SunRise University

Approved by Govt. of Rajasthan vide Sunrise University Act, 2011
Recognized by UGC Act, 1956 u/s 2 (f)

COURSE STRUCTURE AND SYLLABUS
For
ROBOTICS ENGINEERING

Semester -I

Code	Subject	Cr	Hrs. /Week			Exam Hrs.	Maximum Marks				
			L	T	P		MS1	MS2	END TERM	IA	Total
Theory											
1BTRE01	Engineering Mathematics-I	3	3	1	0	3	10	10	60	20	100
1BTRE02	Engineering Physics	3	3	1	0	3	10	10	60	20	100
1BTRE03	Communication Skills	3	3	1	0	3	10	10	60	20	100
1BTRE04	Programming for Problem Solving	3	4	1	0	3	10	10	60	20	100
1BTRE05	Basic Civil Engineering	3	3	1	0	3	10	10	60	20	100
Practicals & Sessionals											
Code	Subject	Cr	Hrs. /Week			Exam Hrs.	IA (60%)		EA (40%)		Total
			L	T	P		MP1 30%	MP2 30%			
1BTRE06	Engineering Physics Lab	2	0	0	2	2	30	30	40		100
1BTRE07	Language Lab	2	0	0	2	2	30	30	40		100
1BTRE08	Computer Programming Lab	2	0	0	2	2	30	30	40		100
1BTRE09	Basic Civil Engineering Lab	2	0	0	2	2	30	30	40		100
1BTRE10	Computer Aided Engineering Graphics	2	0	0	2	2	30	30	40		100
	Grand Total	**27**	**18**	**6**	**11**						**1000**

Semester II

Code	Subject	Cr	Hrs. /Week			Exam Hrs.	Maximum Marks				
			L	T	P		MS1	MS2	END TERM	IA	Total
Theory											
2BTRE01	English – II	3	3	1	0	3	10	10	60	20	100
2BTRE02	Mathematics – II (Mathematical Methods)	3	3	1	0	3	10	10	60	20	100
2BTRE03	Mathematics – III	3	3	1	0	3	10	10	60	20	100
2BTRE04	Engineering Physics	3	4	1	0	3	10	10	60	20	100
2BTRE05	Elements of Mechanical Engineering	3	3	1	0	3	10	10	60	20	100
Practicals & Sessionals											
Code	Subject	Cr	Hrs. /Week			Exam Hrs.	IA (60%)		EA (40%)		Total
			L	T	P		MP1 30%	MP2 30%			
2BTRE06	Engineering ChemistryLab	2	0	0	2	2	30	30	40		100
2BTRE07	Human Values Activities	2	0	0	2	2	30	30	40		100
2BTRE08	Manufacturing Practices Workshop	2	0	0	2	2	30	30	40		100
2BTRE09	Basic Electrical Engineering Lab	2	0	0	2	2	30	30	40		100
2BTRE10	Computer Aided Machine Drawing	2	0	0	2	2	30	30	40		100
	Grand Total	**27**	**18**	**6**	**11**						**1000**

Semester III

Code	Subject	Cr	Hrs. /Week			Exam Hrs.	Maximum Marks				
			L	T	P		MS1	MS2	END TERM	IA	Total
Theory											
3BTRE01	Linear Algebra	3	3	1	0	3	10	10	60	20	100
3BTRE02	Electronic Devices and Circuits	3	3	1	0	3	10	10	60	20	100
3BTRE03	Programming in Python	3	3	1	0	3	10	10	60	20	100
3BTRE04	Sensors and Instrumentation	3	4	1	0	3	10	10	60	20	100
3BTRE05	Electrical Machines and Drives	3	3	1	0	3	10	10	60	20	100
3BTRE06	Strength of Materials	3	3	1	0	3	10	10	60	20	100
Practicals & Sessionals											
Code	Subject	Cr	Hrs. /Week			Exam Hrs.	IA (60%)		EA (40%)		Total
			L	T	P		MP1 30%	MP2 30%			
3BTRE07	Electronic Devices and Circuits Lab	2	0	0	2	2	30	30	40		100
3BTRE08	Programming in Python Lab	2	0	0	2	2	30	30	40		100
3BTRE09	Electrical Machines and Drives Lab	2	0	0	2	2	30	30	40		100
3BTRE10	Strength of Materials Lab	2	0	0	2	2	30	30	40		100
	Grand Total	**27**	**18**	**6**	**11**						**1000**

Semester IV

Code	Subject	Cr	Hrs. /Week			Exam Hrs.	Maximum Marks				
			L	T	P		MS1	MS2	END TERM	IA	Total
Theory											
4BTRE01	Fourier Series and Partial Differential Equations	3	3	1	0	3	10	10	60	20	100
4BTRE02	Principles of Robotics	3	3	1	0	3	10	10	60	20	100
4BTRE03	Analog and Digital Electronics	3	3	1	0	3	10	10	60	20	100
4BTRE04	Automatic Control Systems	3	4	1	0	3	10	10	60	20	100
4BTRE05	Kinematics and Dynamics of Machines	3	3	1	0	3	10	10	60	20	100
4BTRE06	Hydraulics and Pneumatics	3	3	1	0	3	10	10	60	20	100
Practicals & Sessionals											
Code	Subject	Cr	Hrs. /Week			Exam Hrs.	IA (60%)		EA (40%)		Total
			L	T	P		MP1 30%	MP2 30%			
4BTRE07	Analog and Digital Electronics Lab	2	0	0	2	2	30	30	40		100
4BTRE08	Automatic Control Systems Lab	2	0	0	2	2	30	30	40		100
4BTRE09	Kinematics and Dynamics of Machines Lab	2	0	0	2	2	30	30	40		100
4BTRE010	Hydraulics and Pneumatics Lab	2	0	0	2	2	30	30	40		100
	Grand Total	**27**	**18**	**6**	**11**						**1000**

Semester V

Code	Subject	Cr	Hrs. /Week			Exam Hrs.	Maximum Marks				
			L	T	P		MS1	MS2	END TERM	IA	Total
Theory											
5BTRE01	Statistics and Numerical Methods	3	3	1	0	3	10	10	60	20	100
5BTRE02	Microcontroller and Embedded System Design	3	3	1	0	3	10	10	60	20	100
5BTRE03	Programmable Logic Controllers	3	3	1	0	3	10	10	60	20	100
5BTRE04	Robotic Control Systems	3	4	1	0	3	10	10	60	20	100
5BTRE05	CNC Machine and Metrology	3	3	1	0	3	10	10	60	20	100
5BTRE06	Field and Service Robotics	3	3	1	0	3	10	10	60	20	100
Practicals & Sessionals											
Code	Subject	Cr	Hrs. /Week			Exam Hrs.	IA (60%)		EA (40%)		Total
			L	T	P		MP1 30%	MP2 30%			
5BTRE07	Microcontroller and Embedded System Design Lab	2	0	0	2	2	30	30	40		100
5BTRE08	PLC and Robotics Lab	2	0	0	2	2	30	30	40		100
5BTRE09	CNC and MetrologyLab	2	0	0	2	2	30	30	40		100
5BTRE10	General Proficiency – I	2	0	0	2	2	30	30	40		100
	Grand Total	**27**	**18**	**6**	**11**						**1000**

III Year – 6 Semester

Semester VI											
Code	**Subject**	**Cr**	**Hrs. /Week**			**Exam Hrs.**	**Maximum Marks**				
			L	**T**	**P**		**MS1**	**MS2**	**END TERM**	**IA**	**Total**
Theory											
6BTRE01	Modeling and Simulation	3	3	1	0	3	10	10	60	20	100
6BTRE02	Robot Kinematics and Dynamics	3	3	1	0	3	10	10	60	20	100
6BTRE03	Programming for Robotics	3	3	1	0	3	10	10	60	20	100
6BTRE04	Automation System Design	3	4	1	0	3	10	10	60	20	100
6BTRE05	Design of Mechanical Transmission Systems	3	3	1	0	3	10	10	60	20	100
6BTRE06	Applied Robotics	3	3	1	0	3	10	10	60	20	100
Practicals & Sessionals											
Code	Subject	Cr	Hrs. /Week			Exam Hrs.	IA (60%)		EA (40%)		Total
			L	T	P		MP1 30%	MP2 30%			
6BTRE07	Modeling and SimulationLab	2	0	0	2	2	30	30	40		100
6BTRE08	Automation System Design Lab	2	0	0	2	2	30	30	40		100
6BTRE09	Virtual Instrumentation Lab	2	0	0	2	2	30	30	40		100
6BTRE10	General Proficiency – II	2	0	0	2	2	30	30	40		100
	Grand Total	**27**	**18**	**6**	**11**						**1000**

Semester VII

Code	Subject	Cr	Hrs. /Week			Exam Hrs.	Maximum Marks				
			L	T	P		MS1	MS2	END TERM	IA	Total
Theory											
7BTRE01	Industrial Robotics and Material Handling	3	3	1	0	3	10	10	60	20	100
7BTRE02	Artificial Intelligence for Robotics	3	3	1	0	3	10	10	60	20	100
7BTRE03	Totally Integrated Automation	3	3	1	0	3	10	10	60	20	100
7BTRE04	Mobile Robotics	3	4	1	0	3	10	10	60	20	100
7BTRE5	Operations Research	3	3	1	0	3	10	10	60	20	100
Practicals & Sessionals											
Code	Subject	Cr	Hrs. /Week			Exam Hrs.	IA (60%)		EA (40%)		Total
			L	T	P		MP1 30%	MP2 30%			
7BTRE06	Totally Integrated AutomationLab	2	0	0	2	2	30	30	40		100
7BTRE07	Innovative Practices	2	0	0	2	2	30	30	40		100
7BTRE08	Industrial Visit/Training	2	0	0	2	2	30	30	40		100
7BTRE09	Project Work-I	2	0	0	2	2	30	30	40		100
7BTRE10	Totally Integrated AutomationLab	2	0	0	2	2	30	30	40		100
	Grand Total	**27**	**18**	**6**	**11**						**1000**

Semester VIII

Practicals & Sessionals										
Code	Subject	Cr	Hrs. /Week			Exam Hrs.	IA (60%)		EA (40%)	Total
			L	T	P		MP1 30%	MP2 30%		
8BTRE01	Professional Ethics	2	0	0	2	2	30	30	40	100
8BTRE02	Maintenance and SafetyEngineering	2	0	0	2	2	30	30	40	100
8BTRE03	Image Processing and Vision Systems	2	0	0	2	2	30	30	40	100
8BTRE04	Seminar	2	0	0	2	2	30	30	40	100
8BTRE05	Project Work	2	0	0	2	2	30	30	40	100
	Grand Total									**500**

SEMESTER I

MATHEMATICS - I 3 1 0 4

COURSE OBJECTIVES

- To introduce and familiarize with functions of several variables and the idea of applying calculus concepts to problems in Engineering.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.
- To introduce effective mathematical tools for the solutions of differential equations that model physical processes.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Apply knowledge of mathematics to solve functions of several variables.
- Identify, formulate, and solve engineering problems like multiple integrals and their usage.
- To solve differential equations that model physical processes using effective mathematical tools

UNIT I: CALCULUS

Curvature, radius of curvature, evolutes and involutes. Beta and Gamma functions and their properties. (12)

UNIT II : FUNCTIONS OF SEVERAL VARIABLES

Partial derivatives, Total derivatives, Differentiation of implicit functions, Change of variables, Jacobians and their properties, Taylor_s series for functions of two variables, Maxima and minima, Lagrange_s method of undetermined multipliers. (12)

UNIT III : MULTIPLE INTEGRALS AND APPLICATIONS

Multiple Integrals, change of order of integration and change of variables in double integrals (Cartesian to polar). Applications: Areas by double integration and volumes by triple integration (Cartesian and polar). (12)

UNIT IV : DIFFERENTIAL EQUATIONS

Exact equations, First order linear equations, Bernoulli_s equation, orthogonal trajectories, growth, decay and geometrical applications. Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut_s type. (12)

UNIT V: DIFFERENTIAL EQUATIONS (HIGHER ORDER)

Linear differential equations of higher order – with constant coefficients, the operator D, Euler_s linear equation of higher order with variable coefficients, simultaneous linear differential equations, solution by variation of parameters method simple applications to electric circuits. (12)

TEXT BOOKS:

1. Venkataraman, M. K, Engineering Mathematics (First Year), Second Edition, The National Publishing Company, Chennai 2010 (For units I, III, IV, V)
2. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi, 41st Edition, 2011. (For Unit II only)

REFERENCE BOOKS:

1. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
2. Kandasamy P. et al, Engineering Mathematics, Vol.1 & 2, S. Chand & Co., New Delhi.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
4. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, New Delhi,

8th Edition.
5. Bali, N. P, and Manish Goyal, Advanced Engineering Mathematics, Lakshmi Publications, New Delhi, 2007.

PHYSICS **4 0 0 4**

COURSE OBJECTIVES

- To understand the concepts of physics and its significant contributions in the advancement of technology and invention of new products that dramatically transformes modern-day society.
- To expose the students to different areas of physics which have direct relevance and applications to different Engineering disciplines
- To understand the concepts and applications of Ultrasonics, optics and some optical devices, Lasers and Fiber optics, Nuclear energy sources and wave mechanics.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Apply knowledge of science and engineering to understand physics and its significant contributions in the advancement of technology and invention of new products that dramatically transform modern-day society.
- Identify different areas of physics which have direct relevance and applications to different Engineering disciplines.
- Apply fundamental knowledge to understand applications of Ultrasonics, optics and some optical devices, Lasers and Fiber optics, Nuclear energy sources and wave mechanics.

UNIT I : ACOUSTICS & NDT

Ultrasonics- Ultrasonic Waves Productions (Piezoelectric & Magnetostriction method) – Detections (Acoustic Grating). NDT application – Ultrasonic Echo method – Liquid Penetrant method Acoustics - Factors affecting Acoustic of Buildings (Reverberation, Loudness, Focusing, Echo, Echelon Effect and Resonance) and their Remedies - Sabine_s formula for Reverberation Time–Doppler effect and its application to Radars (elementary idea) (9)

UNIT II : OPTICS

Interference-Air Wedge – Michelson_s Interferometer – Wavelength Determination – Interference Filter – Antireflection Coatings.Diffraction - Diffraction Grating – Dispersive power of grating - Resolving Power of Grating & Prism. Polarization –Basic concepts of Double Refraction - Huygens Theory of Double Refraction – Quarter and Half Wave Plates – Specific Rotary Power – Laurent Half Shade Polari meter. (9)

UNIT III: LASERS & FIBER OPTICS

Lasers - Principles of Laser – Spontaneous and Stimulated Emissions - Einstein_s Coefficients – Population Inversion and Laser Action – Types of optical resonators(qualitative Ideas) – Types of Lasers -NdYAG, CO_2 laser, GaAs Laser – Application of Lasers. Fiber Optics - Principle and Propagation of light in optical fiber – Numerical aperture and acceptance angle – Types of optical fibers (material, refractive index, mode)- Application to sensors and Fiber Optic communication. (9)

UNIT IV: WAVE MECHANICS

Matter Waves – de Broglie Wavelength – Uncertainty Principle – Schrödinger Wave Equation – Time Dependent – Time Independent – Application to Particle in a One Dimensional potential Box – Quantum Mechanical Tunneling – Tunnel Diode. (9)

UNIT V: NUCLEAR ENERGY SOURCE

General Properties of Nucleus (Size, Mass, Density, Charge) – Mass Defect – Binding Energy - Disintegration in fission – Nuclear Reactor: Materials Used in Nuclear Reactors. – PWR – BWR – FBTR. Nuclear fusion reactions for fusion reactor – D-D and D-T

reactions, Basic principles of nuclear fusion reactors. (9)

TEXT BOOKS:

1. V Rajendran, Engineering Physics, 2nd Ed., TMH, New Delhi 2011 (For Units I to IV only)
2. Arthur Beiser, Concept of Modern Physics, 6th Ed, TMH, New Delhi 2008 (For Unit V Only)

REFERENCE BOOKS:

1. Ajay Ghatak, Optics, TMH, New Delhi, 2007.
2. Thiagarajan and Ghatak, Lasers fundamental and Application, TMH, New Delhi 2008.
3. R. Murugesan, Modern Physics, S. Chand & Co, New Delhi 2006
4. K.R.Nambiar, Lasers, New Age International, New Delhi, 2008
5. Science of Engineering Materials, 2nd Edition, C.M. Srivastava and C. Srinivasan, New Age Int. (P) Ltd, New Delhi, 1997
6. Avadhanulu M N Engineering Physics, Vol-I, S. Chand & Co,2009.

CHEMISTRY **4 0 0 4**

COURSE OBJECTIVES

- To know about the importance of Chemistry in Engineering domain
- To understand the chemistry background of industrial process
- To apply chemistry knowledge for engineering disciplines

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Apply knowledge of science and engineering to understand the importance of Chemistry in Engineering domain
- Identify different Electrochemical cells and their usage for industrial process
- Apply fundamental knowledge of chemistry and build an interface of theoretical concepts with industrial applications / engineering applications.

UNIT I : WATER

Hardness of water – units and calcium carbonate equivalent. Determination of hardness of water- EDTA method. Disadvantages of hardwater-boiler scale and sludge, caustic embrittlement, priming & foaming and boiler corrosion. Water softening method – internal & external conditioning – Lime-soda process, Zeolite process and Ion exchange process. Desalination – reverse osmosis & electrodialysis. (9)

UNIT II : POLYMERS

Classification, types of polymerization reactions – mechanism of radical, ionic and Ziegler-Natta polymerizations. Polymer properties – chemical resistance, crystallinity and effect of temperature, Mn and Mw. Thermoplastics and thermosets. Preparation, properties and uses of PVC, TEFLON, Nylons, Bakelite, Polyurithane, Rubbers – vulcanization, synthetic rubber, BuNa-S, BuNa-N, silicone and butyl rubber. Conducting polymers – classification and applications. Polymer composites – FRP – laminar composites. Moulding constituents of plastic, moulding techniques – compression, injection, transfer and extrusion moulding. (9)

UNIT III: ELECTROCHEMICAL CELLS

Galvanic cells, single electrode potential, standard electrode potential, electromotive series. EMF of a cell and its measurement. Nernst equation. Electrolyte concentration cell. Reference electrodes-hydrogen calomel, Ag /AgCl & glass electrodes. Batteries - primary and secondary cells, laclanche cell, lead acid storage cell, Ni-Cd battery & alkaline battery. Fuel cells - H2-O2 fuel cell. (9)

UNIT IV: CORROSION AND ITS CONTROL

Chemical & electrochemical corrosion-Galvanic series- galvanic, pitting, stress and concentration cell corrosion. Factors influencing corrosion- corrosion control methods - cathodic protection and corrosion inhibitors. Protective coating - types of protective coatings-metallic coating-tinning and galvanizing, cladding, electroplating and Anodizing. (9)

UNIT V: PHASE RULE

Definition and derivation of phase rule. Application to one component system - water and sulphur systems. Thermal analysis, condensed phase rule. Two component alloy systems - Pb-Ag, Cu-Ni and Mg-Zn systems. (9)

TEXT BOOKS:

1. P.C. Jain and Monika Jain, Engineering Chemistry, Dhanpat Rai and Sons, New Delhi 2010.

REFERENCE BOOKS:

1. S. S. Dara, A Textbook of Engineering Chemistry, 11th Ed, S. Chand & Co., Ltd.

New Delhi., 2008.
2. B. K. Sharma, Engineering Chemistry, 3rd edition Krishna Prakashan Media (P) Ltd., Meerut, 2001
3. P. Kannan and A. Ravi Krishnan –Engineering Chemistry‖ Hi-Tech Sri Krishna Publications, Chennai, 9th Ed, 2009
4. N. Krishnamurthy, P. Vallinayagam and D. Madhavan, Engineering Chemistry, 2nd edition. PHI Learning PVT., LTD, New Delhi, 2008.

BASIC CIVIL AND MECHANICAL ENGINEERING **4 0 0 4**

COURSE OBJECTIVES

- To be able to differentiate the types of buildings according to national building code and understand building components and their functions as well as different types of roads, bridges and dams.
- To explain the concepts of thermal systems used in power plants and narrate the methods of harnessing renewable energies
- To explain the role of basic manufacturing processes and develop an intuitive understanding of underlying working principles of mechanical machines and systems.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Get an idea about construction procedure and steps involved in component design of the building.
- Understand the manufacturing processes such as casting, forming, joining, and machining
- Apply the Functions of Prime movers, working of IC engines and refrigerator Understand.

PART - A CIVIL

ENGINEERINGUNIT I : BUILDINGS, BUILDING

MATERIALS

Buildings-Definition-Classification according to NBC- plinth area, Floor area, carpet area, floor space index-construction materials-stone, brick, cement, cement-mortar, concrete, steel- their properties and uses.

(10)

UNIT II: BUILDINGS AND THEIR COMPONENTS

Buildings- Various Components and their functions. Soils and their classification Foundations-Functions and types of foundations, Masonry - Function and types, Floors-Definition and types of floors, Roofs : Definition and types**.** **(10)**

UNIT III : BASIC INFRASTRUCTURE

Basic Infrastructure: Surveying-classification, general principles, types, uses, instruments used. Roads – types : Components, types and their advantage and disadvantage. Bridges-components and types of bridges. Dams-Purpose, types of dams. Water supply-sources and quality requirements need and principles of Rainwater harvesting. (10)

PART - B MECHANICAL ENGINEERING

UNIT IV: INTERNAL AND EXTERNAL COMBUSTION

SYSTEMS

IC engines – Classification – working principles – Diesel and petrol engines: two stroke and four stroke engines. Merits and demerits.

Steam generators (Boilers) – Classification – Constructional features (of only low pressure boilers)– Boiler mountings and accessories. Merits and demerits- Applications. **(10)**

UNIT V: POWER GENERATION SYSTEMS

Conventional and Non-Conventional: Hydraulic – Thermal – Nuclear power plants –

Schemes and layouts (Description Only) – Solar – Wind - Geothermal – Wave – Tidal and Oceans thermal Energy Conversion systems – Basic power plant schemes and layouts (Description only). **(10)**

UNIT VI : MANUFACTURING PROCESS

Machines – Lathe – Drilling – Bending – Grinding Shearing (Description only) Machining Processes – Turning – Planning – Facing – Blanking – Drilling – Punching – Shearing – Bending – Drawing – Filing – Sawing – Grinding. Moulding and Metal Joining - Pattern making – Green and dry sand moulding – Arc and Gas welding – Brazing – Soldering (process description only). **(10)**

TEXT BOOKS:

1. Natarajan, K V, Basic Civil Engineering, 11th Edition, Dhanalakshmi Publications Chennai, 2011. (For Units I to III)
2. Venugopal , K and Prabhu Raja, Basic Mechanical Engineering, Anuradha Publisher, 2012 (For Units IV to VI).
3.

REFERENCE BOOKS:

1. Purushothama Raj.P., Basic civil engineering, 3rd Edn., Dhanam Publications, Chennai,2001
2. Rajput, R K, Engineering Materials, S Chand & Co. Ltd., New Delhi, 2012.
3. Punmia, B.C., et. al., Surveying , Vol-I, Laxmi Publishers, New Delhi, 2012.
4. Punmia, B.C., et.al Building Construction, Laxmi Publishers, New Delhi ,2012.
5. El. Wakil, M.M., Power Plant Technology, Mc Graw Hill Book Co.,1985.
6. Hajra Choudhry, et. al., Workshop Technology Vol I and II, Media Promoters Publishers Pvt. Ltd., Bombay, 2004.
7. Lindberg, R .A. Process and Materials of Manufacture, PHI, 1999.
8. H.N.Gupta, R.C.Gupta and Arun Mittal, Manufacturing Processes, New Age Publications, 2001
9. Nagpal, Power Plant Engineering, Khanna Publishers, Delhi, 1998.

ENGINEERING MECHANICS **3 1 0 4**

COURSE OBJECTIVES

- 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

On successful completion of the module students will be able to:

- 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
- 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
- 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. **(12)**

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. **(12)**

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. **(12)**

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. **(12)**

UNIT V : KINEMATICS AND KINETICS OF RIGID BODIES

Plane motion, Absolute motion, Relative motion, translating axes and rotating axes, work and energy, impulse and momentum. **(12)**

TEXT BOOKS:

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

REFERENCE BOOKS:

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.

COMMUNICATIVE ENGLISH **4 0 0 4**

COURSE OBJECTIVES

- To improve the LSRW skills of I year B.Tech students
- To instill confidence and enable the students to communicate with ease
- To equip the students with the necessary skills and develop their language prowess

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Apply fundamental knowledge to improve the LSRW skills of I year B.Tech students
- To enable the students to communicate with ease
- Apply basic knowledge to equip the students with the necessary skills and develop their language prowess

UNIT I : BASIC COMMUNICATION THEORY

Importance of Communication – stages of communication, modes of communication – barriers to communication – strategies for effective communication – Listening: Importance, types, barriers – Developing effective listening skills. **(12)**

UNIT II: COMPREHENSION AND ANALYSIS

Comprehension of technical and non-technical material- Skimming, scanning, inferring- Note making and extension of vocabulary, predicting and responding to context- Intensive Reading and Reviewing. **(12)**

UNIT III: WRITING

Effective sentences, cohesive writing, clarity and conciseness in writing – Introduction to Technical Writing – Better paragraphs, Definitions, Practice in Summary Writing – Four modes of writing – Use of dictionaries, indices, library references – making bibliographical entries with regard to sources from books, journals, internet etc. **(12)**

UNIT IV: BUSINESS WRITING / CORRESPONDENCE

Report writing – Memoranda – Notice – Instruction – Letters – Resumes – Job applications. **(12)**

UNIT V: ORAL COMMUNICATION

Basics of phonetics – Presentation skills – Group Discussions – Dialogue writing – Short Extempore – Debates-Role Plays-Conversation Practice. **(12)**

TEXT BOOKS:

1. Robert J.Dixson. ,Complete Course in English, Prentice-Hall of India Pvt. New Delhi,2006

REFERENCE BOOKS

1. Ashraf M.Rizvi., Effective Technical Communication. Tata-McGraw, 2005.
2. Boove, Courtland R et al., Business Communication Today. Delhi. Pearson Education ,2002.
3. Meenakshi Raman and Sangeeta Sharma., Technical Communication Principles And Practice,OUP, 2007.
4. Robert J.Dixson., Everyday Dialogues in English, Prentice-Hall of India Pvt. Ltd., New Delhi,2007.
5. Sethi,J and Kamalesh Sadanand., A Practical Course in English Pronunciation, Prentice-Hall of India Pvt. Ltd, New Delhi,2007.

