5 rectangle whose top left corner is at (*row**5, *col**5). (Where is the bottom right corner?) If the sum of the *row* and *col* numbers is even, set the fill color of the rectangle to white, otherwise set it to black. Then draw the rectangle.



HM-101 A	English						
L	T	P	Credit	Major Test	Minor Test	Total	Time
2	-	-	2	75	25	100	3Hr

Course Outcomes	
CO 1	Building up the vocabulary
CO 2	Students will acquire basic proficiency in English including writing skills

UNIT- 1

Vocabulary Building

1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

UNIT- 2

Basic Writing Skills

2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

UNIT- 3

Identifying Common Errors in Writing

3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

UNIT- 4

Nature and Style of sensible Writing

4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion
4.6 Comprehension
4.7 Précis Writing
4.8 Essay Writing

Suggested Books:

(i) Practical English Usage. Michael Swan. OUP. 1995.
(ii) Remedial English Grammar. F.T. Wood. Macmillan.2007
(iii)On Writing Well. William Zinsser. Harper Resource Book. 2001
(iv) Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
(v) Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
(vi) Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press

Note: The paper setter will set the paper as per the question paper templates provided.

BSR-113A	**BIOLOGY FOR ENGINEERS**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
2	**0**	**0**	**2**	**75**	**25**	**100**	**3**
Purpose :	**The purpose of this course is to provide a basic understanding of biological mechanisms of living organisms from the perspective of engineers. In addition, the course is expected to encourage engineering students to think about solving biological problems with engineering tools.**						
Course Outcomes							
CO 1	**Familiarize the students with the basic organization of organisms and**						
CO 2	**Impart an understanding about the machinery of the cell functions that is ultimately responsible for various daily activities.**						
CO 3	**Provide knowledge about biological problems that require engineering expertise to solve them**						

UNIT I

BASIC CELL BIOLOGY: Introduction: Methods of Science-Living Organisms: Cells and Cell theory Cell Structure and Function, Genetic information, protein synthesis, and protein structure, Cell Metabolism-Homoeostasis- Cell growth, reproduction, and differentiation.

UNIT II

BIOCHEMISTRY AND MOLECULAR ASPECTS OF LIFE: Biological Diversity --Chemistry of life: chemical bonds--Biochemistry and Human biology--Protein synthesis—Stem cells and Tissue engineering.

ENZYMES AND INDUSTRIAL APPLICATIONS: Enzymes: Biological catalysts, Proteases, Carbonic anhydrase, Restriction enzymes, and Nucleoside monophosphate kinases—Photosynthesis

UNIT III

INTRODUCTION TO BIOMOLECULES: Definition, general classification and important functions of carbohydrates, lipids, proteins, nucleic acids (DNA& RNA: Structure and forms). Hierarch in protein structure: Primary secondary, tertiary and quaternary structure. Proteins as enzymes, transporters, receptors and structural elements.

ENZYMES AS BIOCATALYSTS: General characteristics, nomenclature and classification of Enzymes. Effect of temperature, Ph, enzyme and substrate concentrations on the activity of enzymes. Elementary concept of and coenzymes. Mechanism of enzyme action. Enzyme kinetics and kinetic parameters (Km and Vmax)

UNIT IV

MECHANOCHEMISTRY: Molecular Machines/Motors—Cytoskeleton—Bioremediation—Biosensors

NERVOUS SYSTEM, IMMUNE SYSTEM, AND CELL SIGNALING Nervous system--Immune system-General principles of cell signaling

ROLE OF BIOLOGY: Role of Biology in Agriculture, Medicine, Forensic science, Bioinformatics, Nanotechnology, Micro-electromechanical systems (Bio-MEMS) and Sensors (Biosensors).

Text Book:

1. Introduction to Biotechnology, By Deswal & Deswal, Dhanpat Rai Publications N.A

2.Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, “Biology: A global approach”, Pearson Education Ltd, 2014.

3. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, “Outlines of Biochemistry”, John Wiley and Sons, 2009.

