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!:

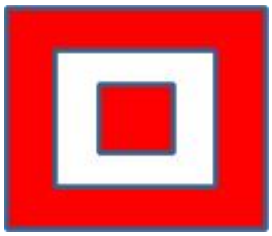
1. Set f = 1
2. Set n = 0
3. Repeat the following 20 times:

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.

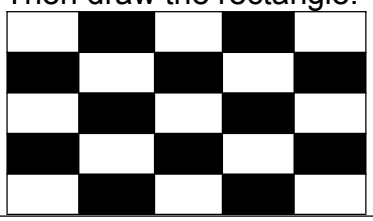
- For the given data, plot the scatter matrix for males only, and for females only. Do you think that the 2 sub-populations correspond to gender?
- For the given data, using python environment, apply, 1-sample t-test: testing the value of a population mean.
- For the given data, using python environment,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

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

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.

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

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.

Semester-3

BS-204A	HIGHER ENGINEERING MATHEMATICS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 h**
Purpose	The objective of this course is to familiarize the prospective Engineers with Laplace Transform, partial differential equations which allow deterministic mathematical formulations of phenomena in engineering processes and to study numerical methods for the approximation of their solution.						
Course Outcomes: After studying the course, students will be able to:							
CO 1	Describe the concept of Laplace transform and how it is useful in solving the definite integrals and initial value problems.						
CO 2	Solve the Partial Differential Equations for multivariable differential equations originated from real world problems.						
CO 3	Solve the problems using numerical methods in a comprehensive manner						
CO 4	Describe the essential tool of Numerical differentiation and Integration needed in approximate solutions for the ordinary differential equations.						

UNIT-I

Laplace Transform

Laplace Transform, Laplace Transform of Elementary Functions, Basic properties of Laplace Transform, Laplace transform of periodic functions, finding inverse Laplace transform by different methods, Convolution theorem, solving ODEs by Laplace Transform method.

UNIT-II

Partial Differential Equations

Formation of Partial Differential Equations, Solutions of first order linear and non-linear PDEs, Charpit's method, Solution to homogenous linear partial differential equations (with constant coefficients) by complimentary function and particular integral method.

UNIT-III

Numerical Methods-1

Solution of polynomial and transcendental equations: Bisection method, Newton-Raphson method and Regula-Falsi method, Finite differences, Relation between operators, Interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Newton's divided difference and Lagrange's formulae.

UNIT-IV

Numerical Methods-2

Numerical Differentiation using Newton's forward and backward difference formulae, Numerical integration: Trapezoidal rule and Simpson's 1/3rd and 3/8 rules, Ordinary differential equations: Taylor's series, Euler and modified Euler's methods. Runge-Kutta method of fourth order for solving first and second order equations.

Textbooks/References:

1. S. J. Farlow, Partial Differential Equations for Scientists and Engineers, Dover Publications, 1993. AICTE Model Curriculum in Mathematics.
2. R. Haberman, Elementary Applied Partial Differential equations with Fourier Series and Boundary Value Problem, 4th Ed., Prentice Hall, 1998.
3. Ian Sneddon, Elements of Partial Differential Equations, McGraw Hill, 1964.
4. Manish Goyal and N.P. Bali, Transforms and Partial Differential Equations, University Science Press, Second Edition, 2010.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
7. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.

8. P. Kandasamy, K. Thilagavathy, K. Gunavathi, Numerical Methods, S. Chand & Company, 2nd Edition, Reprint 2012.
9. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
10. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
11. Erwin Kreyszig and Sanjeev Ahuja, Applied Mathematics-II, Wiley India Publication, Reprint, 2015.

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

RA-201 A	Manufacturing Technology						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	To Study the various manufacturing processes along with the latest developments in this field.						
Course Outcomes: After studying the course, students will be able to:							
CO1	To understand the casting fundamentals, and different casting processes.						
CO2	Understand the powder metallurgy processes and different plastic shaping processes.						
CO3	understand different welding processes with their applications						
CO4	Know the applications of various Traditional, Non-Traditional manufacturing process & CNC machines						

UNIT-I

Fundamentals of castings: Introduction to casting: basic requirements of casting processes, casting terminology, solidification process: cooling curves, prediction of solidification time, the cast structure, molten metal problems, fluidity and pouring temperature, role of gating system, solidification shrinkage, riser and riser design, risering aids, Patterns, design considerations in castings.

Expandable-mold casting processes: Sand casting, cores and core making, other expendable-mold processes with multiple use patterns, expendable-mold processes with multiple use patterns, shakeout, cleaning and finishing. **Multiple-use-mold casting processes**: Permanent mold casting, die casting, squeeze casting and semisolid metal casting, centrifugal casting, cleaning treating and heat treating of castings, automation in foundry operations.

UNIT-II

Powder metallurgy: Characterization of engineering powders: geometric features, other features production of metallic powders: atomization: other production methods, conventional pressing and sintering: blending and mixing of the powders, compaction, sintering, heat treatment and finishing, design considerations in powder metallurgy.

Shaping processes for plastics: Properties of polymer melts, extrusion, production of sheet and film, fiber and filament production (spinning), coating processes, injection molding, compression and transfer molding, blow molding and rotational molding, thermoforming.

UNIT–III

Joining processes: Principles of fusion welding processes, arc welding processes-consumable electrodes: shielded metal arc welding, gas metal arc welding, flux-cored arc welding, submerged arc welding, Arc welding processes-non-consumable electrodes: gas tungsten arc welding, plasma arc welding, resistance welding processes, other fusion-welding processes: electron-beam welding, laser-beam welding, electro-slag welding, thermit welding.

UNIT–IV

Metal forming processes: classifications of metal forming processes, bulk deformation processes, material behavior in metal forming, temperature in metal forming, rolling: flat rolling and its analysis, shape rolling, rolling mills, forging: open-die forging, impression-die forging, flashless forging, forging hammers, presses, and dies, extrusion: types of extrusion, analysis of extrusion, extrusion dies and presses, defects in extruded products, wire and bar drawing, analysis of drawing, drawing practice, tube drawing

Introducing to CNC machines: Basics of Turning tool Geometry, ATC, Programming methods. – Manual part programming, Milling, Turning, (Simple Programs), Computer Aided part programming (Simple problems, DNC, Types , Applications, Types of CNC Programming Software's, Over view CNC machining centers, Turning centre.

TEXT BOOKS:

1. Manufacturing Technology Serope kalpakjain Steuen.R.Sechmid Pearson Education Asia 5 th Ed. 2006
2. Manufacturing Technology Vol 1 & 2 P.N.Rao Tata McGraw Hill 2001
3. N C Machine Programming and software Design ChnoHwachang, Michael.A.Melkan off Prentice Hall 1989

REFERENCES:

1. Process and materials of Manufacturing Roy A Lindberg Pearson 4 th Ed 2006.
2. Workshop Technology Hajra Choudhary. Vol I & II Media Publishers, Bombay 2004

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

RA- 203 A	SENSORS AND INSTRUMENTATION						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	a) To understand the concepts of measurement technology. b) To learn the various sensors used to measure various physical parameters. c)To learn the fundamentals of signal conditioning, data acquisition and communication systems used in the development of mechatronics system.						
Course Outcomes: After studying the course, students will be able to:							
CO1	Familiarize with various calibration techniques and signal types for sensors.						
CO2	Apply the various sensors in the Automotive and Mechatronics applications.						
CO3	Understand the basic principles of various pressure and temperature, smart sensors.						
CO4	Implement the Data Acquisition systems with different sensors for real time applications.						

UNIT-I

Introduction: Sensors & Transducer: Definition, Classification & selection of sensors, Measurement of displacement using Potentiometer, LVDT & Optical Encoder, Measurement of force using strain gauge, Measurement of pressure using LVDT based diaphragm & piezoelectric sensor.

UNIT-II

Measurement of temperature using Thermistor, Thermocouple & RTD, Concept of thermal imaging, Measurement of position using Hall effect sensors, Proximity sensors: Inductive & Capacitive, Use of proximity sensor as accelerometer and vibration sensor, Flow Sensors: Ultrasonic & Laser, Level Sensors: Ultrasonic & Capacitive.

UNIT–III

Virtual Instrumentation: Graphical programming techniques, Data types, Advantage of Virtual Instrumentation techniques, Concept of WHILE & FOR loops, Arrays, Clusters & graphs, Structures: Case, Sequence & Formula nodes, Need of software based instruments for industrial automation.

UNIT–IV

Data Acquisition Methods: Basic block diagram, Analog and Digital IO, Counters, Timers, Types of ADC: successive approximation and sigma-delta, Types of DAC: Weighted Resistor and R-2R Ladder type, Use of Data Sockets for Networked Communication.

Intelligent Sensors: General Structure of smart sensors & its components, Characteristic of smart sensors: Self calibration, Selftesting & self-communicating, Application of smart sensors: Automatic robot control & automobile engine control.

TEXT BOOKS:

1. DVS Murthy, Transducers and Instrumentation, PHI 2nd Edition 2013
2. D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013.
3. S. Gupta, J.P. Gupta / PC interfacing for Data Acquisition & Process Control, 2nd ED / Instrument Society of America, 1994.
4. Gary Johnson / Lab VIEW Graphical Programing II Edition / McGraw Hill 1997.

REFERENCE BOOKS:

1. Arun K. Ghosh, Introduction to measurements and Instrumentation, PHI, 4th Edition 2012.
2. A.D. Helfrick and W.D. cooper,Modern Electronic Instrumentation & Measurement Techniques, PHI – 2001
3. Hermann K.P. Neubert, "Instrument Transducers" 2nd Edition 2012, Oxford University Press.

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

RA-205A	MECHANICS OF SOLIDS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	a) To understand the concepts of stress, strain, principal stresses and principal planes. b) To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses. c) To determine stresses and deformation in circular shafts and helical spring due to torsion. d) To compute slopes and deflections in determinate beams by various methods. e) To study the stresses and deformations induced in thin and thick shells						
Course Outcomes: After studying the course, students will be able to:							
CO1	Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.						
CO2	to calculate the SF and BM in beams subjected to different loading conditions.						
CO3	to determine the torsion in the transmitting shafts subjected to different loading conditions, stresses in crane hook, rings, chain link for different cross section and also the deflection of curved bars and rings.						
CO4	to find strain energy in beams and shafts under different loading conditions and will be able to explain the energy methods and Castigliano's theorem.						

UNIT-I

Simple Stresses & Strains : Concept & types of Stresses and strains, Poisson's ratio, stresses and strain in simple and compound bars under axial loading, stress strain diagrams, Hook's law, elastic constants & their relationships, temperature stress & strain in simple & compound bars under axial loading, Numerical problems.
Principle Stresses: Two dimensional systems, stress at a point on a plane, principal stresses and principal planes, Mohr's circle of stresses, Numerical Problems.

UNIT-II

Shear Force & Bending Moments: Shear Force & Bending Moments: Definitions, SF & BM diagrams for cantilevers, simply supported beams with or without over-hang and calculation of maximum BM & SF and the point of contraflexture under (i) concentrated loads, (ii) uniformly distributed loads over whole span or a part of it, (iii)combination of concentrated loads and uniformly distributed loads, (iv) uniformly varying loads and (v) application of moments, relation between the rate of loading, the shear force and the bending moments, Numerical Problems.
Flexural and Shear Stresses – Theory of simple bending, Assumptions, derivation of equation of bending, neutral axis, determination of bending stresses, section modulus of rectangular & circular (solid & hollow), I,T, Angle, channel sections, composite beams, shear stresses in beams with derivation, shear stress distribution across various beam sections like rectangular, circular, triangular, I, T, angle sections, combined bending and torsion, equivalent torque,. Numerical problems.

UNIT–III

Torsion: Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

Bending of Curved Bars : Stresses in bars of initial large radius of curvature, bars of initial small radius of curvature, stresses in crane hooks, rings of circular & trapezoidal sections, deflection of curved bars & rings,

deflection of rings by Castigliano's theorem, stresses in simple chain links, deflection of simple chain links, Problems.