PHYSICS LABORATORY **0 0 3 2**

COURSE OBJECTIVES

- To provide a practical understanding of some of the concepts learnt in the theory course on Physics.

COURSE OUTCOMES

- An ability to understand, explain and use instrumental techniques for intensity pattern analysis
- Ability to operate optical equipments like Spectrometer, Polarimeter to find the optical properties like dispersive power, Resolving power and specific rotatory power
- Capable of handling screw gauge, vernier caliper and travelling microscope to calculate the required parameters
- Acquire basic knowledge about thermal conduction and magnetic field due to a current carrying coil

LIST OF EXPERIMENTS (ANY 10 EXPERIMENTS)

1. Thermal conductivity – Lee_s DISC
2. Thermal conductivity - Radial flow
3. Spectrometer – Prism or Hollow prism
4. Spectrometer – Transmission grating
5. Spectrometer - Ordinary & Extraordinary rays
6. Newton_s rings
7. Air – wedge
8. Half shade polarimeter – Determination of specific rotatory power
9. Jolly_s experiment – determination of α
10. Magnetism: i – h curve
11. Field along the axis of coil carrying current
12. Vibration magnetometer – calculation of magnetic moment & pole strength
13. Laser experiment: wavelength determination using transmission grating, reflection grating (vernier calipers) & particle size determination
14. Determination of optical absorption coefficient of materials using laser
15. Determination of numerical aperture of an optical fiber
16. Electrical conductivity of semiconductor – two probe / four probe method
17. Hall effect in semiconductor

CHEMISTRY LABORATORY **0 0 3 2**

COURSE OBJECTIVES

- To gain a practical knowledge of Engineering Chemistry in relevance to Industrial applications

COURSE OUTCOMES

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

LIST OF EXPERIMENTS (ANY 10 EXPERIMENTS)

1. Determination of dissolved oxygen in water.
2. Determination of total hardness of water by EDTA method.
3. Determination of carbonate and bicarbonate in water.
4. Estimation of chloride content in water.
5. Estimation of magnesium by EDTA.
6. Estimation of Acetic acid in vinegar.
7. Estimation of ferrous by permanganometry.
8. Estimation of ferrous and ferric iron in a solution mixture by dichrometry.
9. Estimation of available chlorine in bleaching powder.
10. Estimation of copper in copper sulphate solution.
11. Estimation of calcium by permanganometry.
12. Estimation of iron by colorimetry

DEMONSTRATION EXPERIMENTS (ANY TWO OF THE FOLLOWING)

1. Determination of COD of water sample.
2. Determination of lead by conductometry.
3. Percentage composition of sugar solution by viscometry

WORKSHOP PRACTICE **0 0 3 2**

COURSE OBJECTIVES

- To convey the basics of mechanical tools used in engineering
- To establish hands on experience on the working tools
- To develop basic joints and fittings using the hand tools
- To establish the importance of joints and fitting in engineering applications
- To explain the role of basic workshop in engineering
- To develop an intuitive understanding of underlying physical mechanism used in mechanical machines.

COURSE OUTCOMES

- To acquire skills in basic engineering practice.
- To identify the hand tools and instruments.
- To acquire measuring skills.
- To acquire practical skills in the trades.
- To provides the knowledge of job materials in various shops.

I FITTING

Study of tools and Machineries. Exercises on symmetric joints and joints with acute angle

1. Study of tools and Machineries
2. Symmetric fitting
3. Acute angle fitting

II WELDING

Study of arc and gas welding equipment and tools – Edge preparation – Exercises on lap joint and V Butt joints –Demonstration of gas welding

1. Study of arc and gas welding equipment and tools
2. Simple lap welding (Arc)
3. Single V butt welding (Arc)

III SHEET METAL WORK

Study of tools and Machineries – exercises on simple products like Office tray and waste collection tray

1. Study of tools and machineries
2. Funnel
3. Waste collection tray

IV CARPENTRY

Study of tools and Machineries – Exercises on Lap joints and Mortise joints

1. Study of tools and machineries
2. Half lap joint
3. Corner mortise joint

SEMESTER II **3 1 0 4**

MATHEMATICS – II

COURSE OBJECTIVES

- To develop the use of matrix algebra techniques for practical applications and to introduce the concepts of Curl, Divergence and integration of vectors in vector calculus which is needed for many application problems.
- To introduce Laplace transform which is a useful technique in solving many application problems and to solve differential and integral equations
- To acquaint the students with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Apply knowledge of mathematics to solve matrix algebra techniques for practical applications and Curl, Divergence and integration of vectors in vector calculus for many application problems.
- Identify, formulate, and solve engineering problems like Laplace transform which is a useful technique in solving many application problems and to solve differential and integral equations
- Apply formulae and analyze problems of Fourier transform techniques

UNIT I: MATRICES

Eigenvalues and Eigen vectors of a real matrix, Characteristic equation, Properties of Eigenvalues and Eigenvectors. Cayley-Hamilton Theorem, Diagonalization of matrices. Reduction of a quadratic form to canonical form by orthogonal transformation. Nature of quadratic forms. **(12)**

UNIT II: VECTOR CALCULUS

Vector Calculus: Gradient, divergence and curl, their properties and relations. Gauss divergence theorem and Stoke_s theorem (without proof). Simple application problems. **(12)**

UNIT III: LAPLACE TRANSFORM

Definition, Transforms of elementary functions, properties. Transform of derivatives and integrals. Multiplication by t and division by t. Transform of unit step function, transform of periodic functions. Initial and final value theorems. **(12)**

UNIT IV: APPLICATIONS OF LAPLACE TRANSFORM

Methods for determining inverse Laplace Transforms, convolution theorem, Application to differential equations and integral equations. Evaluation of integrals by Laplace transforms. **(12)**

UNIT V: FOURIER TRANSFORM

Fourier Integral theorem (statement only), Fourier transform and its inverse, properties. Fourier sine and cosine transforms, their properties, convolution and Parseval_s identity. **(12)**

TEXT BOOKS:

1. Venkataraman M.K, Engineering Mathematics The National Publishing Company, Chennai, 2012.
2. Kandasamy P. et al, Engineering Mathematics, Vol.2 & 3, S. Chand & Co., New Delhi.

REFERENCE BOOKS:

1. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
2. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, New Delhi,41st Edition, 2011.
3. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
4. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, New Delhi.
5. Bali N. and Goyal M., Advanced Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 7th Edition, 2010

MATERIAL SCIENCE **4 0 0 4**

COURSE OBJECTIVES

To understand the importance of Material Science as a subject that revolutionized modern day technologies

- To understand the significance of material science in the development of new materials and devices for all branches of Engineering
- To impart knowledge to the Engineering students about some of the important areas of Materials Science so as to enable them perceive the significant contributions of the subject in Engineering and Technology

6.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Apply core concepts in Materials Science to solve engineering problems.
- knowledgeable of contemporary issues relevant to Materials Science and Engineering.
- Select materials for design and construction.
- Understand the importance of life-long learning.

UNIT I: CRYSTAL STRUCTURE AND DEFECTS

Crystal structure - Bravais Lattices , Crystal Systems - Coordination Number, Atomic Radius, Packing Factor for FCC & HCP structures – Miller Indices- Powder X Ray Diffraction Method. Lattice defects – Qualitative ideas of point, line, surface and volume defects.

(12)

UNIT II: DIELECTRIC PROPERTIES

Dielectric Polarization and Mechanism –Temperature dependence of polarization, Internal or local Field - Clausius-Mossotti relation. Basic ideas of Dielectric loss - frequency dependence of dielectric constant – Measurement of Dielectric constant and loss using Scherring bridge – Elementary ideas of Piezoelectrics, Ferroelectrics and Pyroelectric materials and Applications.

(12)

UNIT III: MAGNETIC PROPERTIES

Origin of atomic magnetic moment – Bohr magneton-Elementary Ideas of classification of magnetic materials (Dia, Para, Ferro, antiferro & Ferri). – Quantum theory of Para & Ferro Magnetism – Domain Theory of Hysteresis – Heisenberg Theory of Exchange Interaction (without derivation) – Qualitative ideas of Anti ferromagnetic Ordering – Structure and Properties of Ferrites – Properties of Soft & Hard Magnetic Materials – Applications. Magnetic data storage – Magnetic tapes, Hard disks, Magneto optical recording. (12)

UNIT IV: SEMICONDUCTORS AND SUPERCONDUCTORS

Semiconductors -Derivation of Carrier concentration in intrinsic Semiconductors –Basic ideas of Electrical conductivity in intrinsic and extrinsic semiconductors (without derivations) -temperature dependence of carrier concentration and electrical conductivity in semiconductors (qualitative ideas), Hall effect in Semiconductors --Application of Hall Effect, Basic Ideas of Compound Semiconductors (II-VI & III-V) Superconductivity - Basic concepts – transition temperature – Meissener effect – Type I and II superconductors – High Temperature Superconductors – 123 superconductor – Applications of superconductors. **(12)**

UNIT V: ADVANCED MATERIALS

Liquid Crystals – Types – Application as Display Devices Metallic Glasses – preparation by melt spinning. Twin roller system, properties and applications,Shape Memory alloys (SMA), Shape memory effect, Properties and applications of SMA Nanomaterials - Nano materials (one, Two& three Dimensional) –Methods of synthesis (PVD, CVD, Laser Ablation, Solgel, Ball-milling Techniques), Properties and applications of nanomaterials. carbon nanotubes – synthesis, Properties and applications. **(12)**

TEXT BOOKS:

1. V Rajendran, Engineering Physics, 2nd Edition, TMH, New Delhi 2011.

REFERENCE BOOKS:

1. Ali Omar M, Elementary Solid State Physics, Addison Wesley Publishing Co., 2009.
2. William D Callister Jr., Material Science and Engineering, 6th Edition, John Wiley and sons, 2009.
3. Charles Kittel, Introduction to Solid State Physics, 7th Edition, John Wiley & sons, Singapore, 2007.
4. V Raghavan , Materials Science and Engineering- A First Course, 5th Edition, Prentice Hall of India, 2008.
5. B.S. Murty, P. Shankar, Baldev Raj, B.B. Rath, and James Murday, Text book of Nanoscience and Nanotechnology, Universities Press, Hyderabad 2012
6. M.N. Avadhanulu, Enginerring Physics- Volume-II, S.Chand &Co, New Delhi, 2009
7. Pillai S.O, Solid State Physics, 6th Edition – New Age International, 2005.

ENVIRONMENTAL SCIENCE **4 0 0 4**

COURSE OBJECTIVES

- To know about the environment
- To understand about environmental pollution
- To apply the knowledge in understanding various environmental issues and problems

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Apply fundamental knowledge to understand about the environment
- Identify environmental pollution through science
- Apply basic knowledge to solve various environmental issues and problems

UNIT I: ENVIRONMENT AND ENERGY RESOURCES

Environmental segments – atmosphere, hydrosphere, lithosphere and biosphere. Atmospheric layers. Pollution definition and classification.Pollutants classification. Forest resources – use and over exploitation, deforestation, forest management. Water resources – use and conflicts over water, dams - benefits and problems. Mineral resources – mineral wealth of India, environmental effects of extracting and using mineral resources. Food resources – world food problems, environmental impact of modern Agriculture – fertilizer and pesticides. Energy resources – growing needs, renewable and non-renewable energy resources and use of alternate energy sources. From unsustainable to sustainable development. **(12)**

UNIT II: ECOSYSTEM & BIODIVERSITY

Concept of an ecosystem - structure and function of an ecosystem. Producers, consumers, and decomposers. Energy flow in the ecosystem. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of forest, grassland, desert and aquatic (fresh water, esturine and marine) ecosystems. Biodiversity – definition, genetic species and ecosystem diversity. Value of biodiversity - consumptive use, productive use, social, ethical, aesthetic and option values. Hot spots of biodiversity. Threats to biodiversity, habitat loss, poaching of wildlife, human wildlife conflicts. Endangered and endemic species.Conservation of biodiversity – in-situ and ex-situ conservation of biodiversity. (12)

UNIT III: AIR POLLUTION

Definition and classification. Chemical and photochemical reaction in different layers of atmosphere. Causes, sources, effects and control measures of air pollutants - oxides of Nitrogen, oxides of Carbon, oxides of Sulfur, hydrocarbons, chloro-fluoro carbons and particulates. Mechanism and effects of air pollution phenomenon – Global Warming, Ozone Depletion, Acid Rain, Sulfurous Smog and Photochemical Smog. **(12)**

UNIT IV: WATER AND LAND POLLUTION

Water pollution – causes and effects of organic water pollutants – pesticides, insecticides, detergents and surfactants. Causes and effects of inorganic water pollutants – heavy metal pollution due to Hg, Pb, Cr & Cu. Water pollution control and monitoring – DO, COD, BOD & TOC. Land Pollution – Solid waste management – causes, effect and control measures of urban and industrial wastes. Thermal and radioactive pollution. **(12)**

UNIT V: POLLUTION CONTROL AND MONITORING

Basic concepts and instrumentation of IR, UV-VIS, atomic absorption spectrometry, Gas

Chromatography and Conductometry. Analysis of air pollutants – NOx, COx, SOx, H2S, Hydrocarbons and particulates. **(12)**

TEXT BOOKS:

1. Raghavan Nambiar K., ―Text Book of Environmental Studies‖ 2nd edition, Scitech Publications, India, Pvt. Ltd, Chennai, 2008.
2. A.K. De, ―Environmental chemistry‖ 6rd edition; New age international (P) Ltd, New Delhi, 2006

REFERENCE BOOKS:

1. B.K. Sharma, ―Environmental chemistry‖ 11th Ed, KRISHNA Prakashan Media (P) Ltd, Meerut, 2007.
2. S.S.Dara, and D.D. Mishra ―A text book of environmental chemistry and pollution control, 5th Ed, S.Chandand Company Ltd, New Delhi, 2012.
3. Richard T. Wright, Environmental Science: Toward a Sustainable Future, 10thedition, Prentice Hall, 2008
4. G. S. Sodhi, Fundamental concepts of environmental chemistry, I Ed, Alpha Science International Ltd, India, 2000

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING 3 1 0 4

COURSE OBJECTIVES

- To understand and gain basic knowledge about magnetic and electrical circuits, single phase and three phase power measurement and the operating principles of stationary and rotating machines
- To understand the basic operation, functions and applications of PN junction diode, transistor, logic gates and flipflops.
- To understand the measuring devices in electronics.
- To gain knowledge on various communication systems and network models.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Will gain basic knowledge about magnetic and electrical circuits, single phase and three phase power measurement and the operating principles of stationary and rotating machines
- Will gain basic knowledge on instruments for measurements, communication systems and network models.

PART – A - ELECTRICAL

UNIT I: DC CIRCUIT

Definition of Voltage, Current, Power & Energy, circuit parameters, Ohm's law,Kirchoff's law & its applications – Simple Problems - Division of current in Series & parallel circuits - star/delta conversion - Node and mesh methods of analysis of DC circuits. (**10)**

UNIT II: AC CIRCUIT

Concepts of AC circuits – rms value, average value, form and peak factors -Simple RLC series circuits – Concept of real and reactive power – Power factor - Introduction to three phase system - Power measurement by two wattmeter method. **(10)**

UNIT III :ELECTRICAL MACHINES AND POWER PLANTS:

Law of Electromagnetic induction, Fleming_s Right & Left hand rule - Principle of DC rotating machine, Single phase transformer and single phase induction motor(Qualitative approach only) - Simple layout of thermal and hydro generation (block diagram approach only).Fundamentals of fuses and circuit breakers. **(10)**

PART – B – ELECTRONICS

UNIT IV: ELECTRONIC CIRCUIT

V-I Characteristics of diode - Half-wave rectifier and Full-wave rectifier – with and without capacitor filter - Transistor - Construction & working - Input and output characteristics of CB and CE configuration - Transistor as an Amplifier - Principle and working of Hartley oscillator and RC phase shift oscillator - Construction and working of JFET & MOSFET.

(10)

UNIT V: DIGITAL ELECTRONICS

Boolean algebra – Reduction of Boolean expressions - De-Morgan's theorem – Logic gates - Implementation of Boolean expressions - Flip flops - RS, JK, T and D. Combinational logic - Half adder, Full adder and Subtractors. Sequential logic - Ripple counters and shift registers.

(10)

UNIT VI : COMMUNICATION AND COMPUTER SYSTEMS

Model of communication system - Analog and digital - Wired and wireless channel. Block diagram of various communication systems - Microwave, satellite, optical fiber and cellular

mobile system. Network model - PAN, LAN, MAN and WAN - Circuit and packet switching – Overview of ISDN. **(10)**

TEXT BOOKS:

1. Kothari D P and Nagrath I J , Basic Electrical Engineering , Tata McGraw Hill,2009. (For Units I to III)
2. Rajendra Prasad , ― -Fundamentals of Electronic Engineering‖, Cengage learning, New Delhi, First Edition, 2011 (For Unit IV)
3. Morris Mano, --Digital design‖, PHI Learning, Fourth Edition, 2008 (For Unit V)
4. Wayne Tomasi, --Electronic Communication Systems - Fundamentals Theory Advanced‖, Sixth Edition, Pearson Education, 2004. (For Unit VI)

REFERENCE BOOKS:

1. R.Muthusubramaniam, S.Salivahanan and K.A. Mureleedharan, Basic Electrical Electronics and Computer Engineering, Tata McGraw Hill, 2004..
2. J.B.Gupta, A Course in Electrical Power, Katson Publishing House, New Delhi, 1993.
3. David. A. Bell, -Electronic Devices and Circuits‖, PHI Learning Private Ltd, India, Fourth Edition, 2008
4. Donald P Leach, Albert Paul Malvino and Goutam Saha, -Digital Principles and Applications,‖ 6th edition, Tata McGraw Hill Publishing Company Ltd., New Delhi,2008.
5. S.K. Sahdev, Fundamentals of Electrical Engineering and Electronics, Dhanpat Rai & Co, 2013.
6. Jacob Millman and Christos C. Halkias, -Electronic Devices and Circuits‖ Tata McGraw Hill,2008
7. R.L. Boylestad and L. Nashelsky, -Electronic Devices and Circuit Theory‖, PHI Learning Private Limited, Ninth Edition, 2008.
8. M.S.Sukhija and T.K.Nagsarkar, ― Basic Electrical and Electronics Engineering‖, Oxford University Press, 2012.

ENGINEERING THERMODYNAMICS **3 1 0 4**

COURSE OBJECTIVES

- To understand the basics of the thermodynamic principles and establish the relationship of these principles to thermal system behaviors
- To develop methodologies for predicting the system behavior and establish the importance of laws of thermodynamics applied to energy systems
- To explain the role of refrigeration and heat pump as energy systems and develop an intuitive understanding of underlying physical mechanism and a mastery of solving practical problems in real world

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Apply knowledge of mathematics, science and engineering to understand the basics of the thermodynamic principles and establish the relationship of these principles to thermal system behaviors
- Design and conduct experiment, as well as to analyze and develop methodologies for predicting the system behavior and understand the importance of laws of thermodynamics applied to energy systems
- Identify and analyze role of refrigeration and heat pump as energy systems and develop an intuitive understanding of underlying physical mechanism and a mastery of solving practical problems in real world

UNIT I: BASIC CONCEPTS AND DEFINITIONS

Energy conversion and efficiencies - System, property and state - Thermal equilibrium - Temperature - Zeroth law of Thermodynamics – P, V, and T Diagrams, - Thermodynamic Diagram. **(12)**

UNIT II: FIRST LAW OF THERMODYNAMICS

The concept of work and adiabatic process - First law of thermodynamics - Conservation of Energy principle for closed and open systems - Calculation of work for different processes of expansion of gases. **(12)**

UNIT III: SECOND LAW OF THERMODYNAMICS

Equilibrium and the second law - Heat engines - Kelvin-Planck statement of second law of thermodynamics - Reversible and irreversible processes - Carnot principle - Clausius inequality- Entropy. **(12)**

UNIT IV: GAS POWER CYCLES

Air standard cycles: The air standard Carnot cycle - Air standard Otto cycle, diesel cycle, dual cycle and Bryton cycles and their efficiencies. **(12)**

UNIT V: REFRIGERATION CYCLES AND SYSTEMS

Reverse Carnot cycle - COP - Vapor compression refrigeration cycle and systems (only theory) - Gas refrigeration cycle - Absorption refrigeration system - Liquefaction and solidification (only theory) **(12)**

TEXT BOOKS:

1. Nag, P. K., ―Engineering Thermodynamics‖, 4th edition, Tata Mc Graw Hill Publishing Co. Ltd., New Delhi,1995

REFERENCE BOOKS:

1. Arora, C.P., --Thermodynamics‖, Tata Mc Graw Hill Publishing Co. Ltd., New Delhi,1998.
2. Burghardt, M.D., --Engineering Thermodynamics with Applications‖, 4th edition, Harper & Row, N.Y., 1986.
3. Huang, F.F., --Engineering Thermodynamics‖ 2nd edition , Macmillan Publishing Co. Ltd., N.Y.,1989.
4. Cengel, Y.A. and Boles, M.A., "Thermodynamics - An Engineering Approach", 5th edition, Mc-Graw Hill, 2006
5. Wark, K., --Thermodynamics‖, 4th edition ,Mc Graw Hill, N.Y.,1985

COMPUTER PROGRAMMING 3 1 0 4

COURSE OBJECTIVES

- To introduce the basics of computers and information technology and educate problem solving techniques.
- To impart programming skills in C language.
- To practice structured programming to solve real life problems.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Know concepts in problem solving
- To do programming in C language
- To write diversified solutions using C language
- To know about structures, pointers and its manipulation.

UNIT I

History of Computers – Block diagram of a Computer – Components of a Computer system – Classification of computers - Hardware – Software – categories of Software – Operating System – Applications of Computers –Network Structure - Internet and its services – Intranet – Study of word processor – Preparation of worksheets. **(12)**

UNIT II

Problem solving techniques – Program – Program development cycle – Algorithm design – Flowchart - Pseudo code. Introduction to C – History of C – Importance of C - C tokens – data types – Operators and expressions – I/O functions. **(12)**

UNIT III

Decision making statements – branching and looping – arrays – multidimensional arrays – Functions – Recursion – Passing array to functions .Storage classes – Strings – String library functions. **(12)**

UNIT IV

Structures – Arrays and Structures – nested structures – passing structures to functions – user defined data types– Union. Pointers – pointers and arrays – pointers and functions - pointers and strings - pointers and structures. **(12)**

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UNIT V

Files – operations on a file – Random access to files – command line arguments .Introduction to preprocessor – Macro substitution directives – File inclusion directives – conditional compilation directives – Miscellaneous directives. **(12)**

TEXT BOOKS:

1. Balagurusamy. E, ‒Programming in ANSI C‖, Tata McGraw Hill, 12th Edition, 2012

REFERENCE BOOKS:

1. Vikas Verma, ‒-AWorkbook on C‖ ‒,Cengage Learning, Second Edition,2012
2. Ashok N Kamthane, ‒-Computer Programming‖, Pearson education, Second Impression, 2008.

COMPUTER PROGRAMMING LABORATORY **0 0 3 2**

COURSE OBJECTIVES

- To introduce the basics of computers and information technology and educate problem solving techniques.
- To impart programming skills in C language and gain a hands on experience of compilation and execution of _c' programs.
- To practice structured programming to solve real life problems.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Know concepts in problem solving
- To do programming in C language
- To write diversified solutions using C language

LIST OF EXERCISES

1. Study of OS Commands
2. Write a C program to find the Area of the triangle.
3. Write a C program to find the total and average percentage obtained by a student for 6 subjects.
4. Write a C program to read a three digit number and produce output like
   1 hundreds
   7 tens
   2 units for an input of 172.
5. Write a C program to check whether a given character is vowel or not using Switch – Case statement.
6. Write a C program to print the numbers from 1 to 10 along with their squares.
7. Write a C program to find the sum of _ _n_ numbers using for, do – while statements.
8. Write a C program to find the factorial of a given number using Functions.
9. Write a C program to swap two numbers using call by value and call by reference.
10. Write a C program to find the smallest and largest element in an array.
11. Write a C program to perform matrix multiplication.
12. Write a C program to demonstrate the usage of Local and Global variables.
13. Write a C program to perform various string handling functions: strlen, strcpy, strcat, strcmp.
14. Write a C program to remove all characters in a string except alphabets.
15. Write a C program to find the sum of an integer array using pointers.
16. Write a C program to find the Maximum element in an integer array using pointers.
17. Write a C program to create student details using Structures.
18. Write a C program to display the contents of the file on the monitor screen.
19. Create a File by getting the input from the keyboard and retrieve the contents of the file using file operation commands.
20. Write a C program to pass the parameter using command line arguments.

ENGINEERING GRAPHICS 2 0 3 2

COURSE OBJECTIVES

- To convey the basics of engineering drawing
- To explain the importance of an engineering drawing
- To teach different methods of making the drawing
- To establish the importance of projects and developments made in drawing that
- are used in real systems
- To explain the role of computer aided design _Auto Cad
- To develop an intuitive understanding of underlying significance of using these Drawings

COURSE OUTCOMES

On successful completion of this course, the student will be able to familiarize with the fundamentals and standards of Engineering graphics

- Perform freehand sketching of basic geometrical constructions and multiple views of objects.
- Project orthographic projections of lines and plane surfaces.
- Draw projections and solids and development of surfaces.
- Visualize and to project isometric and perspective sections of simple solids.

UNIT I

Introduction to Standards for Engineering Drawing practice, Lettering, Line work and Dimensioning.

UNIT II

Conic sections, Involutes, Spirals, Helix, Projection of Points, Lines and Planes Projection of Solids and Sections of Solids.

UNIT III

Development of surfaces - Intersection of surfaces (cylinder-cylinder, cylinder-cone)

UNIT IV

Isometric projections and Orthographic projections

UNIT V

Computer Aided Drafting: Introduction to Computer Aided Drafting hardware - Overview of application software - 2D drafting commands (Auto CAD) for simple shapes - Dimensioning

TEXT BOOKS:

1. Gopalakrishna K.R. and Sudhir Gopalakrishna, Engineering Graphics, Inzinc Publishers, 2007.

REFERENCE BOOKS:

1. Bhatt N.D., Engineering Drawing, 49th edition, Chorotar Publishing House, 2006.
2. Venugopal K., Engineering Drawing and Grahics + Auto CAD, 4th edition, New Age International Publication Ltd., 2004 .
3. David I cook and Robert N Mc Dougal, Engineering Graphics and Design with computer applications, Holt – Sounders Int. Edn. 1985.
4. James D Bethune and et. al., Modern Drafting, Prentice Hall Int., 1989
5. Natarajan K.V., A Text Book of Engineering Drawing, Dhanalakshmi Publishers, 2006.
6. BIS, Engineering Drawing practice for Schools & College, 1992.

