RAJALAKSHMI ENGINEERING COLLEGE (An Autonomous Institution Affiliated to Anna University Chennai) DEPARTMENT OF ROBOTICS AND AUTOMATION CURRICULUM AND SYLLABUS REGULATIONS – 2019 CHOICE BASED CREDIT SYSTEM B.E. ROBOTICS AND AUTOMATION

VISION:

To be a department of excellence in academics, research and technological advancement in Robotics and Automation with a concern for society.

MISSION:

- To impart high technical knowledge, strong fundamentals, practical skills and creative knowledge for making successful professionals in Robotics and Automation.
- To foster students by infusing leadership qualities to become successful Engineer.
- To inculcate the entrepreneurial qualities for creating, developing and managing global engineering ventures.

Programme Educational Objectives (PEOs):

PEO I

To impart students with strong and comprehensive knowledge in the analytical, scientific and engineering fundamentals for solving engineering problems

PEO II

To disseminate students with necessary skills, knowledge and leadership qualities for successful careers in industry

PEO III

To instil students with Technical expertise, Ethical practices and Team spirit and a concern towards greener society

PROGRAM OUTCOMES (POs):

Engineering Graduates will be able to:

- 1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- 2. **Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- 3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
- 4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- 5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
- 6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
- 7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

- 8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- 9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- 10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- 11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- 12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

- PSO 1: Design and develop efficient Automation system to enhance the quality of life by applying fundamentals of Basic Science, Mechanical and Mechatronics Engineering
- PSO 2: Analyse and improve the performance of Manufacturing and Production system by implementing the Soft and hard Computing methods
- PSO 3: Manage and lead a professional or an entrepreneur career in industries by applying modern Engineering, Management principles and best practices

CURRICULUM AND SYLLABUS

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	Т	Р	С
THE(ORY COUL	RSES						
1	HS19151	Technical English	HS	3	2	1	0	3
2	MA19151	Algebra and Calculus	BS	4	3	1	0	4
3	GE19101	Engineering Graphics	ES	4	2	2	0	4
LAB	ORIENTE	D THEORY COURSES						
4	PH19141	Physics of Materials	BS	5	3	0	2	4
LABO	ORATORY	COURSES						
5	GE19121	Engineering Practices - Civil and Mechanical	ES	2	0	0	2	1
NON-	CREDIT -	MANDATORY COURSE						
6	MC19101	Environmental Science and Engineering	MC	3	3	0	0	0
			TOTAL	21	13	4	4	16

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	Т	Р	С
THE	ORY COU	RSES						
1.	MA19251	Differential Equations and Vector Calculus	BS	4	3	1	0	4
2.	GE19201	Engineering Mechanics	ES	3	2	1	0	3
LAB	ORIENTE	D THEORY COURSES	1		1			
3.	CY19241	Engineering Chemistry	BS	5	3	0	2	4
4.	GE19141	Programming using C	ES	6	2	0	4	4
5.	EE19241	Basic Electrical Engineering	ES	5	3	0	2	4
LAB	ORATORY	COURSES						
6.	MT19221	Computer Aided Drawing Laboratory	ES	2	0	0	2	1
7.	GE19122	Engineering Practices- Electrical and Electronics	ES	2	0	0	2	1
NON	-CREDIT -	MANDATORY COURSE						
8.	MC19102	Indian Constitution and Freedom Movement	MC	3	3	0	0	0
			TOTAL	30	16	2	12	21

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY CONTACT PERIODS		L	Т	Р	С
THE	ORY COU	RSES						
1	MA19355	Transforms and Applications	BS	4	3	1	0	4
2	GE19301	Life Science for Engineers	ES	3	3	0	0	3
3	MT19301	Analog Devices and Circuits	PC	3	3	0	0	3
4	MT19302	Digital System Design	PC	3	3	0	0	3
5	ME19303	Kinematics of Machinery	PC	3	2	1	0	3
6	RO19301	Mechanics of Materials	ES	4	3	1	0	4
LAB	ORATORY	COURSES						
7	MT19311	Digital System Design laboratory	PC	3	0	0	3	1.5
8	RO19311	Mechanics of Materials laboratory	ES	3	0	0	3	1.5
NON	-CREDIT -	MANDATORY COURSE						
9	MC19301	Essence of Indian Traditional Knowledge	MC	2	2	0	0	0
			TOTAL	28	19	3	6	23

SEMESTER IV

SL.	COURSE	COUDSE TITLE	CATECODY	CONTACT	т	T	р	C
NO	CODE	COURSE IIILE	CATEGORY	PERIODS	L	I	P	C
THE	ORY COU	RSES						
1.	MA19455	Statistics and Numerical Methods	BS	4	3	1	0	4
2.	MT19402	Microcontrollers and Embedded Systems	controllers and PC Ided Systems		3	0	0	3
3.	RO19401	Basics of Robotics	PC	3	3	0	0	3
4.	RO19402	Manufacturing Science	PC	3	3	0	0	3
5.	CS19342	Object Oriented Programming Paradigm	PC	7	3	0	4	5
LAB	ORATORY	Y COURSES						
6.	ME19312	Manufacturing Technology laboratory	PC	3	0	0	3	1.5
7.	MT19411	Microprocessors and Microcontrollers for Automation Laboratory	ocessors and PC ntrollers for ion Laboratory		0	0	3	1.5
8.	GE19421	Soft skills – I	EEC	2	0	0	2	1
9.	P.RO19421Internship-IEEC		EEC	2	0	0	2	1
			TOTAL	30	15	1	14	23

SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	Т	Р	С
THE	ORY COUR	RSES						
1	RO19501	Fluid Power Systems	PC	3	3	0	0	3
2	RO19502	Dynamics and Design of Machinery	PC	4	3	1	0	4
3	RO19503	Mechatronics and Manufacturing Automation	PC	3	3	0	0	3
4	MT19503	System Dynamics and Control	PC	3	3	0	0	3
5		Open Elective – I	OE	3	3	0	0	3
6		Professional Elective -I	PE	3	3	0	0	3
LAB	ORATORY	COURSES						
7	RO19511	Robotics laboratory	PC	3	0	0	3	1.5
8	RO19512	Fluid Power Systems laboratory	PC	3	0	0	3	1.5
9	GE19521	Soft Skills – II	EEC	2	0	0	2	1
10	RO19521	Internship-II	EEC	2	0	0	2	1
			TOTAL	29	18	1	10	24

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	Т	Р	С
LAB	LAB ORIENTED THEORY COURSES							
1	RO19641	CAD/CAM	PC	5	3	0	2	4
2	RO19642	Machine Vision systems in Robotics	PC	5	3	0	2	4
THE	CORY COU	RSES			•			
3	RO19601	Mobile Robots	PC	3	3	0	0	3
4	RO19602	Resource Management Techniques	HS	3	3	0	0	3
5		Professional Elective - II	PE	3	3	0	0	3
6		Professional Elective - III	PE	3	3	0	0	3
LAB	ORATORY	COURSES			•			
7	RO19621	Internship-III	EEC	2	0	0	2	1
8	GE19621	Problem solving Techniques	EEC	2	0	0	2	1
			TOTAL	26	18	0	8	22

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	Т	Р	С
THE	CORY COU	RSES						
1	RO19701	AI in Robotics	PC	3	3	0	0	3
2	RO19702	Computer Integrated Manufacturing	PC	3	3	0	0	3
3	RO19703	Material Handling system	PC	3	3	0	0	3
4	GE19304	Fundamentals of Management for Engineers	HS	3	3	0	0	3
5		Professional Elective - IV	PE	3	3	0	0	3
6		Open Elective – II	OE	3	3	0	0	3
LAB	ORATORY	COURSES			•			
7	RO19711	Innovation and Design thinking for Robotics and Automation	EEC	4	0	0	4	2
8	RO19721	Project Work - Phase 1	EEC	2	0	0	2	1
			TOTAL	24	18	0	6	21

SEMESTER VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	Т	Р	С	
THE	HEORY								
1		Professional Elective - V	PE	3	3	0	0	3	
2		Professional Elective – VI	PE	3	3	0	0	3	
PRA	CTICALS								
3	RO19811	Project Work- Phase II	EEC	14	0	0	14	7	
			20	6	0	14	13		

TOTAL NO. OF CREDITS: 163

S.No	COURSE CODE	PROFESSIONAL ELECTIVE	COURSE OFFERED
	I	MANAGEMENT	1
1	ME19603	Total Quality Management	
2	GE19P73	Marketing Management	SEMESTER V & VI
3	GE19P72	Entrepreneurship Development	
4	ME19P88	Supply chain and Logistics management	
5	RO19P01	Project Management	
6	RO19P02	Leadership and Organizational Behaviour	SEMESTER VII & VIII
7	RO19P03	Accounting and Finance for Engineers	
8	RO19P04	Strategic Management	
		ROBOTICS AND AUTOMATION	COURSE OFFERED
1	RO19P05	Humanoid Robotics	
2	RO19P06	Wireless Sensors Networks for Robotics	
3	RO19P07	Field and Service Robotics	SEMESTER V & VI
4	MT19P83	Programming for Robot Operating System	
5	RO19P08	Farm Automation	
6	RO19P09	Totally Integrated Automation	
7	RO19P10	Robotics: Advanced Concepts and Analysis	
8	MT19P61	Internet of Things for Mechatronics	SEMESTER VII & VIII
9	RO19P11	Industrial Data Communication	
10	RO19P12	Medical Robotics	
		MECHANICAL ENGINEERING	COURSE OFFERED
1	ME19P78	Welding Technology	
2	ME19P67	Industrial Safety	
3	ME19601	Finite Element Analysis	SEMESTER V & VI
4	ME 19P64	Industry 4.0	
5	MT 19303	Fluid Mechanics And Thermal Sciences	
6	ME19P72	Additive Manufacturing	
7	ME19P76	Process Planning and Cost Estimation	SEMESTER VII & VIII
8	ME19P86	Research Methodology and Intellectual Property Rights	
9	ME19P82	Design of Jigs, Fixture & Press tools	
10	RO19P13	Electronics Manufacturing Technology]

		COMPUTER SCIENCE	COURSE OFFERED
1	RO19P14	Fuzzy Logic and Neural Networks	
2	RO19P15	Python Programming for Automation	SEMESTED V & VI
3	3 CS19P08 Computer Graphics		SEMESTER V & VI
4	RO19P16 Machine Learning for Robotics		
5	RO19P17	Introduction to Virtual Reality and Augmented Reality	
6	RO19P18	Advanced Optimization Techniques	SEMESTER VII & VIII
7	RO19P20	Data Science using R Programming	
8	RO19P21	Deep Learning Techniques for Robotics	

.SUMMARY

	DEPARTMENT OF ROBOTICS AND AUTOMATION											
	Subject Area			Cred	lits Pe	r Sem	ester			Credits	Percentage	
	Semester	Ι	II	III	IV	V	VI	VII	VIII	Total	%	
1.	Humanities and Social Studies (HS)	3					3	3		9	5.522	
2.	Basic Sciences (BS)	8	8	4	4					24	14.724	
3.	Engineering Sciences (ES)	5	13	8.5						26.5	16.257	
4.	Professional Core (PC)			10.5	17	16	11	9		63.5	38.957	
5.	Professional Electives (PE)					3	6	3	6	18	11.043	
6.	Open Electives (OE)					3		3		6	3.681	
7.	Project Work/ Employability Enhancement Course (PR/EEC)				2	2	2	3	7	16	9.816	
	TOTAL	16	21	23	23	24	22	21	13	163		
8.	Non-Credit*/ (Mandatory)	\checkmark	\checkmark	\checkmark	-	-	-	-	-			