D. L. Nelson and M. M. Cox, “Principles of Biochemistry”, W.H. Freeman and Company, 2012.

4.G. S. Stent and R. Calendar, “Molecular Genetics”, Freeman and company, 1978.

Suggested Books:

1. Molecular Biology of cell, 4th ed. Alberts, Bruce et al. Garland Science Publishing, New York.
2. Microbiology. Pelczar Jr., M.J.; Chan, E.C.S. and Krieg, N.R. Tata McGraw Hill, New Delhi.
3. Lehninger: Principles of Biochemistry, 3rd edition, by David L. Nelson and M.M. Cox. Maxmillan/ Worth publishers.
4. Genetics by Snusted& Simmons.
5. Molecular Biotechnology: Principles Application of Recombinant DNA. Glick, B. R. and Pasternak, J. J. ASM press Washington DC.
6. Kuby's Immunology, Goldsby, R A,.Kindt, T.J, Osborne, B.A.(2003) W. H. Freeman and company, New York.
7. Recombinant DNA 2nd Edition. Watson, James D. and Gilman, M. (2001) W.H Freeman and Company, NewYork.
8. Essentials of Molecular Biology 4thed, Malacinski, G. M. (2003) Jones &Bartlet Publishers, Boston.

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ESR-119A	**MATERIALS SCIENCE**						
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose :	To understand internal structure- properties relationship of different types of materials and learn about Metallographic analysis and Characterization.						
Course Outcomes							
CO 1	To understand the Crystal structures and deformation mechanism in various						
CO 2	To study various types of phase diagrams, TTT curve and Iron carbon diagram. To learn about different heat treatment processes.						
CO 3	To learn about the failure mechanisms like Creep and Fatigue and designation of						
CO 4	To study Basics of Metallography and Basic Principle involved in the working of various types of Material characterization techniques.						

UNITI

Crystallography: Review of Crystal Structure, Space Lattice, Co-ordination Number, Number of Atoms per Unit

Cell, Atomic Packing Factor; Numerical Problems Related to Crystallography. Crystal Imperfections and their Classifications, Point Defects, Line Defects, Edge & Screw Dislocations, Surface Defects, Volume Defects.

Introduction to Engineering materials and Standard Materials Designation: Introduction to Engineering

materials, Steel Terminology, Standard Designation System for Steels, Indian Standard specifications for steels as per BIS: Based on Ultimate Tensile Strength and based on Composition, AISI-SAE standard designation for Steels and Aluminium Alloys

Magnetic, Dielectric and Superconducting Materials: Ferromagnetism – domain theory – types of energy – hysteresis – hard and soft magnetic materials – ferrites - dielectric materials – types of polarization – Langevin-Debye equation – frequency effects on polarization - dielectric breakdown – insulating materials – Ferroelectric materials - superconducting materials and their properties.

UNIT II

Phase Diagrams: Alloy Systems, Solid solutions, Hume Rothery's Rules, Intermediate phases, Phase Diagrams, Gibbs Phase Rule, Cooling curves, The Lever Rule, binary phase diagrams, Applications of Phase Diagrams, Phase Transformation, Micro constituents of Fe-C system, Allotropic Forms of Iron ,Iron-iron carbide phase diagram, Modified Iron Carbon Phase Diagrams, Isothermal Transformation, TTT Curve,

Heat Treatment: Heat treatment of steels, Annealing, Normalising, Hardening, Tempering, Case Hardening, Ageing, Aus tempering and Mar tempering, Surface Hardening, Mass Effect, Equipments for Heat Treatment, Major Defects in Metals or Alloys due to faulty Heat treatment.

UNIT III

Deformation of Metal: Elastic and Plastic Deformation, Mechanism of Plastic Deformation, Slip; Critical Resolved Shear Stress, Twinning, Conventional and True Stress Strain Curves for Polycrystalline Materials, Yield Point Phenomena, Bauschinger Effect, Work Hardening.