UNIT–IV

Strain Energy & Impact Loading: Definitions, expressions for strain energy stored in a body when load is applied (i) gradually, (ii) suddenly and (iii) with impact, strain energy of beams in bending, beam deflections, strain energy of shafts in twisting, energy methods in determining spring deflection, Castigliano's theorem, Numerical.

Theories of Elastic Failures: Various theories of elastic failures with derivations and graphical representations, applications to problems of 2- dimensional stress system with (i) Combined direct loading and bending, and (ii) combined torsional and direct loading, Numericals.

TEXT BOOKS:

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2016

2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2009

REFERENCES:

1. Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2002

2. Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 2005.

3. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013

4. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2010. edition, CRC Press, 2015

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

RA-207A	ELECTRONIC DEVICES AND CIRCUITS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	a) To understand the structure of basic electronic devices. b) Be exposed to active and passive circuit elements. c) To familiarize the operation and applications of transistor like BJT and FET. d) Explore the characteristics of amplifier gain and frequency response. e) To learn the required functionality of positive and negative feedback systems.						
Course Outcomes: After studying the course, students will be able to:							
CO1	Explain the structure and working operation of basic electronic devices						
CO2	Analyze the characteristics of different electronic devices such as diodes and transistors						
CO3	Choose and adapt the required components to construct an amplifier circuit						
CO4	Employ the acquired knowledge in design and analysis of oscillators.						

UNIT-I

PN Junction Devices: PN junction diode –structure, operation and V-I characteristics, diffusion and transition capacitance, Rectifiers – Half Wave and Full Wave Rectifier, clipping and clamping circuits. Display devices- LCD, LED, Seven Segment display, Laser diodes, Zener diode: characteristics and it's applications.

UNIT-II

Transistors and Thyristors: BJT, JFET, MOSFET- structure, operation, characteristics and Biasing, UJT, Thyristors and IGBT - Structure and characteristics.

Amplifiers: BJT small signal model , Analysis of CE, CB, CC amplifiers- Gain and frequency response , MOSFET small signal model, Analysis of CS and Source follower – Gain and frequency response, High frequency analysis.

UNIT–III

Multistage Amplifiers and Differential Amplifier: BIMOS cascade amplifier, Differential amplifier – Common mode and Difference mode analysis, FET input stages, Single tuned amplifiers – Gain and frequency response, Neutralization methods, Power amplifiers –Types (Qualitative analysis).

UNIT–IV

Feedback Amplifiers and Oscillators: Advantages of negative feedback, voltage series & current series feedback amplifier, Shunt feedback amplifier, positive feedback, Oscillators: Condition for oscillations, Types: phase shift, Wien Bridge, Hartley, Colpitts and Crystal oscillators

TEXT BOOKS:

1. David A. Bell ,"Electronic devices and circuits", Oxford University higher education, 5th edition 2008.
2. Sedra and smith, "Microelectronic circuits",7th Ed., Oxford University Press.

REFERENCES:

1. Balbir Kumar, Shail.B.Jain, "Electronic devices and circuits" PHI learning private limited, 2nd edition 2014.

2. Thomas L.Floyd, "Electronic devices" Conventional current version, Pearson prentice hall, 10th Edition, 2017.

3. Donald A Neamen, "Electronic Circuit Analysis and Design" Tata McGraw Hill, 3rd Edition, 2003.

4. Robert L.Boylestad, "Electronic devices and circuit theory", 2002.

5. Robert B. Northrop, "Analysis and Application of Analog Electronic Circuits to Biomedical Instrumentation", CRC Press, 2004

ES-201 A	ENGINEERING MECHANICS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	To understand the vector and scalar representation of forces and moments, static equilibrium of particles and rigid bodies in two dimensions To comprehend the effect of friction on equilibrium and the laws of motion, the kinematics of motion and the interrelationship and to learn to write the dynamic equilibrium equation To emphasis the concepts through solved examples						
Course Outcomes: After studying the course, students will be able to:							
CO1	Apply knowledge of mathematics, science and engineering to analyze the vector and scalar representation of forces and moments, static equilibrium of particles and rigid bodies in two dimensions						
CO2	Design and conduct experiment, as well as to analyze the effect of friction on equilibrium and the laws of motion, the kinematics of motion and the interrelationship and analyze dynamic equilibrium equation						
CO3	Design, construct and analyze Engineering Mechanics through solved examples						

UNIT-I

FUNDAMENTAL OF MECHANICS: Fundamental of Mechanics: Basic Concepts Force System and Equilibrium, Definition of Force, Moment and Couple, Principle of Transmissibility, Varignon_s theorem, Resultant of force system – Concurrent and non-concurrent coplanar forces, Condition of static equilibrium for coplanar force system, stability of equilibrium, applications in solving the problems on static equilibrium of bodies.

UNIT-II

PRACTICAL APPLICATION OF FORCE SYSTEM: Structural member: definition, Degree of freedom, concept of free body diagrams, types of supports and reactions, types of loads, Analysis of Trusses-method of joints, method of sections. Friction: Introduction, Static dry friction, simple contact friction problems, ladders, wedges.

UNIT–III

PROPERTIES OF SURFACES: Properties of sections – area, centroids of lines, areas and volumes, moment of inertia first moment of inertia, second moment of inertia and product moment of inertia, polar moment of inertia, radius of gyration, mass moment of inertia.

UNIT–IV

KINEMATICS AND KINETICS OF PARTICLES: Equations of motion - Rectilinear motion, curvelinear motion, Relative motion, D_Alembert_s principle, work- Energy equation – Conservative forces and principle of conservation of energy, Impulse – momentum, Impact – Direct central impact and oblique central impact.

KINEMATICS AND KINETICS OF RIGID BODIES: Plane motion, Absolute motion, Relative motion, translating axes and rotating axes, work and energy, impulse and momentum.

TEXT BOOKS:

1. Rajesekaran, S and Sankara Subramanian., G., Engineering Mechanics, Vikas Publishing House Private Ltd., 2012.

REFERENCES:

1. Palanichamy, M.S. Nagan, S., Engineering Mechanics – Statics & Dynamics, Tata McGraw-Hill,2001.

2. Beer, F.P and Johnson Jr. E.R, Vector Mechanics for Engineers, Vol. 1 Statics and Vol.2 Dynamics, McGraw – Hill International Edition, 1997

3. Bhavikatti,S.S and K.G.Rajashekarappa, Engineering Mechanics, New Age International (P) Ltd, New Delhi,2010.

RA- 209 LA	ELECTRONIC DEVICES AND CIRCUITS LAB							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**2**	**1**	**0**	**40**	**60**	**100**	**3**
Purpose	To introduce basic semiconductor devices, their characteristics and application To understand analysis and design of simple diode circuits To learn to analyze the PN junction behaviour at the circuit level and its role in the operation of diodes and active devices							
Course Outcomes: After studying the course, students will be able to:								
CO 1	Analyze PN junctions in semiconductor devices under various conditions.							
CO 2	Design and analyze simple rectifiers and voltage regulators using diodes.							
CO 3	Describe the behaviour of special purpose diodes.							
CO 4	Design and analyze simple BJT , FET circuits and oscillators.							

LIST OF EXPERIMENTS:

1. To study V-I characteristics of P-N junction diode.
2. To study clipper circuit and clamper circuits.
3. To study the reverse breakdown characteristics of given Zener diode as a voltage regulator.
4. To study half wave rectifier , Full wave rectifier & bridge rectifier and effect of different filter circuits on ac ripple at different loads.
5. To study the input and output characteristics of a given transistor in common emitter configuration
6. To study characteristics of JFET & evaluate various parameters rd , Idss , Vpo , gm .
7. To study Hartley Oscillator.
8. To study RC phase shift oscillator.
9. To study Wien bridge Oscillator.
10. To study the different types of negative feedback in two stage amplifier and to observe its effects upon amplifier parameters.

Note: At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

RA-211 LA	Manufacturing Technology & CNC Lab							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**2**	**1**	**0**	**40**	**60**	**100**	**3**
Purpose	To study and practice the various operations that can be performed in lathe, shaper, drilling, milling machines etc. and to equip with the practical knowledge required in the core industries.							
Course Outcomes: After studying the course, students will be able to:								
CO1	Demonstrate the safety precautions exercised in the mechanical workshop.							
CO 2	Make the workpiece as per given shape and size using Lathe.							
CO 3	Join two metals using arc welding.							
CO 4	Use sheet metal fabrication tools and make simple tray and funnel.							
CO5	Use different moulding tools, patterns and prepare sand moulds.							

List of Experiments:

Machining and Machining time estimations for:

1. Taper Turning
2. External Thread cutting
3. Internal Thread Cutting
4. Eccentric Turning
5. Knurling
6. Square Head Shaping
7. Hexagonal Head Shaping
8. Fabrication of simple structural shapes using Gas Metal Arc Welding
9. Joining of plates and pipes using Gas Metal Arc Welding/ Arc Welding /Submerged arc welding
10. Preparation of green sand moulds
11. Manufacturing of simple sheet metal components using shearing and bending operations.
12. Manufacturing of sheet metal components using metal spinning on a lathe
13. Develop a part programme for following lathe operations and make the job on CNC lathe and CNC turning center (for finish pass only) – (At least two)

Calculating coordinate points for a cylindrical job by considering sign convention for lathe

- Plain turning and facing operations
- Taper turning operations
- Operation along contour using circular interpolation.

14. Develop a part program by using canned cycle on CNC lathe for turning , facing
15. Preparation of preventive maintenance schedule for CNC machine.

Note: At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

RA -217 LA	MECHANICS OF SOLIDS LAB							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**2**	**1**	**0**	**40**	**60**	**100**	**3**
Purpose	To make the students aware of different properties of material using different experiments.							
Course Outcomes: After studying the course, students will be able to:								
CO1	design and conduct experiments, acquire data, analyze and interpret data							
CO 2	determine the behavior of ferrous metals subjected to normal and shear stresses by means of experiments.							
CO 3	determine the behavior of structural elements, such as bars subjected to tension, compression, shear, bending, and torsion by means of experiments.							
CO 4	physically insight into the behavior materials and structural elements, including distribution of stresses and strains, deformations and failure modes.							
CO5	present objectives, describe test procedures and results, synthesize and discuss the test results.							

List of Experiments:

1. To study the Brinell hardness testing machine & perform the Brinell hardness test.
2. To study the Rockwell hardness testing machine & perform the Rockwell hardness test.
3. To study the Vickers hardness testing machine & perform the Vickers hardness test.
4. To study the Erichsen sheet metal testing machine & perform the Erichsen sheet metal test.
5. To study the Impact testing machine and perform the Impact tests (Izod&Charpy).
6. To study the Universal testing machine and perform the tensile, compression & bending tests.
7. To perform the shear test on UTM.
8. To study the torsion testing machine and perform the torsion test.
9. To draw shear Force, Bending Moment Diagrams for a simply Supported Beam under point and distributed Loads.
10. To prepare the composite specimen using hot compression molding machine and test for different mechanical properties.

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Note: At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

RA-219 A	INDUSTRIAL TRAINING-I							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**2**	**--**	**--**	**100**	**--**	**100**	**03**
Purpose	To provide comprehensive learning platform to students where they can enhance their employ ability skills and exposure to the industrial environment.							
Course Outcomes: After studying the course, students will be able to:								
CO1	acquire and apply fundamental principles of engineering.							
CO 2	update with all the latest changes in technological world.							
CO 3	develop self-improvement through continuous professional development and life-long learning							
CO 4	aware the social, cultural, global and environmental responsibility as an engineer.							

Note: RA-219A 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.

The candidate has to submit a training report of his/her work/project/assignment completed in the industry during the training period. The evaluation will be made on the basis of submitted training report and viva-voce/presentation.