	SEMESTER I					
HS19151	TECHNICAL ENGLISH	HS	L	Т	P	С
	Common to all branches of B.E./ B.Techprogrammes – I semester		2	1	0	3
	•					
Objectives:						
• To enable	learners to acquire basic proficiency in English reading and listening.					
To write in	n English precisely and effectively.					
• To speak f	lawlessly in all kinds of communicative contexts.					
	A DUI A DV DUIL DINC			-	0	
The sensent of	f word formation Doot words from foreign languages and their use in En	alich Asquei	nton			- L
prefixes and su	iffixes from foreign languages in English to form derivatives - Synonym	s. antonyms. a	ntan nd s	ce tan	wii dar	n d
abbreviations.	Compound words – abbreviation – single word substitution – Listening:	Listening com	prel	iens	sio	n,
listening to more	tivational speeches, podcasts and poetry. Speaking: Short talks on incidents	- place of visit	– ad	mir	ing	Ş
personalities, et	tc.					
UNIT-II B	ASIC WRITING SKILLS				9	
Sentence struct	tures - Use of phrases and clauses in sentences - punctuation - coherence	- Organizing J	princ	ipl	es	of
paragraphs in d	locuments - Techniques for writing precisely. Reading & Writing – Free w	riting – paragra	aphs	- a	rtic	le
reading and wri	iting criticism - change of tense forms in short text or story – inferential readin	g - rewrite or 1	nter	oret	tey	ct
- prepare quest	ions based on the text. Speaking: Everyday situations – conversations and c	nalogues, spea	King	101	r ar	la
UNIT-III G	RAMMAR AND LANGUAGE DEVELOPMENT				9	
Subject-verb ag	reement- Noun-pronoun agreement - Articles – Prepositions – Redundancies. Re	ading & Writi	ng: F	Read	d l	
from innovation	n and ideas that changed the world, newspaper column writing – Speaking: I	Demonstrative s	speal	cing	g	
practice using v	visual aids (charts, graphs, maps, pictures, etc,.).		•			
UNIT-IV V	VRITING FOR FORMAL PRESENTATION				9	
Nature and Styl	le of sensible Writing - Describing – Defining – Classifying - Providing examp	ples or evidence	e - V	/rit	ing	,
introduction an	d conclusion. Reading & Writing – Read from Literary pieces – identify dif	ferent parts tex	t –			
difference betw	veen print and digital writing. Writing: Recommendations - Foreword - Revie	w of book. Spe	eaki	ng-		
Formal Presenta	ations – Debate on social issues/taboos and solutions.				0	
UNIT-V E	A TENDED WRITING AND SPEAKING	1 1			9	
writing: Précis	s writing – Essay writing – workplace communication: Resume – Business left	ters and emails				
rioposais. Spe	aking: ranei uiscussion – reporting an event – mock interview – Master Cere	Contact Hours			14	
		Jontact Hours		•	4:	,

Co	urse Outcomes:
On	completion of the course students will be able to
٠	Discuss and respond to the listening content.
٠	Read and comprehend different texts and appreciate them
٠	Use different types of techniques in precise writing
•	Analyse different genres of communication and get familiarized with new words, phrases, and sentence structures.
٠	Write and speak appropriately in varied formal and informal contexts.

Text Books:11. English for Technologists & Engineers, Orient BlackSwan Publications, Chennai 2012.

Re	Reference Books / Web links:	
1	Technical Communication, Meenakshi Raman &Sangeeta Sharma, Oxford University Press	
2	Effective Communication Skills, Kulbushan Kumar, Khanna Publishing House, Delhi	
3	Communication Skills, Pushplata, Sanjay Kumar, Oxford University Press	
4	Practical English Usage. Michael Swan. OUP. 1995.	
5	Remedial English Grammar. F.T. Wood. Macmillan.2007	
6	On Writing Well. William Zinsser. Harper Resource Book. 2001	
7	Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.	
8	Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press	

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MA19151	ALGEBRA AND CALCULUS	BS	L	Т	Р	С
	Common to I sem. B.E. – Aeronautical Engineering ,Automobile Engineering, Civil Engineering, Mechanical Engineering , Mechatronics& Robotics and Automation		3	1	0	4

Ob	Objectives:	
•	To gain knowledge in using matrix algebra techniques and the limitations of using infinite series approximations for those problems arising in mathematical modelling.	
٠	To understand the techniques of calculus which are applied in the Engineering problems.	

UNIT-I MATRICES

Symmetric and skew – symmetric matrices, orthogonal matrices – Eigen values and Eigen vectors - Cayley – Hamilton theorem (without proof) and applications - orthogonal transformation and quadratic forms to canonical forms - Nature of quadratic forms.

UNIT-II SEQUENCES AND SERIES

Convergence of sequence and series – Test for convergence: Comparison Test, D'Alembert Ratio Test, Leibnitz Test, Integral test – Binomial series, Exponential series and logarithmic series: Summations and approximations.

UNIT-III APPLICATIONS OF DIFFERENTIAL CALCULUS

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes - Evolute as envelope of normals.

UNIT-IV FUNCTIONS OF SEVERAL VARIABLES

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT-V APPLICATION OF INTEGRATION

Centre of Gravity – Moment of inertia - Double integrals in Cartesian and polar coordinates – Change of order of integration - Area of a curved surface - Triple integrals – Volume of Solids.

Total Contact Hours:60

Course Outcomes:

On completion of the course students will be able to

- Apply the concept of Eigenvalues and eigenvectors, diagonalization of a matrix for solving problems.
- Develop skills in solving problems involving sequences and series.
- Analyze, sketch and study the properties of different curves and to handle functions of several variables and problems of maxima and minima.
- Obtain the centre of gravity, moment of inertia for rigid bodies and also surface area and volume using multiple integrals.
- Process the data collected and analyze the data for central tendencies.

Text Books:

102	
1	Grewal B.S., - Higher Engineering Mathematics I, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2	T Veerarajan, Engineering Mathematics - I, McGraw Hill Education, 2014

Reference Books / Web links:

1	Ramana. B.V., "Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
2	Erwin Kreyszig," Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.
3	Bali, N.P. and Manish Goyal, A Text Book of Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 2006.

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PH19141	PHYSICS OF MATERIALS	BS	L	Т	Р	С
	Common to I sem. B.E. – Aeronautical Engineering, Automobile		3	0	2	4
	Engineering, Civil Engineering, Mechanical Engineering , Mechatronics&					
	Robotics and Automation					

Objectives:

	To enhance the fundamental knowledge in Physics and its applications relevant to mechanical engineering
•	streams.

To familiarize students in various experimental setups and instruments that are used to study / determine the various properties of materials.

MECHANICS & PROPERTIES OF MATTER UNIT-I

Basic definitions - Newton's laws - forces -solving Newton's equations - constraints and friction - cylindrical and spherical coordinates - potential energy function - conservative and non-conservative forces - central forces conservation of angular momentum - non-inertial frames of reference - rotating coordinate system - centripetal and coriolis accelerations - Elasticity - stress-strain diagram - bending of beams - cantilever depression - Young's modulus determination - I-shape girders.

UNIT-II CRYSTAL PHYSICS

Basis - lattices - symmetry operations and crystal systems -Bravaislattics - atomic radius and packing fraction - SC, BCC, FCC, HCP lattices - Miller indices - diffraction by crystals - reciprocal lattice - interpreting diffraction patterns crystal growth techniques-Czochralski and Bridgmann, crystal defects.

PHYSICS OF MATERIALS **UNIT-III**

Solid solutions - Hume-Rothery's rules --Gibb's phase rule - binary phase diagrams -isomporhpus systems - tie-line and lever rule - eutectic, eutectoid, peritectic, peritectoid, monotectic and syntectic systems - formation of microstructures homogeneous and non-homogenous cooling – nucleation - iron-carbon phase diagram - eutectoid steel - hypo and hypereutectoid steel – diffusion - Fick's laws – T-T-T diagrams.

UNIT-IV ENGINEERING MATERIALS & TESTING

Metallic glasses - preparation and properties - Ceramics - types, manufacturing methods and properties - Composites types and properties - Shape memory alloys - properties and applications - Nano-materials - top down and bottom up approaches - properties - Tensile strength - Hardness - Fatigue - Impact strength - Creep - Fracture - types of fracture. UNIT-V **QUANTUM PHYSICS** Blackbody problem -Planck's radiation law - duality of light -De Broglie hypothesis - properties of matter waves - wave packets -Schrodinger's equations (time dependent and time independent) - Born interpretation (physical significance of

wave function) - probability current - operator formalism (qualitative) - expectation values - uncertainty principle particle in a box -eigen function and eigen values -Dirac notation (qualitative). 45

Contact Hours

List of Experiments
Determination of Laser characteristics (wavelength and angular spread).
Determination of Young's modulus by non-uniform bending method
Determination of thermal conductivity of a bad conductor – Lee's Disc method.
Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer
Coupled oscillators - Two compound pendulums;
Experiment on moment of inertia measurement- Torsional pendulum by resonance,
LC circuit, LCR circuit and Resonance phenomena in LCR circuits;
Experiments on electromagnetic induction – BH-Curve experiment
Determination of thickness of a thin wire – Air wedge method
Determination of solar cell characteristics.
Measurement of hysteresis loss: B -H curve.
Determination of creep characteristics of a metallic wire
Contact Hours : 30
Total Contact Hours : 75

Co	urse Outcomes:
On	completion of the course students will be able to
٠	Determine the elastic moduli of materials.
٠	Apply the basic knowledge of crystallography in materials preparation and treatments.
٠	Create binary phase diagrams and TTT charts and use them to analyse and measure the properties of alloys.
•	Test or measure various engineering material properties and use them in suitable applications.
•	Determine the characteristics of a given laser source by understand the concepts of quantum theory and the nature of light.

Tey	Text Books:	
1	Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2018.	
2	Raghavan, V. "Physical Metallurgy: Principles and Practice". PHI Learning, 2019.	

Ref	Reference Books / Web links:	
1	Balasubramaniam, R. "Callister's Materials Science and Engineering". Wiley India Pvt. Ltd., 2017.	
2	Raghavan, V. "Materials Science and Engineering : A First course". PHI Learning, 2019.	
3	Resnick, R., Halliday, D., & Walker, J. "Principles of Physics", Wiley India Pvt., 2018.	
4	Gaur, R.K. & Gupta, S.L. "Engineering Physics". DhanpatRai Publishers, 2018.	