BASIC ELECTRICAL AND ELECTRONICS LABORATORY **0 0 3 2**

COURSE OBJECTIVES

- To get an exposure on the basic electrical tools, applications and precautions
- To gain training on different types of wiring used in domestic and industrial applications.
- To detect and find faults in electrical lamp and ceiling fan
- To get an exposure on the measurements of voltage and phase using CRO, basic operation and applications of devices such as PN junction diode and transistor
- To gain a practical knowledge on the functions and application of basic logic gates and flip flops

COURSE OUTCOMES

On successful completion of this course, Students will be able to,

- Know about basic electrical tools, applications and precautions
- Perform different types of wiring used in domestic and industrial applications
- Measurements of voltage and phase using CRO, basic operation and applications of devices such as PN junction diode and transistor
- Understand the functions and application of basic logic gates and flip flops

ELECTRICAL LAB

LIST OF EXPERIMENTS

1. Electrical Safety, Precautions, study of tools and accessories.
2. Practices of different joints.
3. Wiring and testing of series and parallel lamp circuits.
4. Staircase wiring.
5. Doctor‘s room wiring.
6. Bed room wiring.
7. Godown wiring.
8. Wiring and testing a ceiling fan and fluorescent lamp circuit.
9. Study of different types of fuses, circuits breakers and A.C and D.C meters.

ELECTRONICS LAB

LIST OF EXPERIMENTS

1. Study of CRO
   (a) Measurement of AC and DC voltages
   (b) Frequency and phase measurements (using Lissajou‘s figures)
2. Verification of Kirchoff‘s Voltage and Current Laws
   Determine the voltage and current in given circuits using Kirchoff‖s laws theoretically and verify the laws experimentally.
3. Characteristics and applications of PN junction diode.
   Forward and Reverse characteristics of PN junction diode.
   Application of Diode as Half wave Rectifier – Measurement of ripple factor with and without capacitor filter
4. Frequency Response of RC Coupled Amplifiers
   Determination of frequency response of given RC coupled amplifier - Calculation of bandwidth.
5. Study of Logic Gates
   (a) Verification of Demorgan‘s theorems
   (b) Verification of truth tables of OR, AND, NOT, NAND, NOR, EX-OR, EX-NOR gates and Flipflops - JK, RS, T and D

(c) Implementation of digital functions using logic gates and Universal gates.

SEMESTER III

LINEAR ALGEBRA 3 1 0 4

COURSE OBJECTIVES

- To introduce the basic notions of groups, rings, fields which will be used to solve related problems.
- To familiarize the applications of algebraic structures.
- To understand the concepts of vector space, linear transformations and diagonalization.
- To apply the concept of inner product spaces in orthogonalization.

COURSE OBJECTIVES

On successful completion of the module students will be able to:

- Understand the concepts and properties of algebraic structures such as groups, rings and fields.
- Demonstrate accurate and efficient use of advanced algebraic techniques.
- Demonstrate their mastery by solving non - trivial problems related to the concepts and by proving simple theorems.

UNIT I : GROUPS

Algebraic systems – Semi groups - Monoids – Groups – Subgroups – Homomorphism‘s – Normal subgroup and cosets – Lagrange‘s theorem. **(12)**

UNIT II : RINGS AND FIELDS

Rings - Sub-rings - Properties of rings – Fields - Integral domain - Ideals and Quotient rings – Polynomial rings. **(12)**

UNIT III : VECTOR SPACES

Vector spaces – Subspaces – Linear combinations and linear system of equations – Linear independence and linear dependence – Bases and dimensions. **(12)**

UNIT IV : LINEAR TRANSFORMATION AND DIAGONALIZATION

Linear transformation - Null spaces and ranges - Dimension theorem - Matrix representation of a linear transformations - Eigen values and eigenvectors - Diagonalizability. **(12)**

UNIT V :INNER PRODUCT SPACES

Inner product- Norms - Gram Schmidt orthogonalization process - Adjoint of linear operations - Least square approximation. **(12)**

TEXTBOOKS:

1. Howard Anton and Chris Rorres, ―Elementary Linear Algebra‖, John Wiley & Sons, New Delhi, 2011.
2. David C Lay, ―Linear Algebra and its Applications‖, Pearson Education, New Delhi, 2012.
3. Stephen H Friedberg, Lawrence E Spence, Arnold J Insel, ― Linear Algebra‖ , Pearson, 4th edition, 2015
4. I. N. Herstein, ―Topics in Algebra‖, John Wiley & Sons, New Delhi, 2006.

REFERENCES:

1. Glyn James, David Burely, Phil Dyke, Dick Clements, Nigel Steele, John Searl and Jerry Wright –Advanced Modern Engineering Mathematics‖, Pearson Education, 15th edition 2018.

2. Kolman, B. Hill, D.R., –Introductory Linear Algebra‖, Pearson Education, New Delhi, First Reprint,
2009.
3. Kumaresan, S., –Linear Algebra - A Geometric Approach‖, Prentice – Hall of India, New Delhi,
Reprint, 2010.
4. Lay, D.C., –Linear Algebra and its Applications‖, 5th Edition, Pearson Education, 2015.
5. Strang, G., –Linear Algebra and its applications‖, Thomson (Brooks/Cole), New Delhi, 4th edition, 2006.

ELECTRONIC DEVICES AND CIRCUITS **4 0 0 4**

COURSE OBJECTIVES

- To introduce the concepts of electron ballistics, the physics of semiconductors and various parameters of diodes.
- To learn and gain insight into the operation, characteristics and functional aspects of BJT, JFET, MOSFET, several special semiconductor devices.
- To design the different types of biasing in BJT, FET and MOSFET and analyze various rectifier circuits with filters and IC regulator circuits

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Apply knowledge science and engineering to understand semiconductor diodes, diode equation and characteristics.
- To analyze functional aspects of BJT, JFET, MOSFET and its biasing.
- Design and construct simple circuits like rectifiers, filters and IC regulators.

UNIT I: SEMICONDUCTOR DIODES

PN junction diode – operation, forward, reverse bias characteristics- theory of diode current - diode equation - temperature effects – DC and AC resistance – diode equivalent circuit – transition and diffusion capacitance – diode switching time – Avalanche and Zener breakdown – Zener diode characteristics. **(12)**

UNIT II: BIPOLAR JUNCTION TRANSISTOR

PNP and NPN transistors – transistor current components – characteristics of transistor in CB, CE, CC configurations –Amplifier-Oscillator- Early effect - Ebers-Moll model. Field Effect Transistors - JFET – construction – operation - drain and transfer characteristics – current equations – pinch-off voltage and its significance. MOSFET – construction, operation and characteristics of EMOSFET, DMOSFET and VMOSFET. **(12)**

UNIT III: SPECIAL SEMICONDUCTOR DEVICES

Construction, principle of operation and characteristics of Schottky barrier diode, Varactor diode, Tunnel diode, PIN diode, LED, LCD, UJT, SCR, DIAC and TRIAC. Photoconductivity – photodiode, APD, phototransistor, LDR, optocoupler, solar cell, LASER diode and MESFET. **(12)**

UNIT IV: BIASING AND STABILIZATION

DC load line and Q-point – Need for biasing – Different types of BJT biasing – Fixed bias, Collector to base bias, Self bias –Stability factor Bias compensation: Diode, Thermistor and Sensistor compensation – FET biasing: Gate bias, Voltage divider bias and Self bias – MOSFET biasing. **(12)**

UNIT V: POWER SUPPLY

Rectifiers – Half wave, Full wave and bridge rectifier – Ripple factor calculation for C, L, LC and CLC filter. Voltage regulators – Shunt voltage regulator – Series voltage regulator – Short circuit protection circuit – Current limiting circuit – Fold back limiting – Op-Amp voltage regulator – Switching regulator – Step up and step down converters. **(12)**

TEXT BOOKS:

1. Jacob Millman and Christos C. Halkias, ―Integrated Electronics‖ Tata McGraw-Hill, Second Edition, 2009.
2. R.L. Boylestad and L. Nashelsky, ―Electronic Devices and Circuit Theory‖, Pearson Education, Tenth Edition, 2009.

REFERENCE BOOKS:

1. David A. ―Bell Electronic Devices and Circuits‖, Oxford university press, 5th Edition, 2010.
2. Donald A Neaman, ―Semiconductor Physics and Devices‖, Tata McGraw-Hill, Third Edition, 2007
3. S. Salivahanan, N. Suresh Kumar and A. Vallavaraj, Electronic Devices and

Circuits, 2nd Edition, TMH, 2007.

PROGRAMMING IN PYTHON **4 0 0 4**

COURSE OBJECTIVES

- To read and write simple Python programs.
- To develop Python programs with conditionals and loops.
- To define Python functions and use them.
- To use Python data structures –- lists, tuples, dictionaries.
- To do input/output with files in Python.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Read, write and execute simple programs by Python
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, dictionaries.

UNIT I: BASICS

Python - Variables - Executing Python from the Command Line - Editing Python Files - Python Reserved Words - Basic Syntax-Comments - Strings and Numeric Data Types - Simple Input and Output.. **(12)**

UNIT II: CONTROL STATEMENTS

Control Flow and Syntax - Indenting - If Statement - Relational Operators - Logical Operators - Bit Wise Operators - while Loop - break and continue - for Loop - Lists – Tuples - Sets - Dictionaries. **(12)**

UNIT III: FUNCTIONS

Definition - Passing parameters to a Function - Variable Number of Arguments - Scope - Passing Functions to a Function - Mapping Functions in a Dictionary – Lambda - Modules - Standard Modules – sys – math – time - Dir Function. **(12)**

UNIT IV: ERROR HANDLING

Run Time Errors - Exception Model - Exception Hierarchy - Handling Multiple Exceptions - Data Streams - Access Modes Writing - Data to a File Reading - Data from a File - Additional File Methods - Using Pipes as Data Streams - Handling IO Exceptions - Working with Directories. **(12)**

UNIT V: OBJECT ORIENTED FEATURES

Classes Principles of Object Orientation - Creating Classes - Instance Methods - File Organization - Special Methods - Class Variables – Inheritance – Polymorphism - Type Identification - Simple Character Matches - Special Characters - Character Classes – Quantifiers - Dot Character - Greedy Matches – Grouping - Matching at Beginning or End - Match Objects – Substituting - Splitting a String - Compiling Regular Expressions. **(12)**

TEXT BOOKS:

1. Mark Summerfield. ―Programming in Python 3: A Complete introduction to the Python Language‖, Addison-Wesley Professional, 2009.
2. Martin C. Brown, ―PYTHON: The Complete Reference‖, McGraw-Hill, 2001.

REFERENCE BOOKS:

1. Wesley J Chun, ―Core Python Applications Programming, Prentice Hall, 2012.
2. Allen B Downey, ―Think Python‖, O_Reilly, 2012.

SENSORS AND INSTRUMENTATION **4 0 0 4**

COURSE OBJECTIVES

- To understand the concepts of measurement technology.
- To learn the various sensors used to measure various physical parameters.
- To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

COURSE OUTCOMES:

On successful completion of the module, students will be able to:

- Use the concepts in common methods for converting a physical parameter into an electrical quantity
- Classify the transducers and explain it with examples for measurement of temperature, strain, motion, position and light
- Choose proper sensor by comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc
- Predict the expected performance of various sensors

UNIT I: INTRODUCTION

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types. **(12)**

UNIT II: MOTION, PROXIMITY AND RANGING SENSORS

Motion Sensors – Potentiometers, Resolver, Encoders – Optical, Magnetic, Inductive, Capacitive, LVDT – RVDT – Synchro – Microsyn, Accelerometer – GPS, Bluetooth, Range Sensors – RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR). **(12)**

UNIT III: FORCE, MAGNETIC AND HEADING SENSORS

Strain Gauge, Load Cell, Magnetic Sensors –types, principle, requirement and advantages. Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers. **(12)**

UNIT IV: OPTICAL, PRESSURE AND TEMPERATURE SENSORS

Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors. **(12)**

UNIT V: SIGNAL CONDITIONING AND DAQ SYSTEMS

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring. **(12)**

TEXT BOOKS:

1. Ernest O Doebelin, ―Measurement Systems – Applications and Design‖, Tata McGraw-Hill, 2009
2. Sawney A K and Puneet Sawney, ―A Course in Mechanical Measurements and Instrumentation and Control‖, 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCE BOOKS:

1. C. Sujatha ... Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons, Canada, 2001
2. Hans Kurt Tönshoff (Editor), Ichiro , ‒Sensors in Manufacturing‖ Volume 1, Wiley-VCH April 2001.
3. John Turner and Martyn Hill, ‒Instrumentation for Engineers and Scientists‖, Oxford Science Publications, 1999.
4. Patranabis D, ‒Sensors and Transducers‖, 2nd Edition, PHI, New Delhi, 2011.
5. Richard Zurawski, ‒Industrial Communication Technology Handbook‖ 2nd edition, CRC Press, 2015.

ELECTRICAL MACHINES AND DRIVES **3 1 0 4**

COURSE OBJECTIVES

- To understand the operations of DC and AC machines.
- To analyze the performance of the special machines for different appliances.
- To study the basics of the Electric Drives unit
- To understand the operation and performance of conventional and solid state speed control of DC and AC drives

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Acquire knowledge on DC and AC machines.
- Know the features of the Synchronous and Special Machines
- Learn the different types of Electric Drives
- Acquire knowledge on DC and AC drives.

UNIT I: ELECTRICAL MACHINES

Mechanical characteristics- speed- torque characteristics of various types of load and drive motors - braking of electrical motors - DC motors: shunt, series, compound motors-single phase and three phase induction motors Transformers: Construction and Principle of operation – Single Phase transformer – Introduction to 3 phase transformers. **(12)**

UNIT II: SYNCHRONOUS AND SPECIAL MACHINES

Construction of Synchronous machines - Types – Induced emf – Working principles of Brushless alternators – Stepper motor - Servomotor – Universal motor - Applications – rating and duty cycle -Sizing of Motor for a Industrial application. **(12)**

UNIT III: ELECTRIC DRIVES

Basic elements-types of electric drives-factors influencing electric 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. **(12)**

UNIT IV: CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C DRIVES

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. **(12)**

UNIT V: CONVENTIONAL AND SOLID STATE SPEED CONTROL OF AC DRIVES

Conventional and solid state speed control of AC drives -Speed control of induction motor-Voltage control, voltage/frequency control, slip power recovery scheme-using inverters and AC voltage regulators-applications. **(12)**

TEXT BOOKS:

1. B.L. Theraja, ‒Electrical Technology Vol.II AC/DC Machines‖, S. Chand, 2008.
2. Vedam Subramaniam, ‒Electric Drives – Concepts and applications‖, Tata McGraw Hill Publishing Co., Ltd., New Delhi 2003
3. G.K. Dubey, ‒Fundamentals of Electric Drives" Alpha Science International Ltd. 2001.
4. R. Krishnan, ‒Electric Motor & Drives: Modelling, Analysis and Control‖, Prentice Hall of India, 2001.

REFERENCE BOOKS:

1. J.B.Gupta, –Theory and Performance of Electrical Machines‖, J.K.Kataria & Sons, 13th edition, 2004.
2. Bimal K. Bose, –Modern Power Electronics and AC Drives", Prentice-hall of India Pvt. Ltd, 2005.
3. M.H.Rashid, "Power Electronic Circuits, Devices and Applications", Prentice Hall International, 2007 Edition, Newness Publications, 2006.
4. H.Partab, –Art and science and utilization of electrical energy‖, Dhanpat Rai and Sons, 1994.

STRENGTH OF MATERIALS **3 1 0 4**

COURSE OBJECTIVES

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- To study the selection of materials used for making components for robotics.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Understand the concepts of stress and strain in simple and compound bars, importance of principal stresses and principal planes.
- Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
- Apply basic equation of simple torsion in designing of shafts and helical spring
- Calculate the slope and deflection in beams using different methods.
- Analyze and design thin and thick shells for the applied internal and external pressure
- To analyze the type of materials and its suitability as per applications.

UNIT I: STRESS, STRAIN AND DEFORMATION OF SOLIDS

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains –Stresses on inclined planes – principal stresses and principal planes – Mohr‘s circle of stress. (**12)**

UNIT II: TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending– bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution. (**12)**

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. (**12)**

UNIT IV: DEFLECTION OF BEAMS & CYLINDERS

Double Integration method – Macaulay‘s method – Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell‘s reciprocal theorems, Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders (**12)**

UNIT V: MATERIALS FOR ROBOTICS:

Robotics /Design Basics/Building Materials – Metal, synthetic materials and composite materials – properties of steel from steel construction – properties of wrought aluminum alloys – Mechanical Properties of stainless steel – Designation of Titanium alloys – structural examination of titanium alloys – case hardening of titanium and alloys- How to build robots using advanced materials – Case study. **(12)**

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

REFERENCE BOOKS:

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.
5. Mikell Grover ., ― Industrial Robotics‖ , McGraw Hill , 2016.

ELECTRONIC DEVICES AND CIRCUITS LABORATORY **0 0 3 2**

COURSE OBJECTIVES

- To understand the operation of semiconductor devices.
- To understand DC analysis and AC models of semiconductor devices.
- To design of Regulators and Amplifiers
- To verify the theoretical concepts through laboratory and simulation experiments.
- To execute mini projects based on implementation of electronic circuits concept.

COURSE OUTCOMES

After successful completion of the course student will be able to

- Understand the voltage - current characteristics of semiconductor devices
- Analyze DC circuits and relate AC models of semiconductor devices with their physical Operation
- Design and analyze the various electronic circuits

1. V-I characteristics of semiconductor diodes
   a) PN Junction diode
   b) Point contact diode
   c) Zener diode
2. Characteristics of BJT in CB configuration
   a) Determination of input and output characteristics
   b) Determination of voltage gain, current gain, input and output resistances from the characteristics
3. Characteristics of BJT in CE configuration
   a) Determination of input and output characteristics
   b) Determination of voltage gain, current gain, input and output resistances from the characteristics
4. Characteristics of JFET
   a) Determination of output and transfer characteristics
   b) Determination of pinch off voltage, r_d, g_m and μ from thecharacteristics
5. Characteristics of MOSFET
   a) Determination of output and transfer characteristics
   b) Determination of pinch off voltage, r_d, g_m and μ from thecharacteristics
6. Characteristics of UJT, SCR and TRIAC
7. Characteristics of photonic devices
   a) Determination of V-I characteristics of LED
   b) Determination of V-I and intensity characteristics of phototransistor
8. Design and testing of biasing circuits
   a) Fixed bias
   b) Collector to base bias
   c) Self bias
9. Rectifier and Voltage Regulators
   a) Determination of ripple factor for different types of rectifiers with and without filters.
   b) Voltage regulation characteristics of shunt, series and IC regulators
10. i) Clipper circuits using diodes
    Positive, negative, biased and combinational clippers
    ii) Switching circuit
    a) AND and OR logic gates using diodes
    b) NOT gate using transistor

PROGRAMMING IN PYTHON LABORATORY **0 0 3 2**

COURSE OBJECTIVES

- Learn Syntax, Semantics and create Functions in Python.
- Handle Strings and Files in Python.
- Understand Lists, Dictionaries and Regular expressions in Python.
- Implement Object Oriented Programming concepts in Python
- Build Web Services and introduction to Network and Database Programming in Python.

COURSE OUTCOMES

After successful completion of the course student will be able to

- Examine Python syntax, semantics and be fluent in using of Python flow control and functions.
- Demonstrate proficiency in handling Strings and File Systems.
- Create, run and manipulate Python Programs using core data structures like Lists, Dictionaries and use Regular Expressions.
- Interpret the concepts of Object-Oriented Programming as used in Python.
- Implement exemplary applications related to Network Programming, Web Services and Databases in Python.

LIST OF EPERIMENTS:

1. Write a Python program to find GCD of two numbers.
2. Write a Python Program to find the square root of a number by Newton‘s Method
3. Write a Python program to find the exponentiation of a number.
4. Write a Python Program to find the maximum from a list of numbers.
5. Write a Python Program to perform Linear Search
6. Write a Python Program to perform Binary Search
7. Write a Python Program to perform selection sort.
8. Write a Python Program to perform insertion sort.
9. Write a Python Program to perform Merge sort.
10. Write a Python program to find first N prime numbers.
11. Write a Python program to multiply matrices.

ELECTRICAL MACHINES AND DRIVES LABORATORY **0 0 3 2**

COURSE OBJECTIVES

- To understand the basics of electrical machines and trigger circuits required for various power converters.
- To acquire knowledge about the operation of various power converter circuits like Controlled rectifiers, Choppers, AC voltage regulators and Inverters.

COURSE OUTCOMES

- The course enables the students to do simulation of the circuits using MATLAB/Simulink and experimentally verify the simulation results in the hardware lab. Besides, the students are introduced with some of the application of the power converters.

LIST OF EXPERIMENT

1. Study of thyristors controlled DC Drive.
2. Study of Chopper fed DC Drive.
3. Study of AC Single phase motor-speed control using TRIAC.
4. PWM Inverter fed 3 phase Induction Motor control using MATLAB / PSIM Software.
5. VSI / CSI fed Induction motor Drive analysis using MATLAB / PSIM Software.
6. Study of V/f control operation of 3 phase induction motor drive.
7. Study of Permanent Magnet Synchronous Motor drive fed by PWM Inverter using Software.
8. Regenerative / Dynamic braking operation for DC Motor - Study uses software.
9. Regenerative / Dynamic braking operation of AC motor - study uses software.
10. PC based AC/DC motor control operation.

SEMESTER IV

FOURIER SERIES AND PARTIAL DIFFERENTIALEQUATIONS 3 1 0 4

COURSE OBJECTIVES

- To introduce the basic concepts for solving standard partial differential equations.
- To provide the concept of Fourier series and expanding functions into Fourier series including Harmonic analysis.
- To make the students knowledgeable in the areas of Boundary Value Problems like vibrating string (wave equation), Heat equation in one and two dimensions.

COURSE OUTCOMES

On successful completion of the module students will be able to understand:

- How to solve the given standard partial differential equations.
- The physical significance of Fourier series techniques in solving one, two dimensional heat flow problems and one dimensional wave equations.

UNIT I :FOURIER SERIES

Dirichlet's conditions – General Fourier series – Periodic - Odd and Even functions – Half Range Sine Series – Half Range Cosine Series. **(12)**

UNIT II :

Root Mean Square Value – Parseval's theorem on Fourier Coefficients - Complex form of Fourier series – Harmonic Analysis. (**12)**

UNIT III :PARTIAL DIFFERENTIAL EQUATIONS

Formation of PDE by elimination of arbitrary constant and arbitrary function – General , Singular , particular and complete integrals - Lagrange's linear first order equation - Higher order PDE with constant coefficients of both homogeneous and non-homogeneous types. (**12)**

UNIT IV : APPLICATION OF FOURIER SERIES

Solution of partial differential equation by the method of separation of variables – Boundary value problems – Fourier series solution – Transverse vibration of an elastic string. (**12)**

UNIT V :

Fourier series solution for one dimensional heat flow equation – Fourier series solutions for two dimensional heat flow equations under steady state condition – (Cartesian and Polar forms) (excluding proof). **(12)**

TEXT BOOKS:

1. Grewal B.S., –Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014.

2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics forEngineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

REFERENCES:

1. Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" Prentice Hall India Learning Pvt Ltd, 2003.
2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014.
3. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
4. James, G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6. Wylie, R.C. and Barrett, L.C., –Advanced Engineering Mathematics –Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

PRINCIPLES OF ROBOTICS **4 0 0 4**

COURSE OBJECTIVES

- 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
- To introduce the dynamics and control of manipulators

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Ability to understand basic concept of robotics.
- To analyze Instrumentation systems and their various applications.
- To know about the differential motion add statics in robotics
- To know about the various path planning techniques.
- To know about the dynamics and control in robotics industries

UNIT I: BASIC CONCEPTS

Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and control issues- Various manipulators – Sensors - work cell - Programming languages. **(12)**

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. **(12)**

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. **(12)**

UNIT IV: 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. **(12)**

UNIT V: 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. **(12)**

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.

REFERENCE 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.

ANALOG AND DIGITAL ELECTRONICS **4 0 0 4**

COURSE OBJECTIVES

- To introduce the theory and applications of analog multipliers and PLL
- To learn the theory of ADC and DAC
- To understand the fundamentals of number systems, Boolean algebra, Simplification of Boolean Function and Karnaugh map method.
- To understand the concepts of Combinational and Sequential Logic Design.
- To conceptualize the logic families and PLDs.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Design linear and non linear applications of OP – AMPS
- Design applications using analog multiplier and PLL
- Design ADC and DAC using OP – AMPS
- To implement number systems, Boolean algebraand Karnaugh map, Simplification method in the design of digital systems.
- Design and analyze Combinational and Sequential Logic Design and Programmable Logic Devices.
- Design and construct Combinational Logic circuits and Synchronous Sequential Circuits.

UNIT I : FUNDAMENTALS OF ANALOG AND DIGITAL ELECTRONICS

ANALOG ELECTRONICS: Functional Block Diagram – Circuit symbol, Pin Configuration – The ideal OPAMP - Open loop gain, Inverting and Non-inverting amplifiers, Voltage follower, Differential amplifier, CMRR, slew rate – DC Characteristics - AC Characteristics. APPLICATIONS- Summing amplifier, Subtractor, Integrator and Differentiator - V-I and I-V converters, Comparator – Regenerative comparator, Zero crossing detector, Window detector, Sample and hold circuit, Rectifiers

DIGITAL ELECTRONICS: Boolean Algebra: Computer codes – BCD, Gray code, Excess 3 code, Error detection and correction codes. Boolean algebra – Basic Postulates and theorems, Switching functions, Canonical forms, Logic gates. Simplification of logic functions through K – maps and Implementation using logic gates. **(12)**

UNIT II :SPECIAL FUNCTION ICs: 555 Timer Functional block diagram and description – Monostable and Astable operation, Applications, 566 Voltage Controlled Oscillator. PLL Functional Block diagram – Principle of operation, Applications: Frequency synthesis, DC Motor speed control.

IC VOLTAGE REGULATORS: Block diagram of 723 general purpose voltage regulator – Circuit configurations, Current limiting schemes, Output current boosting, Fixed and adjustable three terminal regulators. **(12)**

UNIT III : A-D AND D-A CONVERTERS: Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters, Sigma – Delta converters. **(12)**

UNIT IV: COMBINATIONAL AND SEQUENTIAL LOGIC DESIGN

COMBINATIONAL LOGIC DESIGN: Binary / BCD adders and subtractors, Decoders, Encoders, Multiplexers and Demultiplexers, Magnitude comparator, ALU.