MC 901 A	Environmental Sciences						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**0**	**100**	**-**	**100**	**3 Hrs.**
Purpose	To learn the multidisciplinary nature, scope and importance of Environmental sciences.						
Course Outcomes: After studying the course, students will be able to:							
CO1	learn the importance of natural resources.						
CO2	learn the theoretical and practical aspects of eco system.						
CO3	learn the basic concepts of conservation of biodiversity.						
CO4	understand the basic concept of sustainable development.						

UNIT 1

The multidisciplinary nature of environmental studies, Definition, Scope and Importance, Need for public awareness, Natural Resources: Renewable and Non-Renewable Resources: Natural resources and associated problems.

(a) Forest Resources: Use and over-exploitation, deforestation, case studies. Timber eztraction, mining, dams and their effects on forests and tribal people.

(b) Water Resources: Use & over-utilization of surface & ground water, floods, drought, conflicts over water, dams-benefits and problems.

(c) Mineral Resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

(d) Food Resources: World Food Problems, changes caused by agriculture and overgazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

(e) Energy Resources: Growing energy needs, renewable & non-renewable energy sources, use of alternate energy sources. Case studies.

(f) Land Resources: Land as a resource, land, degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources, Equitable use of resources for sustainable lifestyle.

UNIT II

Ecosystem-Concept of an ecosystem. Sturcture and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological Succession, Food Chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem: (a) Forest Ecosystem, (b) Grassland Ecosystem, (c) Desert Ecosystem and (d) Aquatic Ecosystems (ponds, streams, lakes, rivers, oceans, esturaries

Field Work: Visit to a local area to document Environment assets-river/forest/grassland/hill/mountain, Visit to a local polluted site-Urban /Rural Industrial/Agricultural, Study of common plants, insects and birds, Study of simple ecosystems-pond, river, hill, slopes etc. (Field work equal to 5 lecture hours).

UNIT III

Biodiversity and its conservation: Introduction, Definition: genetic, species and ecosystem diversity. Biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversityof global, National and local levels. India as a mega-diversity nation Hot spots of Biodiversity, Threats to biodiversity: Habitat loss, poaching of wild life, man-wildlife conflicts, Endangered and endemic species of India, Conservation of Biodiversity- In situ and Ex-Situ conservation of biodiversity.

Environmental Pollution Definition: Cause, effects and control measures of (a) Air Pollution (b) Water Pollution (c) Soil Pollution (d) Marine Pollution (e) Noise Pollution (f) Thermal Pollution (g) Nuclear Hazards

Solid waste management- cause, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies, Disaster management: floods, earthquake, cyclone and landslides

UNIT IV

Social Issues and the Environment. From unsustainable to sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management. Resettlement and rehabilitation of people: Its problems and concerns, Case Studies: Environmental ethics-issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies: Wasteland Reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and Control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public Awareness, Human population and the Environment, Population growth, variation among nations, Population explosion-Family Welfare Programme, Environment and human health. Human rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human Health, Case Studies, Drugs and their effects; Useful and harmful drugs, Use and abuse of drugs, Stimulant and depressan drugs, Concept of drug de-addiction, Legal position on drugs and laws related to drugs.

Suggested Books

- Environmental Studies- Deswal and Deswal. Dhanpat Rai and Co.
- Environmental Science and Engineering Anandan, P. and Kumaravelan, R. 2009. Scitech Publications (India) Pvt. Ltd., India.
- Environmental Studies. Daniels Ranjit R. J. and Krishnaswamy. 2013. Wiley India.
- Environmental Science- Botkin and Keller. 2012. Wiley , India

Note: The Examiner will be given the question paper template to set the question paper.

Semester-4

HTM-901	Universal Human Values-II						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	Purpose and motivation for the course, recapitulation from Universal Human Values-I						
Course Outcomes: After studying the course, students will be able to:							
CO1	develop a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.						
CO2	understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.						
CO3	Strengthen self-reflection.						
CO4	develop commitment and courage to act.						

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Purpose and motivation for the course, recapitulation from Universal Human Values-I
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facility- the basic requirements for fulfilment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
8. Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
9. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
10. Understanding the characteristics and activities of 'I' and harmony in 'I'
11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
12. Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

13. Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
14. Understanding the meaning of Trust; Difference between intention and competence

15. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship

16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals

17. Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

Module 4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

18. Understanding the harmony in the Nature

19. Interconnectedness and mutual fulfilment among the four orders of nature- recyclability and self- regulation in nature

20. Understanding Existence as Co-existence of mutually interacting units in all-pervasive space

21. Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

22. Natural acceptance of human values

23. Definitiveness of Ethical Human Conduct

24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order

25. Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people- friendly and eco-friendly production
systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.

26. Case studies of typical holistic technologies, management models and production systems

27. Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations

28. Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. to discuss the conduct as an engineer or scientist etc.

READINGS:

Text Book

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi
5. Small is Beautiful - E. F Schumacher.

6. Slow is Beautiful - Cecile Andrews
7. Economy of Permanence - J CKumarappa
8. Bharat Mein Angreji Raj - PanditSunderlal

9. Rediscovering India - by Dharampal
10. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - Romain Rolland (English)
13. Gandhi - Romain Rolland (English)

Reference Books:

MODE OF CONDUCT

Lecture hours are to be used for lecture/practice sessions.
Lectures hours are to be used for interactive discussion, placing the proposals about the topics at hand and motivating students to reflect, explore and verify them.
Practice hours are to be used for practice sessions.
While analysing and discussing the topic, the faculty mentor's role is in pointing to essential elements to help in sorting them out from the surface elements. In other words, help the students explore the important or critical elements.
In the discussions, particularly during practice sessions, the mentor encourages the student to connect with one's own self and do self-observation, self-reflection and self-exploration. Scenarios may be used to initiate discussion. The student is encouraged to take up" ordinary" situations rather than" extra-ordinary" situations. Such observations and their analyses are shared and discussed with other students and faculty mentor, in a group sitting.
Practice experiments are important for the course. The difference is that the laboratory is everyday life, and practical are how you behave and work in real life. Depending on the nature of topics, worksheets, home assignment and/or activity are included. The practice sessions would also provide support to a student in performing actions commensurate to his/her beliefs. It is intended that this would lead to development of commitment, namely behaving and working based on basic human values.
It is recommended that this content be placed before the student as it is, in the form of a basic foundation course, without including anything else or excluding any part of this content. Additional content may be offered in separate, higher courses.
This course is to be taught by faculty from every teaching department, including HSS faculty. Teacher preparation with a minimum exposure to at least one 8-day FDP on Universal Human Values is deemed essential.

ASSESSMENT:

This is a compulsory credit course. The assessment is to provide a fair state of development of the student, so participation in classroom discussions, self-assessment, peer assessment etc. will be used in evaluation.
Example:
Assessment by
faculty mentor: 5 marks
Self-assessment: 5 marks
Assessment by peers: 5 marks
Socially relevant project/Group Activities/Assignments: 10 marks
Semester End Examination: 75 marks
The overall pass percentage is 40%. In case the student fails, he/she must repeat the course.

RA-202 A	AUTOMATIC CONTROL SYSTEMS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	To study the basics of control system and its response. Stability of mechanical and electrical systems. Use of MATLAB to design a stable control system. a) To introduce the elements of control system and their modelling using various Techniques. b) To introduce methods for analysing the time response. c) To impart knowledge about the frequency response and the stability of systems d) To introduce the state variable analysis method						
Course Outcomes: After studying the course, students will be able to:							
CO1	understand the basics of the control system						
CO2	study the concept of time response of control system						
CO3	study the concept of frequency response of control system & different types of stability criteria of the system.						
CO4	provide a complete idea about the behaviour of a system at any given time utilizing the history of system using state space analysis						

UNIT-I

Introduction: Basic elements of control systems- Open loop and closed loop systems-Differential equation representation of physical systems- Transfer function, Mathematical modelling of Electrical and Mechanical (translational and rotational) systems, Block diagram reduction techniques, Signal flow graph – Mason‟ gain formula.

UNIT-II

Time Domain Analysis: Time response analysis –Analysis of transient and steady state behaviour of control systems. Standard Test signals- Time response of first and second order system, Time domain specifications, Types of systems, Steady state error –generalized error coefficients – response with P, PD, PI and PID controllers.

UNIT–III

Frequency Domain Analysis and Stability: : Frequency domain specifications, Time and frequency response correlation , Characteristic equation , Routh Hurwitz criterion of stability , Nyquist stability , Nyquist stability criterion , Polar plot , Bode plot , Root Locus Method: Root locus concepts , Construction of root loci , Root contours.

UNIT–IV

STATE SPACE ANALYSIS: Limitations of conventional control theory, Concepts of state, state variables and state model , state model for linear time invariant systems , Diagonalization of State Matrix. Solution of state equations. Eigenvalues and Stability Analysis. Concept of controllability and observability., Introduction to state space representation using physical - Phase and canonical variables-diagonal canonical form-Jordan canonical form.

TEXT BOOKS:

1. Nagrath I J, and Gopal, M, 'Control Systems Engineering" Prentice Hall of India, New Delhi, 2008.

2. Richard C Dorf and Robert H Bishop, "Modern Control Systems.", Addison-Wesley -2007

REFERENCES:

1. Ogata K, "Modern Control Engineering", Pearson Education, New Delhi, 2006.

2. Kuo B C, "Automatic Control Systems", Prentice-Hall of India Pvt. Ltd, New Delhi, 2004.

3. Norman C. Nise S, "Control system Engineering", John Wiley & Sons, Singapore, 2004.

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

Course No.	Course Title	Teaching Schedule			Credits	Allotment of Marks			Duration of Exam (Hrs.)
		L	T	P		Theory	Sessional	Total	
RA-204 A	COMPUTER AIDED DESIGN AND ANALYSIS	3	0	0	3	75	25	100	3

Purpose	The subject empowers the students to know about the extreme function of computer in designing, manufacturing as well as in the business scenario.
Course Outcomes: After studying the course, students will be able to:	
CO1	describe the history and application CAD/CAM.
CO 2	aware about the Modeling of different types of curves, surface and solid. The modeling is used for further analysis.
CO 3	know about the transformation of points and lines in computer aided software.
CO 4	know the usages of the numerical control machines and its code and How computer is useful in making the process planning.

UNIT-I

Introduction to CAD/CAM, Historical Development, Industrial look at CAD/CAM Application of CA/CAM, Display devices, Input/ Output Devices, CPU.
Introduction to CIM, Definition, Nature of Elements of CIM, CIM Wheel,
Introduction to computer aided quality control, Contact and Non Conduct Inspection Method.

UNIT-II

Wireframe modeling, Representation of curves, Parametric and non-parametric curves, straight lines, Hermite cubic splines, B splines curves.
Plane surface, ruled surface, surface of revolution, bi-cubic surface, Bezier surface, B spline surface, Solid modeling, boundary representation, sweeping, parametric solid modeling.
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UNIT-III

Introduction, Transformation of points & line, 2-D translation, rotation, Reflection, Scaling, shearing and combined transformation, Homogeneous coordinates, Orthographic and perspective Projections.
Group technology, Part families, Part classification and coding, Optiz method, product flow analysis, Machine cell Design, Advantages of GT

UNIT-IV

Numerical control, Types of NC systems, MCU & other components, Co-ordinate system, NC manual part programming, G & M codes, part program for simple parts, Computer assisted part programming.
Introduction, FMS component, Types of FMS, FMS layout, planning for FMS, advantage and applications
Introduction, conventional process planning, Steps in variant process planning, types of
CAPP, planning for CAPP

Text books:

1. **Chris McMahon and Jimmie Browne**, CAD/CAM – Principle Practice and Manufacturing Management, Addison Wesley England, Second Edition, 2000.
2. **Rogers, D.F. and Adams, A**., Mathematical Elements for Computer Graphics, McGraw Hill Inc, NY, 1989
3. **Ibrahim Zeid**, CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 1992.
4. **M.P. Groover**, Automation, Productions systems and Computer-Integrated Manufacturing by Prentice – Hall

Reference Books:

1. **Ibrahim Zeid**, Mastering CAD/CAM, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
2. **P. Radhakrishnan, S. Subramanayan and V.Raju**, CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.
3. **Groover M.P. and Zimmers E. W.**, CAD/CAM: Computer Aided Design and Manufacturing, Prentice Hall International, New Delhi, 1992.
4. **Dr. Sadhu Singh**, Computer Aided Design and Manufacturing, Khanna Publishers, New Delhi, Second Edition, 2000.
5. **Chang, Wang &Wysk** Computer Aided Manufacturing. Prentice Hall
6. **Kundra** &**Rao**, Numerical Control and Computer Aided Manufacturing by, Rao and Tiwari, Tata Mc-Graw Hill.
7. **Mattson**, CNC programming Principles and applications, Cengage Learning India Pvt. Ltd. Delhi

NOTE: In the semester examination, the examiner will set 8 questions in all, at least one question from each unit, and students will be required to attempt only 5 questions.