GE19101	Engineering Graphics	ES	L	Т	Р	С
	Common to I sem. B.E. – Aeronautical Engineering ,Automobile Engineering, Civil Engineering, Mechanical Engineering , Mechatronics & Robotics and Automation		2	2	0	4

Objectives:					
• To unde	• To understand the importance of the drawing in engineering applications				
To deve	elop graphic skills for communication of concepts, ideas and design of engineering products				
 To expo 	ose them to existing national standards related to technical drawings.				
• To impr	rove their visualization skills so that they can apply these skill in developing new products.				
To impr	rove their technical communication skill in the form of communicative drawings				
CONCEPTS	AND CONVENTIONS (Not for Examination)	1			
Importanceofgra	aphicsinengineeringapplications-Useofdraftinginstruments- BIS conventions and specifications-				
Size, layout ar	nd folding of drawing sheets- Lettering and dimensioning. Basic Geometrical constructions				
UNIT-I	PLANECURVES AND FREE HAND SKETCH	11			
Curves used	in engineering practices: Conics-Construction of ellipse, parabola and hyperbola by eccentricity	method-			
Construction	n of cycloids, Construction of involutes of square and circle drawing of tangents and normal to th	ne above			
curves.					
Visualization	n concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensiona	l objects			
– Layout of	views- Freehand sketching of multiple views from pictorial views of objects				
UNIT-II	PROJECTION OF POINTS, LINES AND PLANE SURFACE	12			
Orthographic	c projection-principles-Principal planes- projection of points. First angle projection - Projection of	straight			
lines incline	ed to both the principal planes - Determination of true lengths and true inclinations by rotating	g line			
method- Pro	jection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating	object			
method.					
UNIT-III	PROJECTION OF SOLIDS	12			
Projection of	f simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the prin	cipal			
planes by rot	tating object method.				
UNIT-IV	PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENTOF SURFACES	12			
Sectioning of	of solids in simple vertical position when the cutting plane is inclined to the one of the principal plan	es and			
perpendicula	ar to the other – obtaining true shape of the section.				
Development	t of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.				
UNIT-V	ISOMETRIC AND PERSPECTIVEPROJECTIONS	12			
Principles of isometric projection-isometric scale-Isometric projections of simple solids and truncated solids - Prisms,					
pyramids, cy	ylinders and cones.				
Perspective j	projection of simple solids-Prisms, pyramids and cylinders by visual ray method.				
	Total Contact Hours	: 60			

Text Book (s):

- Bhatt N.D. and Panchal V.M., —Engineering Drawingl, Charotar Publishing House, 50th Edition, 2010. Natrajan K.V., —A text book of Engineering Graphicsl, DhanalakshmiPublishers, Chennai, 2017. 1
- 2

Re	Reference Books(s) / Web links:				
1	Varghese P I., -Engineering Graphicsl, McGraw Hill Education (I) Pvt.Ltd., 2013.				
2	Venugopal K. and PrabhuRaja V., - Engineering Graphicsl, New Age International (P)Limited, 2008.				
3	Gopalakrishna K.R., -Engineering Drawing (Vol. I&II combined), Subhas Stores, Bangalore, 2017.				
4	BasantAgarwal and Agarwal C.M., -Engineering Drawing, McGraw Hill Publishing Company Limited, New				
Ŧ	Delhi, 2018.				
Course Outcomes:					
Co	urse Outcomes:				
Co	urse Outcomes:				
Co On	urse Outcomes: completion of the course students will be able to				
Co On	urse Outcomes: completion of the course students will be able to Construct different plane curves and free hand sketching of multiple views from pictorial objects.				
Co On •	urse Outcomes: completion of the course students will be able to Construct different plane curves and free hand sketching of multiple views from pictorial objects. Comprehend the theory of projection and to draw the basic views related to projection of points, lines and planes				
Co On •	arse Outcomes: completion of the course students will be able to Construct different plane curves and free hand sketching of multiple views from pictorial objects. Comprehend the theory of projection and to draw the basic views related to projection of points, lines and planes Draw the projection of solids in different views				

Visualize and prepare Isometric and Perspective view of simple solids •

MC19101	ENVIROMENTAL SCIENCE AND ENGINEERING	MC	L	Т	Р	С
	Common to All Branches		3	0	0	0
Objectives:						
• To understand the importance of natural resources, pollution control and waste management.						

• To provide the students about the current social issues and environmental legislations.

UNIT-I NATURAL RESOURCES

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Environment -definition - scope and importance - forest resources -use and overexploitation -water resources -use and
over utilization - dams - benefits and problems - water conservation -energy resources - growing energy needs -
renewable and non renewableenergy sources - use of alternate energy sources -land resources -land degradation - role
of an individual in conservation of natural resources.

UNIT-II ENVIRONMENTAL POLLUTION

Definition - causes, effects and control measures of air pollution -chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, and ozone depletion- noise pollution -mitigation procedures - control of particulate and gaseous emission(Control of SO_2 , NO_X , CO and HC).

Water pollution - definition-causes-effects of water pollutants-marine pollution-thermal pollution-radioactive pollution-control of water pollution by physical, chemical and biological processes-waste water treatment-primary, secondary and tertiary treatment.

Soil pollution : definition-causes-effects and control of soil pollution.

UNIT-III | SOLID WASTE MANAGEMENT

Solid wastes - sources and classification of solid wastes -solid waste management options - sanitary landfill, recycling, composting, incineration, energy recovery options from wastes

Hazardous waste -definition -sources of hazardous waste-classification (biomedical waste, radioactive waste, chemical waste, household hazardous waste)-characteristics of hazardous waste ignitability (flammable) reactivity, corrosivity, toxicity -effects of hazardous waste -case study- bhopal gas tragedy - disposal of hazardous waste-recycling , neutralization, incineration, pyrolysis, secured landfill - E-waste management -definition-sources-effects -electronic waste recycling technology.

UNIT-IV | SOCIAL ISSUES AND THE ENVIRONMENT

Sustainable development -concept, components and strategies - social impact of growing human population and affluence, food security, hunger, poverty, malnutrition, famine - consumerism and waste products - environment and human health - role of information technology in environment and human health -disaster management– floods, earthquake, cyclone and landslide.

UNIT-V TOOLS FOR ENVIRONMENTAL MANAGEMENT

Environmental impact assessment (EIA) structure -strategies for risk assessment–EIS-environmental audit-ISO 14000precautionary principle and polluter pays principle- constitutional provisions- - pollution control boards and pollution control acts- environmental protection act1986- role of non-government organisations- international conventions and protocols.

Contact Hours : 45

Course Outcomes: On completion of the course students will be able to • Be conversant to utilize resources in a sustainable manner. • Find ways to protect the environment and play proactive roles. • Apply the strategies to handle different wastes • Develop and improve the standard of better living. • Be conversant with tools of EIA and environmental legislation.

Text Books:

- Benny Joseph, —Environmental Science and Engineeringl, 2nd edition, Tata McGraw-Hill, New Delhi,2008. Gilbert M.Masters, —Introduction to Environmental Engineering and Sciencell, 2nd edition, Pearson Education, 2004. 1
- 2

Re	Reference Books / Web links:				
1	Dharmendra S. Sengar, -Environmental law, Prentice hall of India Pvt Ltd, New Delhi,2007.				
2	ErachBharucha, —Textbook of Environmental Studiesl, 3rd edition, Universities Press(I) Pvt Ltd, Hydrabad, 2015.,				
3	G. Tyler Miller and Scott E. Spoolman, —Environmental Sciencel, 15 th edition, CengageLearning India PVT, LTD, Delhi, 2014.				
4	Rajagopalan, R, —Environmental Studies-From Crisis to Curel, 3 rd edition,Oxford University Press,2015.				
5	De. A.K., -Environmental Chemistryl, New Age International, New Delhi, 1996.				
6	K. D. Wager, Environmental Management, W. B. Saunders Co., Philadelphia, USA, 1998.				

GE19121	ENGINEERING PRACTICES LABORATORY - Civil and	ES	L	Т	Р	С
	Mechanical					
			0	0	2	1

Objectives:

To provide exposure to the students with hands on experience on various basic engineering practices in Civil and Mechanical Engineering.

List of Experiments				
CIVII	CIVIL ENGINEERING PRACTICE			
1.	Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, and elbows in household fittings.			
2.	Preparation of basic plumbing line sketches for wash basins, water heaters, etc.			
3.	Hands-on-exercise: Basic pipe connections – Pipe connections with different joining components.			
Carpe	entry Works:			
4.	Study of joints in roofs, doors, windows and furniture.			
5.	Hands-on-exercise: Woodwork, joints by sawing, planning and chiselling.			
MECI	HANICAL ENGINEERING PRACTICE			
6.	Preparation of butt joints, lap joints and T- joints by Shielded metal arc welding.			
7	Gas welding practice.			
Basic	Machining:			
8	Simple Turning and Taper turning			
9	Drilling Practice			
Sheet	Metal Work:			
10	Forming & Bending:			

11	Model making – Trays and funnels				
12	Different type of joints.				
Mach	Machine Assembly Practice:				
13	Study of centrifugal pump				
14	14 Study of air conditioner				
		Total Contact Hours	:	30	

Course Outcomes:

00	
On	a completion of the course students will be able to
•	Perform plumbing activities for residential and industrial buildings considering safety aspects while gaining clear understanding on pipeline location and functions of joints like valves, taps, couplings, unions, reducers, elbows, etc.
•	Perform wood working carpentry activities like sawing, planning, cutting, etc. while having clear understanding of the joints in roofs, doors, windows and furniture.
•	Produce joints like L joint, T joint, Lap joint, Butt joint, etc. through arc welding process while acquiring in depth knowledge in the principle of operation of welding and other accessories
•	Perform operations like Turning, Step turning, Taper turning, etc. in lathe and Drilling operation in drilling machine
•	Perform sheet metal operations like Forming, Bending, etc. and fabricating models like Trays, funnels, etc.

SEMESTER II

MA19251	DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS	BS	L	Т	Р	С
	Common to II sem.B.E. – Aeronautical Engineering, Automobile		3	1	0	4
	Engineering, Civil Engineering, Mechanical Engineering, Mechatronics&					
	Robotics and Automation					
	and					
	B. Tech Biotechnology, Food Technology & Chemical Engineering					

Objectives:

٠	To handle practical problems arising in the field of engineering and technology using differential equations.
•	To solve problems using the concept of Vectors calculus, Complex analysis, Laplace transforms.

UNIT-I SECOND AND HIGHER ORDER DIFFERENTIAL EQUATIONS 12 Second and higher order Linear differential equations with constant coefficients - Method of variation of parameters Cauchy's and Legendre's linear equations - Simultaneous first order linear equations with constant coefficients. UNIT-II PARTIAL DIFFERENTIAL EQUATIONS 12 Formation of partial differential equations - Solutions of standard types of first order partial differential equations -Lagrange's linear equation -- Linear partial differential equations of second and higher order with constant coefficients of both homogeneous and non-homogeneous types. UNIT-III VECTOR CALCULUS 12 Gradient, divergence and curl - Directional derivative - Irrotational and solenoidal vector fields - Vector integration -Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) - Simple applications involving cubes and rectangular parallelopipeds. **ANALYTIC FUNCTIONS** UNIT-IV 12 Analytic functions - Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties - Harmonic conjugates - Construction of analytic function - Conformal mapping and Bilinear transformation-Cauchy's integral theorem and Cauchy's integral formula (proof excluded) - Taylor's series and Laurent's series - Singularities - Residues - Residue theorem (without proof), simple problems. LAPLACE TRANSFORM **UNIT-V** 12 Laplace transform - Sufficient condition for existence - Transform of elementary functions - Basic properties -Transforms of derivatives and integrals of functions - Derivatives and integrals of transforms - Transforms of unit step function and impulse functions, periodic functions. Inverse Laplace transform – Problems using Convolution theorem – Initial and final value theorems - Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques. **Total Contact Hours** : 60

(Course Outcomes:		
(On completion of the course students will be able to		
	• Apply various techniques in solving ordinary differential equations.		
•	 Develop skills to solve different types of partial differential equations 		
	• Use the concept of Gradient, divergence and curl to evaluate line, surface and volume integrals.		
•	• Use the concept of Analytic functions, conformal mapping and complex integration for solving Engineering problems.		
•	• Use Laplace transform and inverse transform techniques in solving differential equations.		