SEQUENTIAL LOGIC DESIGN: Latch, Flip Flops, Level triggering, Edge triggering, Master slave configuration. Shift register, Binary counters, Ring counter, Johnson counter. Mealy/Moore state machines. **(12)**

UNIT V : DIGITAL LOGIC FAMILIES AND PLDS

DIGITAL LOGIC FAMILIES -Characteristics of digital IC's - TTL logic family – Totem pole, Open collector and tristate outputs. MOS transistor switches –nMOS Inverter / Logic gates, CMOS logic, Inverter / logic gates. ECL logic families – Comparison of performance of various logic families.

PROGRAMMABLE LOGIC DEVICES: Introduction to PLDs – ROM, PAL, PLA, FPGA, ASIC. **(12)**

TEXT BOOKS:

1. Gayakwad A R, ―OP-Amps and Linear Integrated circuits‖, Pearson Education, New Delhi, 2004.
2. Sedra and Smith, ―Microelectronic Circuits‖, Oxford University Press, 2004.
3. V Tocci R J, Widmer N S and Moss G L, ―Digital Systems: Principles and applications‖, Pearson Education (Singapore) Pvt. Ltd, 2010.
4. Nelson V P, Nagle H T, Carroll B D, and Irwin J D, ―Digital Logic Circuit Analysis and Design‖, Prentice Hall International Inc., New Jersey, 1995.

REFERENCE BOOKS:

1. Coughlin F R, and Driscoll F F, ―Operational Amplifiers and Linear Integrated Circuits‖, Prentice Hall of India, New Delhi, 1997.
2. Roy Choudhury and Shail Jain, ―Linear Integrated Circuits‖, New Age International Limited, 2003.
3. Leach D P, Malvino A P and Goutam Saha, ―Digital Principles and Applications‖, Tata Mc Graw – Hill, 2010.
4. Donald Givone, ―Digital Principles and Design‖, Tata Mc Graw – Hill Edition, 2003.
5. Floyd, ―Digital Fundamentals‖, Prentice Hall of India, New Delhi, 2014.

AUTOMATIC CONTROL SYSTEMS **3 1 0 4**

COURSE OBJECTIVES

- To acquire a fundamental understanding of linear and digital control systems and their design.
- To understand the concepts of control system components and mathematical modeling of electrical system, mechanical system, etc.
- To study the concept of time response and frequency response of the system.
- An understanding of the concept of marginal stability, asymptotic stability and bounded-input bounded-output stability for continuous and discrete systems.
- To pioneer the basics of different plots such as Bode plot, Nyquist plot, Root locus method and Polar plot.
- To familiarize the theory of Z-transform, inverse Z-transform and their properties in the digital control system.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Understand and demonstrate discrete, digital, linear control systems.
- Explain sampling, quantization, encoding and their mathematical modeling.
- Explain effects of common non linearities introduced in a system.
- Understand Z transform, pulse transfer function and able to apply that concept for digital system analysis.
- Able to analyze digital system and non linear system stability using different analysis tools.

UNIT I: SYSTEM MODELING

Introduction to control system-Basic elements of control system- Open and Closed loop control systems-Differential equation representation of physical systems-Transfer function-Mathematical modeling of electrical and mechanical systems (Translational and Rotational)-Analogous system-Block diagram reduction techniques- Signal flow graph. **(12)**

UNIT II: TIME DOMAIN ANALYSIS

Time response analysis-Analysis of transient and steady state behavior of control systems-Standard test signals –Time response of First order system- step, ramp and impulse response analysis-Second order system – step response analysis- steady state error-generalized error co-efficient–Response with P, PI, PD and PID controllers-Analysis using MATLAB. **(12)**

UNIT III: FREQUENCY DOMAIN ANALYSIS

Frequency response-Frequency domain specifications- Correlation between time domain and frequency domain specifications-Bode plot- Stability analysis using Bode plot- transfer function from Bode plot-Polar plot-Analysis using MATLAB. **(12)**

UNIT IV: STABILITY ANALYSIS AND ROOT LOCUS:

Concepts of stability-Location of poles on s-plane for stability-Routh-Hurwitz stability criterion-Nyquist stability criterion-Root locus Techniques-Analysis using MATLAB. **(12)**

UNIT V : DIGITAL CONTROL SYSTEM

Basic digital control system-Z transform and its properties- Inverse Z transform-Response of linear discrete time systems-Pulse transfer function- Stability analysis-Jury_s stability criterion. State Space Analysis: State space model of a control system -State space

representation using physical, phase and canonical variables-diagonal canonical form-Jordan canonical form. **(12)**

TEXT BOOKS:

1. Benjamin.C.Kuo, ‐Digital control systems‖, Second Edition, Oxford University Press, 2012.
2. I.J.Nagrath, M. Gopal, ‐Control Systems Engineering‖, Fifth Edition, New Age International,NewDelhi,2011.

REFERENCE BOOKS:

1. R.Anandanatarajan, P. Ramesh Babu, ‐Control Systems Engineering‖, Second edition ,Scitech Publications, 2005.
2. Benjamin C. Kuo, ‐Automatic Control Systems‖, Seventh Edition, PHI Learning, New Delhi, 1997.
3. Katsuhiko Ogata, ‐Discrete Time Control Systems‖, Second Edition, PHI Learning, New Delhi, 2006.

KINEMATICS AND DYNAMICS OF MACHINCES **4 0 0 4**

COURSE OBJECTIVES

- 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

On successful completion of the module students will be able to:

- Understand the basic knowledge of kinematics of machines
- Students can able to apply fundamentals of mechanism for the design of new mechanisms
- Able to know about the linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
- Impart knowledge about the gears and gear trains.
- Ability to analyze them for optimum design

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. **(12)**

UNIT II: 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. **(12)**

UNIT III: FRICTION

Sliding and Rolling Friction angle – friction in threads – Friction Drives –Belt and rope drives. **(12)**

UNIT IV: KINEMATICS OF CAM MECHANISMS

Classification of cams and followers – Terminology and Definitions – Displacement Diagrams- Uniform velocity , Parabolic , Simple Harmonic and cycloid motions – Derivatives of follower motions – Layout of plate cam profiles – Specified Contour cams – Circular arc and tangent cams – Pressure angle and undercutting – Sizing of cams. **(12)**

UNIT V: 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. **(12)**

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

REFERENCE BOOKS:

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.

HYDRAULICS AND PNEUMATICS **4 0 0 4**

COURSE OBJECTIVES

- To provide student with knowledge on the application of fluid power in process Construction and manufacturing Industries.
- To provide students with 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

On successful completion of the module students will be able to:

- Understand the Fluid power and operation of different types of pumps.
- Summarize the features and functions of Hydraulic motors, actuators and Flow control valves.
- Understand the Different types of Hydraulic circuits and systems.
- Understand the working of different pneumatic circuits and systems.
- Summarize the various trouble shooting methods and applications of hydraulic and pneumatic systems.

UNIT I : FLUID POWER PRINICIPLES 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. **(12)**

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. **(12)**

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. **(12)**

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. **(12)**

UNIT V: 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. **(12)**

TEXT BOOKS:

1. Anthony Esposito, -Fluid Power with Application‖, Pearson Education (Singapore) Pvt. Ltd, Delhi, India, 2003.
2. Majumdar S.R., –Oil Hydraulics Systems- Principles and Maintenance‖, Tata McGraw-Hill, 2001.
3.

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.

ANALOG AND DIGITAL ELECTRONICS LABORATORY **0 0 3 2**

COURSE OBJECTIVES

- To supplement the design concepts in analog electronics.
- To understand how to design combinational and sequential circuits.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Ability to design linear integrated circuits and its applications
- Ability to design combinational and sequential circuits.

LIST OF EXPERIMENTS

1. Applications of Op-amp
   To study the application of Op-amp IC741 as
   a. Inverting amplifier
   b. Non-inverting amplifier
   c. Voltage follower
   d. Summer
   e. Subtractor
2. Differentiator and Integrator
   To study the op-amp performance as differentiator and integrator for various time constants
3. Comparator circuits and Signal converters
   a. To study zero crossing detector, window detector using Op-amp 741
   b. To study operation of op-amp as V to I and I to V converters
4. Data converters
   Construction and study performance of
   a. DAC circuits – R-2R and ladder type.
   b. Successive approximation type ADC.
5. Study of 555 Timer and 566 VCO.
6. Performance characteristics of Voltage Regulator ICs.
7. Design and implementation of the following Code convertors
   a. BCD to excess-3 code and vice versa
   b. Binary to gray code and vice-versa
8. Design of Multiplexers and Encoders
9. Design of Decoders and Demultiplexers
10. Shift register
    Study of a universal shift registers IC
11. Construction of Ring counter and Johnson counter using a shift register IC and study of their timing diagrams

KINEMATICS AND DYNAMICS LABORATORY **0 0 3 2**

COURSE OBJECTIVES

- To supplement the principles learnt in kinematics and Dynamics of Machinery.
- To understand how certain measuring devices are used for dynamic testing.

COUSE OUTCOMES

On successful completion of the module students will be able to:

- Ability to demonstrate the principles of kinematics and dynamics of machinery
- Ability to use the measuring devices for dynamic testing.

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
   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 – un damped 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.

HYDRAULICS AND PNEUMATICS LABORATORY **0 0 3 2**

COURSE OBJECTIVES

- To familiarize the fluid power automation and different components of Hydraulics, pneumatics, electro hydraulic/ electro pneumatic and PLC based systems
- Hands on experience in design and execution of circuits for real systems

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Explain the similarities and differences of the electrical, pneumatic and hydraulic systems, can decide which system is better for a specific application,
- Explain the basic parts of the industrial hydraulic and pneumatic systems and their functions, can design a hydraulic or pneumatic system circuit by using related software and make simulations,
- Design a hydraulic or pneumatic system and outline PLC control algorithm for a predefined automation process.

LIST OF EXPERIMENTS

1. Simulation of basic hydraulic, pneumatic and electrical circuits.
2. Study of Electro pneumatic circuits.
3. Simulation of electro- pneumatic circuits using microprocessor.
4. Modeling and analysis of basic hydraulic, pneumatic and electrical circuits using ‗AUTOMATION STUDIO' Software.
5. Study of various types of transducers.
6. Study of various signal conditioning circuits.
7. Open and closed loop control of AC and DC drives.
8. Study of PLC and its applications.

PHYSICAL EDUCATION **0 0 0 0**

Physical Education is compulsory for all the Undergraduate students and Pass in this course is mandatory for the award of degree. Physical Education activities will include games and sports/extension lectures. The student participation shall be for minimum period of 45 hours. Physical Education activities will be monitored by the Director of Physical Education. Pass/Fail will be determined on the basis of participation, attendance, performance and conduct. If a candidate fails, he/she has to repeat the course in the subsequent years.

SEMESTER V

- STATISTICS AND NUMERICAL METHODS **3 1 0 4**

COURSE OBJECTIVES

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

COURSE OUTCOMES

- Apply the concept of testing of hypothesis for small and large samples in real life problems.
- Apply the basic concepts of classifications of design of experiments in the field of agriculture.
- Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.
- Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
- Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

UNIT I: TESTING OF HYPOTHESIS

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit. **(12)**

UNIT II: DESIGN OF EXPERIMENTS

One way and two way classifications - Completely randomized design – Randomized block design – Latin square design - factorial design. (**12**)

UNIT III: SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method - Solution of linear system of equations - Gauss elimination method – Pivoting - Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigenvalues of a matrix by Power method and Jacobi‘s method for symmetric matrices. **(12)**

UNIT IV: INTERPOLATION, NUMERICAL DIFFERENTIATION ANDNUMERICAL INTEGRATION

Lagrange‘s and Newton‘s divided difference interpolations – Newton‘s forward and backward difference interpolation – Approximation of derivates using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson‘s 1/3 rules. **(12)**

UNIT V: NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

Single step methods : Taylor‘s series method - Euler‘s method - Modified Euler‘s method - Fourth order Runge-Kutta method for solving first order equations - Multi step methods : Milne‘s and Adams - Bash forth predictor corrector methods for solving first order equations. **(12)**

TEXT BOOKS :

1. Grewal. B.S. and Grewal. J.S., –Numerical Methods in Engineering and Science ", 10th Edition, Khanna Publishers, New Delhi, 2015.
2. Johnson, R.A., Miller, I and Freund J., –Miller and Freund‘s Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
3.

REFERENCE BOOKS :

1. Burden, R.L and Faires, J.D, "Numerical Analysis‖, 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences‖, Cengage Learning, New Delhi, 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis‖ Pearson Education, Asia, New Delhi, 2006.
4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum‘s Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 2004.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., –Probability and Statistics for Engineers and Scientists", 8th Edition, Pearson Education, Asia, 2007.

MICROCONTROLLER AND EMBEDDED SYSTEM DESIGN **4 0 0 4**

COURSE OBJECTIVES

- To understand the architectures and the instruction set of 8085, 8086, 8051
- To learn the assembly language program using 8085, 8086 and 8051 instruction set
- To learn interfacing of microprocessors and microcontrollers with various peripheral
- To introduce embedded systems, its hardware, software, devices and buses used for embedded networking.

COURSE OUTCOMES

On successful completion of this course students will be able to:

- Interpret the architecture & instruction set of 8085, 8086, 8051 microcontroller to develop assembly language programs
- Illustrate the application of 8051 microcontroller on chip peripherals to implement the functions of I/O port, timer/Counter, serial port & interrupts.
- Demonstrate 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
- 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 architectureand programming model of ARM processor.
- Infer the instruction set and exception types of ARM processor to develop Assembly language programs

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. **(12)**

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). **(12)**

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. **(12)**

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. **(12)**

UNIT V: ARM PROGRAMMING

ARM Instruction Set - ARM Instruction Types: Data Transfer, Data Processing and Control Flow Instructions - Interrupts – Exceptions types - NVIC Registers for interrupt control**.(12)**

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.

PROGRAMMABLE LOGIC CONTROLLERS **4 0 0 4**

COURSE OBJECTIVES

- To provide knowledge levels needed for PLC programming and operating.
- To make the students understand how devices are connected with PLC input and output modules.
- To train the students to create ladder diagrams from process control descriptions.
- To make the students understand various types of PLC registers
- Apply PLC Timers and Counters for the control of industrial processes
- To make the students understand PLC functions, Data Handling Function
- To train the students to develop a ―coil and contact‖ control system to operate a basic robot and analog PLC operations.

COURSE OUTCOMES

Ability to gain knowledge on Programmable Logic Controllers

- The students will learn about the design of systems using Programmable Logic Controllers
- To know about the different applications of Programmable Logic Controllers
- Will understand different types of Devices to which PLC input and output modules are connected
- To provide the knowledge about understand various types of PLC registers
- Able to create ladder diagrams from process control descriptions.
- Ability to apply PLC timers and counters for the control of industrial processes
- Able to use different types PLC functions, Data Handling Function.
- Able to develop a ―coil and contact‖ control system to operate a basic robot and analog PLC operations.

UNIT I : INTRODUCTION TO FACTORY & PROCESS AUTOMATION

Industrial Versions - Control elements of Industrial Automation- IEC/ ISA Standards for Control Elements – Selection criteria for control elements- Construction of Relay Ladder logic with different control elements- Need for PLC - PLC evolution. **(12)**

UNIT II: PROGRAMMABLE LOGIC CONTROLLERS

Architecture of PLC - Types of PLC – PLC modules, 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. **(12)**

UNIT III: PROGRAMMING OF PLC

Types of Programming – Bit Instructions -Timers and counters– PLC arithmetic functions PTO / PWM generation- High Speed Counter – Analog Scaling – Encoder Interfacing- Servo drive control – Stepper Motor Control. **(12)**

UNIT IV: 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. **(12)**

UNIT V: NETWORKING

PLC Networking- Networking standards & IEEE Standard - Protocols - Field bus - Process bus and Ethernet -CAN Open**.** APPLICATIONS OF PLC: Case studies of manufacturing automation and Process automation. **(12)**

TEXT BOOKS:

1. W. Bolton, -Programmable logic controllers‖, Elsevier Ltd, 2015.
2. Frank D Petruzella, -Programmable logic controllers‖, McGraw-Hill, 5th Ed, 2016..

REFERENCE BOOKS:

1. John R Hackworth and Fredrick D Hackworth Jr., -Programmable Logic Controllers: Programming Methods and Applications‖, Pearson Education, 2015.
2. SIMATIC Programming with STEP 7, SIEMENS Manual, 2014.

ROBOTIC CONTROL SYSTEMS **3 1 0 4**

COURSE OBJECTIVES

- To introduce the overview of robotic systems and their dynamics
- To impart knowledge on system stability
- To acquire knowledge on joint space and task space control schemes
- To understand the concept of nonlinear control and observer schemes

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Understand basic concept of robotic systems and their dynamics.
- Analyze system stability and types of stability
- Know about joint space and task space control schemes
- Understand the concept of nonlinear control and observer schemes

UNIT I: INTRODUCTION AND OVERVIEW OF ROBOTIC SYSTEMS ANDTHEIR DYNAMICS

Forward and inverse dynamics. Properties of the dynamic model and case studies. Introduction to nonlinear systems and control schemes. **(12)**

UNIT II: SYSTEM STABILITY AND TYPES OF STABILITY

Lyapunov stability analysis, both direct and indirect methods. Lemmas and theorems related to stability analysis. **(12)**

UNIT III: JOINT SPACE AND TASK SPACE CONTROL SCHEMES

Position control, velocity control, trajectory control and force control. **(12)**

UNIT IV: NONLINEAR CONTROL SCHEMES

Proportional and derivative control with gravity compensation, computed torque control, sliding mode control, adaptive control, observer based control, robust control and optimal control. **(12)**

UNIT V: NONLINEAR OBSERVER SCHEMES:

Design based on acceleration, velocity and position feedback. Numerical simulations using software packages namely MATLAB/MATHEMATICA. **(12)**

TEXT BOOKS:

1. R Kelly, D. Santibanez, LP Victor and Julio Antonio, ―Control of Robot Manipulators in Joint Space‖, Springer, 2005.
2. A Sabanovic and K Ohnishi, ―Motion Control Systems‖, John Wiley & Sons (Asia), 2011
3.

REFERENCE BOOKS:

1. R M Murray, Z. Li and SS Sastry, ―A Mathematical Introduction to Robotic Manipulation‖, CRC Press, 1994.
2. J J Craig, ―Introduction to Robotics: Mechanics and Control, Prentice Hall, 4th Ed, 2018.

CNC MACHINE AND METROLOGY **4 0 0 4**

COURSE OBJECTIVES

- Understand evolution and principle of CNC machine tools
- Write simple programs for CNC turning and machining centres
- Generate CNC programs for popular CNC controllers
- Describe about linear and angular measurements in metrology
- Study about the advancement in metrology

COURSE OUTCOMES

On successful completion of the module students will be able to:

- To understand about the basic in CNC machineries
- Understand Evolution and principle of CNC machine tools and different measurement technologies. Able to write simple programs for CNC machinery
- Impart knowledge about linear and angular measurements in metrology
- Know about the advancement in metrology

UNIT I: INTRODUCTION TO CNC MACHINE TOOLS

Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines – turning centre, machining centre, grinding machine, EDM, types of control systems, CNC controllers, characteristics, interpolators– Computer Aided Inspection, CNC Machine building, structural details, configuration and design, guide ways – Friction, Anti friction and other types of guide ways. **(12)**

UNIT II:DRIVES AND WORK HOLDING DEVICES

Spindle drives – DC shunt motor, 3 phase AC induction motor, feed drives –stepper motor, servo principle, DC and AC servomotors, Axis measuring system – synchro, synchro-resolver, gratings, moiré fringe gratings, encoders, inductosysn, laser interferometer, work holding devices for rotating and fixed work parts, economics of CNC, maintenance of CNC machines. **(12)**

UNIT III:CNC PROGRAMMING

Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre for well known controllers such as Fanuc, Heidenhain, Sinumerik etc., generation of CNC codes from CAM packages. **(12)**

UNIT IV: LINEAR AND ANGULAR MEASUREMENTS

Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges – gauge design – terminology – procedure – concepts of interchange ability and selective assembly – Angular measuring instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar – Angle alignment telescope – Autocollimator – Applications. **(12)**

UNIT V:ADVANCES IN METROLOGY

Basic concept of lasers Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications – Straightness – Alignment. Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System – Element – Applications. **(12)**

TEXT BOOKS:

1. M.D. Singh, J.G. Joshi, ‑Mechatronics‖, HMT, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2006.

2. Warren S.Seamers, –Computer Numeric Control‖, Fourth Edition, Thomson Delmar, 2002.
3. Jain R.K. –Engineering Metrology‖, Khanna Publishers, 2005.
4. Gupta. I.C., –Engineering Metrology‖, Dhanpatrai Publications, 2005.

REFERENCE BOOKS:

1. Charles Reginald Shotbolt, –Metrology for Engineers‖, 5th edition, Cengage Learning EMEA,1990.
2. Backwith, Marangoni, Lienhard, –Mechanical Measurements‖, Pearson Education , 2006.
3. Peter Smid, –CNC Programming Hand book‖, Industrial Press Inc., 2000
4. Berry Leathan – Jones, –Introduction to Computer Numerical Control‖, Pitman, London, 1987.
5. Radhakrishnan P –Computer Numerical Control Machines‖, New Central Book Agency, 2002.

MICROCONTROLLER AND EMBEDDED SYSTEM DESIGN LABORATORY **0 0 3 2**

COURSE OBJECTIVES

- To enable the students to program, simulate and test the 8085, 8051, PIC 18 and ARM processor based circuits and their interfaces
- Introduce students to embedded systems design tools and hardware programmers

COURSE OUTCOMES

Upon completion of this course the students will be able to demonstrate an ability to

- Develop 8051 Assembly Language Programs for Arithmetic, Logic, Bit manipulation, String operations and
- Demonstrate an application for 8051 microcontroller using Traffic light controller, ADC & DAC interfacing boards
- Demonstrate 8051 Embedded C Coding for Programming the GPIO, Timer, Interrupts & Serial Port and a system for
- temperature monitoring using Ardiuno target Board
- Develop communication skills and capability to work in team

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

PLC AND ROBOTICS LABORATORY **0 0 3 2**

COURSE OBJECTIVES

To introduce different types of robotics and demonstrate them to identify different parts and components.

- To write programming for simple operations.
- Understanding the wiring diagram interfacing with I/O elements.
- Design and development of ladder diagrams for various applications.
- Interfacing and programming for motor control using PLC

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Development of ladder logic diagram using Bit Instructions.
- PLC based Crane control.
- PLC based parking station using Counter and Bit Instructions.
- Analog Sensor interfacing with PLC.
- Encoder interfacing with PLC.
- Stepper motor / Servo motor control using PLC
- Upon Completion of the course, the students will be able to use of any robotic simulation software to model the different types of robots and calculate work volume for different robots

LIST OF EPERIENTS:

PLC

1. Development of ladder logic diagram using Bit Instructions.
2. PLC based Crane control.
3. PLC based parking station using Counter and Bit Instructions.
4. Analog Sensor interfacing with PLC.
5. Encoder interfacing with PLC.
6. Stepper motor / Servo motor control using PLC.

ROBOTICS

1. Forward and Inverse kinematics of two axis planar articulated robot using analytical and DH algorithm using Lego NXT.
2. Forward and Inverse kinematics to control hand movements in NAO.
3. Study and selection of Gripper.
4. Implementation of trajectory planning algorithm for straight line motion using Matlab and executing PID based control of two axis planar articulated robot in Lego NXT.
5. Analysis and Simulation using Fanuc Robo guide software and real time Programming of Fanuc M 710i robot.
6. Programming of Adept Cobra S 600 SCARA robot.

CNC AND METROLOGY LABORATORY **0 0 3 2**

COURSE OBJECTIVES

- To impart knowledge in CNC programming for turning and milling operations
- To use measuring systems for the geometrical measurements of gears and threads.
- To know the measurement of Taper Angle using Sine Bar

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Ability to understand the features and operation of CNC machines.
- Ability to prepare CNC program from the component drawings
- Understanding the usage of profile projectors and tool makers microscopes.

LIST OF EXPERIMENTS:

1. Study of the CNC machine
2. Programming and simulation of a lathe using any CAM package
3. Programming and simulation of a machining centre using any CAM package
4. Programming and operation of a CNC Lathe
5. Programming and operation of a CNC machining centre
6. Measurement of Taper Angle using Sine Bar
7. Optical profile projector – study of profile of gear tooth, screw threads.
8. Tool maker‘s microscope – to study cutting tool geometry, screw threads.
9. Tool wear and surface finish measurement.
10. Dimensional measurement of machined components using, bore gauge, air gauge and Height master.

GENERAL PROFICIENCY-I **0 0 3 1**

COURSE OBJECTIVES

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-
- The course aims to: Enhance the Employability and Career Skills of students
- Orient the students towards grooming as a professional
- Make them Employable Graduates.
- Develop their confidence and help them attend interviews successfully.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- At the end of the course Learners will be able to:
- Make effective presentations
- Participate confidently in Group Discussions.
- Attend job interviews and be successful in them.
- Develop adequate Soft Skills required for the workplace

UNIT I: ART OF COMMUNICATION

Verbal and Non-verbal Communication – Barriers to Communication – Importance of Body Language – Effective Listening – Feedback.

UNIT II: INTRODUCTION TO SOFT SKILLS

Attitude – Self-Confidence – Leadership Qualities – Emotional Quotient – Effective Time Management Skills – Surviving Stress – Overcoming Failure – Professional Ethics – Interpersonal Skills.

UNIT III: WRITING

Importance of Writing – Written Vs Spoken Language – Formal and Informal Styles of writing – Resources for improving writing – Grammar and Usage – Vocabulary Building – SWOT analysis.

UNIT IV: SPEAKING PRACTICE

Dialogue – Telephone Etiquette – Public Speaking – Debate – Informal Discussions – Presentations

UNIT V: APTITUDE

Verbal and Numerical aptitude.

REFERENCE BOOKS:

1. Nicholls, Anne. Mastering Public Speaking. Jaico Publishing House,2003.
2. Aggarwal, R.S. Quantitative Aptitude. S.Chand&Co.,2004.
3. Leigh, Andrew and Michael Maynard. The Perfect Leader. Random House Business Books,1999.
4. Whetton .A.David and Kim S. Cameron. Developing Management Skills. Pearson Education, 2007.
5. K.R. Lakshminarayan. Developing Soft Skills. Scitech, 2009.
6. Sherfield M Robert. Developing Soft Skills Pearson Education, 2005.
7. Hair O_ Dan, Friedrich W. Gustav and Lynda Dee Dixon. Strategic Communication in Business and the Professions. Pearson Education,2008.
8. Chaney Lilian and Jeanette Martin. Intercultural Business Communication, Fourth Edition. Pearson Education, 2008.