RA-206 A	ELECTRICAL MACHINES AND POWER						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	a) To study about basic electrical prime movers, electrical transmission and distribution systems. b) To study about the transformers c) To study about the different types of induction motors d) To study about the special machines e) To study about the power system						
Course Outcomes: After studying the course, students will be able to:							
CO1	Understand the principles of operations and characteristics of DC machines						
CO2	Describe the electrical transformers and induction motors						
CO3	visualize the operation of synchronous motors, stepper and servo motors						
CO4	understand about the basic structure of power system.						

UNIT–I

D.C. Machines: Constructional details , EMF equation , methods of excitation – self and separately excited generators , characteristics of series and shunt generators , principle of operation of D.C. Motor , function of commutator in DC motors, back emf and torque equation , characteristics of series, shunt and compound motors , starting of D.C. Motors , types of starters , speed control and braking of DC. Motors.

UNIT–II

Transformer: Constructional detail , Working Principle , EMF Equation ,Transformation Ratio , Transformer on No Load , Transformer on Load , Equivalent Circuit , Parameters referred to HV/LV Windings , Phasor diagram at ideal, no load and on load conditions, Losses, Voltage regulation and efficiency, OC & SC test, Load Test , concept of auto transformer

UNIT–III

Induction Motors: Construction , types , principle of operation of three-phase induction motors ,equivalent circuit , Torque equation, Torque-slip characteristics, starting and speed control of three phase induction motor, single-phase induction motors (only qualitative analysis).

Synchronous and Special Machines: Construction of Synchronous machine, types, emf equation, Brushless alternators, Reluctance motor, Stepper motor, Servo motor.

UNIT–IV

Introduction to Power System: Structure of electric power systems: generation, transmission, and distribution systems, EHVAC and EHVDC transmission system , Underground and overhead system, Modern trends in power system transmission, Effects of increase in Voltage on transmission line efficiency, Radial and ring main system. Relative copper consumption in various systems. Conductor size and Kelvin's Law, substation layout. (Concepts only).

TEXT BOOKS:

1. Murugesh Kumar K. , "Electric Machines Vo I", Vikas Publishing House Pvt Ltd, 2010.

2. Murugesh Kumar K. , "Electric Machines Vol II", Vikas Publishing House Pvt Ltd, 2010

3. Mehta V.K. and Rohit Mehta, "Principles of Power System", S.Chand and Company Ltd, 2003.

REFERENCE BOOKS:

1. Fitzgerald A.E., Charles Kingsley, Stephen.D.Umans, "Electric Machinery", Tata McGraw Hill publishing Company Ltd, 2003.

2. Gupta J.B., "Theory and Performance of Electrical Machines", S.K.Kataria and Sons, 2002

3. Kothari D.P. and Nagrath I.J., "Electric Machines", Tata McGraw Hill Publishing Company Ltd, 2002.

4. Bhimbhra P.S. "Electrical Machinery", Khanna Publishers, 2003.

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

RA- 208 A	KINEMATICS AND DYNAMICS OF MACHINCES						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	a) To understand the basic knowledge about kinematics of machines. b) To understand the basic components and layout of linkages in the assembly of a system/ machine. c) To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism. d) To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions. e) To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components						
Course Outcomes: After studying the course, students will be able to:							
CO1	Understand the basic knowledge of kinematics of machines						
CO2	apply fundamentals of mechanism for the design of new mechanisms						
CO3	know about the linkages, design few linkage mechanisms and cam mechanisms for specified output motions						
CO4	Impart knowledge about the gears and gear trains						

UNIT-I

Kinematic of Machines: Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons – Analytical methods – computer approach – cams – classifications – displacement diagrams - layout of plate cam profiles – derivatives of followers motion – circular arc and tangent cams.

UNIT-II

Robot Kinematics and Dynamics: Direct kinematics of a manipulator, workspace, Inverse kinematics, Algebraic approaches to inverse kinematics, Lagrange – Euler formulation of dynamic equations of a manipulator, Geometric approaches for inverse kinematics

Gears and Gear Trains: Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains

UNIT–III

Force Analysis: Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D‟Alembert‟s principle – superposition principle – dynamic Force Analysis in simple machine members

UNIT–IV

Balancing and Vibration: Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – free vibrations – Equations of motion – natural Frequency – Damped Vibration – bending critical speed of simple shaft

TEXT BOOKS:

1. Ambekar A.G., “Mechanism and Machine Theory” Prentice Hall of India, New Delhi, 2007

2. Shigley J.E., Pennock G.R and Uicker J.J., “Theory of Machines and Mechanisms”, Oxford University Press, 2003

REFERENCES:

1. Thomas Bevan, “Theory of Machines”, CBS Publishers and Distributors, 1984.

2. Ghosh. A, and A.K. Mallick, “Theory and Machine”, Affiliated East-West Pvt. Ltd., New Delhi, 1988.

3. Rao.J.S. and Dukkipatti R.V. “Mechanisms and Machines”, Wiley-Eastern Ltd., New Delhi, 1992.

4. John Hannah and Stephens R.C., “Mechanics of Machines”, Viva Low Prices Student Edition, 1999.

5. V.Ramamurthi, Mechanisms of Machine, Narosa Publishing House, 2002.

6. Robert L.Norton, Design of Machinery, McGraw-Hill, 2004.

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

Course No.	Course Title	Credits	Teaching Schedule			Allotment of Marks			Duration of Exam (Hrs.)
			L	T	P	Minor Test	Practical	Total	
RA-210 LA	**COMPUTER AIDED DESIGN LAB**	1	0	0	2	40	60	100	3
Purpose	To empower the students to know about the computer aided design by using CAD								
Course Outcomes: After studying the course, students will be able to:									
CO1	aware about the 2D drawing and modelling.								
CO 2	know how to use 3D software in part designing.								
CO 3	know about the assembly and aware about the G codes and M codes.								
CO 4	aware about the NC part programming and OPTIZE method.								

List of experiments:

1 To study the 2 dimensional drawing, orthographic views, front view, top view and side view.
2 To study the wireframe, surface and solid modelling.
3 Draw the part drawing of product 1 using any 3D software.
4 Draw the part drawing of product 2 using any 3D software.
5 Make assembly by using any 3D software.
6 To study the G codes and M codes.
7 Write a NC program for milling operation.
8 Write a NC program for drilling operation.
9 Write a NC program for turning operation.
10 To study the optiz method.

Note: Any 8 experiments from the above list and other 2 from others (developed by institute) are required to be performed by students in the lab.

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RA-212 LA	ELECTRICAL MACHINES AND POWER SYSTEMS LAB							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**2**	**1**	**0**	**40**	**60**	**100**	**3**
Purpose	To impart Knowledge about the basic operations of DC machines and help them to develop experimental skills. To measure equivalent circuit parameters of single phase transformers. To expose the students to the basic operations of AC machines and help them to develop experimental skills.							
Course Outcomes: After studying the course, students will be able to:								
CO 1	describe basic operation of DC machines and help them to develop experimental skills.							
CO 2	describe various characteristics of DC generators and determine the efficiency of DC Machines.							
CO 3	determine the equivalent circuit parameters of single phase transformers.							
CO 4	operate AC electrical machines and determine the equivalent circuit parameters of single phase & 3-phase Induction motor.							

LIST OF EXPERIMENTS:

1. Draw characteristics of series, shunt and compound generators.
2. To perform load test on DC shunt generator & find efficiency & observe speed at different load.
3. To perform Hopkinson's test of DC shunts M/Cs.
4. To perform Swinburne's test of DC shunts motor and find efficiency.
5. Speed control of DC shunt motor by armature & field control method, draw graph between speed & field current.
6. Parallel operation of two 1-phase transformers and observe load sharing.
7. To perform open & short circuit tests on a 1-phase transformer & find parameters.
8. To perform light running and block rotor test on 1-phase induction motor and to determine the parameters of the equivalent circuit.
9. To perform no load test and block rotor test on 3-phase induction motor and draw the circle diagram.
10. To perform load test on a 3-phase induction motor & DC generator set and to determine the efficiency of induction motor.
11. Determine mechanical losses by light running of a 3-phase induction motor.
12. To calculate regulation by synchronous impedance method:-
a) Conduct open and short circuit test on a three phase alternator.
b) Determine and plot variation of synchronous impedance with If
c) Determine SCR
d) Determine regulations for 0.8 lagging power factor, 0.8 leading power factor and unity PF.
13. To plot V curves of a synchronous machine.
a) Determination of Xo of a synchronous machine.
b) Measurement Xd & Xq (Direct axis and Quardrature axis reactance) by slip test
14. To perform and study parallel operation of synchronous generators.

Note: At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

RA-214 LA	KINEMATICS AND DYNAMICS OF MACHINCES LAB							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**2**	**1**	**0**	**40**	**60**	**100**	**3**
Purpose	To supplement the principles learnt in kinematics and Dynamics of Machinery. To understand how certain measuring devices are used for dynamic testing.							
Course Outcomes: After studying the course, students will be able to:								
CO 1	demonstrate the principles of kinematics and dynamics of machinery							
CO 2	use the measuring devices for dynamic testing.							
CO 3	learn the various mechanism have used in Machines and Robots							
CO 4	understand the concepts and working of Flywheel, Governor and Cams							

LIST OF EXPERIMENTS:

1. a) Study of gear parameters.

b) Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.

2. a) Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms.

b) Kinematics of single and double universal joints.

3. a) Determination of Mass moment of inertia of Fly wheel and Axle system.

b) Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table

apparatus.

c) Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.

4. Motorized gyroscope – Study of gyroscopic effect and couple.

5. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.

6. Cams – Cam profile drawing, Motion curves and study of jump phenomenon

7. a) Single degree of freedom Spring Mass System – Determination of natural Frequency and verification of Laws of springs – Damping coefficient determination.

b) Multi degree freedom suspension system – Determination of influence coefficient.

8. a)Determination of torsional natural frequency of single and Double Rotor systems.- Undamped and Damped Natural frequencies. b) Vibration Absorber – Tuned vibration absorber.

9. Vibration of Equivalent Spring mass system – undamped and damped vibration.

10. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.

11. a) Balancing of rotating masses. (b) Balancing of reciprocating masses.

12. a) Transverse vibration of Free-Free beam – with and without concentrated masses.

b) Forced Vibration of Cantilever beam – Mode shapes and natural frequencies.

c) Determination of transmissibility ratio using vibrating table

Note: At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

MC 902A	Constitution of India					
Lecture	**Tutorial**	**Practical**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**100**	**0**	**100**	**3 Hrs.**
Purpose	**To know the basic features of Constitution of India**					
Course Outcomes: After studying the course, students will be able to:						
CO1	**Describe the salient features of the Constitution of India.**					
CO2	**Discuss the fundamental duties and federal structure of Constitution of India.**					
CO3	**describe about emergency provisions in Constitution of India.**					
CO4	**describe fundamental rights under Constitution of India.**					

UNIT-I

Meaning of the constitution law and constitutionalism, Historical perspective of the Constitution of India. Salient features and characteristics of the Constitution of India, Scheme of the fundamental rights.