Text Books:

1	Grewal B.S., — Higher Engineering Mathematics I, Khanna Publishers, New Delhi, 43rd Edition, 2014.
2	T Veerarajan, Engineering Mathematics -II, McGraw Hill Education, 2018

Re	Reference Books / Web links:		
1	Ramana. B.V., "Higher Engineering Mathematics ", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.		
2	Erwin Kreyszig," Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.		
3	Bali, N.P. and Manish Goyal, A Text Book of Engineering Mathematics, Lakshmi Publications Pvt. Ltd., New Delhi, 2006.		
4	T Veerarajan, Transforms and Partial Differential Equations, Third Edition, 2018.		

CY19241	ENGINEERING CHEMISTRY	BS	L	Т	Р	С
	Common to II sem. B.E. – Aeronautical Engineering, Automobile Engineering, Mechanical Engineering , Mechatronics& Robotics and Automation		3	0	2	4
Objectives						
• To understa	nd the theoretical and practical principles of corrosion and its control					
 To understat To familiari 	se the fundamentals of chemical energy conversions in batteries and fuels					
To familiar To acquaint	knowledge on alloys and analytical techniques					
- To ucquaint	nio vieuge on unoys and analyteat cominques					
UNIT-I CO	DRROSION AND PROTECTIVE COATINGS				9	
Cause and effect	ts of corrosion - theories of chemical and electrochemical corrosion -emf	series- types of	of c	orro	osic	n:
Galvanic, water-	line, intergranular and pitting corrosion - passivity - factors affecting ra	te of corrosion	1 - C	corr	osi	on
control methods-	- cathodic protection -sacrificial anode and impressed current cathodic met	nods - corrosion	n in	hibi	tor	s -
metal cladding -	anodizing - electroplating - electroless plating - factors influencing ele	ctroplating - p	olaı	risat	tior	ı -
decomposition p	otential - over voltage - current density - electrolyte concentration- additives	s - organic coati	ings	- p	ain	ts
- constituents - fu	inctions - special paints - fire retardant - water repellent - temperature indicat	ing and lumino	us p	ain	ts.	
UNIT-II EN	IERGY STORAGE DEVICES	-	-		9	
Batteries - prima and Lithium – ic oxide, direct met	ry battery - alkaline battery - secondary battery (Lead acid storage battery, on battery) -flow battery -components, working principle and applications of hanol and proton exchange membrane fuel cells.	Nickel - Cadmi of hydrogen-ox	um yge	bat n, s	tery olic	7
UNIT-III PH	IASE RULE AND ALLOYS				9	
Phase rule - defin	nition of terms - one component system -water system - reduced phase rule -	thermal analys	sis -	two)	
component syste	m- eutectic system - lead silver system - safety fuses and solders.					
Alloys - purpose	e of alloying - function and effects of alloying elements - properties of alloys	- classification	ofa	allo	ys -	
Ferrous alloys - n	ichrome and stainless steel - Non-ferrous alloys - brass and bronze - heat treat	ment of alloys (ann	eali	ng,	
hardening, tempe	ering, normalising, carburizing and nitriding)					
UNIT-IV FU	NDAMENTAL SPECTROSCOPIC TECHNIQUES AND THERMAL A	NALYSIS			9	
Principles of spece	ctroscopy - UV, visible and IR spectroscopy principle - instrumentation (bloc	k diagram) - ap photometry	plic	atic	ons.	
UNIT-V FU	ELS AND COMBUSTION	photoineu y			9	
Fuels- classificat	ion -coal-ranking of coal- proximate and ultimate analysis metallurgical co	ke - manufactu	e b	v O	tto-	
Hoffmann metho	d - Petroleum processing and fractions -knocking - octane number and cetane	number - svnth	etic	pet	rol	
- Fischer Tropsch and Bergius processes -power alcohol, biodiesel- Gaseous fuels CNG and LPG.						
Combustion-calorific value- Dulongs formula-problems- flue gas analysis – Orsat apparatus–theoretical air for						
combustion – pro	combustion – problems					
1	C	ontact Hours		:	4	5

	List of Experiments	
1	Determination of corrosion rate on mild steel by weight loss method	
2	Estimation of DO by winkler's method	
3	Determination of total, temporary and permanent hardness by EDTA method.	
4	Estimation of alkalinity by indicator method.	
5	Estimation of chloride by argentometric method	
6	Estimation of extent of corrosion of Iron pieces by potentiometry	
7	Estimation of mixture of acids by conductometry.	

8	Estimation of acid by pH metry	
9	Estimation of copper / ferrous ions by spectrophotometry.	
10	Estimation of sodium and potassium in water by flame photometry.	
11	Determination of flash and fire point of lubricating oil	
12	Determination of cloud and pour point of lubricating oil	
13	Determination of phase change temperature of a solid.	
	Contact Hours :	30
	Total Contact Hours :	75

Co	Course Outcomes:	
On	On completion of the course students will be able to	
٠	Analyse type of corrosion and identify suitable corrosion control method	
•	Construct electrochemical cells and measure its potential	
•	Modify metal properties by alloying	
•	Characterize various material systems	
•	Know the importance of fuels in day to day applications	

Text Books:

104	A DOVAS.
1	P. C. Jain and Monika Jain, —Engineering Chemistryl, DhanpatRai Publishing Company (P) Ltd, New Delhi, 2015.
2	O.G.Palanna, -Engineering Chemistryl, McGraw Hill Education (India) PVT, Ltd, New Delhi, 2017.

Re	Reference Books / Web links:		
1	C. N. Banwell and E.M. McCash, —Fundamentals of Molecular Spectroscopy, 4th Edn, Tata McGraw-Hill		
I	Edition, 1995		
2	ShashiChawla, —A Text Book of Engineering Chemistryl, DhanpatRai& Co, New Delhi, 2017.		
3	Sharma Y.R., -Elementary Organic Spectroscopyl, Sultan Chand & Sons, New Delhi, 2014.		
4	Sharma B. K.,-AnalyticalChemistryl,Krishna Prakashan Media (P) Ltd., Meerut, 2005.		

GE19141	PROGRAMMING USING C	ES	L	Т	Р	С
			2	0	4	4

Ob	Objectives:		
•	To develop simple algorithms for arithmetic and logical problems.		
•	To develop C Programs using basic programming constructs		
•	To develop C programs using arrays and strings		
•	To develop applications in C using functions, pointers and structures		
•	To do input/output and file handling in C		

UNIT-I GENERAL PROBLEM SOLVING CONCEPTS

Computer – components of a computer system-Algorithm and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops.

UNIT-II C LANGUAGE - TYPES OF OPERATOR AND EXPRESSIONS

Introduction- C Structure- syntax and constructs of ANSI C - Variable Names, Data Type and Sizes, Constants, Declarations - Arithmetic Operators, Relational Operators, Logical Operators, Type Conversion, Increment and

6

6

Contact Hours :	30		
Access -Error Handling, Line I/O, Miscellaneous Functions.			
Array of structures, Pointer of Structures, Self-referential Structures, Table look up, Typedef, Unions, Bit-fields, File			
Command line arguments, Pointers to functions, complicated declarations. Basic Structures, Structures and Functions,			
and Functions, Pointer Arrays, Pointer to Pointer, Multi-dimensional arrays, Strings, Initialisation of Pointer Arrays,			
Pointers and addresses, Pointers and Function Arguments, Pointers and Arrays, Address Arithmetic, character Pointers			
UNIT-V POINTERS, ARRAYS AND STRUCTURES	6		
Block structure, Initialisation, Recursion, C Pre-processor, Standard Library Functions and return types.			
Basics of functions, parameter passing and returning type, External, Auto, Local, Static, Register Variables, Scope Ru	ıles,		
UNIT-IV FUNCTIONS AND PROGRAM STRUCTURE	6		
Blocks, If-Else-If, Switch, Loops – while, do, for, break and continue, GoTo Labels.			
Standard I/O, Formatted Output - Printf, Variable-length argument lists- Formatted Input - Scanf, Statements and	ł		
UNIT-III I/O AND CONTROL FLOW	6		
proper variable naming and Hungarian Notation.			
Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation,			

	List of Experiments		
1	Algorithm and flowcharts of small problems like GCD.		
	Structured code writing with:		
2	Small but tricky codes		
3	Proper parameter passing		
4	Command line Arguments		
5	Variable parameter		
6	Pointer to functions		
7	User defined header		
8	Make file utility		
9	Multi file program and user defined libraries		
10	Interesting substring matching / searching programs		
11	Parsing related assignments		
	Contact Hours	:	60
	Total Contact Hours	:	90

Co	Course Outcomes:			
On	completion of the course students will be able to			
•	Formulate simple algorithms for arithmetic and logical problems.			
•	Implement conditional branching, iteration and recursion.			
•	Decompose a problem into functions and synthesize a complete program using divide and conquer approach.			
•	Use arrays, pointers and structures to formulate algorithms and programs.			
•	Apply programming to solve matrix addition and multiplication problems and searching and sorting problems.			

Te	xt Books:
1	Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Pearson Education India; 2 nd Edition, 2015.
2	Byron Gottfried, "Programming with C", Second Edition, Schaum Outline Series, 1996.

Re	Reference Books:				
1	Herbert Schildt, -C: The	Complete Referencel, Fourth Edition, McGraw Hill, 2017.			
2	YashavantKanetkar,	"Let Us C", BPB Publications, 15 th Edition, 2016.			

Web links for virtual lab: 1 https://www.tutorialspoint.com/compile_c_online.php 2 https://www.codechef.com/ide 3 https://www.jdoodle.com/c-online-compiler 4 https://rextester.com/i/c_online_compiler_gcc

EE19241 BASIC ELECTRICAL ENGINEERING ES		ES	L	Т	Р	С
	Common To Auto, ECE, Mech, , Mechatronics& Robotics and		3	0	2	4
	Automation					. <u> </u>
Objectives:						
• To intro	duce electric circuits and provide knowledge on the analysis of circuits using net	work theorem	.s.			
• To impa transien	rt knowledge on the phenomenon of resonance in series and parallel circuits and t response of RC, RL and RLC circuits.	l also to obtain	1 the			
To prov	ide knowledge on the principles of electrical machines.					
• To learn	the concepts of different types of power converter and batteries.					
• To teach	n methods of experimentally analyzing electrical circuits and machines					
UNIT-I	DC CIRCUITS				9	
Electrical cir simple circui	cuit elements (R, L and C), voltage and current sources, Kirchhoff_s current and ts with dc excitation. Superposition. Theyenin and Norton Theorems.	1 voltage laws	, ana	lysi	s of	
UNIT-II	AC CIRCUITS				9	
Representati	on of sinusoidal waveforms, peak and rms values, phasor representation, re	al power, rea	ctive	po	wei	r,
apparent pov	ver, power factor. Analysis of single-phase ac circuits consisting of R, L, C, R	L, RC, RLC	comb	oinat	tion	IS
(series and pa	arallel), resonance. Three phase balanced circuits, voltage and current relations in	i star and delta	conr	nect	ions	5
UNIT-III	DC MOTORS AND TRANSFORMERS				9	
Construction operation- El	Construction, working, torque-speed characteristic and speed control of DC motors Construction and principle of operation- EMF Equation- regulation, losses and efficiency of Single Phase Transformers - Auto-transformer.					
UNIT-IV	AC ROTATING MACHINES				9	
Construction and working of Synchronous Generators-EMF Equation - Construction and working- torque-slip						
characteristic	characteristic-starting methods of three phase induction motors-Single-phase induction motors- Construction and					
Working of Permanent Magnet Brushless DC Motors and Stepper Motors.						
UNIT-V	BATTERIES AND POWER CONVERTERS				9	
Types of Bat	teries, Important Characteristics for Batteries -DC-DC buck and boost conver	ters- duty rati	0 col	ntro	1 -	