SEMESTER VI

MODELING AND SIMULATION **3 1 0 4**

COURSE OBJECTIVES

- To provide an overview of how computers are being used in mechanical component design with the use of various CAD standards
- To introduce the concepts of Mathematical Modelling of Engineering Problems using FEM with 2D scalar and vector variables problems respectively.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- know the basic concepts of modelling and assembly for different mechanical components
- know the different types of CAD standards used in modeling of mechanical components
- know about basic concepts of FEA and analysis software for analyzing mechanical components
- know about different mathematical techniques used in finite element analysis to solve structural and thermal problems

UNIT I: MODELLING AND ASSEMBLEY

Assembly modelling – Interferences of positions and orientation – Tolerance analysis-Mass property calculations – Mechanism simulation and interference checking. **(12)**

UNIT II: CAD STANDARDS

Standards for computer graphics- Graphical Kernel System (GKS) - Standards for exchange images- Open Graphics Library (OpenGL) - Data exchange standards - IGES, STEP, CALS etc. - communication standards. **(12)**

UNIT III:INTRODUCTION TO ANALYSIS

Basic concepts of the Finite Element Method - Discretization -Meshing – Mesh refinement- Mesh Enrichment- Natural co-ordinate systems -Types of elements- Special Elements- Crack tip Element- Introduction to Analysis Software. **(12)**

UNIT IV:TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems. **(12)**

UNIT V:TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements. **(12)**

TEXT BOOKS:

1. Ibrahim Zeid ‒Mastering CAD CAM‖ Tata McGraw-Hill Publishing Co.2007
2. Rao, S.S., ‒The Finite Element Method in Engineering‖, 5th Edition, Butterworth Heinemann, 2010

REFERENCE BOOKS

1. Donald Hearn and M. Pauline Baker ‒Computer Graphics‖'. Prentice Hall, Inc, 1996.

2. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, ―Concepts and Applications of Finite Element Analysis‖, 4th Edition, Wiley Student Edition, 2002.
3. Foley, Wan Dam, Feiner and Hughes - "Computer graphics principles & practice" Pearson, 3rd edition, 2013.

ROBOT KINEMATICS AND DYNAMICS **3 1 0 4**

COURSE OBJECTIVES

- 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

On successful completion of the module students will be able to:

- Understand the basic knowledge of kinematics of machines
- Apply fundamentals of mechanism for the design of new mechanisms
- Know about the linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
- Impart knowledge about the gears and gear trains.
- Analyse them for optimum design.

UNIT I: INTRODUCTION

Specifications of Robots- Classifications of robots – Work envelope - Flexible automation versus Robotic technology – Applications of Robots. **(12)**

UNIT II: 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 axisrobots. Inverse Kinematic problem, General properties of solutions, Tool configuration, Inverse Kinematics of Two axis Three axis, Four axis and Five axis robots. **(12)**

UNIT III: 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. **(12)**

UNIT IV: 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. **(12)**

UNIT V: 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, Straightline motion. **(12)**

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.

PROGRAMMING FOR ROBOTICS **3 1 0 4**

COURSE OBJECTIVES

- To acquire the knowledge on advanced algebraic tools for the description of motion.
- To analyze and design the motion for articulated systems
- To develop an ability to use software tools for analysis and design of robotic systems.

COURSE OUTCOMES

On successful completion of the module students will be able to:

- Understand the matrix algebra and Lie algebra for computing the kinematics of robots
- Analyze the forward kinematics and inverse kinematics of serial and parallel robots
- Do the path planning for a robotic system

UNIT I: BASICS OF ROBOTICS

History – Definition – Components – Building a robot – The Robot drive mechanism.**ROBOT SIMULATION:** Mathematical modeling of the robot - Robot kinematics – Concepts of ROS and Gazebo. **(12)**

UNIT II: DESIGNING CHEFBOT HARDWARE

Specifications - Block diagram - Working with Robotic Actuators and Wheel Encoders - Interfacing DC geared motor with Tiva C LaunchPad - Interfacing quadrature encoder with Tiva C Launchpad - Working with Dynamixel actuators. **(12)**

UNIT III: WORKING WITH ROBOTIC SENSORS

Working with ultrasonic distance sensors - Working with the IR proximity sensor - Working with Inertial Measurement Unit. **(12)**

UNIT IV: PYTHON AND ROS

Introduction to OpenCV, OpenNI, and PCL - Programming Kinect with Python using ROS, OpenCV, and OpenNI - Working with Point Clouds using Kinect, ROS, OpenNI, and PCL. **(12)**

UNIT V: INTERFACING IT INTO ROS, USING PYTHON

Building ChefBot hardware - Writing a ROS Python driver for ChefBot - Understanding ChefBot ROS launch files - Working with ChefBot Python nodes and launch files - The Calibration and Testing of ChefBot - The Calibration of Xbox Kinect using ROS - Wheel odometry calibration - Testing of the robot using GUI. **(12)**

TEXT BOOKS:

1. Lentin Joseph, ―Learning Robotics using Python‖, PACKT Publishing, 2015.
2. Aaron Martinez and Enrique Fernandez, ―Learning ROS for Robotics Programming‖, PACKT Publishing, 2013, 2nd Ed, 2015.

REFERENCE:

1. Bill Smart, Brian Gerkey, Morgan Quigley, ― Programming Robots with ROS: A Practical Introduction to the Robot Operating System‖, O_Reilly Publishers, 2015.

AUTOMATION SYSTEM DESIGN **4 0 0 4**

COURSE OBJECTIVES

- To know about the basic concepts in industrial automation
- To design automated systems.
- To know about transfer lines and automated assembly
- Be exposed to pneumatic, electric, hydraulic and electronic systems in automation of mechanical operations.
- To know about the advancement in hydraulics and pneumatics

COURSE OUTCOMES

- Knowledge of industrial automation by transfer lines and automated assembly lines. Ability to design an automated system.
- Understanding of automated controls using pneumatic and hydraulic systems.
- Ability to understand the electronic control systems in metal machining and other manufacturing processes.
- To understand advancement in hydraulics and pneumatics systems.

UNIT I: FUNDAMENTAL CONCEPTS OF INDUSTRIAL AUTOMATION

Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production and types of automation, automation strategies, levels of automation. Selection of motor for automation system, sizing of servo motor for a specific application, importance of sizing, selection of mechanical components, load cycle definition, load inertia and torque calculations, selection of motors.(Motion control in Automation) **(12)**

UNIT II: TRANSFER LINES AND AUTOMATED ASSEMBLY

General terminology and analysis, analysis of transfer lines without storage, partial automation. Automated flow lines with storage buffers. Automated assembly-design for automated assembly, types of automated assembly systems, part feeding devices, analysis of multi-station assembly machines. AS/RS, RFID system, AGVs, modular fixturing. Flow line balancing. **(12)**

UNIT III: DESIGN OF MECHATRONIC SYSTEMS FOR MATERIAL HANDLINGAPPLICATIONS:

Stages in design, traditional and mechatronic design, possible design solutions. Case studies-pick and place robot, engine management system. belt conveyor elements, selection of belt, drive, greasing of idlers, Plow Vs Trippers, magnetic pulley, skirt boards, training of belt conveyors, weighing material in motion, shuttle belt conveyor, pinion –swivel arrangement, troughing, suspended idlers, belt cleaners, transfer of material from belt to belt, cover, safety protection at pulleys, belt speeds and widths, design of a belt conveyor, belt conveyor calculation, minimum pulley diameters, enclosures for conveyors, idler selection, conveyor belt troubles. **(12)**

UNIT IV: PROGRAMMABLE AUTOMATION

Special design features of CNC systems and features for lathes and machining centers. Drive system for CNC machine tools. Introduction to CIM; condition monitoring of manufacturing systems. CNC architecture for intelligent machine tool – case study – CNC machine parts and working with block diagram. **(12)**

UNIT V: DESIGN FOR HIGH SPEED AUTOMATIC ASSEMBLY

Introduction, Design of parts for high speed feeding and orienting, high speed automatic insertion. Analysis of an assembly. General rules for product design for automation. **(12)**

TEXT BOOKS:

1. Mikell P Groover, –Automation Production Systems and Computer- Integrated Manufacturing‖ Pearson Education, New Delhi, 2015.
2. Bolton W, –Mechatronics–, Pearson Education, 2011.

REFERENCE BOOKS:

1. Mikell P Groover, "Industrial Robots – Technology Programmes and Applications‖ , McGraw Hill , New York, USA. 2012.
2. Steve F Krar, –Computer Numerical Control Simplified–, Industrial Press, 2001.
3. Geoffrey Boothroyd, Peter Dewhurst and Winston A. Knight, –Product Design for manufacture and Assembly‖, CRC Press, 2011
4. Radhakrishnan , – CAD/CAM/CIM –, New age International Publishers , 2018.

DESIGN OF MECHANICAL TRANSMISSION SYSTEMS **4 0 0 4**

COURSE OBJECTIVES

- To introduce students to the design and theory of common machine elements and to give students experience in solving design problems involving machine elements.

COURSE OUTCOMES

Upon completion of this course, the students can able

- Formulate and analyze stresses and strains in machine elements subjected to various loads.
- Analyze and design structural joints such as Riveted joints, welded joints, Bolts.
- Analyze and design the components for power transmission like shaft and couplings.
- Analyze and design different types of gears and belts for engineering applications.
- Analyze and design mechanical springs and bearings.

UNIT I: DESIGN OF GEARS

Review of gear fundamentals, interference, gear forces, determining dimensions of a spur gear pair. Design of helical gears-parallel axis helical gear, normal and transverse planes, helix angles, equivalent number of teeth, determining dimension of helical gear pair. **(12)**

UNIT II : DESIGN OF SHAFTS AND COUPLINGS

Forces on shafts due to gears, belts and chains, estimation of shaft size based on strength and rigidity – Couplings, types and applications, design of rigid and flexible couplings – Keys, types and applications, Design of keys. **(12)**

UNIT III: BELTS AND CHAINS

Belts -Types and application, selection of flat, V-belts, and Timing belt for given power and velocity ratio. Selection of roller chain and power speed ratio, silent chain. **(12)**

UNIT IV : ROLLING CONTACT BEARINGS

Static and dynamic load capacity, cubic mean load, variable load, probability of survival, selection of deep groove and angular contact ball bearings. **(12)**

UNIT V: FRICTION DRIVES

Clutches, role of clutches, principle of operation of clutch, classification of clutches, friction materials for clutches, design of single plate and multiple plate clutches- Case studies of Conveyor Design, case study on integrated conveyor belt model for mining Industry**.** **(12)**

TEXT BOOKS:

1. Robert L Norton, -Machine Design - An Integrated Approach, Pearson Education, New Delhi, 2014.
2. Bandari VB, -Design of Machine Elements, Tata McGraw Hill Publishers Co. Ltd., New Delhi, 2016.

REFERENCE BOOKS:

1. Shigley and Mische, -Mechanical Engineering Design‖, McGraw Hill, Inc., New Delhi, 2008.
2. Robert L Mott, -Machine Elements in Mechanical Design‖, Pearson/Prentice Hall, 2013.
3. PrabhuTJ, -Design of Transmission Elements‖, Mani offset, Chennai, 2003.
4. Faculty of Mechanical Engineering, PSG College of Technology, -Design Data Book‖, M/s DPV Printers, Coimbatore, 2010.

MODELING AND SIMULATION LABORATORY **0 0 3 2**

COURSE OBJECTIVES

- To expose the students is the usage of Solid Modeling, Ansys, Adams, Delmia and CAD/CAE softwares for modeling and analysis purposes.

COURSE OUTCOMES:

- Exposed to use CAD softwares for modeling of machine components.
- Exposed to use softwares for mechanism analysis.
- Knowledge in conducting crash/impact analysis using FEA.

LIST OF EXPERIMENTS:

1. Solid modeling of engineering components and assembly.
2. Determination of stresses and factor of safety in critical machine components by FEM and experimental validation of the results by strain measurement.
3. Dynamic analysis of chassis frame of an automobile.
4. Crash analysis of an automobile using FEA software.
5. Kinematic and dynamic analysis of mechanisms using mechanism Ansys software.

REFERENCE BOOKS:

1. William T Shaw, -Cybersecurity for SCADA systems‖, PennWell, 2006.
2. Stuart G McCrady, -Designing SCADA Application Software‖, Elsevier, 2013.
3. SIMATIC STEP 7 in the Totally Integrated Automation Portal‖, SIEMENS AG, 2012.

AUTOMATION SYSTEM DESIGN LABORATORY 0 0 3 2

COURSE OBJECTIVES

- To illustrate the design and simulation of multiple actuator systems using pneumatic, electro-pneumatic and PLCs and enable the students to integrate various fringe conditions in multiple actuator systems.
- To design a system using PNEUMOSIM software
- To design a Microcontroller kit with stepper motor and drive circuit using LABVIEW software
- To expose the students in sensors/actuators interfaced with computers.
- To design a circuit using stepper motor

LIST OF EXPERIMENTS

1. Co-ordinated motion of multiple pneumatic actuators in a desired sequence using Cascade method
2. Integration of fringe condition modules in multiple actuator pneumatic systems
3. Co-ordinated motion of multiple actuator, electro – pneumatic systems in a desired sequence using hard – wire programmed control systems
4. Co-ordinated motion of multiple actuator, electro – pneumatic systems in a desired sequence using PLC.
5. Interfacing of an LVDT with a PC for monitoring the displacement of machine slide and raising an alarm if the displacement exceeds specified limit.
6. Inspection using Machine vision System
7. Control of speed, direction and number of revolutions of a stepper motor using PC.
8. Development of an obstacle avoidance robot using servo motors, ultrasonic and touch sensors.

VIRTUAL INSTRUMENTATION LAB **0 0 3 2**

COURSE OBJECTIVES

- Introduce the programming technique with instrument interfaces and applications of virtual instruments and to understand the basics of data acquisition are introduced in Robotics and Automation systems.

COURSE OUTCOMES

- Understand the evolution, advantages, techniques, architecture and applications of visual instrumentation
- Acquiring knowledge on VI programming techniques
- Study about the basics of data acquisition
- Understanding the concept of common instrument interfaces with industrial applications
- Study about the use of analysis tools with various applications

LIST OF EPERIENTS

1. Creating Virtual Instrumentation for simple applications
2. Programming exercises for loops and charts
3. Programming exercises for clusters and graphs.
4. Programming exercises on case and sequence structures, file Input / Output.
5. Data acquisition through Virtual Instrumentation.
6. Developing voltmeter using DAQ cards.
7. Developing signal generator using DAQ cards.
8. Simulating reactor control using Virtual Instrumentation.
9. Real time temperature control using Virtual Instrumentation.
10. Real time sequential control of any batch process.

GENERAL PROFICIENCY – II **0 0 3 1**

COURSE OBJECTIVES

- To enable the learner to communicate effectively and appropriately in real life situation
- To use English effectively for study purpose across the curriculum;
- To develop interest in and appreciation of Literature;
- To develop and integrate the use of the four language skills i.e. Reading, Listening, Speaking and Writing;
- To revise and reinforce structure already learnt.

COURSE OUTCOMES

At the end of the course Learners will be able to:

- Make effective presentations
- Participate confidently in Group Discussions.
- Attend job interviews and be successful in them.
- Develop adequate Soft Skills required for the workplace

UNIT I: COMPOSITION ANALYSIS

Technical and Non-Technical Passages (GRE Based) Differences in American and British English – Analyzing Contemporary issues – Expanding Terminology.

UNIT II: WRITING

Job Application Letter Writing – Resume Writing

UNIT III: ORAL SKILLS

Group Discussion – Introduction and Practice – Team Work – Negotiation Skills – Organizing and Attending Meetings – Facing Interviews

UNIT IV: ADAPTING TO CORPORATE LIFE

Corporate Etiquette – Grooming and Dressing

UNIT V: APTITUDE

Verbal and numerical aptitude

REFERENCE BOOKS:

1. Pushplata and Sanjay Kumar, Communicate or Collapse: A Handbook of Effective Public Speaking, Group Discussions and Interviews, PHI Learning, Delhi, 2007.
2. Thorpe, Edgar. Course in Mental Ability and Quantitative Aptitude. Tata McGraw-Hill, 2012.
3. Thorpe, Edgar, Test of Reasoning, Tata McGraw-Hill, 2013.
4. Prasad, H.M, How to prepare for Group Discussion and Interview, Tata McGraw-Hill, 2012.
5. Career Press Editors,101 Great Resumes, Jaico Publishing House,2003.
6. Aggarwal, R.S, A Modern Approach to Verbal and Non-Verbal Reasoning, S.Chand& Co., 2012.

SEMESTER VII

INDUSTRIAL ROBOTICS & MATERIAL HANDLING **4 0 0 4**

COURSE OBJECTIVES

- 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 robots, justification and implementation of robot.
- To know about material handling in a system.

COURSE OUTCOMES

The Student must be able

- Learn about the basic concepts, parts of robots and types of robots.
- To design automatic manufacturing cells with robotic control using the principle behind robotic drive system, end effectors, sensor, machine vision robot kinematics and programming.
- Ability in selecting the required robot
- Know various applications of robots
- 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. **(12)**

UNIT II: ROBOTS FOR INSPECTION

Robotic vision systems, image representation, object recognition and categorization, depth measurement, image data compression, visual inspection, software considerations. **(12)**

UNIT III: OTHER APPLICATIONS

Application of Robots in continuous arc welding, Spot welding, Spray painting, assembly operation, cleaning, robot for underwater applications. **(12)**

UNIT IV: END EFFECTORS

Gripper force analysis and gripper design for typical applications, design of multiple degrees of freedom, active and passive grippers. SELECTION OF ROBOT**:** Factors influencingthe choice of a robot, robot performance testing, economics of robotisation, Impact of robot on industry and society. **(12)**

UNIT V: 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. Introduction to Automation Plant design softwares. **(12)**

TEXT BOOKS:

1. Richard D Klafter, Thomas A. chmielewski and Michael Negin, ―Robotic Engineering – An integrated Approach‖ Prentice HallIndia, New Delhi, 2001.
2. Mikell P Groover, "Automation, Production Systems, and Computer-Integrated Manufacturing", Pearson Education, 2015.

REFERENCES:

1. James A Rehg, ―Introduction to Robotics in CIM Systems‖, Prentice Hall of India, 2002.
2. Deb S R, "Robotics Technology and Flexible Automation", Tata McGraw Hill, New Delhi, 2017.

ARTIFICIAL INTELLIGENCE FOR ROBOTICS **4 0 0 4**

COURSE OBJECTIVES

- Study the concepts of Artificial Intelligence.
- Learn the methods of solving problems using Artificial Intelligence.
- Introduce the concepts of Expert Systems and machine learning.
- Learn about planning and reasoning artificial intelligence.
- Solve the risk in artificial intelligence.

COURSE OUTCOMES

Upon successful completion of this course student will:

- To understand the basics of Artificial Intelligence , Intelligent Agents and its structure
- To understand the problem solving by various searching techniques
- To understand the concept of informed search and Exploration
- To understand the concept of constraint satisfaction Problems and Adversarial Search
- To Understand what is Reasoning and Knowledge Representation
- To understand the concept of Reasoning with Uncertainty & Probabilistic Reasoning
- To Understand the basic forms of Machine Learning, decision trees and statistical Learning setting

UNIT I: INTRODUCTION

History, state of the art**,** Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents. PROBLEM SOLVING: Solving problems by searching – Informed search and exploration–Constraint satisfaction problems–Adversarial search, knowledge and reasoning–knowledge representation – first order logic. **(12)**

UNIT II: PLANNING

Planning withforward and backward State space search – Partial order planning – Planning graphs–Planning with propositional logic – Planning and acting in real world. **(12)**

UNIT III: REASONING

Uncertainity – Probabilistic reasoning–Filtering and prediction–Hidden Markov models–Kalman filters–Dynamic Bayesian Networks, Speech recognition, making decisions. **(12)**

UNIT IV: LEARNING

Forms of learning – Knowledge in learning – Statistical learning methods –reinforcement learning, communication, perceiving and acting, Probabilistic language processing, perception. **(12)**

UNIT V: AI IN ROBOTICS

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics. **(12)**

TEXT BOOKS:

1. Stuart Russell, Peter Norvig, –Artificial Intelligence: A modern approch‖, Pearson Education, India 2009.
2. Negnevitsky, M, –Artificial Intelligence: A guide to Intelligent Systems‖,. Harlow: Addison-Wesley, 2011.

REFERENCE BOOKS:

1. David Jefferis, –Artificial Intelligence: Robotics and Machine Evolution‖, Crabtree Publishing Company, 1999.

TOTALLY INTEGRATED AUTOMATION **4 0 0 4**

COURSE OBJECTIVES

- To gain knowledge in automation in industries.
- To gain knowledge in various electrical and electronic programmable automations and their applications.
- To know about the basic in SCADA and DCS systems.
- To gain knowledge in communication protocols in an integrated system
- To know about the advanced in automation industries

COURSE OUTCOMES

- Knowledge of PLC& PAC automation
- Ability to apply SCADA and usage of C programming for report generation
- Acquiring information‘s on communication protocols in automation systems
- Ability to design and develop automatic control system using distributed control systems.
- Knowledge in automation of industries.

UNIT I: TOTALLY INTEGRATED AUTOMATION

Need for TIA - TIA Architecture - Components of TIA systems - Selection of TIA Components – Programmable Automation Controllers (PAC) - Vertical Integration structure. **(12)**

UNIT II: 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. **(12)**

UNIT III: 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 device. **(12)**

UNIT IV: DISTRIBUTED CONTROL SYSTEMS (DCS):

DCS – architecture – local control unit- programming language – communication facilities – operator interface – engineering interfaces. **(12)**

UNIT V: INDUSTRIAL PLANT DESIGN

Design criteria – Process sequencing - Plant layout modeling – Selection of industrial power and automation cables, Overview of plant simulation software.Case Studies: Case studies of Machine automation, Process automation. **(12)**

TEXT BOOKS:

1. David Bailey, Edwin Wright, -Practical SCADA for industry, Newnes, Burlington, 2003.
2. Gordon Clarke, Deon Reynders,Edwin Wright, -Practical Modern SCADA Protocols: DNP3, 60870.5 and Related systems‖, Newnes Publishing, 2004.

TOTALLY INTEGRATED AUTOMATION LABORATORY **0 0 3 2**

COURSE OBJECTIVES

- To develop student‘s skills in perform kinematics analysis of robot systems
- To provide the student with knowledge of the singularity issues associated with the operation of robotic systems.
- To provide the student with some knowledge and analysis skills associated with trajectory planning.
- To provide the student with some knowledge and skills associated with robot control.

COURSE OUTCOMES

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

- Select & identify suitable automation hardware for the given application.
- Describe & explain potential areas of automation.
- Differentiate various control aspects of automation.
- Demonstrate the self learning capability of Industrial Automation.

LIST OF EPERIMENTS:

1. Design of conveyor automation system using PLC, SCADA and Electrical drive.
2. Design of inspection automation system using sensors, PLC, HMI/SCADA.
3. Sizing and Selection of industrial power and automation cable for a typical application.
4. Design of simple water management system using PLC, SCADA and Electrical drive.
5. Design of simple power system automation.
6. Design and Simulation of process automation using CIROS.
7. Simulation of robotic system using CIROS.

INNOVATIVE PRACTICES **0 0 3 2**

Students have to do design a Mechatronic product based on the given topic. It includes modeling, simulation, and design of a particular product

INDUSTRIAL VISIT/TRAINING **0 0 2 1**

The students are required to undergo in plant training for a period of two weeks /four industrial visits during the summer vacation after the fourth semester. Each student has to submit a detailed report on the training programme undergone. Each student will be evaluated by an internal assessment committee (comprising of the Head of the Department and two faculty members) for a total of 50 marks

PROJECT WORK-I **0 0 6 4**

COURSE OBJECTIVES

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

COURSE OUTCOMES

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

Each batch of 2 or 3 students will be assigned an experimental or a theoretical project to be carried out under the supervision of a guide. The project work has to be carried out in the 7^{th} and 8^{th} semesters and has to be completed by the end of the 8^{th} semester. In the phase I of the project work, the progress of the work carried out in the 7^{th} semester will be monitored and assessed internally for a total of 50 marks. A committee of departmental faculty members comprising the project guide, the Head of the Department and one more faculty member will conduct the internal assessment.

SEMESTER VIII

PROFESSIONAL ETHICS **2 0 0 1**

COURSE OBJECTIVES

- To enable the students to create an awareness on Engineering Ethics and Human Values to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

CORSE OUTCOMES

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

The course should covered the following topics by way of Seminars, Expert Lectures and

ASSIGNMENTS

Engineering Ethics– Moral issues, Ethical theories and their uses Engineering as Experimentation–Code of Ethics Engineer‘s responsibility for safety Responsibilities and rights Global issues of engineering ethics

REFERENCEBOOKS

1. MikeMartin and Roland Schinzinger, –Ethics in Engineering‖, Tata McGraw-Hill, 2003

MAINTENANCE AND SAFETY ENGINEERING **4 0 0 4**

COURSE OBJECTIVES

- To impart knowledge in maintenance
- To know about the fundamentals of maintenance and to implement it.
- To study about safety engineering practices.
- To analyze the hazards in protection.
- To know about the safety in machine operation.

COURSE OUTCOMES

- Maintain the industry without any risk in its operation Improve the production
- Analyze the hazards in maintenance and to solve it.
- Identify and prevent chemical, environmental mechanical, fire hazard through analysis
- Apply proper safety techniques on safety engineering and management

UNIT I: MAINTENANCE

Types – breakdown, preventive, predictive, TPM; elements of preventive maintenance – checklist, schedule, procedure. **(12)**

UNIT II: TOTAL PRODUCTIVE MAINTENANCE

Principles; preparatory stages of implementation – TPM organisation structure, creation; basic TPM policies and aids, master plan. TPM IMPLEMENTATION: Small group activities, autonomous maintenance, establishing planned maintenance, training, developing equipment management program. **(12)**

UNIT III: SAFETY SYSTEMS ANALYSIS

Definitions, safety systems; safety information system: basic concept, safety cost / benefit analysis; industrial safety engineering, OSHA regulations. **(12)**

UNIT IV: HAZARD ANALYSIS

General hazard analysis: electrical, physical and chemical hazard, detailed hazard analysis. Cost effectiveness in hazard elimination. Logical analysis: map method, tabular method, fault tree analysis and hazop studies. Fire Protection System: Chemistry of fire, water sprinkler, fire hydrant, alarm and detection system. Suppression system: CO2 system, foam system, Dry Chemical Powder (DCP) system, halon system, portable extinguisher.