Failure of Materials: Fatigue, Fatigue fracture, fatigue failure, Mechanismof Fatigue Failure, Fatigue Life calculations ,Fatigue Tests, Theories of Fatigue.

Creep: Creep Curve , Types of Creep, Factors affecting Creep, Mechanism of Creep, Creep Resistant Material, Creep Fracture, Cre ep Test, Stress Rupture test.

UNIT IV

New Materials: Ceramics – types and applications – composites: classification, role of matrix and reinforcement, processing of fiber reinforced plastics – metallic glasses: types , glass forming ability of alloys, melt spinning process, applications - shape memory alloys: phases, shape memory effect, pseudoelastic effect, NiTi alloy, applications – nanomaterials: preparation (bottom up and top down approaches), properties and applications – carbon nanotubes: types.

Materials Characterization Techniques: Characterization techniques suchas X-Ray Diffraction (XRD), Scanning Electron Microscopy, transmission electron microscopy, atomic force microscopy, scanning tunneling microscopy, Atomic absorption spectroscopy.

Text Books:

1. Material Science by S.L.Kakani, New Age Publishers.
2. The Science and Engineering of Materials, Donald R. Askeland , Chapman & Hall.
3. Fundamentals of Material Science and Engineering by W. D. Callister, Wiley.
4. FundamentalofLightMicroscopyandElectronicImagingbyDouglasB.Murphy, Kindle Edition 2001
5. Materials Science and Engineering, V. Raghvan
6. Phase Transformation in Metals and Alloys,D. A.Porter &K.E. Easterling

Reference Books:

7. Material Science by Narula, TMH
8. Metallographic Handbook by Donald C. Zipperian, Pace Technologies, USA.
9. Robert Cahn Concise Encyclopedia of Materials Characterization, SecondEdition:2nd Edition (Advances in Materials Science and Engineering) Elsevier Publication 2005.
10. Smart Materials and Structures by Gandhi and Thompson, Chapman and Hall.

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HM-103LA	Language Lab						
L	T	P	Credit	Practical	Minor Test	Total	Time
-	-	2	1	30	20	50	3Hr

OBJECTIVES

1. Listening Comprehension
2. Pronunciation, Intonation, Stress and Rhythm
3. Common Everyday Situations: Conversations and Dialogues
4. Communication at Workplace
5. Interviews
6. Formal Presentations

ES-111LA								
Course title	Workshop Practice							
Scheme and Credits	L	T	P	Credits	Practical	Minor Test	Total	Time
	0	0	3	1.5	30	20	50	3 Hr
Pre-requisites (if any)								

Aim: To make student gain a hands-on work experience in a typical manufacturing industry environment.	
CO-1	To familiarize with different manufacturing methods in industries and work on CNC machine.
CO-2	To learn working in Fitting shop and Electrical and Electronics shops,
CO-3	To practice working on Carpentry and Plastic moulding/glass cutting jobs.
CO-4	To gain hands on practice experience on Metal casting and Welding jobs.

Manufacturing Processes Workshop

Contents

1.Manufacturing Methods-casting, forming, machining, joining, advanced manufacturing methods
2. CNC machining, Additive manufacturing
3. Fitting operations & power tools
4. Electrical & Electronics
5. Carpentry
6. Plastic moulding, glass cutting
7. Metal casting
8. Welding (arc welding & gas welding), brazing

Suggested Books:

1. Kalpakjian S. And Steven S. Schmid, “Manufacturing Engineering and Technology” , 7th edition, Pearson Education India Edition.
2. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., “Elements of Workshop Technology”, Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Gowri P. Hariharan and A. Suresh Babu,” Manufacturing Technology – I” Pearson Education, 2008.
4. Roy A. Lindberg, “Processes and Materials of Manufacture”, 4th edition, Prentice Hall India, 1998
5. Rao P.N., “Manufacturing Technology”, Vol. I and Vol. II, Tata McGraw-Hill House, 2017.