Single-phase and three-phase voltage source inverters – Sinusoidal modulation

Total Contact Hours

45

:

List of Experiments Experimental verification of Kirchhoff's voltage and current laws. 1 Experimental verification of network theorems (Thevenin and, Norton Theorems). 2 3 Load test on DC shunt motor. Speed control of DC shunt motor. 4 5 Load test on single-phase transformer. Open circuit and short circuit tests on single phase transformer. 6 Speed control of chopper fed DC motor. 7 Speed control of 3Φ Induction motor. 8 **Contact Hours** 30 : **Total Contact Hours** : 75

Course Outcomes:		
On completion of the course students will be able to		
• Analyses DC and AC circuits and apply circuit theorems.		
Realize series and parallel resonant circuits.		
Understand the principles of electrical machines.		
• Understand the principles of different types of power converter and batteries.		
• Experimentally analyze the electric circuits and machines.		
Text Book(s):		

1	D. P. Kothari and I. J. Nagrath, —Basic Electrical Engineering, Tata McGraw Hill, 2010.	
2	M.H.Rashid, —Power Electronics: Circuits, Devices and Applicationsl, Pearson Education, PHI New Delhi, 2014.	Third Edition,
3	David Linden and Thomas B. Reddy, - Handbook of Batteries McGraw-Hill Professional, 2001	
Refe	erence Books(s) / Web links:	

Curriculum and Syllabus | B.E. Robotics and Automation |R 2019

1	D. C. Kulshreshtha, -Basic Electrical Engineeringl, McGraw Hill, 2009.
2	E. Hughes, -Electrical and Electronics Technologyl, Pearson, 2010.
3	D. Toro, -Electrical Engineering Fundamentalsl, Prentice Hall India, 1989.
4	L. S. Bobrow, -Fundamentals of Electrical Engineeringl, Oxford University Press, 2011.
5	P.S.Bimbra —Power Electronicsl, Khanna Publishers, 4th Edition, 2007.

GE19201	Engineering Mechanics	ES	L	Т	Р	С
	(Common to Mech, Aero, Auto Civil ,MCT& Robotics and		2	1	0	3
	Automation)					

Ob	Objectives:			
•	To understand the basics of mechanics and apply the concept of equilibrium to solve problems of concurrent forces.			
•	To understand the concept of equilibrium and to solve problems of rigid bodies.			
•	To learn about the center of gravity and moment of inertia of surfaces and solids.			
٠	To learn the basic concepts of friction.			
٠	To learn the concepts in kinematics and kinetics of rigid bodies in plane motion.			

STATICS OF PARTICLES UNIT-I 9 Introduction - Units and Dimensions - Laws of Mechanics - Lami's theorem, Parallelogram and triangular Law of forces - Vectorial representation of forces - Vector operations of forces - additions, subtraction, dot product, cross product - Coplanar Forces - rectangular components - Equilibrium of a particle - Forces in space - Equilibrium of a particle in space - Equivalent systems of forces - Principle of transmissibility. **EQUILIBRIUM OF RIGID BODIES UNIT-II** 9 Free body diagram - Types of supports - Action and reaction forces - stable equilibrium - Moments and Couples - Moment of a force about a point and about an axis - Vectorial representation of moments and couples - Scalar components of a moment - Varignon's theorem - Single equivalent force -Equilibrium of Rigid bodies in two dimensions - Equilibrium of Rigid bodies in three dimensions - (Descriptive treatment only) UNIT-III PROPERTIES OF SURFACES AND SOLIDS Centroids and centre of mass - Centroids of lines and areas - Rectangular, circular, triangular areas by integration - T section, I section, - Angle section, Hollow section by using standard formula – Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas - Principal axes of inertia-Mass moment of inertia -mass moment of inertia for prismatic, cylindrical and spherical solids from first principle - Relation to area moments of inertia. UNIT-IV DYNAMICS OF PARTICLES 9 Displacements, Velocity and acceleration, their relationship - Relative motion - Curvilinear motion - Newton's laws of motion - Work Energy Equation- Impulse and Momentum - Impact of elastic bodies. FRICTION AND RIGID BODY DYNAMICS **UNIT-V** Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction, Ladder friction, Rolling resistance - Translation and Rotation of Rigid Bodies - Velocity and acceleration - General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere. **Total Contact Hours** 45 :

Course Outcomes:

On	completion of the course students will be able to
•	Comprehend and analysis the forces in the system.
•	Solve problems in engineering systems using the concept of static equilibrium.
•	Determine the centroid of objects such as areas and volumes, center of mass of body and moment of inertia of composite areas.
•	Solve problems involving kinematics and kinetics of rigid bodies in plane motion.
•	Solve problems involving frictional phenomena in machines.

Text Book (s):

1	Beer, F.P and Johnston Jr. E.R, Cornwell and Sanghi ., —Vector Mechanics for Engineers (In SI Units): Statics and Dynamicsl, 11thEdition, McGraw-Hill Publishing company, New Delhi (2017).

2	MikellPGr	oover, Mitchell Weiss, Roger N Nagel, Nicholas Odrey,	AshishDutta	"]	Indu	strial
2	Robotics(S	IE): Technology, Programming and Applications", McGraw Hill Education I	ndia., 2012			
Df						
Refe	erence Boo	ks(s) / Web links:		10	1.4.	
1	Wiley Ind	a. and Kraige L.G., — Engineering Mechanics- Statics - Volume 1, Dynamics- v ia,2017.	olume 21, 1 hir	a Eo	11110	n,
2	Hibbeller, Education	R.C and Ashok Gupta, —Engineering Mechanics: Statics and Dynamicsl, 1 2010.	1th Edition, P	ears	on	
3	Irving H. S Pearson Fo	hames and Krishna Mohana Rao. G., —Engineering Mechanics – Statics and Dy lucation 2006	namics 4thEd	ition	l,	
4	S SBhavik	atti Engineering Mechanics New Age International Publishers 2019				
5	Vela Mural	i. —Engineering Mechanics, Oxford University Press (2010)				
-		,				
MC	19102	INDIAN CONSTITUTION AND FREEDOM MOVEMENT	MC	L	Т	P C
		(Common to Mech, Aero, Auto Civil, Mechatronics& Robotics and		3	0	0 0
		Automation)				
Obj	ectives:					
•	To inculca	te the values enshrined in the Indian constitution				
•	To create a	sense of responsible and active citizenship				
•	To know a	bout Constitutional and Non- Constitutional bodies				
•	To underst	and sacrifices made by the freedom fighters				
UN	II I -T	VTRODUCTION				9
Hist	orical Back	ground – Constituent Assembly of India – Philosophical foundations of the I	ndian Constitu	itioi	1 –	
Prea	mble – Fur	damental Rights – Directive Principles of State Policy – Fundamental Duties	s – Citizenship) —		
Con	stitutional I	Remedies for citizens. Constitution' meaning of the term, Indian Constitution	: Sources and	c	a	
cons	titutional h	istory, Features: Citizenship, Preamble, Fundamental Rights and Duties, Direc	ctive Principle	s of	Stat	e
Pono	су тп s	PDIICTUDE AND EUNCTION OF CENTRAL COVEDNMENT				0
Uni	n Governn	TRUCTURE AND FUNCTION OF CENTRAL GOVERNMENT	rasidant Drin		lini	7 stor
-Ca	binet – Par	liament – Supreme Court of India – Judicial Review			11111	sici
UN	T-III S	FRUCTURE AND FUNCTION OF STATE GOVERNMENT AND LOC	AL BODY			9
State	Governme	ent – Structure and Functions – Governor – Chief Minister – Cabinet – State Le	oislature – Iu	licia	1.51	stem
in St	tates – Hig	a Courts and other Subordinate Courts- Role and Importance Municipalities	. Introduction	M	avo	and
role	of Elected	Representative, CEO of Municipal Corporation, Pachavati Rai: Introduction.	Elected offic	ials	and	their
roles	s, ,Village l	evel: Role of Elected and Appointed officials.				
UN	T-IV C	ONSTITUTIONAL FUNCTIONS AND BODIES				9
India	an Federal	System – Center – State Relations – President's Rule – Constitutional Function	onaries – Asse	ssm	ent	of
worl	king of the	Parliamentary System in India- CAG, Election Commission, UPSC, GST Co	uncil and othe	r		
Con	stitutional b	oodies NITI Aayog, Lokpal, National Development Council and other Non	-Constitutiona	al bo	odie	S
UN	T-V II	NDIAN FREEDOM MOVEMENT				9
Briti	sh Colonia	ism in India-Colonial administration till 1857- Revolt of 1857- Early Resistan	ice to British I	Rule	-Ris	se
of N	ationalism	in India-Indian Freedom Struggle under Mahatma Gandhi-Non- Cooperation	Movement-C	ivil		
Disc	bedience N	Iovement- Quit India Movement-British Official response to National movem	ent- Independ	lenc	e of	
India	a Act 1947-	Freedom and Partition				
		Total C	Contact Hours		:	45
a	A (
Cou	rse Outcon					
Onc	Unpletion	of the course students will be able to				
	Understa	nd and abida the mlass of the Indian sometime is				
	Cointersta	nu and adde the rules of the Indian constitution.				
	Gain Kno	when the second state of the second s	atitutional k -	lice		
	Underste	nd the societies made by freedom fighters during freedom meyorment	isututional DOC	nes		
-	Understa	nd the sacrifices made by needon fighters during freedom movement				

Text Book (s):

• Durga Das Basu, —Introduction to the Constitution of India —, Lexis Nexis, New Delhi., 21st ed 2013

•	Bipan Chandra, History of Modern India, Orient Black Swan, 2009
•	Bipan Chandra, India's Struggle for Independence, Penguin Books, 2016
•	
•	Maciver and Page, - Society: An Introduction Analysis -, Mac Milan India Ltd., New Delhi.2nd ed, 2014
•	P K Agarwal and K N Chaturvedi , PrabhatPrakashan, New Delhi, 1st ed , 2017

Reference Books(s) / Web links:

•	Sharma, Brij Kishore, — Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
•	U.R.Gahai, -Indian Political System -, New Academic Publishing House, Jalaendhar.

MT19221	COMPUTER AIDED DRAWING LABORATORY	ES	L	Т	Р	C
			0	0	2	1

Ob	Objectives:		
•	To introduce the students the Indian standard code of practice for engineering drawing and general symbols and abbreviation used on the drawing.		
•	To provide hands on experience to develop 2D and 3D models of engineering components.		
•	To provide knowledge to use Drawing/Modeling software.		

	List of Experiments		
1	 Indian standard code of practice for engineering drawing – general principles of Presentation. Conventional representations of threaded parts, springs, gear and Common features. Abbreviations and symbols for use on technical drawings. Conventions for sectioning and dimensioning. 		
2	 GEOMETRIC DIMENSIONING & TOLERANCING (GD&T) PRINCIPLES Tolerances – types – representation of tolerances on drawing, fits – types – selection of Fits – allowance. Geometric tolerances – form and positional tolerances – datum, datum Features. Maximum material principle – symbols and methods of indicating it on drawing Surface finish symbols–welding symbols and methods of indicating it on drawing. 		
3	 INTRODUCTION TO DRAFTING SOFTWARE Introduction to the use of any drafting software – creation of simple geometric bodies using primitives (line, arc, circle etc.,) and editing for the drawing, Dimensioning and text writing, concept of layer creation and setting, line types. 		
4	 MANUAL AND CAD DRAWING OF MACHINE ELEMENTS Preparation of 2-D drawings using CAD software for components and assemblies of Plummer block, screw jack, machine vice, lathe tailstock, tool head of the shaper. Introduction to 3-D modeling solid and frame modeling. 		
	Total Contact Hours : 30		

Co	Course Outcomes:		
On	On completion of the course students will be able to		
	Develop engineering drawing and dimensioning for the industrial component using Indian Standard code of		
•	practice.		
•	Implement Geometric Dimensioning & Tolerancing principles in production drawing.		
•	Use CAD software for drafting machine components.		
•	Learn the working principles of different machine elements.		
•	Develop 2D and 3D models of the component using manual/software.		