(12)

UNIT V: SAFETY IN MACHINE OPERATION

Design for safety, lock out system, work permit system, safety in use of power press, cranes. Safety in foundry, forging, welding, hot working and cold working, electroplating and boiler operation. SAFETY AND LAW: Provisions in factory act for safety, explosive act, workmen compensation act, compensation calculation. Boiler act and pollution control act.

(12)

TEXT BOOKS:

1. John Ridley, ‐Safety at Work‖, Butter Worth Publisher, Oxford, 1997.
2. Robinson C J and Ginder A P, ‐Implementing TPM‖, Productivity Press, USA, 1995.

REFERENCE BOOKS:

1. Dhillon B S, ―Maintainability, Maintenance and Reliability for Engineers‖, CRC Press, 2006.
2. Heinrich H W, ―Industrial Accident Prevention‖, National Safety Council, Chicago, 1998.
3. National Safety Council, ―Personal Protective Equipment‖, Bombay, 1998.
4. National Safety Council, ―Accident Prevention Manual for Industrial Operations‖, Chicago, 1995.
5. Patrick A Michaud, ―Accident Prevention and OSHA Compliance‖, CRC Press, 1995.
6. Derek James, ―Fire Prevention Handbook‖, Butter Worth & Co., Oxford, 1991.
7. Dan Peterson, ―Techniques of Safety Management‖, 1990.

PROJECT WORK - II **0 0 9 8**

COURSE OBJECTIVES

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same. To train the students in preparing project reports and to face reviews and viva voce examination.

COURSE OUTCOMES

- On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology.

Extension and completion of project work started in the previous semester. On completion of the project work, each student has to prepare a project report and submit the same to the department. In the Phase II, the project work and the report will be evaluated by the internal assessment committee by conducting two reviews and one demo for a total of 50 marks. The external university examination, which carries a total of 50 marks, will have report evaluation and viva voce examination conducted by a committee of one external examiner and one internal examiner appointed by the university.

LIST OF ELECTIVES

SEMESTER V – ELECTIVE I

- VLSI DESIGN **4 0 0 4**

COURSE OBJECTIVES

- To introduce Digital VLSI design concepts and to introduce IC designing using Field Programmable Gate Arrays.
- To impart skill set in VHDL Hardware Description Language and understand real time modeling of ICs with test benches.

COURSE OUTCOMES

- Foundational skill set in CMOS technology and logic implementation using CMOS.
- Basics of VHDL hardware description language and VHDL levels of abstraction.
- Working knowledge of VHDL programming using concurrent architecture
- Designing complex digital systems using component instantiation.
- Working knowledge of test bench development.

UNIT I: CMOS TECHNOLOGY

Introduction to MOS transistors and VLSI fabrication(NMOS, PMOS, CMOS and BiCMOS)- Introduction to power reduction techniques-Dynamic Power Reduction-Static Power Reduction- NMOS and CMOS inverter- Determination of pull up to pull down ratios – propagation delays – power dissipation Stick Diagram -MOS layers - Design rules and layout- choice of layers and Scaling. **(12)**

UNIT II: COMBINATIONAL AND SEQUENTIAL CIRCUIT DESIGN

Pass transistor and transmission gates-Inverter-NAND gates and NOR Gates for n MOS, CMOS and Bi CMOS – parity generator – Multiplexers- code converters – Programmable Logic Devices (nMOS PLA and CMOS PLA) – Clocked sequential circuits – D-Latch and D- Flip- Flop –Memories (DRAM cell, SRAM Cell and Pseudo Static RAM cell) – Inverting and Non-Inverting Registers – Barrel Shifter. **(12)**

UNIT III: SUBSYSTEM DESIGN

Circuit Families – Dynamic CMOS logic, Domino CMOS logic and Pseudo NMOS logic-One bit adder- multi bit adder –Ripple carry- Carry Skip Adder-Carry Look Ahead Adder-Design of signed parallel adder-comparison of different schemes in terms of delay – Multipliers – Design of serial and parallel multipliers- Different schemes and their comparison. 2_s complement array multiplication-Booth encoding. **(12)**

UNIT IV: CMOS TESTING

Need for testing- Test Procedure, Design for Testability – Ad Hoc Testing – Scan-Based Test-Boundary-Scan Design – Built-in-Self-Test(BIST)- Test- Pattern Generation – Fault Models – Automatic Test Pattern Generation – Fault Simulation. **(12)**

UNIT V: INTRODUCTION TO VERILOG:

Basics of Verilog, operators, Data Types, Continuous assignments, Sequential and parallel statement groups. Timing control (level and edge sensitive) and delays, tasks and functions, control statements, Blocking &non blocking assignments, If-else and case statements, For-while-repeat and forever loops, Rise, fall, min, max delays, Behavioural and synthesizable coding styles for modelling combinational logic, Behavioural& synthesizable coding styles

for modelling sequential logic. **(12)**

TEXT BOOKS:

1. Neil H.E. Weste and K.Eshraghian, ―Principles of CMOS VLSI design,‖ Addison Wesley Publishing Company, old edition publication 2010.
2. Neil He Weste,David Harris and Ayan Banerjee, ―CMOS VLSI design-A circuits and Systems Perspective, Dorling Kindersley (india) Pvt Ltd, 2009.
3. Jan M. Rabaey, AnanthaChandrakasan and BorivojeNikolic, ― Digital Integrated Circuits – A Design Perspective,‖ Prentice Hall of India, 2012.
4. J. Bhasker ―A Verilog HDL Primer,‖Star Galaxy Press, old edition, 2004.
5. Wayne wolf, ―Modern VLSI Design: System on Chip Design,‖ Prentice Hall of India, 2012.

REFERENCE BOOKS:

1. E.D.Fabricious, ‐Introduction to VLSI design‖, McGraw Hill, 2005.
2. Thomas, D .E .,Philip.R. Moorby ‐The Verilog Hardware Description Language‖,2nd ed.,Kluwer Academic Publishers,2002.
3. Sebastian Smith, ‐Application Specific Integrated Circuits‖, Pearson Education,2001.
4. DebaPrasad Das, ‐VLSI Design‖, Oxford University Press, 2012.

SOFT COMPUTING **4 0 0 4**

COURSE OBJECTIVES

- To expose the students to the concepts of feed forward neural networks.
- To provide adequate knowledge about feedback neural networks
- To provide adequate knowledge about fuzzy and neuro-fuzzy systems
- To provide comprehensive knowledge of fuzzy logic control to real time systems.
- To provide adequate knowledge of genetic algorithms and its application to economic dispatch and unit commitment problems.

COURSE OUTCOMES

- The students will be able to understand neural network, fuzzy logic and its application and neuro fuzzy controller.

UNIT I: ARTIFICIAL NEURAL NETWORK

Review of fundamentals – Biological neuron, Artificial neuron, activation function, Single layer perceptron- limitation – Multilayer perceptron- Back propagation algorithm –Recurrent Network adaptive resonance theory based network – Radial base function network- Online learning algorithms, BP through time- RTRL algorithm reinforce learning. **(12)**

UNIT II: NEURAL NETWORKS FOR MODELING AND CONTROL

Modeling of non-linear systems using ANN- Generation of training data – Optimal architecture –Model validation – Control of non- linear systems using ANN – Direct and Indirect neuro control schemes – Adaptive neuro controller – Familiarization with neural network toolbox. **(12)**

UNIT III: FUZZY SET THEORY

Fuzzy set theory- Fuzzy sets- Operation on fuzzy sets- Scalar cardinality, Fuzzy cardinality, union and intersection- complement (Yeger and sugeno), equilibrium points, aggregation, projection,composition, cylindrical extension, fuzzy relation- fuzzy membership functions. **(12)**

UNIT IV: FUZZY LOGIC FOR MODELING AND CONTROL

Modeling of non linear systems using fuzzy models – TSK model – Fuzzy logic controller fuzzification – knowledge base- Decision making logic – Defuzzification – Adaptive fuzzy systems – Familiarization with fuzzy logic toolbox. **(12)**

UNIT V: HYBRID CONTROL SCHEMES

Fuzzification and rule base using ANN – Neuro fuzzy systems ANFIS – Fuzzy neuron – Introduction to GA – Optimization of membership function and rule base using Genetic algorithm – Introduction to support vector machine – particle swarm optimization – case studyfamiliarization with ANFIS toolbox. **(12)**

TEXT BOOKS:

1. Laurene V.Fausett, ―Fundamentals of Neural Networks, Architecture, Algorithms, and Applications‖, Pearson Education, 2008.
2. Timothy J.Ross, ―Fuzzy Logic with Engineering Applications‖, Wiley, Third Edition, 2010.

3. David E.Goldberg, –Genetic Algorithms in Search, Optimization, and Machine Learning‖, Pearson Education, 2009

REFERENCE BOOKS:

1. George J.Klir and Bo Yuan, –Fuzzy Sets and Fuzzy Logic: Theory and Applications‖, Prentice HalI, First Edition, old edition,2007.
2. W.T.Miller, R.S.Sutton and P.J.Webrose, –Neural Networks for Control‖, MIT Press, 2008.
3. C.Cortes and V.Vapnik, "Support-Vector Networks, Machine Learning‖, old edition,2018.

INDUSTRIAL NETWORKING **4 0 0 4**

COURSE OBJECTIVES

- Basic knowledge about networking in industries.
- Understand the evolution of computer networks using the layered network architecture.
- Understand the concepts of data communications.
- Be familiar with the Transmission media and Tools.
- Design computer networks using sub-netting and routing concepts.

COURSE OUTCOMES

At the end of the course, the student should be able to:

- Apply the concepts of data communications and to design computer networks using subnetting and routing concepts.
- Compare the various medium access control techniques.
- Compare and contrast the characteristics of physical layer.
- Analyze the different protocols.
- Compare and contrast the different network components.

UNIT I: INTRODUCTION

Modern instrumentation and control systems – Terminology – Topology – Mechanisms - Protocols – Standards – Common problems and solutions – Grounding/shielding and noise - EIA-232 interface standard – EIA-485 interface standard – Current loop and EIA-485 converters - Fibre optic cable components and parameters – Basic cable types – Connection fibers – Troubleshooting. **(12)**

UNIT II: COMMUNICATION BUS PROTOCOLS

Overview – Protocol structure – Function codes – Modbus plus protocol –Data Highway – AS interface (AS-i)-DeviceNet: Physical layer – Topology – Device taps –Profibus PA/DP/FMS: Protocol stack – System operation.CAN BUS: Concepts of bus access and arbitration – CAN: Protocol-Errors: Properties – Detection – processing – Introduction to CAN 2.0B. **(12)**

UNIT III: ETHERNET SYSTEMS

IEEE 802.3 – Physical layer - Medium access control – Collisions - Ethernet design rules - Fast and gigbit Ethernet systems - design considerations - Internet layer protocol - UDP - TCP/IP - ProfiNet - LAN system components – Structured cabling – Industrial Ethernet – Troubleshooting Ethernet. **(12)**

UNIT IV: WIRELESS COMMUNICATIONS

Radio spectrum – Frequency allocation – Radio modem – Intermodulation – Implementing a radio link – RFID: Basic principles of radio frequency identification – Transponders – Interrogators, WirelessHART. **(12)**

UNIT V: APPLICATIONS

Automotive communication technologies – Design of automotive X-by-Wire systems, - The LIN standard – The IEC/IEEE Train communication network: Applying train communication network for data communications in electrical substations. **(12)**

TEXT BOOKS:

1. Steve Mackay, Edwin Wright, Deon Reynders and John Park, ―Practical Industrial Data Networks: Design, Installation and Troubleshooting, Newnes (Elsevier), 2004.
2. Dominique Paret, ―Multiplexed Networks for Embedded Systems, John Wiley & Sons, 2007.

REFERENCE BOOKS:

1. Richard Zurawski, ―The Industrial Communication Technology Handbook‖, Taylor and Francis, 2005.
2. Deon Reynders and Edwin Wright, ―Practical TCP/IP and Ethernet Networking, IDC Technologies, 2006.
3. James Powell, Henry Vandelinde, ―Catching the Process Fieldbus an Introduction to PROFIBUS for Process Automation", Momentum Press, 2013.
4. Albert Lozano-Nieto, ―RFID Design Fundamentals and Applications‖, CRC Press, 2011.

FIELD AND SERVICES ROBOTICS 4 0 0 4

COURSE OBJECTIVES

- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study about the localization, planning and navigation.
- To study the control of robots for some specific applications.
- To study about the humanoid robots.

COURSE OUTCOMES

Upon completion of the course, the student should be able to:

- Explain the basic concepts of working of robot.
- Analyze the function of sensors in the robot.
- Developing programs to use a robot for a typical application.
- Use Robots in different applications.
- Know about the humanoid robots functions & its operations.

UNIT I: INTRODUCTION

History of service robotics – Present status and future trends – Need for service robots - Applications- Examples and Specifications of service and field Robots. Non conventional Industrial robots. **(12)**

UNIT II: LOCALIZATION

Introduction-Challenges of Localization- Map Representation- Probabilistic Map based Localization- Monte carlo localization- Landmark based navigation-Globally unique localization- Positioning beacon systems- Route based localization. **(12)**

UNIT III: PLANNING AND NAVIGATION

Introduction-Path planning overview- Road map path planning- Cell decomposition path planning-Potential field path planning-Obstacle avoidance - Case studies: Tiered robot architectures. (**12)**

UNIT IV: FIELD ROBOTS

Ariel robots- Collision avoidance-Robots for agriculture, mining, exploration, underwater, Civilian and military applications, Nuclear applications, Space applications. **(12)**

UNIT V: HUMANOIDS

Wheeled and legged, Legged locomotion and balance, Arm movement, Gaze and auditory orientation control, Facial expression, Hands and manipulation, Sound and speech generation, Motion capture/Learning from demonstration, Human activity recognition using vision, touch, sound, Vision, Tactile Sensing, Models of emotion and motivation. Performance, Interaction, Safety and robustness, Applications_Case studies. **(12)**

TEXT BOOKS:

1. Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, „Introduction to Autonomous Mobile Robots‖, Bradford Company Scituate, USA, 2004

2. Riadh Siaer, „The future of Humanoid Robots- Research and applications“, Intech Publications, 2012.

REFERENCE BOOKS:

1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.
2. Kelly, Alonzo; Iagnemma, Karl; Howard, Andrew, "Field and Service Robotics ", Springer, 2011

PC BASED INDUSTRIAL AUTOMATION **4 0 0 4**

COURSE OBJECTIVES

To study the TC3 functions and types of connectivity used in Industrial automation.

COURSE OUTCOMES

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

- Study TwinCAT Introduction & Licensing.
- Apply TC3 functions in Matlab/LabVIEW/Simulink
- Learn the various types of connectivity used in Automation
- Implement the techniques in hardware platform.

UNIT I: INTRODUCTION

PC based Automation: TwinCAT Introduction & Licensing - TC3 Workbench - Source Control - Project compare tool - System I/O Variable - ADS Setting-Global Data types - EtherCAT - Hardware Configuration - EPC & IPC Introduction to Basic Components - Editors - Library Management - Visualization - Programming References - Library Creation. **(12)**

UNIT II: TC3 FUNCTIONS

Measurement Control-Motion - Motion Axis Configuration - NC PTP - NCI - TwinCAT Kinematic transformation-Stepper Motor & Drive terminal Configuration - C/C++ - Matlab/LabVIEW/Simulink - I/O - Safety PLC. **(12)**

UNIT III: CONNECTIVITY

Serial Communication - RS232, RS485/RS422, MODBUS RTU, CANOpen, ProfiBus, DeviceNet - Database Server - SMS/SMTP - TCP/IP. **(12)**

UNIT IV :BUILDING AUTOMATION

Introduction - Hardware Requirements - BA PLC Libraries - HVAC - BACnet IP - EIB - TwinCAT Diagnostics. **(12)**

UNIT V: LAB SESSION

1. TwinCAT Software and Hardware
2. NC PTP Programming
3. Motion Control programming with kinematic transformation
4. Communication programming
5. Building automation system integration **(12)**
6.

TEXT BOOKS:

1. A.D. Rodic, Automation & Control-Theory & Practice, In-Tech publications, 2009.
2. Frank Lamb, Industrial Automation, Hands on practice, Mc Graw Hill, 2018.
3.

REFERENCE:

https://infosys.beckhoff.com

SEMESTER VI – ELECTIVE II

IMAGE PROCESSING AND VISION SYSTEMS **4 0 0 4**

COURSE OBJECTIVES

- To represent and interpret image in its numeric and graphical form.
- To understand geometric relationship of pixels.
- To write simple codes for improving image quality.
- To extract useful information from image contents through processing.
- To understand and document needs for specific machine vision system.
- To develop machine vision system based on requirement.

COURSE OUTCOMES

After successful completion of the course, student will be able to

- Represent and interpret image in its numeric and graphical form.
- Understand geometric relationship of pixels.
- Write simple codes for improving image quality.
- Extract useful information from image contents through processing.
- Understand and document needs for specific machine vision system.
- Develop machine vision system based on requirement.

UNIT I: VISION SYSTEM

Basic Components - Elements of visual perception: structure of human eye, Image formation in the eye – pinhole cameras - color cameras – Image formation model – Imaging components and illumination techniques - Picture coding – Basic relationship between pixels - Camera-Computer interfaces. **(12)**

UNIT II: LOW-LEVEL VISION:

Image representation – Gray level transformations, Histogram equalization, Image subtraction, Image averaging – Filters: Smoothing spatial filters, sharpening spatial filters, smoothing frequency domain filters, sharpening frequency domain filters - Edge detection. **(12)**

UNIT III: HIGHER-LEVEL VISION:

Segmentation: Edge linking and Boundary Detection, Thresholding, Region-oriented segmentation, the use of motion – Description: Boundary Descriptors, Regional Descriptors, Recognition: Decision-Theoretic methods, structural methods. **(12)**

UNIT IV: APPLICATIONS:

Camera Calibration - Stereo Imaging - Transforming sensor reading, Mapping Sonar Data, Aligning laser scan measurements - Vision and Tracking: Following the road, Iconic Image processing, Multiscale image processing, Video Tracking - Learning landmarks: Landmark spatiograms, K-means Clustering, EM Clustering, Kalman Filtering. **(12)**

UNIT V: ROBOT VISION

Basic introduction to Robotic operating System (ROS) - Installing and testing ROS camera Drivers, ROS to OpenCV - The cv bridge Package.Introduction to OpenCV image processing libraryand MATLAB programming. **(12)**

TEXTBOOKS:

1. K.S.Fu, R.C.Gonzalez, CSG. Lee, -Robotics control, sensing, vision and Intelligence‖, McGraw Hill Education Pvt. Ltd., 2013.
2. Richard D Klafter, Thomas A Chmielewski, Michael Negin, -Robotics Engineering: An Integrated Approach‖, PHI Learning, New Delhi, 2009.

REFERENCE BOOKS:

1. Damian M Lyons,-Cluster Computing for Robotics and Computer Vision‖, World Scientific, Singapore, 2011.
2. RafelC.Gonzalez, Richard E.Woods, Steven L.Eddins,‖Digital ImageProcessing using MATLAB‖,2nd edition, Tata McGraw Hill, 2010.
3. Carsten Steger, Markus Ulrich, Christian Wiedemann, -Machine Vision Algorithms and Applications‖, WILEY-VCH, Weinheim, 2008.
4. Kenneth Dawson-Howe, -A Practical Introduction to Computer Vision with OpenCV‖, Wiley, Singapore, 2014.

FPGA BASED SYSTEM DESIGN **4 0 0 4**

COURSE OBJECTIVES

- To learn the algorithms and models developed in MATLAB, simulink into VHDL for implementing in PLD and also realize the concept of interfacing

COURSE OUTCOMES

- Acquire knowledge about programmable logic devices.
- Extrapolate various programming languages to develop digital designs for implementation in either a processor or in PLD.
- Generalize with VHDL to simulate and synthesize the digital design.
- Implement combinational logic, sequential logic using VHDL and acquire knowledge about state machine design, memories.
- Translate algorithms and models developed in MATLAB, simulink into VHDL for implementing in PLD and also realize the concept of interfacing.

UNIT I: INTRODUCTION TO PROGRAMMABLE LOGIC DEVICES

Introduction to the programmable logic devices, comparison of programmable logic with digital logic and processors - Types of programmable logic, Simple Programmable Logic Device (SPLD), Complex Programmable Logic Device (CPLD), Field Programmable Gate Array (FPGA)- PLD configuration technologies- Programmable logic design methods and tools, Technology trends. **(12)**

UNIT II: DESIGN LANGUAGES

Introduction to various software programming languages: C, C++, Java, Visual basics, scripting language, PHP- Hardware description language, VHDL description for two input and gate- Hardware description language, Verilog HDL description for full adder- Hardware description language, Verilog description for voltage amplifier- Introduction to mathematical modeling tools, modeling of motor control system using simulink. **(12)**

UNIT III: DIGITAL LOGIC DESIGN WITH VHDL

Designing with high definition language- Design entry methods- Logic synthesis- Entities, architectures, packages and configurations- Coding styles for VHDL. **(12)**

UNIT IV: COMBINATIONAL AND SEQUENTIAL LOGIC DESIGN

Introduction to combinational logic design, VHDL design for adders and four to one multiplexer- Encoder design using VHDL- Introduction to sequential logic design and VHDL design for D-latch- Design of binary counter using VHDL- Introduction to state machine design, design of sequence detector using VHDL- VHDL design of memories: RAM, ROM- Testing of VHDL design. **(12)**

UNIT V: SYSTEM LEVEL DESIGN

Creating VHDL test bench for digital to analog converter- Creating VHDL test bench for thyristor gate control pulse-generator- Electronic system level design- Creating VHDL test bench for digital filter design. **(12)**

TEXT BOOKS

1. Ian Grout, –Digital System Design with FPGA and CPLD‖, Newnes publishers, 2nd edition, 2008.

REFERENCE BOOKS

1. Peter Wilson, –Design Recipes for FPGAs‖, Newnes publishers, 3rd edition, 2007.
2. Wayne Wolf, –FPGA Based System Design‖, Prentice Hall, 1st edition, 2004.

INDUSTRIAL DRIVES FOR AUTOMATION **4 0 0 4**

COURSE OBJECTIVES

Analysis and application of load control techniques in Industries.

COURSE OUTCOMES

- Acquire knowledge about load control techniques in industries and its application.. Acquire knowledge about load management to reduce demand of electricity during peak time.
- Analyse and understand different energy saving opportunities in industries.
- Acquire knowledge about reactive power control in industries and analyse different power factor improvement methods.
- Learn mathematical modelling and profiling of various loads such as cool storage, cooling and heating loads.
-

UNIT I : INTRODUCTION

Construction and Principle of operation of PMSM and SynRM – AC drive Hardware Blocks – Control Blocks – Automatic Motor Adaptation – Parameterization of Drives (Local and Remote). **(12)**

UNIT II: CONFIGURATIONS OF DIFFERENT I/O CONTROL

Digital Input and output – Analog Input and output Control-word access – Motion control - Sequential Logic Control (SLC) - Parameterization for different communication protocol: RS 485 – MODBUS - PROFIBUS. **(12)**

UNIT III: CONFIGURATION FOR DIFFERENT APPLICATIONS

AQUA – HVAC – Automation – Master/ Slave control. **(12)**

UNIT IV: PRACTICAL

Performance characterization of PMSM and SynRM - Conveyor control – Cascaded Pump Control – Synchronization of Drives with Master Slave Control. **(12)**

TEXT BOOKS:

2. Vedam Subramaiyan, Electric Drives, Tata Mc Graw Hill, 2011.

REFERENCES:

1. Programming Guide for FC Drives by Danfoss Industries pvt. Ltd.
2. Monograph prepared by PSG-Danfoss CoE for Climate and Energy.

APPLIED ROBOTICS **4 0 0 4**

COURSE OBJECTIVES

- This course attempts to address the applications of robots in some specific areas where the use of robots have significantly improved productivity

COURSE OUTCOMES

At the end of the course, student will be able to

- Understand the various types of Industrial, field and service Robots and their characteristics and capabilities.
- Equip with the knowledge of Mathematical modeling of specialized Robots.
- Familiarize with the operation of Robots and processes involved.
- Select the right Robot with required configurations and specifications for applications.
- Familiarize with the applications of various field and service Robots.

UNIT I: APPLICATIONS OF ROBOTS IN INDUSTRIES

Introduction to robotics - overview, A short history of industrial Robots - Applications of Robots in Welding, car body assembly, painting- Applications of Robot in Machining, material transfer- Kinematics and mechanisms review, tasks descriptions, teaching and programming- End-effectors and system integration. **(12)**

UNIT II: COOPERATIVE AND SWARM ROBOTS

Cooperative manipulation, Challenges in cooperative manipulation- Case studies for Cooperative manipulation for Industrial and Service applications- Introduction to swarm Robots, comparison with other multi-agent systems, challenges and benefits of swarm systems- Algorithms for swarm Robots, application, case study of swarm Robots. **(12)**

UNIT III: FIELD ROBOTICS

Forestry, Robot locomotion, forestry automation, SLAM in forestry- autonomous Robots for silviculture and treatment- Broad acre Applications: Automatic guidance, sowing, weeding, spraying and broad-acre harvesting, Horticulture: picking of fruits- Robot milking, sheep shearing, slaughtering, livestock inspection- Robots in construction, unsolved problems in construction, Futuredirections- Robots for hazardous applications, enabling technologies- Search and Rescue robotics: Disaster characteristics-Impact on Robots, Robots actually used at disaster, promising robots, open issues – case studies. **(12)**

UNIT IV: ROBOTS IN SURGERY AND REHABILITATION

Medical robotics, Core concepts, Technology- Medical robotic systems, Research areas and applications- Rehabilitation and Health care robotics: Overview, physical therapy and training Robots- Aids for people with disabilities- Smart prostheses and orthoses, diagnosis and monitoring. **(12)**

UNIT V: ENTERTAINMENT AND PERSONAL ROBOTICS

Cleaning Robots, lawn moving Robots- Smart appliances and smart homes- The role of Robots in education, Educational robotic platforms-. Robots and informal learning venues **(12)**

TEXT BOOKS

1. Bruno Siciliano, OussamaKhatib, –Springer Handbook of Robotics‖, Springer-Verlag Berlin Heidelberg 2008.
2. Yangsheng Xu Huihuan Qian Xinyu Wu, "Household and Service Robots", Elsevier Ltd, 2015.

REFERENCE BOOKS

1. AleksandarLazinica, –Mobile Robots Towards New Applications‖, Advanced Robotic Systems International, 2006.
2. Gregory Dudek,Michael Jenkin, –Computational Principles of Mobile Robotics‖, 2nd edition, Oxford University Press, 2010.
3. L Marques,A de Almeida,Mo Tokhi,GSVirk, –Advances in Mobile Robotics‖, World Scientific Publishing Co. Pte. Ltd. 2008.