UNIT - II

The scheme of the Fundamental Duties and its legal status. The Directive Principles of State Policy – Its importance and implementation. Federal structure and distribution of legislative and financial powers between the Union and the States.

Parliamentary Form of Government in India – The constitution powers and status of the President of India

UNIT - III

Amendment of the Constitutional Powers and Procedure. The historical perspectives of the constitutional amendments in India.

Emergency Provisions: National Emergency, President Rule, Financial Emergency. Local Self Government – Constitutional Scheme in India.

UNIT-IV

Scheme of the Fundamental Right to Equality. Scheme of the Fundamental Right to certain Freedom under Article 19.

Scope of the Right to Life and Personal Liberty under Article 21.

Text Books

1. Constitution of India. Prof.Narender Kumar (2008) 8th edition. Allahabad Law Agency**.**

Reference Books:

1. The constitution of India. P.M. Bakshi (2016) 15th edition. Universal law Publishing.

Semester-5

RA-301A	DESIGN OF MACHINE ELEMENTS AND TRANSMISSION SYSTEMS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	To understand the fundamentals for solving engineering problems relating to design of machine components and transmission systems.						
Course Outcomes							
CO1	The students will understand the design procedures and methods, properties of engineering materials and their selection, design against static and fluctuating loads.						
CO2	The students will be able to solve the design problems of different types of joints i.e. bolted, riveted joint and welded joint and the problems related to the design of shafts and couplings under different loading conditions.						
CO3	Students could solve the design problems of gears and springs.						
CO4	Students will be able to select the bearings for a particular application.						

UNIT-I

Introduction: Fundamentals of Machine Design-Engineering Design, Phases of Design, Design Consideration - Standards and Codes - Selection of Materials –Design against Static and Dynamic Load –Modes of Failure, Factor of Safety, Principal Stresses, Theories of Failure-Stress Concentration, Stress Concentration Factors, Variable Stress, Fatigue Failure, Endurance Limit, Design for Finite and Infinite Life, Soderberg and Goodman Criteria.

UNIT-II

Detachable and Permanent Joints: Design of Bolts under Static Load, Design of Bolt with Tightening/Initial Stress, Design of Bolts subjected to Fatigue – Keys -Types, Selection of Square and Flat Keys-Design of Riveted Joints and Welded Joints

UNIT–III

Shafts and Coupling: Design of Shaft –For Static and Varying Loads, For Strength and Rigidity-Design of Coupling-Types, Flange, Muff and Flexible Rubber Bushed Coupling

UNIT–IV

Gears and Belt Drives: Design of Spur and Helical Gear Drives-Design of Belt Drives-Flat and V Belts
Springs and Bearings: Design of Helical Spring-Types, Materials, Static and Variable Loads-Design of Leaf Spring-Design of Journal Bearing -Antifriction Bearing-Types, Life of Bearing, Reliability Consideration, Selection of Ball and Roller Bearings

TEXT BOOKS:

1. Joseph Edward Shigley, Charles R. Mischke " Mechanical Engineering Design", McGraw Hill, International Edition, 1992
2. Bhandari. V.B., "Design of Machine Elements", Tata McGraw-Hill Publishing Company Limited, 2003.

REFERENCE BOOKS:

1. Sharma. C.S. and Kamlesh Purohit, "Design of Machine Elements", Prentice Hall of India Private Limited, 2003
2. Robert L. Norton, "Machin Design – An Integrated Approach", Prentice Hall International Edition, 2000.

RA-303A	DIGITAL ELECTRONICS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	To make the students understand the concepts of digital electronics and its applications in different fields.						
Course Outcomes							
CO1	Students will be able to understand the number systems and its arithmetic operations and Illustrate Use of Boolean algebra.						
CO2	Students will be able to formulate and apply Karnaugh Map to reduce Boolean expressions and logic circuits to their simplest POS and SOP forms						
CO3	Students will be able to design various combinational digital circuits using logic gates						
CO4	Students will be able to do the analysis and design procedures for synchronous and asynchronous sequential circuits						

UNIT-I

Binary Codes and Boolean Algebra

Signals: Analog and Digital, Binary Number System. Addition, Subtraction, Multiplication, Division of binary numbers, Subtraction using 2's complement method. Binary codes: weighted and non-weighted codes, self-complementary.

Codes, BCD, Excesses-3, Gray codes, Alphanumeric codes, ASCII Codes.

Boolean algebra: Boolean Laws and Expression using Logic Gates, Realization of different gates using Universal gates, De- Morgan's Theorem, Duality Theorems.

UNIT-II

Boolean Function Minimization Techniques: Standard forms: SOP, POS, Simplification of Switching function & representation (Maxterm & Minterm), Boolean expression & representation using logic gates, Propagation delay in logic gate. Karnaugh map: K-map, mapping and minimization of SOP and POS expression, don't care condition, conversion from SOP to POS and POS to SOP form using K-map, Minimization of multiple output circuits,

UNIT–III

Combinational Circuits Design: Adder & Subtractor (Half and Full), Parallel Binary adder, BCD Adder, Binary multipliers, Code Converters, parity bit generator, Comparators, Decoder, BCD to 7-segment Decoder, Encoders, Priority Encoders, Multiplexers, De- Multiplexers.

Sequential Circuits Elements: Introduction to Sequential Circuit, Flip-flop and Latch: SR latch, JK flip-flop, Master Slave JK Flip-flop, T flip-flop, D flip-flop and latch, Master-slave RS flip-flop, Master-slave JK flip-flop, asynchronous inputs.

UNIT–IV

Shift Registers and Counters: Shift registers: buffer register, controlled buffer register. Data transmission in shift resistor SISO, SIPO, PISO, PIPO, Bidirectional shift register, universal shift registers. Counter: Classification, Ripple or asynchronous counter, Effect of propagation delay in ripple counters, up-down counter, Design of Mod-n counter, synchronous counter, Ring counter, Johnson counter.

Text books:

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition, 2006. 2012
4. Modern digital Electronics, 4rd Edition by R.P. Jain, Tata McGraw Hill, 2009.
5. VHDL, 4rd Edition by Douglas Perry, Tata McGraw Hill, 2002
6. Digital Electronics- An introduction to theory and practice, 2nd edition by W.H. Gothmann, PHI, 2012

Reference Books:

1. Digital Circuits and Systems, D.V. Hall, Tata McGraw Hill, 1989
2. Digital System Design using VHDL, 2nd edition, by Charles Roth, Tata McGraw Hill,

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

RA-305A	HYDRAULICS AND PNEUMATICS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	To provide student with knowledge on the application of fluid power in process, construction and manufacturing Industries and an understanding of the fluids and components utilized in modern industrial fluid power system. To develop a measurable degree of competence in the design, construction and operation of fluid power circuits.						
Course Outcomes							
CO1	Students will be able to explain the fluid power and operation of different types of pumps						
CO2	Students will be able to summarize the features and functions of hydraulic motors, actuators and flow control valves						
CO3	Students will be able to explain the different types of hydraulic circuits and systems and Explain the working of different pneumatic circuits and systems						
CO4	Students will be able to understand various trouble shooting methods and applications of hydraulic and pneumatic systems.						

UNIT-I

Fluid Power Principles and Hydraulic Pumps: Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power : Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps – Problems.

UNIT-II

Hydraulic Actuators and Control Components Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components: Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories: Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols – Problems.

UNIT–III

Hydraulic Circuits and Systems Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double- Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT–IV

Pneumatic And Electro Pneumatic Systems Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, Introduction to fluidics and pneumatic logic circuits.

Trouble Shooting and Applications Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools – Low-cost Automation – Hydraulic and Pneumatic power packs.

Text Books:

1. Anthony Esposito, "Fluid Power with Applications", Pearson Education 2005.
2. Majumdar S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw-Hill, 2001.

Reference Books:

1. Anthony Lal, "Oil hydraulics in the service of industry", Allied publishers, 1982.
2. Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", Prentice Hall, 1987.
3. Majumdar S.R., "Pneumatic systems – Principles and maintenance", Tata McGraw Hill, 1995
4. Michael J, Prinches and Ashby J. G, "Power Hydraulics", Prentice Hall, 1989.
5. Shanmugasundaram.K, "Hydraulic and Pneumatic controls", Chand & Co, 2006

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

RA-307A	Microcontroller and Embedded System Design						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	To understand the architectures and the instruction set of different microcontrollers and interfacing of microprocessors and microcontrollers with various peripheral. To introduce embedded systems, its hardware, software, devices and buses used for embedded networking.						
Course Outcomes							
CO1	Students will be able to interpret the architecture & instruction set of 8085, 8086, 8051 microcontroller to develop assembly language programs						
CO2	Students will be able to understand the application of 8051 microcontroller on chip peripherals to implement the functions of I/O port, timer/Counter, serial port & interrupts.						
CO3	Students will be able to know about the peripheral devices 8255 PPI and 8279 for integrating keyboard, 7 segment display, LCD display and traffic light controller & 8259 PIC for handling multiple interrupts I/O.						
CO4	Students will be able to design 8051 Microcontroller based systems for measuring electrical and physical quantities & Motor control. Interpret the hardware and software components of an embedded system for an application and infer the architecture and programming model of ARM processor						

UNIT I

INTEL 8085 MICROPROCESSOR

Intel 8085 Hardware - Architecture – Pin description and addressing modes; Intel 8086 Hardware – Pin description and addressing modes; Intel 8051 Microcontroller: Introduction – Architecture – Memory Organization – Special Function Registers – Pins and Signals – Timing and control – Port Operation – Memory and I/O interfacing – Interrupts – Instruction Set and Programming.

UNIT II

ON-CHIP PERIPHERALS & PERIPHERAL DEVICES I/O Port Programming - Timer Registers -Timer Modes - Overflow Flags – Clocking Sources -Timer/ Counter Interrupts – Timer Programming - Baud Rate Generation – Serial Port Register -Modes of Operation - Serial Port Programming- Interrupt Organization Processing Interrupts - Interrupt Programming- Programmable Peripheral Interface (8255) - Keyboard / Display Controller (8279) - Programmable Interrupt Controller (8259).

UNIT III

DESIGN OF MICROCONTROLLER BASED SYSTEM

Voltage, Current and Frequency Measurement - DC Motor Control - Stepper Motor control - Case Studies: Arduino Board Overview - Arduino IDE - Temperature Control.

UNIT IV

EMBEDDED SYSTEMS & ARCHITECTURE OF ARM PROCESSOR

Processor Embedded into a system - Embedded Hardware units and devices in a system - Embedded Software in a System -Classification of Embedded Systems - Embedded Design Life Cycle - Design Example: Model Train Controller. ARM Embedded System - CISC and RISC Processors - ARM Architecture - Programming Model - Operating Modes.

ARM PROGRAMMING

ARM Instruction Set - ARM Instruction Types: Data Transfer, Data Processing and Control, Flow Instructions - Interrupts – Exceptions types - NVIC Registers for interrupt control.

TEXT BOOKS:

1. Krishna Kant, ―Microprocessors and Microcontrollers – Architectures, Programming and System Design 8085, 8086, 8051, 8096‖, PHI, 2014.
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi and Rolin D. McKinley, "The 8051 Microcontroller and Embedded Systems Using Assembly and C ", 2nd Edition, Pearson Education 2013.
3. Kenneth J. Ayala, "The 8051 Microcontroller. Architecture, Programming and Applications", 3rd Edition, West publishing company 2014
4. Andrew N.Sloss, Dominic Symes and Chris Wright, "ARM System Developer's Guide: Designing and Optimizing System Software", Morgan Kaufmann Publishers, 1st Edition, 2004.
5. Raj Kamal, "Embedded Systems Architecture, Programming and Design", Tata McGraw Hill, 2nd Edition, 2009

REFERENCE BOOKS:

1. Soumitra Kumar Mandal "Microprocessors and Microcontrollers Architecture Programming and Interfacing using 8085, 8086 & 8051" Tata McGraw Hill Publishing Co Ltd, 1st Edition, 2011.
2. Myke Predko, "Programming and Customizing the 8051 Microcontroller", 1st Edition, 2012.
3. Chris Braith, "8051 Microcontroller Application based Introduction", Elsevier 2004.
4. Manish K Patel, "The 8051 Microcontroller Based Embedded Systems "Tata McGraw Hill Publishing Co Ltd, Ist Edition, 2014.
5. Jonathan W Valvano, "Embedded Systems: Introduction to Arm® Cortex TM-M Microcontrollers", 5th Edition, 2015.
6. Shibu K.V, "Introduction to Embedded Systems", Tata Mc Graw Hill, 1st Edition, 2009.
7. Jean J.Labrosse, "Embedded Systems Building Blocks", CMP Books, 2nd Edition, 2010.