GE19122	ENGINEERING PRACTICES- ELECTRICAL AND ELECTRONICS	ES	L	Т	Р	С
			0	0	2	1

Ob	Objectives:		
•	To provide hands on experience on various basic engineering practices in Electrical Engineering.		
•	To impart hands on experience on various basic engineering practices in Electronics Engineering.		

	List of Experiments			
A. 1	A. ELECTRICAL ENGINEERING PRACTICE			
1	Residential house wiring using switches, fuse, indicator, lamp and energy met	er.		
2	Fluorescent lamp wiring.			
3	Stair case wiring.			
4	Measurement of electrical quantities - voltage, current, power & power factor	in RLC circuit.		
5	Measurement of resistance to earth of an electrical equipment.			
B. I	ELECTRONICS ENGINEERING PRACTICE			
1	Study of Electronic components and equipment's – Resistor, colour coding, measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.		eter	
2	Study of logic gates AND, OR, EOR and NOT.			
3	3 Generation of Clock Signal.			
4	4 Soldering practice – Components Devices and Circuits – Using general purpose PCB.			
5	5 Measurement of ripple factor of HWR and FWR.			
		Total Contact Hours	:	30

Co	Course Outcomes:	
On	On completion of the course students will be able to	
•	Fabricate electrical and electronic circuits	
•	Formulate the house wiring	
•	Design the AC-DC converter using diode and passive components	
•	Perform soldering activity	
•	Measure ripple factor of HWR and FWR	

RE	REFERENCE		
1	Bawa H.S., -Workshop Practicel, Tata McGraw - Hill Publishing Company Limited, 2007.		
2	Jeyachandran K., Natarajan S. & Balasubramanian S., —A Primer on Engineering Practices Laboratoryl, Anuradha Publications, 2007.		
3	Jeyapoovan T., Saravanapandian M. & Pranitha S., —Engineering Practices Lab Manuall, Vikas Publishing House Pvt.Ltd, 2006.		
4	Rajendra Prasad A. &Sarma P.M.M.S., -Workshop Practicel, SreeSai Publication, 2002.		

SEMESTER – III

MA 19355	TRANSFORMS AND APPLICATIONS	BS	L	Т	Р	С
	Common to III sem. B.E. Mechanical Engineering, Mechatronics,		3	1	0	4
	Civil Engineering & Robotics and Automation					

Ob	jectives:
٠	To introduce Fourier series and to solve boundary value problems that arise in the field of Engineering.
٠	To acquain the student with different transform techniques used in wide variety of situations.

UNIT-I	FOURIER SERIES		12
Dirichlet's c	onditions - General Fourier series - Odd and even functions - Half rat	nge sine series –Half range cosin	e
series - Pars	eval's identity – Harmonic analysis.		
UNIT-II	BOUNDARY VALUE PROBLEMS - ONE DIMENSIONAL EQ	UATIONS	12
Classification wave equation	n of second order quasi linear partial differential equations – Fourier on – One dimensional heat equation: Problems with temperature and	series solutions of one dimension temperature gradients.	onal
UNIT-III	BOUNDARY VALUE PROBLEMS – TWO DIMENSIONAL EQ	UATIONS	12
Steady state solution of t	solution of two-dimensional heat equation in Cartesian coordinates: In wo-dimensional heat equation in Polar coordinates: Circular and Sem	finite and finite plates – Steady s icircular disks.	state
UNIT-IV	FOURIER TRANSFORMS		12
Statement o Transforms	f Fourier integral theorem – Fourier transform pair – Fourier sine and of simple functions – Convolution theorem – Parseval's identity - Appl	l cosine transforms – Properties ication to boundary value proble	– ms.
UNIT-V	Z - TRANSFORMS AND DIFFERENCE EQUATIONS		12
Z- transform - Formation	s - Elementary properties – Inverse Z - transform (using partial fraction a of difference equations – Solution of difference equations using Z- trar	and residues) – Convolution theor asform.	em
		Total Contact Hours :	60

Co	Course Outcomes:			
On	On completion of the course students will be able to			
٠	Develop skills to construct Fourier series for different periodic functions and to evaluate infinite series.			
٠	Classify different types of PDE and solve one dimensional boundary value problems.			
٠	Solve two-dimensional heat equations.			
٠	Solve Engineering problems using Fourier transform techniques.			
•	Solve difference equations using Z – transforms that arise in discrete time systems.			

Te	Text Books:				
1	Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.				
2	Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt.Ltd.,New Delhi, Second reprint, 2012.				
Reference Books / Web links:					
1	Grewal B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, Delhi, 2014.				

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2	Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3	Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
4	Ray Wylie C and Barrett.L.C, "Advanced Engineering Mathematics" Tata McGraw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.

GE 19301	LIFE SCIENCE FOR ENGINEERS	ES	L	Т	Р	С
			3	0	0	3

Ob	jectives:			
•	Broad of	bjective of this course is to give an introduction of life science to engin	eering students.	
•	The cou	urse helps students to familiarize with human physiology, life style dise	eases and their management and	
	basic di	agnostic aspects.		
UN	тт-т	OVERVIEW OF CELLS AND TISSUES		9
Intr	oduction	to Bacteria, virus, fungi and animal cells. Organization of cells into ti	ssues and organs. Functions of	vital
org	ans.		and organist i unetions of	
UN	IT-II	HEALTH AND NUTRITION		9
Bal	anced die	et, Importance of RDA, BMR, and diet related diseases. Role of antiox	idants PUFA, DHA, Essential a	mino
acio	ls, Essent	tial fatty acids in diet. Water and its significance for human health. Phys	ical and Mental health – Signific	cance
of e	exercise a	and yoga.		
	<u>IT-III</u>	UNHEALTHY PRACTICES AND THEIR IMPACT ON HEAL		9
eleo	ig induce	d toxicity, Unhealthy practices - Drug abuse/Narcotics/Smoking/Alcol adgets.	hol/Self-medication/Undue usag	ge of
UN	IT-IV	COMMON DISEASES AND LIFESTYLE DISORDERS		9
Pre	vention a	and management of food, water and airborne illness (Common cold	l, dehydration, food poisoning	etc.).
Life	estyle dis	orders - obesity, diabetes, stroke, heart attack, ulcer, renal calculi, car	ncer, AIDS, hepatitis- preventio	n and
mai	nagement	t.		_
UN	IT-V	DIAGNOSTIC TESTS AND THEIR RELEVENCE		9
No	rmal rang	e of biochemical parameters, significance of organ function tests, organ	n donation.	
			Total Contact Hours :	45
Co	urse Out	comes:		
On	completi	on of the course students will be able to		
٠	Classif	y the living organisms and relate the functions of vital organs		
•	Demon	strate the importance of balanced diet and plan methods for healthy live	ing	
•	Analyz	e the hazards of unhealthy practices and take preventive measures		
•	Catego	rize the various life style disorders and recommend ways to manage the	e common diseases	
•	Evaluat	e and interpret biochemical parameters and their significance		
Tey	t Books:			
1	Disease Compa	es of human body , Carol D Tamparo, Marcia A Lewis , Marcia A, Lew ny, 2011.	vis ,EdD, RN, CMA-AC, F.A D	avis
2	Textbo	ok of Medical Biochemistry ,Chatterjea ; Rana Shinde.		
Ref	ference E	Books(s) / Web links:		
1	Biology	of for Engineers, Arthur.T., Johnson, CRC Press, Taylor and Francis, 201	1.	
2	Cell Bi	ology and Genetics, Cecie Starr, Ralph Taggart, Christine Evers and Li	sa Starr, Cengage Learning, 200)8.

3 https://nptel.ac.in/courses/122103039/

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MT 19301	ANALOG DEVICES AND CIRCUITS	PC	L	Т	P	С
			3	0	0	3

Ob	Objectives:			
•	To study the IC fabrication procedure and basic characteristics of transistors.			
•	To study characteristics; realize circuits; design for signal analysis using Op-amp ICs.			
•	To study the applications of Op-amp.			
•	To study internal functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits, ADCs.			

UNIT-I INTRODUCTION AND FABRICATION OF ANALOG DEVICES

Introduction to Integrated Circuit- IC Classification and Fabrication- Special Diodes, Transistor Characteristics, Configurations; BJT and FET- Working and Characteristics 0

OPERATIONAL AMPLIFIER UNIT-II

Ideal OP-AMP characteristics, DC characteristics, AC characteristics, differential amplifier; frequency response of OP-AMP; Basic applications of op-amp - Inverting and Non-inverting Amplifiers-V/I & I/V converters, summer, differentiator and integrator.

UNIT-III APPLICATIONS OF OPAMP

Instrumentation amplifier, Log and Antilog Amplifiers, first and second order active filters, comparators, multivibrators, waveform generators, clippers, clampers, peak detector, S/H circuit, Oscillators

APPLICATIONS OF ANALOG ICs UNIT-IV

Functional block, characteristics & application circuits with 555 Timer IC-566 voltage-controlled oscillator IC; 565phase lock loop IC, Analog multiplier ICs. 9

UNIT-V **VOLTAGE REGULATOR ICs**

IC voltage regulators -LM78XX,79XX Fixed voltage regulators - LM317, 723 Variable voltage regulators, switching regulator- SMPS- LM 380 power amplifier- ICL 8038 function generator IC. 45

Total Contact Hours :

Co	Course Outcomes:		
On	On completion of the course students will be able to		
•	Analyze, linear and digital electronic circuits.		
•	Learn different IC fabrication procedure.		
•	Design Op-amp ICs for signal analysis.		
٠	Learn various applications of Op-amp.		
٠	Analyze various internal functional blocks and special ICs		

Text Book (s):

1.	Salivahanan S, Suresh kumar N — Electronic Devices and Circuits, Third Edition, Tata McGraw Hill, 2012
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- Roy D Choudhary, Sheil B.Jain, -Linear Integrated Circuits, 5th edition, New Age, 2018. 2
- 3. Ramakant A.Gayakward, - Op-amps and Linear Integrated Circuits, IV edition, Pearson Education, 2015.

Reference Books(s) / Web links:

Fiore, —Opamps & Linear Integrated Circuits Concepts & Applicationsl, Cengage, 2010. 1.