WIRELESS SENSOR NETWORKS FOR ROBOTICS **4 0 0 4**

COURSE OBJECTIVES

- To know the basic knowledge about wireless sensor networks
- To impart knowledge in networking using sensors
- To know about the tools used in networking
- To understand the basic in wireless architecture
- To know about the different techniques used in networking

COURSE OUTCOMES:

- Ability to know about the different techniques used in networking
- To expose basic knowledge about wireless sensor networks
- Ability to know about the tools in networking
- Understand the basic in wireless architecture
- Ability to know about the protocols used in networking

UNIT I: OVERVIEW OF WIRELESS SENSOR NETWORKS

Challenges for Wireless Sensor Networks, Enabling Technologies For Wireless Sensor Networks. **(12)**

UNIT II: ARCHITECTURE

Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, Network Architecture -Sensor Network Scenarios, Optimization Goals and Figures of Merit, Gateway Concepts. **(12)**

UNIT III: NETWORKING SENSORS

Physical Layer and Transreceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts - S-MAC, The Mediation Device Protocol, Wakeup Radio Concepts, Address and Name Management, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing.**(12)**

UNIT IV: INFRASTRUCTURE ESTABLISHMENT

Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control. **(12)**

UNIT V: SENSOR NETWORK PLATFORMS AND TOOLS

Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming. **(12)**

TEXT BOOKS

1. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", John Wiley, 2005.
2. Feng Zhao & Leonidas J. Guibas, –Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

REFERENCE BOOKS

1. KazemSohraby, Daniel Minoli, &TaiebZnati, –Wireless Sensor Networks- Technology, Protocols, And Applications‖, John Wiley, 2007.
2. Anna Hac, –Wireless Sensor Network Designs‖, John Wiley, 2003.

SEMESTER VII – ELECTIVE III

INTERNET TOOLS AND JAVA PROGRAMMING **4 0 0 4**

COURSE OBJECTIVES

- To learn about the various tools used in internet.
- To learn Java Programming.
- To understand different Internet Technologies and the way to handle it.
- To be familiar with client – side programming and server – side programming.
- To learn to develop web based applications.

COURSE OUTCOMES

At the end of the course, the student should be able to:

- Implement Java programs and to create a basic website using HTML and Cascading Style Sheets.
- Design and implement dynamic web page with validation using JavaScript objects and by applying different event handling mechanisms.
- Design rich client presentation using AJAX.
- Design and implement simple web page in PHP, and to present data in XML format.
- Design and implement server side programs using Servlets and JSP.

UNIT I:INTERNET SERVICES AND PROTOCOLS

Fundamentals - Internet Addresses - File Transfer Protocol (FTP) –HTTP – HTTPS - SMTP-DNS - Net Telephony – Internet Relay Chat - Newsgroups - Remote Login - Telnet - Socket programming, UDP, TCP. **(12)**

UNIT II:OBJECT ORIENTATION IN JAVA

Introduction - Data Types - Operators - Declarations - Control Structures - Arrays and Strings - Input/Ouput. Java Classes - Fundamentals - Methods - Constructors - Scope rules - this keyword - object based Vs oriented programming.- -Inheritance-Reusability - Composing class - Abstract classes - Abstract Functions – Method Overloading and Method Overriding-Wrapper Classes. **(12)**

UNIT III:PACKAGES AND INTERFACES

Packages - Access protection - Importing packages - Interface - Defining and Implementing Interface - Applying Interface - Variables in Interfaces. **(12)**

UNIT IV:EXCEPTION HANDLING

Fundamentals - Exception types - Uncaught Exception - Using Try and Catch - Multiple catch clauses - Nested try statements - Throw - Throws - Java Built-in Exception - Creating your own subclasses. **(12)**

UNIT V:MULTI THREADED PROGRAMMING

Java thread model - Priorities - Synchronization - Messaging - Thread class and runnable Interface - Main thread - Creating the Thread - Synchronization - Interthread Communication - Deadlock. I/O, APPLETS: I/O basics - Stream - Stream Classes - Predefined stream - Reading/Writing console input - Applet fundamentals - Native methods - GUI Components - Applets - Java Scripts – AWT / Swings. JAVA DATABASE PROGRAMMING: JDBC – Database Connection and Table Creation. **(12)**

TEXT BOOKS:

1. Patrick Naughton and Herbert Schildt, "JAVA - The Complete Reference", Tata McGraw Hill, old edition, 2010.
2. James K L,‖ The Internet: A Users Guide‖, Prentice Hall of India, New Delhi, 2003.

REFERENCE BOOKS:

1. Deitel and Deitel, "JAVA - How to Program", Prentice Hall International Inc, 2003.
2. William Stanek and Peter Norton, "Peter Norton's Guide to JavaProgramming",Tech Media Publications, old edition, 1997.
3. Mark Grand, "JAVA Language Reference", O'Reilly & Associates Inc., old edition, 2018, Jan13th .
4. Horstmann and Cornell, Core Java‖, Pearson Education, 2001.

MOBILE ROBOTICS **4 0 0 4**

COURSE OBJECTIVES

- To recognize and describe the role of unmanned aerial vehicles (UAVs) in past, present, and future society.
- To comprehend and explain various components of UAVs.
- To comprehend and explain basics of flight and flight control systems.
- To understand and describe basics of underwater robots.

COURSE OUTCOMES

At the end of the course, student will be able to

- Understand the challenges in developing autonomous mobile Robots.
- Abstract kinematic control of wheeled mobile Robots.
- Understand the challenges involved in sensory perception for mobile Robots.
- Develop localization and path planning algorithms for mobile Robot navigation.
- Comprehend the challenges and configurations of legged, aerial and underwater Mobile Robots.

UNIT I: OVERVIEW AND BACKGROUND

Definitions- History of UAVs - classifications of UAVs scale- lift generation method- contemporary applications- military- government- civil-societal impact and future outlook- operational considerations- liability / legal issues-insurance- ethical implications- human factors- LOS / BLOS. **(12)**

UNIT II: PAYLOAD FOR UAV

Introduction – Types – Non dispensable Payloads - Electro-optic Payload Systems - Electrooptic Systems Integration - Radar Imaging Payloads - Other Non dispensable Payloads -Dispensable Payloads - Payload Development **(12)**

UNIT III: UNMANNED AERIAL SYSTEM (UAS) COMPONENTS

Platforms- configurations- characteristics-applications- propulsion- Internal combustion - on-board flight control- payloads- sensing / surveillance- weaponized- delivery- communications- command/control- telemetry - launch / recovery systems- Ground control stations. **(12)**

UNIT IV : UNDERWATER ROBOTICS

Robotics in Water - Basics Representation of Underwater Robot - Types and Classification of Underwater Robotics - Differentiating Aerial and Underwater Robotics - Overview about Environmental Factors affecting object in water. **(12)**

UNIT V: CONTROL SYSTEM AND MANIPULATOR

Control System and Types of Control Systems in Underwater Robotics - Sensors Connected with the Underwater Robotics - Introduction to Underwater Manipulators - Introduction to Hydraulics on Underwater Vehicles - Applications of Underwater Vehicles. **A**UTONOMOUS UNDERWATER SYSTEMS: Introduction to AUVS - Development of

AUVs,ROV in Market - Case Study on AUV Control System Basics - Case Study on Subsea Manipulator - Case Study on Technologies Used. **(12)**

TEXT BOOKS:

1. Roland Siegwant & Illah R. Nourbakhsh, Introduction to Autonomous Mobile Robots, MIT Press, 2004.

REFERENCE BOOKS:

1. ASA Test Prep. Remote Pilot Test Prep — UAS: Study & Prepare. Wellfleet Press, 2016. 978-1577151326
2. Austin, Unmanned Aircraft Systems: UAVS Design, Development and Deployment. Wiley, 2010. 978-0-470-05819-0
3. Baichtal, Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs. Que Publishing,2016. 978-0789755988
4. Beard & McLain, Small Unmanned Aircraft: Theory and Practice. Princeton University Press, 2012. 978-0691149219
5. Cares & Dickmann, Operations Research for Unmanned Systems. Wiley, 2016. 978-1-118-91894-4
6. Gianluca Antonelli, ―Underwater Robots‖, Springer, 2014.

VISION GUIDED ROBOTICS 4 0 0 4

COURSE OBJECTIVES

- To impart knowledge in the field of computer vision applied to guidance of manipulators and mobile Robots.

COURSE OUTCOMES

At the end of the course, student will be able to

- Understand the foundations of the field of computer vision required for Robot vision.
- Explain the Mathematics and Implementation of vision guidance for manipulators.
- Formulate the various ways to utilize computer vision for mobile Robots.
- Develop algorithms for Motion analysis.
- Apply the computer vision algorithms for suitable applications involving Manipulators and mobile Robots.

UNIT I: INTRODUCTION

Vision for robot manipulation and navigation-Motivation. Modeling velocity of a rigid object- Camera configurations in vision guided Robots-Triangulation-Vision based pose estimation. **(12)**

UNIT II: VISUAL SERVOING

Mathematical formulation of visual servo problem-classification of visual servoing architectures-Image based visual servoing (IBVS), Interaction matrix derivation-Geometrical interpretation of IBVS, stability analysis-Case study: IBVS with stereo vision system-IBVS with other geometrical features, direct estimation-Position based visual servoing: Point feature based motion, pose based motion-Calibration for visual servoing systems**. (12)**

UNIT III: VISION FOR MOBILE ROBOTS

Introduction to simultaneous localization and mapping, visual SLAM (VSLAM)-VSLAM approaches-Introduction to visual odometry (VO).VO: Motion from Image feature correspondences, motion from 3D structure. Comparison between VSLAM and VO calibration techniques-Case study of VSLAM and VO application. **(12)**

UNIT IV: MOTION ANALYSIS

Formulation of the motion analysis-Motion field of Rigid objects, Aperture problem-Optical flow and motion field, brightness constancy equation and validity-Estimating motion field: Differential techniques, feature based techniques.Target tracking: Challenges and solutions, Kalman filtering basics-Kalman tracking. **(12)**

UNIT V: ADVANCED TOPICS

Hybrid visual servoing, partitioned visual servoing, switching -schemes in visual servoing. Joint space control of eye-in-hand and eye-to-hand systems-Motion based segmentation. Structure from motion (SFM), multi-view SFM-3-D structure and motion from motion field. **(12)**

TEXT BOOK:

1. Emanuele Trucco, Alessandro Verri, ‒Introductory Techniques For 3D Computer Vision‖, Prentice Hall of India, April 11-13, 2018.

REFERENCE BOOKS :

1. Bruno Siciliano, Oussama Khatib, –Springer Handbook of Robotics‖, Springer, 2008.
2. D. Scaramuzza and F. Fraundorfer, "Visual Odometry [Tutorial]", IEEE Robotics & Automation
3. Magazine, vol. 18, no. 4, pp. 80-92, December, 2011.
4. F. Fraundorfer and D. Scaramuzza, "Visual Odometry : Part II: Matching, Robustness, Optimization, 1 EE Robotics & Automation Magazine, Vol 18, Issue 4, 2011.
5. Applications", IEEE Robotics and Automation Magazine, vol. 19, no. 2, pp. 78-90, June, 2012.

MEDICAL ROBOTICS 4 0 0 4

COURSE OBJECTIVES

- Identify and describe different types of medical robots and their potential applications.
- Know basic concepts in kinematics, Dynamics, and control relevant to Medical Robotics.
- Develop the Analytical and Experimental skills necessary to Design and Implement robotic assistance for both minimally invasive surgery and Image-guided interventions.
- Be familiar with the state of the art in applied medical robotics and medical robotics research.
- Understand the various roles that robotics can play in healthcare.

COURSE OUTCOMES

- The students will be able to simulate a MIS procedure and be aware of the state-of art in surgical and oncology robotics.
- Students should be able to have a fundamental understanding of robot kinematics and dynamics.
- Understand the challenges in the design of a medical robotic system given the specific requirements for a particular application.
- Appreciate the design, development, and evaluation of a medical robotic system.

UNIT I: INTRODUCTION

Types of medical robots - Navigation - Motion Replication - Imaging - Rehabilitation and Prosthetics - State of art of robotics in the field of healthcare. **(12)**

UNIT II: LOCALIZATION AND TRACKING

Position sensors requirements - Tracking - Mechanical linkages - Optical - Sound-based - Electromagnetic - Impedance-based - In-bore MRI tracking - Video matching - Fiber optic tracking systems - Hybrid systems. **(12)**

UNIT III: SURGICAL ROBOTICS

Minimally invasive surgery and robotic integration – surgical robotic sub systems - synergistic control. Control Modes – Radio surgery - Orthopedic Surgery - Urologic Surgery and Robotic Imaging - Cardiac Surgery – Neurosurgery – case studies. **(12)**:

UNIT IV: REHABILITATION

Rehabilitation for Limbs - Brain-Machine Interfaces - Steerable Needles – case studies. Robots in Medical Care**:** Assistive robots –types of assistive robots – case studies. **(12)**

UNIT V: DESIGN OF MEDICAL ROBOTS

Characterization of gestures to the design of robots- Design methodologies- Technological choices- Security. **(12)**

TEXT BOOKS:

1. Mark W. Spong, Seth Hutchinson, and M. Vidyasagar, ―Robot Modeling and Control‖, Wiley Publishers, 2006.
2. Paula Gomes, "Medical roboticsMinimally invasive surgery", Woodhead, 2012.

REFERENCE BOOKS:

1. Achim Schweikard, Floris Ernst, ―Medical Robotics‖, Springer, 2015.
2. Jocelyne Troccaz, ―Medical Robotics‖, Wiley-ISTE, 2012.
3. Vanja Bonzovic, ‖Medical Robotics‖, I-tech Education publishing, Austria,2008.

– INDUSTRIAL IOT AND AUTOMATION **4 0 0 4**

COURSE OBJECTIVES

- The objective of this course is to impart necessary and practical knowledge of components of Internet of Things and develop skills required to build real-life IoT based projects.

COUESE OUTCOMES

After the completion of this course, the students will be able to:

- Understand internet of Things and its hardware and software components
- Interface I/O devices, sensors & communication modules
- Remotely monitor data and control devices
- Develop real life IoT based projects

UNIT I: INTRODUCTION

Modern instrumentation and control systems – Terminology – Topology – Mechanisms - Protocols – Standards – Common problems and solutions – Grounding/shielding and noise - EIA-232 Interface standard – EIA-485 interface standard – Current loop and EIA-485 converters - Fibre optic cable components and parameters – Basic cable types – Connection fibers – troubleshooting. **(12)**

UNIT II: COMMUNICATION BUS PROTOCOLS

Overview – Protocol structure – Function codes – Modbus plus protocol –Data Highway – AS interface (AS-i)-DeviceNet**:** Physical layer – Topology – Device taps –Profibus PA/DP/FMS**:** Protocol stack – System operation.CAN BUS: Concepts of bus access and arbitration – CAN: Protocol-Errors: Properties – detection – processing – Introduction to CAN 2.0B. **(12)**

UNIT III: ETHERNET SYSTEMS

IEEE 802.3 – Physical layer - Medium access control – Collisions - Ethernet design rules - Fast and gigbit Ethernet systems - design considerations - Internet layer protocol - UDP - TCP/IP - ProfiNet - LAN system components – Structured cabling – Industrial Ethernet – Troubleshooting Ethernet. **(12)**

UNIT IV: WIRELESS COMMUNICATIONS

Radio spectrum – Frequency allocation – Radio modem – Inter modulation – Implementing a radio link – RFID: Basic principles of radio frequency identification – Transponders – Interrogators, Wireless HART. **(12)**

UNIT V: APPLICATIONS

Automotive communication technologies – Design of automotive X-by-Wire systems, - The LIN standard – The IEC/IEEE Train communication network: Applying train communication network for data communications in electrical substations.

(12)

TEXT BOOKS:

1. Steve Mackay, Edwin Wright, Deon Reynders and John Park, -Practical Industrial Data Networks: Design, Installation and Troubleshooting‖, Newnes (Elsevier), 2004.
2. Dominique Paret, -Multiplexed Networks for Embedded Systems‖, John Wiley & Sons, 2007.

REFERENCE BOOKS:

1. Richard Zurawski, -The Industrial Communication Technology Handbook‖, Taylor and Francis, 2005.
2. Deon Reynders and Edwin Wright, -Practical TCP/IP and Ethernet Networking‖, IDC Technologies, 2006.
3. James Powell, Henry Vandelinde, -Catching the Process Fieldbus an Introduction to PROFIBUS for Process Automation", Momentum Press, 2013.
4. Albert Lozano-Nieto, -RFID Design Fundamentals and Applications‖, CRC Press, 2011.

SEMESTER VII – ELECTIVE IV

OPERATIONS RESEARCH 4 0 0 4

COURSE OBJECTIVES

- To provide knowledge and training in applying optimization techniques under limited resources for the engineering and business problems.

COURSE OUTCOMES

- Upon completion of this course, the students can able to use the optimization techniques for use of engineering and Business problems.
- Students will have the ability to develop Mathematical Model for Engineering problems.

UNIT I: LINEAR MODELS

The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis – Case studies. **(12)**

UNIT II: TRANSPORTATION MODELS AND NETWORK MODELS

Transportation Assignment Models –Traveling Salesman problem-Networks models – Shortest route – Minimal spanning tree – Maximum flow models –Project network – CPM and PERT networks – Critical path scheduling – Sequencing models **(12)**

UNIT III: INVENTORY MODELS

Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice – Case studies on Inventory **(12)**

UNIT IV: QUEUEING MODELS

Queueing models - Queueing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation case studies. **(12)**

UNIT V: DECISION MODELS

Decision models – Game theory – Two person zero sum games – Graphical solution- Algebraic solution– Linear Programming solution – Replacement models – Models based on service life – Economic life– Single / Multi variable search technique – Dynamic Programming – Simple Problem – case studies. **(12)**

TEXT BOOKS:

1. Hillier and Libeberman, –Operations Research‖, Holden Day, 2005
2. Taha H.A., –Operations Research‖, Sixth Edition, Prentice Hall of India, 2003.
3. R. Panneerselvam,‖Operations Research‖, 2nd edition, Published 2006.

REFERENCE BOOKS:

1. Bazara M.J., Jarvis and Sherali H., –Linear Programming and Network Flows‖, John Wiley, 2009.
2. Budnick F.S., –Principles of Operations Research for Management‖, Richard D Irwin, 1990, Nov 17, 2018.
3. Philip D.T. and Ravindran A., –Operations Research‖, John Wiley, 1992, 2007.
4. Shennoy G.V. and Srivastava U.K., –Operation Research for Management‖, Wiley Eastern, 1994, 2013.
5. Tulsian and Pasdey V., –Quantitative Techniques‖, Pearson Asia, 2002.

COMPUTER INTEGRATED MANUFACTURING 4 0 0 4

COURSE OBJECTIVES

- To understand the application of computers in various aspects of Manufacturing viz., Design, Process planning, Manufacturing cost, Layout & Material Handling system.

COURSE OUTCOMES

- Explain the basic concepts of CAD, CAM in Computer Integrated Manufacturing systems.
- Summarize the production planning and control and Computerized process planning by differentiating the different coding systems used in group technology.
- Explain the concepts of Flexible manufacturing system (FMS) and Automated guided vehicle (AGV) system.
- Classification of robots used in Industrial applications.

UNIT I: INTRODUCTION

Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production – case studies. **(12)**

UNIT II: PRODUCTION PLANNING AND CONTROL AND COMPUTERISEDPROCESS PLANNING

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems. **(12)**

UNIT III: CELLULAR MANUFACTURING

Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems. **(12)**

UNIT IV: FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATEDGUIDED VEHICLE SYSTEM (AGVS)

Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control – Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety. **(12)**

UNIT V: INDUSTRIAL ROBOTICS

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

Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems. **(12)**

TEXT BOOK:

1. Mikell.P.Groover –Automation, Production Systems and Computer Integrated Manufacturing‖, Prentice Hall of India, 2008.
2. Radhakrishnan P, Subramanyan S.and Raju V., –CAD/CAM/CIM‖, 2nd Edition, New Age International (P) Ltd, New Delhi, 2000

REFERENCE BOOKS:

1. Peter Smid, –CNC programming Hand book‖ 3rd edition, Ny 2008.

RELIABILITY AND QUALITY CONTROL **4 0 0 4**

COURSE OBJECTIVES

This course introduces students to concepts and methods of modern statistical quality control.

- Students learn to apply standard quality control tools.
- They learn the theoretical statistical concepts that justify the use of particular quality control tools in particular situations.
- They learn theory and methods for analyzing the performance of different quality control tools used in Industry practices.
- To learn some softwares related to statistics & Quality control.

COURSE OUTCOMES

- Principles of probability and statistics and their appropriate application to quality engineering, including use of computer software.
- Through homeworks and computer projects, students learn to formulate and solve quality characteristic monitoring problems.
- Assignment and class discussion on relationship between product quality, public safety, liability, and professional ethics.
- Use of interactive PC - based computer programs for statistical analysis. MATLAB is introduced in class, students may also use Excel or specialized mathematical and statistical packages.

UNIT I: STATISTICAL PROCESS CONTROL

Chance and assignable causes of quality variation, statistical basis of the control charts - Basic principles, choice of control limits, Analysis of patterns on control charts. **(12)**

UNIT II: CONTROL CHARTS FOR VARIABLES AND ATTRIBUTES

chart, R chart, chart, p chart, np chart, c chart, and u chart. **(12)**

UNIT III: ACCEPTANCE SAMPLING

Types of sampling plans, lot formation, single sampling plans for attributes, double, multiple and sequential sampling plans, acceptance sampling by variables, chain sampling, continuous sampling, skip lot sampling plans. **(12)**

UNIT IV: BASIC RELIABILITY MODELS

The failure distribution – Terminologies in Reliability, the reliability function, mean time to failure, Hazard rate function, bathtub curve, conditional reliability. Constant failure rate model (MTF): Exponential reliability function. Time - dependent Weibull failure model, Time - Dependent normal failure model.

(12)

UNIT V : RELIABILITY OF SYSTEMS

Serial configuration, parallel configuration, combined series, parallel systems - k out of n: system -system structure function, minimal cuts, minimal paths, common mode failures, three state devices. **(12)**

TEXT BOOKS:

1. Douglas C Montgomery , Introduction to Statistical Quality Control, Wiley India, New Delhi, 2008.
2. Charles E. Ebeling, Introduction to Reliability and Maintainability Engineering,Tata Mc –Graw Hill, New Delhi, 2010. 55

REFERENCE BOOKS:

1. Eugene L Grant, Richard S Leavenworth, Statistical Quality Control, Tata Mc- Graw Hill, New Delhi, 2011.
2. Dale H Besterfield, Quality Control, Pearson Education , New Delhi, 2008.
3. Hoang Pham, Hand book of Reliability Engineering, Springer- Verlag, New York, 2006.

PROCESS PLANNING AND COST ESTIMATION **4 0 0 4**

COURSE OBJECTIVES

- To introduce the process planning concepts to make cost estimation for various products after process planning.

COURSE OUTCOMES

Upon the completion of this course the students will be able to

- Select the process, equipment and tools for various industrial products.
- Prepare process planning activity chart for several jobs.
- Ability to learn the concept of cost estimation for various operations.
- Compute the job order cost for different types of shop floor activities.
- Calculate the machining time for various machining operations.

UNIT I: PROCESS PLANNING

Introduction- Process & Production Planning, Process Planning & Concurrent Engineering- Types of production- standardization- Production design & selection. Design and Concepts of Process Plan: Selection of processes, tools, cutting parameters & machine tools - Grouping of processes- Sequencing of operations- Selecting primary manufacturing processes for rough & refined needs Process capability, Process Charts. **(12)**

UNIT II: MANUAL AND COMPUTER AIDED PROCESS PLANNING

Retrieval type/variant approach, group technology – generative approach, logics decision tress and tables, axiomatic approach – AI expert systems – feature recognition – applications. Estimating and Costing: Concepts, differences, different costing methods – classification of costs – cost grid-problems. **(12)**

UNIT III: DIRECT AND INDIRECT COST COMPONENTS

Labour cost–direct, indirect–estimation–labour norms–time study rating – labour cost variances; material cost–direct, indirect–estimation–material issue valuation – material cost variances–problems. Overhead cost - Elements – factory, administrative, sales and distribution expenses–methods of absorbing overheads – direct labour, direct Material, Machine Hour Rate methods – depreciation – methods –accounting for service department expenses – problems. **(12)**

UNIT IV: COST CALCULATIONS

Machined components, welded components, forged components, powder metallurgy parts, calculation of sales cost, case studies, use of computers in cost estimation, cost of rejection. Optimum Machining Conditions: Taylor_s equation, deriving the equation for optimum economic cutting velocity– selection of cutting speed for optimum cost, problems process capability analysis. **(12)**

UNIT V: BREAK EVEN ANALYSIS

Concept, make or buy decision, assumptions, merits and demerits of break even analysis. Applications - Linear, multi product break-even analysis. Cost Management: Learning curves, product life cycle cost analysis -Tools and techniques–activity based costing - concepts, cost drivers; introduction to target costing - need and applications. **(12)**

TEXT BOOKS:

1. Kannappan D, ―Mechanical Estimating and Costing‖, Tata McGraw Hill, New Delhi, 2003.
2. Kesavon R and others, ―Process Planning and Cost Estimation‖, New Age International, Chennai, 2005.
3. R. Panneerselvam & P. Sivasankaran – Process & Cost Estimation, PH | Ltd, 2018.

REFERENCE BOOKS:

1. Thomas E. Vollmann et al., ―Manufacturing Planning and Control Systems ―, Galgotia Publications, Delhi, 2018.
2. Samuel Eilon, ―Elements of Production Planning and Control‖, MacMillan, London. ASME, ―Manufacturing Planning and Estimation-Hand Book‖, McGraw Hill, New Delhi, 2018, Dec 26.
3. Frederic C Jelen and James H Black, ―Cost and Optimization Engineering‖, McGraw Hill, New Delhi, 2007, May 31.

MICRO AND NANO ELECTROECHANICAL SYSTEMS **4 0 0 4**

COURSE OBJECTIVES

- To understand the detailed introduction of the Nano scalesystems.
- To understand the concepts of Quantum Dots and Synthesis of Nanostructure Materials.

COURSE OUTCOMES

On successful completion of the course students will be able to:

- Have a knowledge of Nano science and nanotechnology including theory & practical application.
- Potentially apply the concepts of Quantum Dots and Synthesis of Nanostructure Materials in research projects.
- Understanding scaling of Electronic components for producing MEMS switches.
- Propose novel ideas using the concepts of characterization and Nanotechnology application.