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

RAP-301A	Robot Kinematics and Dynamics						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	To understand the basic knowledge about kinematics of machines. To understand the basic components and layout of linkages in the assembly of a system/machine. To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism. To understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions. To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.						
Course Outcomes							
CO1	Students will be able to understand the basic knowledge of kinematics of machines						
CO2	Students will be able to apply fundamentals of mechanism for the design of new mechanisms						
CO3	Students will be able to know about the linkages, design few linkage mechanisms and cam mechanisms for specified output motions.						
CO4	Students will be able to impart knowledge about the gears and gear trains.						

UNIT I

INTRODUCTION

Specifications of Robots- Classifications of robots – Work envelope - Flexible automation versus Robotic technology – Applications of Robots.

DIRECT & INVERSE KINEMATICS

Dot and cross products, Co-ordinate frames, Rotations, Homogeneous Coordinates, Link coordinates, D-H Representation, Arm equation -Two axis, three axis, four axis, five axis and six axis robots. Inverse Kinematic problem, General properties of solutions, Tool configuration, Inverse Kinematics of Two axis Three axis, Four axis and Five axis robots.

UNIT II

WORKSPACE ANALYSIS

Workspace analysis of Four axis, Five axis and Six axis robots, Perspective transformation, structured illumination, Camera calibration, Work envelope of Four and Five axis robots, Workspace fixtures.

UNIT III

DIFFERENTIAL MOTION AND STATICS

The tool Configuration jacobian matrix for three axis and, four axis robots, joint space singularities, resolved motion rate control, manipulator jacobian for three and four axis joint space singularities, induced joint torques and forces.

UNIT IV

DYNAMIC ANALYSIS AND FORCES

Introduction, Langrangian mechanics, Effects of moments of Inertia, Dynamic equation for two axis planar articulated robot. Trajectory planning, Pick and place operations, Continuous path motion, Interpolated motion, Straight line motion.

Text Books

1. Robert J. Schilling, ―Fundamentals of Robotics Analysis and Control‖, PHI Learning, 2011.

2. Niku S B, ―Introduction to Robotics, Analysis, Systems, Applications‖, Prentice Hall, 2001.

Reference Books

1. John J Craig, ―Introduction to Robotics: Mechanics and control, Pearson, 2009,4th Ed, 2018.

2. Deb S R and Deb S, ―Robotics Technology and Flexible Automation‖, Tata McGraw Hill Education Pvt. Ltd, 2010.

3. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.

4. Saha S K, ―Introduction to Robotics‖, Tata McGraw Hill Education Pvt. Ltd,2010, 2nd Ed, 2014.

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

RAP-303A	Electrical Drives Control Systems						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	To understand the basic concepts of different types of electrical machines and their performance. To study the different methods of starting D.C motors and induction motors. To study the conventional and solid-state drives						
Course Outcomes							
CO1	Students will be able to know the basics of electrical drives, selection and applications.						
CO2	Students will be able to know the drive motor characteristics.						
CO3	Students will be able to understand different starting methods.						
CO4	Students will be able to understand the speed control of DC drives and AC drives.						

UNIT I

INTRODUCTION

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors

UNIT II

DRIVE MOTOR CHARACTERISTICS

Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series and compound – single phase and three phase induction motors.

UNIT III

STARTING METHODS

Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors.

UNIT IV

CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES

Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system – Using controlled rectifiers and DC choppers –applications.

CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES

Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications.

Text Books:

1. G.K. Dubey, Fundamentals of Electric Drives, Narosa publishing House.
2. S.K.Pillai, A First Course on Electric Drives, New Age International.
3. V Subrahmanyam, Electric Drives, Mcgrawhill Education.

Reference Books:

1. M.Chilkin, Electric Drives,Mir Publishers, Moscow.
2. Mohammed A. El-Sharkawi, Fundamentals of Electric Drives, Thomson Asia, Pvt. Ltd. Singapore.
3. N.K. De and Prashant K.Sen, Electric Drives, Prentice Hall of India Ltd.
4. V.Subrahmanyam, Electric Drives: Concepts and Applications, Tata McGraw Hill.

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

RA-305 A	INDUSTRIAL DESIGN AND APPLIED ERGONOMICS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	To explain the general principles that governs the interaction of humans in their working environment for improving worker performance and safety. To know about the environmental conditions in the industry. To know about bio thermodynamics and bioenergetics To know about the human factors in industrial aspects						
Course Outcomes							
CO1	Students will be able to know about ergonomic principles to design workplaces						
CO2	Students will be able to improve human performance and judge the environmental conditions in the work place						
CO3	Students will be able to know about bio thermodynamics and bioenergetics						
CO4	Students will be able to implement latest occupational health and safety to the work place.						

UNIT-I

INTRODUCTION: Definition, human technological system, multidisciplinary engineering approach, human–machine system, manual, mechanical, automated system, human system reliability, conceptual design, advanced development, detailed design and development. INFORMATION INPUT: Input and processing, text, graphics, symbols, codes, visual display of dynamic information, auditory, tactual, olfactory displays, speech communications.

UNIT-II

HUMAN OUTPUT AND CONTROL: Physical work, manual material handling, motor skill, human control of systems, controls and data entry devices, hand tools and devices. WORKPLACE DESIGN: Applied anthropometry, workspace design and seating, arrangement of components within a physical space, interpersonal aspects of work place design, design of repetitive task, design of manual handling task, work capacity, stress, and fatigue.

UNIT–III

ENVIRONMENTAL CONDITIONS: Illumination, climate, noise, motion, sound, vibration, colour and aesthetic concepts. BIOMECHANICS: Biostatic mechanics, statics of rigid bodies, biodynamic mechanics, human body kinematics, kinetics, impact and collision.

UNIT–IV

BIOTHERMODYNAMICS AND BIOENERGETICS: Biothermal fundamentals, human operator heat transfer, human system bioenergetics, thermoregulatory physiology, human operator thermo regularity, passive operator, active operator, heat stress.
HUMAN FACTORS APPLICATIONS: Human error, accidents, human factors and the automobile, organizational and social aspects, steps according to ISO/DIS6385, OSHA‟s approach, virtual environments.

Text Books:

1. Chandler Allen Phillips, “Human Factors Engineering”, John Wiley and Sons, New York, 2000.

Reference Books:

1. Bridger R S, “Introduction to Ergonomics”, Taylor and Francis, London, 2003.
2. Mayall W H, “Indus trial Design for Engineers”, London ILIFFEE Books Ltd., UK, 1998.
3. Mark S Sanders, “Human Factors in Engineering and Design”, McGraw Hill, New York, 1993.

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

RA 309 LA	DIGITAL ELECTRONICS LAB							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**2**	**1**	**0**	**40**	**60**	**100**	**3**
Purpose	To impart the basic practical aspects of Digital Electronics. To make a differentiation between the Analog Electronics and Digital electronics through practical modes. To lay the foundation for the courses in electronics related to microprocessors, microcomputers and computers which are more advanced courses based on digital electronics and the revolution in electronics.							
Course Outcomes								
CO 1	Students will be able to know the fundamentals and the parameters of digital components related to their fabrication and internal circuitry.							
CO 2	Students will be able to design various logic circuits.							
CO 3	Students will be able to design synchronous and asynchronous sequential circuits.							
CO 4	Students will be able to verify the Truth Table.							

LIST OF EXPERIMENTS:

1. Digital Signals Interface Compare analog and digital electronics systems (Tutorial)
2. Realization of basic and universal logic gates using ICS 7400, 7432, 7402, 7408, 7486, 7404.
3. Derived Basic gate using NAND and NOR Gate
4. Verification of Demorgan's theorem.
5. Develop Verification of Truth Table of 4:1 mux & 1:4 demux using IC's.
6. Verification of Truth Table of flip flops
7. Verification of Truth Table of shift registers (7495)
   a. SISO
   b. SIPO
   c. PISO
   d. PIPO
8. Verification of 4-bit Asynchronous mod-10 (decade) counter (IC 7490)
9. Verification of 4-bit synchronous up/down counter ((IC 74193)
10. Segment Display Decoder.

.**Note:** At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

RA-311LA	Microcontroller and Embedded System Design Lab							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**2**	**1**	**0**	**40**	**60**	**100**	**3**
Purpose	To enable the students to program, simulate and test the 8085, 8051, PIC 18 and ARM processor based circuits and their interfaces							
Course Outcomes								
CO 1	Students will be able to develop 8051 Assembly Language Programs for Arithmetic, Logic, Bit manipulation, String operations							
CO 2	Students will be able to demonstrate an application for 8051 microcontroller using Traffic light controller, ADC & DAC interfacing boards							
CO 3	Students will be able to perform 8051 Embedded C Coding for Programming the GPIO, Timer, Interrupts & Serial Port.							
CO 4	Students will be able to perform temperature monitoring using Arduino target board.							

LIST OF EXPERIMENTS:

Microcontroller Lab:

Developing Assembly Language Programs using 8051 Microcontroller Kits

- Data manipulating Operations and Delay Routines
- String operations
- Interfacing Traffic light controller
- Interfacing ADC
- Interfacing DAC

Embedded Laboratory

1. Voltage Measurement with display

Designing a voltmeter to measure voltage from 0 to 5 volts and displaying the measured value using 7 segment displays

2. Design of Water Pump Controller to sense the water level in a tank
3. Digital Clock with LCD display
4. Temperature Measurement with 7 segment display
5. PC Communication

Interfacing the microcontroller to a PC through RS232 interface and displaying the messages sent by the microcontroller on the PC using Visual Basic program running in PC

6. Remote Control through FM Link

Establishing an FM link between two microcontrollers for data transfer.

7. Hot Chamber Controller to maintain the temperature at the set point.
8. Obstacle Detector using ultrasonic transmitter- receiver
9. Moisture sensor and sprinkler controller design
10. Designing a lamp controller having a light sensor and a timer

RA-313LA	HYDRAULIC PNEUMATICS LAB							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**2**	**1**	**0**	**40**	**60**	**100**	**3**
Purpose	To develop required skills in the students so that they are able to acquire knowledge to Identify and solve various Hydraulic and Pneumatic problems.							
Course Outcomes								
CO 1	Students will be able to acquire required learning out comes in cognitive, psychomotor and affective domain							
CO 2	Students will be able to operate different types of valves used in hydraulic systems.							
CO 3	Students will be able to maintain different valves and auxiliaries.							
CO 4	Students will be able to assemble pumps and motors to rectify problems							

LIST OF EXPERIMENTS:

1. Demonstrate application of Pascal's law in hydraulic system
2. Demonstrate various accessories and their uses in hydraulic system.
3. Demonstrate use of directional control valves
4. Demonstrate use of pressure control valves
5. Demonstrate use of pressure intensifier
6. Demonstrate application of flow control valves
7. Demonstrate applications of various types of pumps
8. Demonstrate use of hydraulic motors
9. Demonstrate application of injection control circuit
10. Demonstrate use of clamp control and reciprocating screw circuits.
11. Demonstrate application of single stage compressors

Note: At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

RA-315LA	PROJECT-I							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**4**	**2**	**--**	**-**	**100**	**100**	**3**
Purpose:	To implement the engineering principles and theories into innovative practical projects for solving real world problems.							
Course Outcomes								
CO1	Students will be able to apply the theoretical knowledge into practical/software projects.							
CO2	Students will be able to design new products related to robotics and automation using latest technologies.							