2.	Floyd ,Buchla, —Fundamentals of Analog Circuits, Pearson, 2013.
3.	Jacob Millman, Christos C.Halkias, —Integrated Electronics - Analog and Digital circuits systeml, Tata McGraw Hill, 2003.
4.	Robert F.Coughlin, Fredrick F. Driscoll, —Op-amp and Linear ICs. PHI Learning, 6th edition, 2012

MT 19302	DIGITAL SYSTEM DESIGN	PC	L	Т	Р	С
			3	0	0	3

Objectives:							
• To introduce basic postulates of Boolean algebra and shows the correlation between Boolean expressions							
To outl	• To outline the formal procedures for the analysis and design of combinational circuits						
To outl	ine the formal procedures for the analysis and design of sequential circu	uits					
To illus	strate the concept of synchronous and asynchronous sequential circuits						
• To intro	oduce the concept of memories and programmable logic devices.						
UNIT-I	LOGIC GATES AND MINIMIZATION TECHNIQUES		9				
Gates, Logi	c circuits using gates - Multi level gate implementations - Boole	ean Postulates and Laws - Bo	olean				
Expressions	- Minimization of Boolean expressions - SOP, POS - Karnaug	sh map Minimization – Don't	Care				
Conditions -	 Quine-McCluskey Method of Minimization. 						
UNIT-II COMBINATIONAL CIRCUITS 9							
Adder, Sub	tractor, Carry Look Ahead Adder, BCD Adder - Code Converters	– Encoder, Decoder – Multiple	exer,				
Demultiplex	xer – Parity checker, Parity Generator – Code Converter.						
UNIT-III	SEQUENTIAL CIRCUITS		9				
Latches, Edge Triggering - Level Triggering - Flip-Flops, SR, JK, D, T, Master Slave JK - Realization of one Flip-Flop							
using other	using other Flip-Flop – Registers – Shift Registers, SISO, SIPO, PISO, PIPO, Bidirectional Shift Register, Universal						
Shift Regist	er.						
UNIT-IV	SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIR	CUITS	9				
Counters, S	ynchronous / Asynchronous Counters, Mod N Counters, Ring Counter,	Johnson Counter – State Machi	ines:				
State transition diagram, Moore and MEALY Machines – Design equation and circuit diagram.							
UNIT-V	MEMORIES AND PROMMABLE LOGIC DEVICES		9				
Memory Basics, ROMs, PROMS, and EPROMs, RAMS – Sequential Programmable Logic Devices – PAL, PLA.							
Introduction and basic concepts of FPGA, VHDL and Verilog – Implementation of AND, OR, Adders using VHDL and							
Verilog.	Verilog.						
		Total Contact Hours :	45				

Co	Course Outcomes:						
On	On completion of the course students will be able to						
•	Design and Analyse any digital logic gate circuits.						
•	Construct Combinational Logic Circuit for the given requirement.						
•	Design and Analyse any Flip-Flop based systems.						
•	Gain the capability of implementing various Counters.						
•	Acquire basic knowledge on memories, FPGA, VHDL and Verilog.						

Morris Mano M., —Digital Design: With an Introduction to the Verilog HDL, VHDL and S Edition, Pearson Education Pvt.Ltd., New Delhi, 2018.	System Verilog 6 th
,,,,,,,,,	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
2 Charles H.Roth, — Fu ndamentals of Logic Designl, 7 th Edition, Thomson Learning, 2015.	
3 Ronald J.Tocci Neal S. Widmer and Gregory L. Moss, Digital Systems: Principles and Appli of India, New Delhi, 2010.	cations, Prentice Hall

Reference Books(s) / Web links:

Ite	terence books(b) / Web mins.
1	Thomas L. Floyd, -Digital Fundamentals, 11th Edition, Pearson Education Inc, 2014
2	John F.Wakerly, —Digital Designl, 5 th Edition, Pearson/PHI, 2017
3	Donald P.Leach and Albert Paul Malvino, —Digital Principles and Applications, 8th Edition, TMH, 2014.
4	John.M Yarbrough, -Digital Logic Applications and Designl, Thomson Learning, 2006.
5	Donald D.Givone, -Digital Principles and Designl, McGraw Hill Education, 2017.

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ME 19303	KINEMATICS OF MACHINERY	PC	L	Т	Р	С
			2	1	0	3

Objectives:

•	То	uno	lerst	and t	he l	basic	concept	s of	mec	hanis	sms
-											

- To develop the velocity, and acceleration diagram of mechanisms
 To understand the cam mechanisms
- To understand the cam mechanisms
 To understand the basic concents of c
- To understand the basic concepts of cam mechanism, gears and gear trains
- To have the basic knowledge on friction in machine elements

UNIT-I BASICS OF MECHANISMS

Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law – Kinematic inversions of four-bar chain and slider crank chains – Limit positions – Mechanical advantage – Transmission Angle – Description of some common mechanisms – Quick return mechanisms, Straight line generators, Universal Joint – rocker mechanisms.

UNIT-II KINEMATICS OF LINKAGE MECHANISMS

Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method– Velocity and acceleration polygons – Velocity analysis using instantaneous centres – kinematic analysis of simple mechanisms – Coincident points– Coriolis component of Acceleration – Introduction to linkage synthesis problem. Introduction to simulation software

UNIT-III KINEMATICS OF CAM MECHANISMS

Classification of cams and followers – Terminology and definitions – Displacement diagrams –Uniform velocity, parabolic, simple harmonic and cycloidal 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.

UNIT-IV GEARS AND GEAR TRAINS

 Law of toothed gearing – Involutes and cycloidal tooth profiles –Spur Gear terminology and

 definitions –Gear tooth action – contact ratio – Interference and undercutting. Helical, Bevel, Worm, Rack and Pinion

 gears [Basics only]. Gear trains – Speed ratio, train value – Parallel axis gear trains – Epicyclic Gear Trains.

 UNIT-V
 FRICTION IN MACHINE ELEMENTS

 Surface contacts – Sliding and Rolling friction – Friction drives – Friction in screw threads – Bearings and lubrication

 – Friction clutches – Belt and rope drives – Friction in brakes- Band and Block brakes

 Total Contact Hours
 :

Co	Course Outcomes:					
On	On completion of the course students will be able to					
•	Analyze the mechanisms					
•	Construct the velocity and acceleration diagrams for a given mechanism					
•	Design and analyse the cam mechanisms.					
٠	Analyze the given gear trains					
٠	Analyze and predict the influence of friction in machine elements					

Text Books:

1	Uicker, J.J., Pennock G.R and Shigley, J.E., —Theory of Machines and Mechanismsl, Oxford University Press, 4 th Edition, Reprint: 2017
2	Rattan, S.S., —Theory of Machinesl, McGraw-Hill Education Pvt. Ltd., 5 th edition, 2019.

1 Amitabha Ghosh and Asok Kumar Mallik, —Theory of Mechanisms and Machinesl, Affiliated East-West Pvt Ltd.,3 rd edition, 1988.	
Ltd.,3 rd edition, 1988.	
2 Rao.J.S. and Dukkipati.R.V. —Mechanism and Machine Theoryl, New Age International Pvt. Ltd., 2 nd Editio 2014	ι,
3 Singh.V.P, —Theory of Machinel, Dhanpat Rai & Co., 6 th Edition, 2017	
4 Robert L. Norton, Kinematics and Dynamics of Machinery, McGraw-Hill Education, Special Indian Edition	n,
Reprint-2017	
5. https://nptel.ac.in/courses/112/104/112104121/	
6. https://nptel.ac.in/courses/112105268/	
7. https://nptel.ac.in/courses/112101096/	

RO 19301 MECHANICS OF MATERIALS	PC	L	Т	Р	С	
		3	1	0	4	
Objectives:						
• To understand the fundamental concepts of stress, strain and elastic constants of solids ur	nder external lo	badi	ng			
To learn about torsion of linearly elastic materials						
• To learn about the shear force, bending moment and deflection of beams						
• To study the Stresses in Beams and to analysis plane stress and strain						
• To learn about the stability of columns and shell structures like thin cylinders, spheres an	nd thick cylind	ers				
UNIT-I TENSION, COMPRESSION, AND SHEAR				12		
Introduction - Normal Stress and Strain, Mechanical Properties of Materials, Elasticity, Pl	asticity, and C	reer). L	ine	ar	
Elasticity, Hooke's Law, and Poisson's Ratio, Shear Stress and Strain, Allowable Stresses and	d Allowable L	oads	, D	esi	gn	
For Axial Loads and Direct Shear, Changes in Lengths of Axially Loaded Members, Change	es in Lengths	unde	r N	on	-	
uniform Conditions, Statically Indeterminate Structures, Thermal Effects, Misfits, and Press	trains, Stresses	s on	Inc	line	ed	
Sections, Strain Energy, Impact Loading, Repeated Loading and Fatigue.						
UNIT-II TORSION				12	_	
Torsional Deformations of a Circular Bar. Circular Bars of Linearly Elastic Materials. Non 1	iniform Torsi	on S	tre	sses		
and Strains in Pure Shear. Relationship Between Moduli of Elasticity. Transmission of I	Power by Circ	ular	Sh	aft	s.	
Statically Indeterminate Torsional Members, Strain Energy in Torsion and Pure Shear, Torsion	of Noncircular	Pris	sma	tic	- 7	
Shafts, Thin-Walled Tubes, Stress Concentrations in Torsion.						
UNIT-III SHEAR FORCES, BENDING MOMENTS AND DEFLECTIONS OF BE	AMS			12		
Introduction, Types of Beams, Loads, and Reactions, Shear Forces and Bending Moments, Re	elationships ar	non	g Lo	oad	s,	
Shear Forces, and Bending Moments, Shear-Force and Bending-Moment Diagrams. Dif	ferential Equa	tion	s o	f th	e	
Deflection Curve, Deflections by Integration of the Bending-Moment Equation.	-					
UNIT-IV STRESSES IN BEAMS AND ANALYSIS OF PLANE STRESS				12		
Pure Bending and Nonuniform Bending, Curvature of a Beam, Longitudinal Strains in Bear	ns, Normal St	ress	es i	n		
Beams (Linearly Elastic Materials), Design of Beams for Bending Stresses, Composite Beam	s, Principal St	ress	es a	nd		
Maximum Shear Stresses, Mohr's Circle for Plane Stress, Hooke's Law for Plane Stress, Tria	ixial Stress, Pl	ane	Stra	in		
UNIT-V COLUMNS AND CYLINDERS				12		
Buckling and Stability, Columns with Pinned Ends, Columns with Other Support Conditions	s. Columns wi	th E	cce	ntri	c	
Axial Loads, Secant Formula for Columns, stresses in thin cylinder and spheres, stresses in thi	ck cylinder an	d co	mpo	oun	d	
cylinders.	5		I			
Total Co	ntact Hours		:	6()	
Course Outcomes:						
On completion of the course students will be able to		1	•			
 Apply the principle concepts behind stress, strain and deformation of solids for various er 	ngineering app	incat	10n	5		
• Draw the shear force diagram and bending moment diagram for beams subjected to differ	rent loading co	ndıt	ions	3.		
• Calculate the deformation of shafts subjected to torsional loads.						
• Calculate the deflection of beams through Macaulay's method, Moment area method and	strain energy	metl	nod	s.		
• Analyze the Columns, thin and thick shells for various engineering applications						

102	At DUOKS.
1	Barry J. Goodno and James M. Gere "Mechanics of Materials", Cl-Engineering; 9th edition., Canada, 2016.
2	Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2015.