-

UNIT I: NANOSCALE SYSTEMS

Length, energy, and time scales - Quantum confinement of electrons in semiconductor nanostructures: Quantum confinement in 3D, 2D, 1D and zero dimensional structures -Size effect and properties of nanostructures- Landauer - Buttiker formalism for conduction in confined geometries - Top down and Bottom up approach. **(12)**

UNIT II: QUANTUM DOTS

Excitons and excitonic Bohr radius – difference between nanoparticles and quantum dots - Preparation through colloidal methods - Epitaxial methods- MOCVD and MBE growth of quantum dots - current-voltage characteristics - magneto tunneling measurements - spectroscopy of Quantum Dots: Absorption and emission spectra - photo luminescence spectrum - optical spectroscopy - linear and nonlinear optical spectroscopy. **(12)**

UNIT III: INTRODUCTION TO MEMS AND NEMS

working principles as micro sensors (acoustic wave sensor, biomedical and biosensor, chemical sensor, optical sensor, capacitive sensor, pressure sensor and thermal sensor), micro actuation (thermal actuation, piezoelectric actuation and electrostatic actuation–micro gripers, motors, valves, pumps, accelerometers, fluidics and capillary electrophoresis, active and passive micro fluidic devices, Pizoresistivity, Pizoelectricity and thermoelectricity, MEMS/NEMS design, processing, Oxidation, Sputter deposition, Evaporation, Chemical vapor deposition etc.

(12)

UNIT IV: INTRODUCTION ELECTRONIC SCALING

Scaling of physical systems – Geometric scaling & Electrical system scaling. The Single-Electron Transistor: The Single- Electron Transistor Single-Electron Transistor Logic, Other SET and FET Structures, Carbon Nanotube Transistors (FETs and SETs), Semiconductor Nanowire FETs and SETs,Coulomb Blockade in a Nanocapacitor, Molecular SETs and Molecular Electronics. **(12)**

UNIT V: NANOTECHNOLOGY APPLICATIONS

Applications of nanoparticles, quantum dots, nanotubes and nanowires for nano device fabrication – Single electron transistors, coulomb blockade effects in ultra-small metallic tunnel junctions - nanoparticles based solar cells and quantum dots based white LEDs – CNT based transistors – principle of dippenlithography. **(12)**

TEXT BOOKS:

1. G. Timp, Nanotechnology. Editor, AIP press, Springer-Verlag, New York, 2007
2. Stephen D. Senturia, Microsystem Design, Kluwer Academic Press, 2005.
3. Marc Madou, Fundamentals of microfabrication & Nanofabrication, 2013, March 30.

REFERENCE BOOKS:

1. Hand book of Nanostructured Materials and Technology, Vol.1-5, Editor:- Hari Singh Nalwa; Academic Press, USA(2000).
2. Hand book of Nanoscience, Engineering and Technology (The Electrical Engineering handbook series), Kluwer Publishers,2002
3. C.J. Brinker, G.W. Scherrer and Sol-Gel Science, Academic Press, Boston, Dec 11, 2016.
4. Nanoscale characterization of surfaces & interfaces, N John Dinardo, Weinheim Cambridge: Wiley-VCH, 2nd ed.,2000.
5. T. Fukada&W.Mens, Micro Mechanical system Principle & Technology, Elsevier, 2012.
6. 4. Julian W.Gardnes, Vijay K. Varda, Micro sensors MEMS & Smart Devices, 2001.

SEMESTER VIII– ELECTIVE V

COGNITIVE ROBOTICS 4 0 0 4

COURSE OBJECTIVES

- To understand the fundamentals of Biometric terms.
- To acquire knowledge on Fingerprint Identification, Iris Recognition ,Face Recognition and learn about their real time applications.
- To frame ideas on working of Voice Scan and Integrating it with other Biometric systems.

COURSE OUTCOMES

- Apply their knowledge of machine vision and robot kinematics to create computer programs that control mobile robots and robot arms, enabling the robots to recognize and manipulate objects and navigate their environments.
- Explain how a robot can be designed to exhibit cognitive goal-directed behaviour through the integration of computer models of visual attention, reasoning, learning, prospection, and social interaction.
- Create computer programs that realize limited instances of each of these models.

UNIT I: BIOMETRIC FUNDAMENTALS

Key Biometric terms and Processes – Definitions-verification and identification – Matching, Accuracy in Biometric Systems – False match rate - False on match rate - Failure to enroll rate – Derived metrics - An Introduction to Biometric Authentication Systems- a taxonomy of application environment, a system model, biometrics and privacy. **(12)**

UNIT II: FINGERPRINT IDENTIFICATION TECHNOLOGY

History, Components, Application of Fingerprints, The Technology- Finger Scan Weaknesses, Criminal Applications, Civil Applications, Commercial Applications, Technology Evaluation of Fingerprint Verification Algorithms. **(12)**

UNIT III: IRIS RECOGNITION

Introduction, Anatomical and Physiological underpinnings, Components, Sensing, Iris Scan Representation and Matching, Iris Scan Strengths and Weaknesses, System Performance, Future Directions. **(12)**

UNIT IV: FACE RECOGNITION

Introduction, components, Facial Scan Technologies, Face Detection, Face Recognition-Representation and Classification, Kernel- based Methods and 3D Models, Learning the Face Spare, Facial Scan Strengths and Weaknesses, Methods for assessing progress in Face Recognition. **(12)**

UNIT V: VOICE SCAN

Introduction, Components, Features and Models, Addition Method for managing Variability, Measuring Performance, Alternative Approaches, Voice Scan Strengths and Weaknesses, NIST Speaker Recognition Evaluation Program, Biometric System Integration – case studies softwares (Voice Recognition) **(12)**

TEXT BOOKS:

1. James Wayman & Anil Jain, Biometric Systems – Technology, Design and Performance Evaluation, Springer-verlag London Ltd, USA, 2005
2. SanirNanavati,Michael Thieme, Biometrics Identity Verification in a Networked world, Wiley Computer Publishing Ltd, New Delhi,2003.

REFERENCE BOOKS:

1. John D. Woodword Jr., Biometrics, Dreamtech Press, New Delhi, 2003.

MACHINE LEARNING FOR ROBOTICS **4 0 0 4**

COURSE OBJECTIVES

- To introduce students about the basic concepts and techniques of Machine Learning
- To become familiar with regression methods, classification methods, clustering methods.
- To become familiar with Dimensionality reduction Techniques.

COURSE OUTCOMES

Students will be able to:

- Gain knowledge about basic concepts of Machine Learning Environment.
- Identify machine learning techniques suitable for a given problem.
- Solve the problems using various machine learning techniques.
- Apply Dimensionality reduction techniques.
- Design application using machine learning techniques.

UNIT I: INTRODUCTION

Machine learning – Varieties of Machine learning – Learning Input- Output functions: Types of learning – Input Vectors – Outputs – Training regimes – Noise – Performance Evaluation. Foundations of Supervised Learning: Decision trees and Inductive bias – Geometry and nearest neighbors – Logistic regression – Perceptron – Binary classification. **(12)**

UNIT II: ADVANCED SUPERVISED LEARNING:

Linear models and gradient descent – Support Vector machines – Naïve Bayes models and probabilistic modeling – Model selection and feature selection – Model Complexity and Regularization. **(12)**

UNIT III: CASE STUDY 1

Line following using Supervised Learning techniques. Goal: A simulation model will be developed for understanding both regression and classification techniques. A framework need to be fixed and the complexity of the model will be varied in order to analyze the effect on the system. The effectiveness of the Biasvariance has to be studied. **(12)**

UNIT IV: UNSUPERVISED LEARNING

Curse of dimensionality, Dimensionality Reduction, PCA, Clustering – K-means – Expectation Maximization Algorithm – Mixtures of latent variable models – Supervised learning after clustering – Hierarchical clustering – Case studies. **(12)**

UNIT V: NEURAL NETWORKS

Network Representation, Feed-forward Networks, Back propagation, Gradient-descent method. CASE STUDY: Obstacle avoidance and navigation of a mobile robot in an unknown environment with the help of Neural Network. Goal: A hands-on experience with real world noisy data. The stochastic PCA and the PCA neural network are used to find low dimensional features. The low dimensional features can be used to build a feed-forward neural network in order to ascertain automatic navigational queries like: Where are the free spaces? How can robot reach the goal? **(12)**

TEXT BOOKS:

1. Tom Mitchell, Machine Learning_, McGraw Hill, 2015.
2. Peter Flach, _Machine Learning: The Art and Science of Algorithms that make sense of data_, Cambridge, 2014.
3.

REFERENCE BOOKS:

1. Hal Daume III, _A course in Machine Learning_, Todo, 2015.
2. EthemAlpaydin,_Introduction to Machine Learning_,The MIT Press, 2004
3. David MacKay, Information Theory, Inference and Learning Algorithms_, Cambridge, 2003

MICROBOTICS **4 0 0 4**

COURSE OBJECTIVES

- The objective of this course is to expose students to the fundamental aspects of the emerging field of microbotics.
- This includes a focus on physical laws that predominate at the microscale, technologies for fabricating small devices, bio-inspired design, and applications of the field.

COURSE OUTCOMES

Students will be able to:

- Formulate the specifications of a mechatronic system.
- Design of mechatronic systems (choice of sensors, actuators, embedded systems)
- Explain and apply the concepts of mass, energy, and momentum balance.
- Model design, and optimize energy conversion systems and Industrial processes.
- Characterize experimentally the steady-state or dynamic response of solids and fluids.
- Apply adapt, and synthesize learned engineering skills to create novel solutions.
- Expound and Iterate multiple design concepts based on the models and simulations.
- Describe in scientific terms and apply the principles of tribology and contact mechanics.

UNIT I: INTRODUCTION

MST (Micro System Technology) – Micromachining - Working principles of Microsystems - Applications of Microsystems-Case studies. **(6)**

UNIT II: SCALING LAWS AND MATERIALS FOR MEMS

Introduction - Scaling laws - Scaling effect on physical properties, scaling effects on Electrical properties, scaling effect on physical forces. Physics of Adhesion - Silicon-compatible material system - Shape memory alloys - Material properties: Piezoresistivity, Piezoelectricity and Thermoelectricity. **(12)**

UNIT III: FLEXURES, ACTUATORS AND SENSORS

Elemental flexures - Flexure systems - Mathematical formalism for flexures.Electrostatic actuators, Piezo-electric actuators, Magneto-strictive actuators. Electromagnetic sensors, Optical-based displacement sensors, Motion tracking with microscopes. **(12)**

UNIT IV: MICROROBOTICS

Introduction, Task specific definition of micro-robots - Size and Fabrication Technology based definition of microrobots - Mobility and Functional-based definition of microbot - Applications for MEMS based microbots. **(12)**

UNIT V: IMPLEMENTATION OF MICROROBOTS

Arrayed actuator principles for microbotic applications – Micro-robotic actuators -Design of locomotive microbot devices based on arrayed actuators. Microbotics devices: Micro-

grippers and other micro-tools -Micro-conveyors - Walking MEMS Micro-robots – Multi-robot system: Microbot powering, Microbot communication**.** **(12)**

UNIT VI: MICROFABRICATION AND MICROASSEMBLY

Micro-fabrication principles - Design selection criteria for micromachining -Packaging and Integration aspects – Micro-assembly platforms and manipulators**.** **(6)**

TEXT BOOKS:

1. Mohamed Gad-el-Hak, ―The MEMS Handbook‖, CRC Press, New York, 2002.
2. Yves Bellouard, ―Microrobotics Methods and Applications‖, CRC Press, Massachusetts, 2011.

REFERENCE BOOKS:

1. Nadim Maluf and Kirt Williams, _‖An Introduction to Microelectromechanical systems Engineering‖, Artech House, MA, 2002.
2. Julian W Gardner, ―Microsensors: Principles and Applications‖, John Wiley & Sons, 2013.

COLLOBORATIVE ROBOT(COBOT) **4 0 0 4**

COURSE OBJECTIVES

- To gain the knowledge on basics of Ladder Logic, Basic programming, Safety for Hydraulics and Pneumatics, Robot Safety, Robotic Drives, Hardware, and Components, Robot Installations, Vision Systems, and Robot Troubleshooting.

COURSE OUTCOMES

Students will be able to:

- Gain a greater understanding of Industrial robotics, including types, applications, and programming methods.
- Understand the importance of "Robot Safety" by reviewing and demonstrating the different ways to prevent robot accidents.
- Gain a greater understanding of the physical components of industrial and collaborative robots, and how these components operate and allow the robot to perform work.
- Demonstrate the basic steps for installing and maintaining industrial and/or collaborative robots.
- Learn the use of a systematic approach in solving issues that cause robotic malfunction.

UNIT I : REVIEW OF THE BASICS OF INDUSTRIAL ROBOTICS

Identify and describe the basic components of a robot's body and arms- Description of the axis of movement for the robotic arm - Describe the coordinate systems used to program a robot's movement, and review stationary and mobile industrial robots and appropriate applications for each. **(12)**

UNIT II: ROBOTIC DRIVES, HARDWARE AND COMPONENTS

Describe and demonstrate items used in robots such as frames and frame material, robot joints, bearings, hydraulics drives, pneumatic drives, servomotors and encoders, transmissions, ballscrews, sensors, wiring and hoses- the methods robotic axis control, and describe sensors for robots. **(12)**

UNIT III:ROBOT INSTALLATION

Packing/unpacking and transporting the robot, installing the robot and the controller, making connections of power, grounding and other cables, robotic start-up, writing and loading programs, and troubleshooting the robotic assembly. **(12)**

UNIT IV: VISION SYSTEMS

Vision system for Industrial Robots including the concepts of linear array, matrix arrays, machine vision, pixel display, camera mounting, image intensity, Vidicon vs. Solid State cameras, lighting, lighting devices, laser vision and machine vision applications. **(12)**

UNIT V: ROBOT TROUBLESHOOTING

Basic troubleshooting process, useful troubleshooting tools, and common robotic malfunction root causes and corrective actions. Collection and organization of troubleshooting information, as well as the use of troubleshooting manuals and flow charts,

assessment of troubleshooting costs, working backwards, the 5 Whys Technique, implementation of corrective actions, temporary vs. permanent corrective actions, and system testing following corrective action. **(12)**

TEXT BOOKS:

1. M.A. Reshkin, J.E. Colgate, C.A. Moore, Cobot Architecture, I EEE Transaction on Robotics & Automation, Vol 17, issue 4, 2001.

REFERENCES:

1. ISO 10218 Part 1 & Part 2 (2011)
2. ANSI/RIA R15.06 2012
3. VDMA position-paper –Safety in Human-Robot Collaboration‖ (http://rua.vdma.org/en/article/-/articleview/4217015)

PRODUCT DESIGN AND DEVELOPMENT **4 0 0 4**

COURSE OBJECTIVES

- The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product as and how to incorporate them suitably in product.

COURSE OUTCOMES

- The student will be able to design some products for the given set of applications; also the knowledge gained through prototyping technology will help the student to make a prototype of a problem and hence product design and development can be achieved.

UNIT I: INTRODUCTION

Need for IPPD (Integrated Product and Process Development) – Strategic importance of Product development – Integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications. **(12)**

UNIT II :CONCEPT GENERATION AND SELECTION

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits. **(12)**

UNIT III: PRODUCT ARCHITECTURE

Implications – Product change – variety – component standardization – product performance –manufacturability – product development management – establishing the architecture – creation –clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications. **(12)**

UNIT IV: INDUSTRIAL DESIGN

Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools –Simulating product performance and manufacturing processes electronically – Need for industrial design – Impact – Design process – Investigation for Industrial design – Impact – Design process –Investigation of customer needs – conceptualization – refinement – management of the industrial design process – Technology driven products – user – driven products – assessing the quality of industrial design. **(12)**

UNIT V: DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT

Definition – Estimation of Manufacturing cost – Reducing the component costs and assembly costs –Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes –Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution. **(12)**

TEXT BOOK:

1. Kari T.Ulrich and Steven D.Eppinger, ‖Product Design and Development‖, McGraw-Hill International Edns. 2008.

REFERENCE BOOKS:

1. Kemnneth Crow, ‒Concurrent Engg./Integrated Product Development‖, DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book, 2002
2. Staurt Pugh, ‒Tool Design –Integrated Methods for Successful Product Engineering‖, Addison Wesley Publishing, New york, NY, 2006.

SEMESTER VIII – ELECTIVE VI

LEAN MANUFACTURING **4 0 0 4**

COURSE OBJECTIVES

- To introduce the students the lean manufacturing concepts
- To understand group technology and use of it for part identification
- To understand value stream mapping in lean manufacturing.
- To teach the tools and method used in lean manufacturing
- To introduce concept of Total Productive Maintenance and other system

COURSE OUTCOMES

- Ability to implement lean manufacturing concepts in industries.
- Ability to apply group technology and cellular layout in manufacturing.
- Ability to apply value stream mapping and take time calculations.
- Ability to use the lean manufacturing tools and method.
- Ability to apply total productive maintenance concepts in industries.

UNIT I: INTRODUCTION:

Origins and objectives of lean manufacturing – lean process,3M concept key principles and implications of lean manufacturing – traditional Vs lean manufacturing characteristics– roadmap for lean implementation and lean benefits - study of Ford and Toyota production systems - JIT manufacturing, Lean building blocks. LEAN MANUFACTURING CONCEPTS: Value creation and waste elimination – seven types of waste – pull production-different models of pull production -the Kanban system-continuous flow-the continuous improvement process / Kaizen-Worker involvement. Design of Kanban quantities – Leveled production - tools for continuous improvement. **(12)**

UNIT II: GROUP TECHNOLOGY AND CELLULAR LAYOUT

JIT with cell manufacturing – part families- production flow analysis – Composite part concept – machine cell design – quantitative analysis – case studies – single piece flow.**(12)**

UNIT III: VALUE STREAM MAPPING :

The value stream– benefits mapping process - the current state map–mapping icons - mapping steps.VSM exercises - Take time calculations. **(12)**

UNIT IV: LEAN MANUFACTURING TOOLS AND METHODOLOGIES

: Standardized work–standard work sequence timing and working progress .Quality at source – Autonomation /Jidoka, Visual management system, Mistake proofing / Poka-Yoke. 5S technique – Elements and waste elimination through 5S, advantages and benefits - 5S-audit - visual control aids for improvement, flexible work force **(12)**

UNIT V: TOTAL PRODUCTIVE MAINTENANCE

Goals and benefits – Hidden factory, the six big losses, types of maintenance. Overall equipment effectiveness - pillars of TPM and implementation. Change over and set up timer education techniques. Temple of quality, OEE calculations. Reconciling Lean with other systems: Study of lean Six-sigma and lean design – lean and ERP- lean with ISO9001:2000 - administrative lean. **(12)**

TEXT BOOKS:

1. Micheal Wader, ‒Lean Tools: A Pocket guide to Implementing Lean Practices‖, Productivity and Quality Publishing, 2007.
2. William M Feld, ‒Lean Manufacturing: Tools, Techniques and How to use them‖, APICS, 2001/2000.
3. Dennis P Hobbs, ‒Lean Manufacturing Implementation‖ ,Leverage Learning Publications, 2009.
4. Gopalakrishnan N, ‒Simplified Lean Manufacture‖, PHI Learning Pvt Ltd, 2010-14-2

REFERENCE BOOKS:

1. Richard B Chase‒ Production and Operations Management‖, McGraw Hill, 2003
2. Taiichi Ohno, ‒Toyoto Production Systems: Beyond Large Scale Production‖, Productivity Press, 1988.
3. Askin R G and Goldberg J B,— Design and Analysis of Lean Production Systems‖, John Wiley and Sons, 2003.
4. Mahadevan B,— Operations Management‖, Pearson,2010

- ENTREPRENEURSHIP DEVELOPMENT **4 0 0 4**

COURSE OBJECTIVES

- To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.

COURSE OUTCOMES

- Upon completion of the course, students will be able to gain knowledge and skills needed to run a business successfully.
- Ability to recall the basics of entrepreneurship
- Ability to develop a business model
- Ability to identify forms of business organization
- Ability to determine the financial need for new Business
- Ability to apply industry, competitor and market Analysis

UNIT I: INTRODUCTION TO ENTREPRENEURSHIP

Definition – Characteristics and Functions of an Entrepreneur – Common myths about entrepreneurs – Importance or Entrepreneurship. Creativity and Innovation: The role of creativity – The innovation Process – Sources of New Ideas – Methods of Generating Ideas – Creative Problem Solving – Entrepreneurial Process. **(12)**

UNIT II: DEVELOPING AN EFFECTIVE BUSINESS MODEL

The Importance of Business Model – Starting a small scale industry - Components of an Effective Business Model. Appraisal of Projects: Importance of Evaluating various options and future investments- Entrepreneurship incentives and subsidies – Appraisal Techniques. **(12)**

UNIT III: FORMS OF BUSINESS ORGANIZATION

Sole Proprietorship – Partnership – Limited liability partnership - Joint Stock Companies and Cooperatives. **(12)**

UNIT IV: FINANCING THE NEW VENTURE

Determining Financial Needs – Sources of Financing – Equity and Debt Funding – Case studies in Evaluating Financial Performance. **(12)**

UNIT V: THE MARKETING FUNCTION

Industry Analysis – Competitor Analysis – Marketing Research for the New Venture – Defining the Purpose or Objectives – Gathering Data from Secondary Sources – Gathering Information from Primary Sources – Analyzing and Interpreting the Results – The Marketing Process. Intellectual Property Protection and Ethics: Patents – Copyright - Trademark- Geographical indications – Ethical and social responsibility and challenges. **(12)**

TEXT BOOKS:

1. Donald F.Kuratko and Richard M. Hodgetts, ―Entrepreneurship‖, South-Western‖ - a contemporary approach south western college publication, 6th edition 2003.
2. Vasant Desai, ―The Dynamics of Entrepreneurial Development and Management‖, Himalaya Publishing House, 2010.edition-5-2009.

REFERENCE BOOKS:

1. Gupta S.L., Arun Mittal, ―Entrepreneurship Development, International Book House, 2011.
2. Sudha G. S., ―Management and Entrepreneurship Development‖, Indus Valley Publication, 2009.
3. Badi V., Badi N. V., ―Business Ethics‖, R. Vrinda Publication (P) Ltd.,edition-2 2014.
4. Prasanna Chandra, ―Projects- Planning, Analysis, Financing, Implementation and review, TATA McGraw Hill, 2017.

- DISASTER MANAGEMENT **4 0 0 4**

COURSE OBJECTIVES

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

COURSE OUTCOMES

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.
- Ability to analyses and solve disaster issue using case study approach

UNIT I: INTRODUCTION TO DISASTERS

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters. **(12)**

UNIT II: APPROACHES TO DISASTER RISK REDUCTION (DRR)

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders - Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies. **(12)**

UNIT III: INTER-RELATIONSHIP BETWEEN DISASTERS ANDDEVELOPMENT

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources. **(12)**

UNIT IV: DISASTER RISK MANAGEMENT IN INDIA

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, and Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment **(12)**

UNIT V: DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIESAND FIELD WORKS

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

(12)

TEXTBOOKS:

1. Singhal J.P. –Disaster Management‖, Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, –Disaster Science and Management‖, McGraw Hill India Education Pvt. Ltd., 2017. ISBN-10: 1259007367, ISBN-13: 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCE BOOKS :

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.

TOTAL QUALITY MANAGEMENT 4 0 0 4

COURSE OBJECTIVES

- To facilitate the understanding of Quality Management principles and process.

COURSE OUTCOMES

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.
- Ability to remember the basics of quality
- Ability to apply TQM tools and techniques to resolve quality problems
- Ability to demonstrate quality management system

UNIT I : INTRODUCTION

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention. (12)

UNIT II :TQM PRINCIPLES

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating. **(12)**

UNIT III: TQM TOOLS AND TECHNIQUES - I

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types. **(12)**

UNIT IV :TQM TOOLS AND TECHNIQUES - II

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures. **(12)**

UNIT V :QUALITY MANAGEMENT SYSTEM

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration--ENVIRONMENTAL MANAGEMENT **SYSTEM:** Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001—Benefits of EMS**.** **(12)**

TEXT BOOK:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, –Total Quality Management‖, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2011.
2. B.Janakiraman and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2009.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Learning 7th print,Pvt. Ltd., 2011.
4. ISO 9001-2015 Quality Management Systems.

SUPPLY CHAIN MANAGEMENT **4 0 0 4**

COURSE OBJECTIVES

- To provide an insight on the fundamentals of supply chain networks, tools and techniques.

COURSE OUTCOMES

- The student would understand the framework and scope of supply chain networks andfunctions.
- To recall the role, scope and decision phases of supply chain.
- To identify the factors, option of distribution network design.
- To analyse the roles and factors of transportation decision and network.
- To explore the role of governing and coordination in supply chain.
- To identify the role of IT in supply chain.

UNIT I : INTRODUCTION

Role of Logistics and Supply chain Management: Scope and Importance- Evolution of Supply Chain -Decision Phases in Supply Chain – Competitive and Supply chain Strategies – Drivers of Supply Chain Performance and Obstacles. **(12)**

UNIT II : SUPPLY CHAIN NETWORK DESIGN

Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network Distribution Network in Practice- Role of network Design in Supply Chain – Framework for network Decisions. **(12)**

UNIT III : LOGISTICS IN SUPPLY CHAIN

Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation**.** **(12)**

UNIT IV: SOURCING AND COORDINATION IN SUPPLY CHAIN

Role of sourcing supply chain supplier selection assessment and contracts- Design collaboration – sourcing planning and analysis – supply chain co ordination – Bull whip effect – Effect of lack of co-ordination in supply chain and obstacles – Building strategic partnerships and trust within a supply chain. **(12)**

UNIT V : SUPPLY CHAIN AND INFORMATION TECHNOLOGY

The role IT in supply chain- The supply chain IT frame work Customer Relationship Management – Internal supply chain management – supplier relationship management –future of IT in supply chain –E-Business in supply chain**.**

1. Sunil Chopra, Peter Meindl and Kalra, ―Supply Chain Management, Strategy, Planning, and operation‖, Pearson Education, 6th edition, 2016.

REFERENCE BOOK:

1. Jeremy F.Shapiro, ―Modeling the supply chain‖, Thomson Brooks / cole, 2007.
2. Srinivasan G.S, ―Quantitative models in Operations and Supply Chain Management‖, PHI, 2010.
3. David J.Bloomberg , Stephen Lemay and Joe B.Hanna, ―Logistics‖, PHI 2002.
4. James B.Ayers, ―Handbook of Supply chain management‖, St.Lucie press, 2001.