The project work could be done for the problem statement of an industry or practical project in the institute. The students may also opt for the analysis-based software projects with proper validation. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

Note: The maximum number of students in a group should not exceed four.

RA-317A	INDUSTRIAL TRAINING-II							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**2**	**--**	**--**	**100**	**--**	**100**	**3**
Purpose	To provide an industrial exposure to the students and enhance their skills and creative capability for conversion of their innovative ideas into physical reality.							
Course Outcomes								
CO 1	Students will be able to self-improve through continuous professional development and life-long learning.							
CO 2	Students will be able to develop social, cultural, global and environmental responsibility as an engineer.							
CO 3	Students will be able to weigh all the latest changes in technological world.							

Note: 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.

The candidate has to submit a training report of his/her work/project/assignment completed in the industry during the training period. The evaluation will be made on the basis of submitted training report and viva-voce/presentation.

MC 903A	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
3	**0**	**0**	**--**	**100**	**--**	**--**	**100**	**3**
Purpose	To impart basic principles of thought process, reasoning and inferencing.							
Course Outcomes								
CO 1	Students will be able to understand, connect up and explain basics of Indian traditional knowledge in modern scientific perspective.							

Course Contents

- Basic structure of Indian Knowledge System: अष्टादशविद्या -४वेद,४उपवेद (आयुर्वेद, धनुर्वेद, गन्धर्ववेद, स्थापत्य आदि) ६वेदांग (शिक्षा, कल्प, निरुक्त, व्याकरण, ज्योतिष, छंद) ४ उपाङ्ग (धर्मशास्त्र, मीमांसा, पुराण, तर्कशास्त्र)
- Modern Science and Indian Knowledge System
- Yoga and Holistic Health care
- Case studies

References

- V. Sivaramakrishnan (Ed.), *Cultural Heritage of India-course material*, Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014
- Swami Jitatmanand, *Modern Physics and Vedant*, Bharatiya Vidya Bhavan
- Swami Jitatmanand, *Holistic Science and Vedant*, Bharatiya Vidya Bhavan
- Fritzof Capra, *Tao of Physics*
- Fritzof Capra, *The Wave of life*
- VN Jha (Eng. Trans.), *Tarkasangraha of Annam Bhatta*, International Chinmay Foundation, Velliarnad, Arnakulam
- *Yoga Sutra of Patanjali*, Ramakrishna Mission, Kolkata
- GN Jha (Eng. Trans.), Ed. RN Jha, *Yoga-darshanam with Vyasa Bhashya*, Vidyanidhi Prakashan, Delhi 2016
- RN Jha, *Science of Consciousness Psychotherapyand Yoga Practices*, Vidyanidhi Prakashan, Delhi 2016
- P B Sharma (English translation), *Shodashang Hridayan*

Pedagogy: Problem based learning, group discussions, collaborative mini projects.

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

Semester-6

RA-302 A	PLC & Industrial Automation						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	To make the students understand about the PLC, PLC programming and SCADA and their applications.						
Course Outcomes							
CO1	Students will be able to know about the PLC, its architecture, selection and applications.						
CO2	Students will be able to perform PLC programming.						
CO3	Students will be able to know PLC networking standards.						
CO4	Students will be able to know about SCADA and communication protocols.						

UNIT-I

Industrial Automation -review, Control elements of Industrial Automation-IEC/ ISA Standards for Control Elements, Selection criteria for control elements-Construction of relay logic circuits with different control elements-Need for PLC -PLC evolution. PROGRAMMABLE LOGIC CONTROLLERS: Architecture of PLC -Types of PLC –PLC modules, Input and Output modules –Digital and Analog Input/Output- examples of Digital and Analog Inputs/Outputs- PLC Configuration -Scan cycle -Capabilities of PLC-Selection criteria for PLC –PLC Communication with PC and software-PLC Wiring-Installation of PLC and its modules.

UNIT-II

PROGRAMMING OF PLC: – Ladder Programming –Realization of simple logic circuits, Timers and counters–arithmetic and logic functions- PTO / PWM generation-Programming examples- High Speed Counter –Analog Scaling –Encoder Interfacing-Servo drive control – Stepper Motor Control. Other programming types: Functional Block Diagram FBD (most commonly used in industries) -Sequential Flow Chart SFC -Structured Text (Textual) -Instruction List (Textual).

UNIT-III

NETWORKING: PLC Networking-Networking standards & IEEE Standards -Protocols –Ethernet- Process field bus (PROFIBUS)-CAN open, different methods of interfacing with a PLC.

Case studies- PLC based traffic light system, stepper motor & servo motor control using PLC, Analog sensor interfacing with PLC, encoder interfacing with PLC. HMI SYSTEMS: Need for HMI in Industrial Automation, Types of HMI –Configuration of HMI, Screen development and navigation, Configuration of HMI elements/objects and interfacing with PLC.

UNIT-IV

APPLICATIONS OF PLC: Case studies of manufacturing automation and process automation. ROBOTICS & AUTOMATION SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA):Overview –Developer and runtime packages –Architecture –Tools –Tags–Graphics -Alarm logging –Tag logging – Trends –History –Report generation, VB & C Scripts for SCADA application.

COMMUNICATION PROTOCOLS OF SCADA: Proprietary and open Protocols –OLE/OPC –DDE –Server/Client Configuration –Messaging –Recipe –User administration –Interfacing of SCADA with PLC, drive, and other field devices. DISTRIBUTED CONTROL SYSTEMS (DCS): DCS –architecture –local control unit programming language - communication facilities -operator interface -engineering interfaces. Case studies- Design of conveyor automation system using PLC, SCADA and Electrical drive; Design of inspection automation system using sensors, PLC, HMI/SCADA; Design of simple water management system using PLC, SCADA and Electrical drive.

Text Books:

1. Programmable Logic Devices and Logic Controllers, Enrique Mandado, Jorge Marcos, Serafin A. Peres, Prentice Hall, 1996.

2. Practical SCADA for industry, David Bailey, Edwin Bright, Newnes, Burlington, 2003.

Reference Books:

1. Introduction to Programmable Logic Controllers, Gray Dunning, Delamar Thomson Learning, 1998.
2. Programmable Controllers- AnEngineers's Guide, 2nd Edition, E.A. Parr, Newness, 1999.
3. Programmable controllers, Hardware, Software & Applications, George L. Batten Jr., McGrawHill, 2nd Edition, 1994.
4. Programmable logic controllers, W. Bolton, Elsevier Ltd, 2015.
5. Programmable logic controllers,Frank D Petruzella, McGraw-Hill, 2011.
6. Programmable Logic Controllers: Programming Methods and Applications. John R Hackworth and Fredrick D Hackworth Jr., Pearson Education, 2006.
7. Practical Modern SCADA Protocols: DNP3, 60870.5 and Related systems, Gordon Clarke, Deon Reyneders, Edwin Wright, Newnes Publishing, 2004.48
8. Designing SCADA Application Software, Stuart G McCrady, Elsevier, 2013.

RA-304 A	PRINCIPLES OF ROBOTICS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	To introduce the functional elements of Robotics. To impart knowledge on the direct and inverse kinematics To introduce the manipulator differential motion and control To educate on various path planning techniques and to introduce the dynamics and control of manipulators						
Course Outcomes							
CO1	Students will be able to understand basic concept of robotics.						
CO2	Students will be able to analyse the instrumentation systems and their applications to various and to know about the dynamics and control in robotics industries.						
CO3	Students will be able to know about the differential motion, add statics in robotics						
CO4	Students will be able to know about the various path planning techniques.						

UNIT-I

Basic Concepts: Brief History-Types of Robots–Technology-Robot classifications and specifications-Design and control issues- Various manipulators – Sensors - work cell - Programming languages.

Coordinate Frames, Mapping and Transforms: Coordinate Frames, Description of Objects in Space, Transformation of Vectors, inverting a Homogeneous Transform, Inverting a Homogeneous Transform, Fundamental Rotation Matrices

UNIT-II

Direct and Inverse Kinematics: Mathematical representation of Robots - Position and orientation – Homogeneous transformation- Various joints- Representation using the Denavit Hattenberg parameters - Degrees of freedom-Direct Kinematics-Inverse kinematics- SCARA robots- Solvability – Solution Methods-Closed form solution.

UNIT–III

Manipulator Differential Motion and Statics: Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance. PATH PLANNING: Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation planning.

UNIT–IV

Dynamics and Control: Lagrangian mechanics-2DOF Manipulator-Lagrange Euler Formulation-Dynamic model – Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator

Text Books:

1. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi, 4th Reprint, 2005.
2. JohnJ.Craig, Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.
3. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996.

References Books:

1. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.
2. K. K.Appu Kuttan, Robotics, I K International, 2007.

3. Edwin Wise, Applied Robotics, Cengage Learning, 2003.
4. R.D.Klafter,T.A.Chimielewski and M.Negin, Robotic Engineering–An Integrated Approach, Prentice Hall of India, New Delhi, 1994.
5. B.K.Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998. 6. S.Ghoshal, "Embedded Systems & Robotics" – Projects using the 8051 Microcontroller", Cengage Learning, 2009.

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

RA-306 A	Digital Image Processing & Vision System						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	To impart the basic concepts of image segmentation and shaping To apply different types signal processing techniques in image processing						
Course Outcomes							
CO1	Students will be able know basics of image formation and transformation using sampling and quantization						
CO2	Students will be able to define different types of signal processing techniques used for image sharpening and smoothing						
CO3	Students will be able to perform and demonstrate the compression and coding techniques used for image data						
CO4	Students will be able to perform the shape analysis.						

UNIT I

Introduction to Image Processing

Image formation, image geometry perspective and other transformation, sterio imaging elements of visual perception. Digital Image-sampling and quantization serial & parallel Image processing.

Signal Processing

Signal Processing – Fourier, Walsh-Hadmard discrete cosine and Hotelling transforms and their properties, filters, correlators and convolvers. Image enhancement-Contrast modification. Histogram specification, smoothing, sharpening, frequency domain enhancement, pseudo-colour Enhancement.

UNIT II

Image Restoration

Image Restoration-Constrained and unconstrained restoration Wiener filter , motion blur remover, geometric and radiometric correction Image data compression-Huffman and other codes transform compression, predictive compression two tone Image compression, block coding, run length coding, and contour coding.

UNIT III

Segmentation Techniques

Segmentation Techniques-thresholding approaches, region growing, relaxation, line and edge detection approaches, edge linking, supervised and unsupervised classification techniques, remotely sensed image analysis and applications.

UNIT IV

Shape Analysis

Shape Analysis – Gestalt principles, shape number, moment Fourier and other shape descriptors, skelton detection, Hough transform, topological and texture analysis, shape matching. Practical Applications – Finger print classification, signature verification, text recognition, map understanding, bio-logical cell classification.

Text Books

1. Ganzalez and Wood, “Digital Image Processing”, Addison Wesley, 1993
2. Anil K.Jain, “Fundamental of Image Processing”, Prentice Hall of India

Reference Books

1. Rosenfeld and Kak, "Digital Picture Processing" vol.I & vol.II, Academic,1982
2. Ballard and Brown, "Computer Vision", Prentice Hall, 1982.
3. Wayne Niblack, "An Introduction to Digital Image Processing", Prentice Hall, 1986
4. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing, Analysis and Machine Vision", Vikas Publications.

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

HM-302A	Research Methodology & IPR						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	To impart knowledge on formulation of research problem, research methodology, ethics involved in doing research and importance of IPR protection.						
Course Outcomes							
CO1	Students will be able to understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.						
CO2	Students will be able to understand research problem formulation & Analyze research related information and Follow research ethics						
CO3	Students will be able to write a review article in the field of engineering.						
CO4	Students will be able to appreciate the importance of IPR and protect their intellectual property. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits						

UNIT I

RESEARCH METHODOLOGY

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, Approaches of investigation of solutions for research problem, data collection, analysis, Plagiarism, Research ethics.

UNIT II

RESULTS AND ANALYSIS

Importance and scientific methodology in recording results, importance of negative results, different ways of recording, industrial requirement, artifacts versus true results, types of analysis (Analytical, objective, subjective), outcome as new idea, hypothesis, concept, theory, model etc.

UNIT III

TECHNICAL WRITING

Effective technical writing, how to write a manuscript/ response to reviewers' comments, preparation of research article/ research report, Writing a Research Proposal - presentation and assessment by a review committee

UNIT IV

INTELLECTUAL PROPERTY RIGHTS

Nature of Intellectual Property: Patents, Designs, Trade Mark and Copyright. Process of Patenting and Development: technological research, innovation, patenting & development. Procedure for grants of patents,

Patenting under PCT.

PATENT RIGTS AND NEW DEVELOPMENTS IN IPR

Scope of Patent Rights. Licensing and transfer of technology, Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System.

Text Books

1. Ranjit Kumar, Research Methodology- A step by step guide for beginners, Pearson Education, Australia, 2005.

2. Ann M. Korner, Guide to Publishing a Scientific paper, Bioscript Press 2004.

3. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Reference Books

1. Kothari, C. R. Research Methodology - Methods and Techniques, New Age International publishers, New Delhi, 2004.

2. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students', Juta & Company, 1996.

3. Robert P. Merges, Peter S. Menell and Mark A. Lemley, "Intellectual Property in New Technological Age", Aspen Publishers, 2016.

4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.

5. Mayall , "Industrial Design", McGraw Hill, 1992.

6. Niebel , "Product Design", McGraw Hill, 1974.

7. Asimov , "Introduction to Design", Prentice Hall, 1962.

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

RAP-302A	Neural Network and Fuzzy System						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	The purpose of this course is to familiarize with the Artificial Neural Networks & Fuzzy Logic and to understand the importance of tolerance of imprecision and uncertainty for design of robust & low cost intelligent machines.						
Course Outcomes							
CO1	Students will be able to identify and describe Fuzzy Logic and Artificial Neural Network techniques in building intelligent machines						
CO2	Students will be able to apply Artificial Neural Network models to handle uncertainty and solve engineering problems						
CO3	Students will be able to apply Fuzzy Logic models to handle uncertainty and solve engineering problems						
CO4	Students will be able to recognize the feasibility of applying a Neuro-Fuzzy model for a particular problem						

UNIT I

Introduction to Artificial Neural Network

Artificial neural networks and their biological motivation: Terminology, Models of neuron, Topology, characteristics of artificial neural networks, types of activation functions; learning methods: error correction learning, Hebbian learning, Perceptron: XOR Problem, Perception learning rule convergence theorem; Adaline.

UNIT II

Feedforward and Recurrent Neural Networks

Architecture: perceptron model, solution, single layer artificial neural network, multilayer perceptron model; back propagation learning methods, effect of learning rule co-efficient ;back propagation algorithm, factors affecting backpropagation training, applications; Recurrent neural networks: Linear auto associator – Bi-directional associative memory – Hopfield neural network.

UNIT III

Fuzzy Logic & Fuzzy Sets

Introduction to Fuzzy Logic, Classical and Fuzzy Sets, Membership Function, Membership Grade, Universe of Discourse, Linguistic Variables, Operations on Fuzzy Sets: Intersections, Unions, Negation, Product, Difference, Properties of Classical set and Fuzzy sets, Fuzzy vs Probability, Fuzzy Arithmetic, Fuzzy Numbers.

UNIT IV

Fuzzy Relations & Aggregations

Essential Elements of Fuzzy Systems, Classical Inference Rule, Classical Implications and Fuzzy

Implications, Crisp Relation and Fuzzy Relations, Composition of fuzzy relations, Cylindrical Extension and

Projection. Fuzzy IF-THEN rules, Inference: Scaling and Clipping Method, Aggregation, Fuzzy rule-based Model: Mamdani Model, TSK model, Fuzzy Propositions, Defuzzification: MOM, COA

Fuzzy Optimization and Neuro Fuzzy Systems

Fuzzy optimization –one-dimensional optimization. Introduction of Neuro-Fuzzy Systems, Architecture of Neuro Fuzzy Networks.

Text Books

1. Ross, Timothy J. Fuzzy logic with engineering applications. John Wiley & Sons, 2009.
2. Yegnanarayana, B. Artificial neural networks. PHI Learning Pvt. Ltd., 2004.

Reference Books

1. Zurada, Jacek M. Introduction to artificial neural systems, West St. Paul, 1992.
2. Hagan, Martin T., Howard B. Demuth, and Mark H. Beale. Neural network design. Boston: Pws Pub., 1996.
3. Haykin, Simon. Neural networks: a comprehensive foundation. Prentice Hall PTR, 1994.
4. Passino, Kevin M., and Stephen Yurkovich. Fuzzy control. Vol. 42. Menlo Park, CA: Addison-Wesley, 1998.

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

RAP-304A	SENSORS TECHNOLOGY						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	To make students familiar with the constructions and working principle of different types of sensors and transducers. To make students aware about the measuring instruments and the methods of measurement and the use of different transducers.						
Course Outcomes							
CO1	Students will be able to use concepts in common methods for converting a physical parameter into an electrical quantity						
CO2	Students will be able to use concepts in common methods for converting a physical parameter into an electrical quantity						
CO3	Students will be able to choose a proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc.						
CO4	Students will be able to predict correctly the expected performance of various sensors						

UNIT-I

Sensors: Principles and classification of transducers, guidelines for selection and application of transducers, basic requirements of transducers. Different types of transducers,
displacement, strain gauge, LVDT, potentiometer, capacitive & inductive, Piezoelectric, temperature, optical, Hall effect transducers.
Measurement of parameter: Measurement of length, angle, area, temperature, pressure flow, speed force, torque, vibration, level, concentration (conductivity and ph.)
measurement- sensors in robotics-tactile sensors-proximity and range sensors- miscellaneous sensors and sensor based systems-use of sensors in robotics.

UNIT-II

Fundamentals of Electric drives - Components of electric drives, factors affecting choice of drives, fundamental torque equation, speed-torque conventions, steady state stability, multi-quadrant operation of electric drives, load torque components, nature and classification of load torque, equivalent moment of inertia, modes of operation.

UNIT–III

Control Speed control and drive classification, closed loop control, current limit control, speed control, position control, torque control, PLL control, multi-motor drive control, digital control. DC motor control, speed control, position control, proportional control, PID controllers.

UNIT–IV

Merits of Fluid power & its utility for increasing productivity through Low-Cost Automation, Transmission of Fluid Power through various types of Cylinders), Symbolic representation of Pneumatic elements (CETOP), Compressors and Air supply system including airline installations, signalling & control system. Pneumatic control elements (control valves & remote-control system), Basic pneumatic circuits for controlling single & double acting cylinder, Basic pneumatic circuits, Advanced pneumatic circuits for controlling multi-cylinders (operable). Advanced pneumatic circuits for controlling multi-cylinders (inoperable circuits), Electro pneumatics with relay logic, and Pneumatics system with PID controls, Application of fluidics a non-moving part logic.

Text Books

1. Sensors And Transducers By D. Patranabi W. Shepherd, and L. N. Hully, "Power Electronics and Motor control", (2e), Cambridge University, 1995.
2. Gopal K. Dubbey,"Fundamentals of Electric Drives", (2e), Narosa Publishers, 2001.

Reference Books

1. R. Krishnan, "Electric Motor Drives Modeling, Analysis, and Control", (2e), Prentice Hall, 2001.

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

RAP-306A	INDUSTRIAL ROBOTICS AND MATERIAL HANDLING SYSTEMS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time (Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Purpose	To introduce the basic concepts, parts of robots and types of robots. • To make the student familiar with the various drive systems for robot, sensors and their applications in robots and programming of robots. • To select the robots according to its usage. • To discuss about the various applications of robot						
Course Outcomes							
CO1	Students will be able to learn about the basic concepts, parts of robots and types of robots.						
CO2	Students will be able to design automatic manufacturing cells with robotic control using the principle behind robotic drive system, end effectors, sensor, machine vision robot kinematics and programming.						
CO3	Students will be able to develop the ability in selecting the required robot and know various applications of robots						
CO4	Students will be able to apply their knowledge in handling the materials.						

UNIT-I

Introduction: Types of industrial robots, Load handling capacity, general considerations in Robotic material handling, material transfer, machine loading and unloading, CNC machine tool loading, Robot centered cell.

UNIT-II

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

UNIT III OTHER APPLICATIONS: Application of Robots in continuous arc welding, Spot welding, Spray painting, assembly operation, cleaning, robot for underwater applications.

UNIT–III

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.

UNIT–IV

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.

TEXT BOOKS:

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

REFERENCE BOOKS:

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 Delhi, 1994

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

RA-308LA	ROBOTIC SIMULATION LAB							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**2**	**1**	**0**	**40**	**60**	**100**	**3**
Purpose	a) To impart the fundamental knowledge on using various analytical tools b) To know various fields of engineering where these tools can be effectively used to improve the output of a product c) To impart knowledge on how these tools are used in Industries by solving some real time problems using these tools							
Course Outcomes								
CO 1	Students will be able to know the utility of the tools like robotics programming							
CO 2	Students will be able to use these tools for any engineering and real time applications							
CO 3	Students will be able to get the knowledge on utilizing these tools for a better project in their curriculum							
CO 4	Students will be able to handle industry problems with confidence when it matters to use these tools in their employment.							

LIST OF EXPERIMENTS:

1. Open solution with an empty station, Import Robot and use the 3D window navigation
2. Creating a Robot system from layout and use Jog function.
3. Use Import tool and create path functions
4. Use Path and Targets, import and position training object
5. Create work-object
6. Create geometry and save station.
7. Create complete Arc welding cell structure, import CAD files, build station and save station.
8. Create a station, use Jogging menu.
9. Create collision and use collision detection functionality in the station.
10. Understand and measure cycle time in station.
11. Create backup file and restoring back up.
12. Understand and use CAD/CAM software.

Note: At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

RA-310LA	PLC SCADA and HMI Lab							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total**	**Time (Hrs.)**
0	**0**	**2**	**1**	**0**	**40**	**60**	**100**	**3**
Purpose	To familiarize the students with different applications of PLC, SCADA HMI.							
Course Outcomes								
CO 1	Students will be able to perform different functions using PLC.							
CO 2	Students will be able to perform different operations using SCADA-HMI.							

List of Experiments

1. To identify the given parts of the given PLC and front panel status indicators.
2. To develop the ladder program to test the START/STOP logic using two input and one output.
3. To develop the ladder program for blinking of LED.
4. To develop the ladder program for sequential ON-OFF control of lamps.
5. Use various functions of SCADA simulation editors to develop simple projects.
6. Develop a SCADA mimic diagram and tag database for ON-OFF control of lamps.
7. Develop a SCADA mimic diagram and tag database for traffic light control system.
8. To perform graphical animation of process data and alarming using SCADA-HMI.
9. To perform data logging, trending and report generation using SCADA-HMI

Note: At least eight experiments are required to be performed by students from the above list and two may be performed from the experiments developed by the institute.

RA-312LA	PROJECT-II							
Lecture	**Tutorial**	**Practical**	**Credits**	**Major Test**	**Minor Test**	**Practical**	**Total Time**	**Time (Hrs.)**
0	**0**	**6**	**3**	**--**	**0**	**100**	**100**	**3**
Purpose	To implement the engineering principles and theories into innovative practical projects for solving real world problems.							
Course Outcomes								
CO1	Students will be able to apply the theoretical knowledge into practical/software projects.							
CO2	Students will be able to design new products using latest technologies.							

The project work could be done for the problem statement of an industry or practical project in the institute. The analysis-based software projects undergone in the previous semester can be extended to its fabrication i.e. functional machine/product in this semester. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.

Note: The maximum number of students in a group should not exceed four.