Ref	Reference Books(s) / Web links:		
1	Egor. P.Popov - Engineering Mechanics of Solidsl Prentice Hall of India, New Delhi, 2001.		
2	Ramamurtham S., "Strength of Materials", Dhanpat rai publishing company, 2011.		
3	Hibbeler, R.C., "Mechanics of Materials", Pearson Education, 2018.		
4	Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill		
	Publishing _co. Ltd., New Delhi, 2016.		
5.	https://nptel.ac.in/courses/112107146/		

MT 19311	DIGITAL SYSTEM DESIGN LABORATORY	PC	L	Т	Р	С
			0	0	3	1.5

Ob	Objectives: This laboratory course enables students to		
•	To understand the functionality of Logic Gates and Boolean Expressions.		
•	To understand the functionality of Adder, Subtractor and Comparator.		
•	To understand the functionality of Flip-Flops.		
•	To understand the functionality of combinational and sequential circuits		
٠	To simulate basic combinational and sequential circuits using Hardware Description Language HDL		

	List of Experiments
1	Verification of logic gates and realization of Boolean expressions using gates.
2	Design and Implement Adders and Subtractors using logic gates.
3	Design and Implement 4-bit Parallel Adder / Subtractor using IC 7483.
4	Design and Implement 4-bit Magnitude Comparator using IC 7485.
5	Realize 3-variable function 8:1 Mux using IC 74151.
6	Realize 1:8 Demux and 3:8 Decoder using IC 74138.
7	Verification of state tables of SR, JK, T and D Flip-Flops using NAND & NOR gates.
8	Simulate Mod-8 Synchronous UP/DOWN Counter using Simulation tool.
9	Simulate Mod-8 Asynchronous UP/DOWN Counter using Simulation tool.
10	Realization of Digital circuits using HDL – Combinational circuits
11	Realization of Digital circuits using HDL – Sequential circuits
12	Mini project on design of a digital circuit for solving practical problems
	Total Contact Hours : 45

Course Outcomes:		
On completion of the course students will be able to		
Simplify complex Boolean functions.		
Implement digital circuits using combinational logic ICs.		
Learn the characteristics of various Flip-Flops.		
Design digital circuits with combinational and sequential components.		
• Use HDL to build digital systems.		
Web links for virtual lab (if any)		
1 http://vlabs.iitkgp.ernet.in/dec/index.html		
2 http://he-coep.vlabs.ac.in/		
3 https://www.iitg.ac.in/cseweb/vlab/vlsi/		
4 https://www.ee.iitb.ac.in/fpgasimulation/docs/exp/sequence_detector/index.html		

5 http://cse14-iiith.vlabs.ac.in/

RO19311	MECHANICS OF MATERIALS LABORATORY	PC	L	Т	Р	С
			0	0	3	1.5

-			
Ob	Objectives: The main learning objective of this course is to prepare the students for		
•	To study the mechanical properties of materials when subjected to different types of loadings.		
•	To study the impact strength of given specimen.		
•	To study the hardness properties of given specimen.		
•	To understand the deflection of different beams.		
•	To verify the spring material properties by experimentally.		
٠	To calculate the mechanical properties of materials using strain gauge.		

List of Experiments					
1	Tension test on a mild steel rod				
2	Double shear test on Mild steel and Aluminium rods				
3	Torsion test on mild steel rod				

4	Impact test on metal specimen (Charpy and Izod test)				
5	Hardness test on metals – (Brinell and Rockwell Hardness Number)				
6	Deflection test on beams (Simply supported beam)				
7	Compression test on helical springs (Closed coil)				
8	Beam Deflections using Maxwell Reciprocal Theorem				
9	9 Strain Measurement				
10	10 Deflection Of Continuous Beam.				
	Total Contact Hours : 45				
Co	ourse Outcomes:				
On	completion of the course students will be able to				
•	Perform Tension, shear test, Torsion, impact test and Hardness test on given ma	terial.			
•	Determine the stiffness and modulus of rigidity of the spring wire.				
•	Measure the deflection of a Continuous beam				
	• Measure the stress & strain on cantilever beam using strain gauges				
	intersate and subsciele strain on culture (et occult using strain gauges				

MC 19301		ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	MC	L	Т	P	С
				2	0	0	0
Ob	jectives:						
•	This course aims at imparting basic principles of thought process, reasoning and inference. Sustainability is the core of Indian traditional knowledge system connecting society and nature. Holistic life style of yogic science and wisdom are important in modern society with rapid technological advancements and societal disruptions. The course mainly focuses on introduction to Indian knowledge system, Indian perspective of modern science, basic principles of Yoga and holistic healthcare system, Indian philosophical, linguistic and artistic traditions.						

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

UNIT-I	Introduction To Indian Knowledge System: Basic structure of the Indian Knowledge System – Veda – Upaveda - Ayurveda, Dhanurveda-Gandharvaveda, Sthapathyaveda and Arthasasthra. Vedanga (Six forms of Veda) – Shiksha, Kalpa, Nirukta, Vyakarana, Jyothisha and Chandas- Four Shasthras - Dharmashastra, Mimamsa, Purana and Tharkashastra.	6
UNIT-II	NIT-II Modern Science And Yoga: Modern Science and the Indian Knowledge System – a comparison – Merits and demerits of Modern Science and the Indian Knowledge System - the science of Yoga- different styles of Yoga – types of Yogaasana, Pranayam, Mudras, Meditation techniques and their health benefits – Yoga and holistic healthcare – Case studies.	
UNIT- III	Indian Philosophical Tradition: Sarvadharshan/Sadhdharshan – Six systems (dharshans) of Indian philosophy - Nyaya, Vaisheshika, Sankhya, Yoga, Mimamsa, Vedanta-Other systems- Chavarka, Jain (Jainism), Boudh (Buddhism) – Case Studies	
UNIT- IV	Indian Linguistic Tradition: Introduction to Linguistics in ancient India – history – Phonetics and Phonology – Morphology –Syntax and Semantics-Case Studies.6	
UNIT-V	Indian Artistic Tradition: Introduction to traditional Indian art forms – Chitrakala (Painting), Murthikala / Shilpakala (Sculptures), Vaasthukala, Sthaapathya kala (Architecture), Sangeeth (Music), Nruthya (Dance) and Sahithya (Literature) – Case Studies.	6
	Total Contact Hours :	30

Course Outcomes:			
•	At the end of the course, students will be able to appreciate the importance of traditional Indian knowledge system, Yoga and other Indian traditions that are important in a modern society with technological advancements and lifestyle changes.		
Taxt Book (s):			

1CA DOOR (5).				
1	V. Sivaramakrishnan (Ed.), <i>Cultural Heritage of India-course material</i> , Bharatiya Vidya Bhavan, Mumbai. 5th Edition, 2014.			
2	Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan.			
3	Swami Jitatmanand, <i>Holistic Science and Vedant</i> , Bharatiya Vidya Bhavan.			
4	Fritzof Capra, Tao of Physics.			
5	Fritzof Capra, The Wave of life.			
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Ref	ference Books(s) / Web links:			
1	VN Jha (Eng. Trans.), Tarkasangraha of Annam Bhatta, International Chinmay Foundation, Velliarnad,			
1	Arnakulam.			
2	Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkata.			
3	GN Jha (Eng. Trans.), Ed. RN Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakashan, Delhi 2016.			
4	RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakashan, Delhi 2016.			

SEMESTER – IV

MA19455	STATISTICS AND NUMERICAL METHODS	BS	L	ΓP	' C
	Common to IV sem. B.E. Mechanical Engineering and Mechatronics		3	1 0) 4
Objectives					
 To pro 	vide the necessary basic concepts of a few statistical methods in designing and s	olving problems.			
• To pro	vide various numerical methods in solving problems that occur in the field of En	gineering and Teo	hnol	ogy	•
UNIT-I	TESTING OF HYPOTHESIS			1	.2
Statistical h	ypothesis - Large sample test based on Normal distribution for single mean an	l difference of me	ans ·	Tes	ts
based on t,	F and Chi-square test for single sample standard deviation. Chi-square tests for	r independence of	attr	ibute	es
and goodne	ss of fit.				
UNIT-II	DESIGN OF EXPERIMENTS			1	.2
One way an	d two way classifications - Completely randomized design – Randomized block	design –Latin sq	uare		
design.					
UNIT-III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS			1	2	
Newton Ra	Newton Raphson method - secant method - Gauss Jordan method - Iterative method of Gauss Seidel - Eigen value of				2
a matrix by	power method and by Jacobi method for symmetric matrix.				
UNIT-IV	INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERIC	AL		1	2
	INTEGRATION				
Curve fittin	g (y= a+ bx, y = a+bx+cx ²)-Lagrange's interpolations – Newton's forward and	backward different	ence		
interpolatio	n – Approximation of derivates using interpolation polynomials – Numerical i	tegration using T	rape	zoid	al
and Simpso	n's 1/3 rules.			-	
UNIT-V NUMERICAL SOLUTION OF DIFFERENTIAL EQUATIONS			1	2	
Taylor's set	ies method – Modified Euler's method – Fourth order Runge - Kutta method fe	r solving first ord	er		
equations – Finite difference methods for solving second order equations- Finite difference solution of one					
dimensiona	heat equation by explicit and implicit methods - Two dimensional Laplace equation	uation.			
	Tota	Contact Hours		. (60

	Course Outcomes:		
On	On completion of course students will be able to		
•	Obtain statistical data from experiments and able to analyze the same using statistical test.		
•	Design experiments using suitable ANOVA techniques and draw conclusions.		
•	Solve algebraic equations and eigen value problems that arise during the study of engineering problems.		
•	• Use interpolation methods to solve problems involving numerical differentiation and integration		
•	solve differential equations numerically that arise in course of solving engineering problems.		

Text Books:

-	
1	Veerarajan T., _Probability, Statistics and Random Processes with Queueing Theory and Queueing Networks', Mc Graw Hill, 2016.
2	Kandasamy P., Thilagavathi and K. Gunavathi., —Statistics and Numerical Methodsl, S. Chand & Company Ltd. (2010).

1	Johnson R.A., and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers", 11thEdition,
	Pearson Education, , Asia, 2011.
2	Walpole R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineersand Scientists", 8th
	Edition, Pearson Education, Asia, 2007.
3	Spiegel M.R., Schiller. J., and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics", Tata
	McGraw Hill Edition, 2004.
4	Grewal B.S., and Grewal. J.S., "Numerical Methods in Engineering and Science", 9th Edition, Khanna
	Publishers, New Delhi, 2007.
5	Gerald C.F., and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 2006.

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MT19402	MICROCONTROLLERS AND EMBEDDED SYSTEMS	PC	L	Т	Р	С
			3	0	0	3

Objectives:					
•	To learn about the architecture, functions, programming and usage of 8085 microprocessor.				
•	To understand architecture of microcontroller and usage of built-in special function blocks.				
•	To design and verify the various interfacing techniques with microcontrollers.				
•	• To impart knowledge on basics of embedded system architecture.				
-					

• To provide essential knowledge on real time embedded operating system.

UNIT-I BASICS OF MICROPROCESSOR

8085 Architecture – Address space – Instruction set – Addressing modes, Interrupts – Instruction cycle and Timing diagram – Assembly Language Programming.

UNIT-II MICROCONTROLLER

Architecture of 8051 – Memory organization - I/O Ports - Instruction set - Addressing modes - Assembly language programming, PIC Architecture – Programming Techniques – PIC Development Systems – Application Design – Program Debugging - Introduction to Arduino microcontroller, Raspberry Pi.

		· ·	
UNIT-III	PROGRA EMBEDI	AMMING AND INTERFACING WITH PIC MICROCONTROLLER USING DED C	
I/O Davet Dea	· · · · · · · · · · · · · · · · · · ·	$A'_{1} + A'_{2} + A$	

I/O Port Programming – Arithmetic, Logical Instructions and Programs – PIC18 Timer – Serial Port Programming, Interrupt Programming – LCD and Keyboard Interfacing – Stepper Motor Interfacing – DC Motor Control.

UNIT-IV INTRODUCTION TO EMBEDDED SYSTEMS

 Embedded system Architecture - Design Process in Embedded system- Classification of Embedded system,

 Timer and Counting devices - Watchdog Timer - Real Time Clock - In circuit emulator - Target Hardware Debugging.

 UNIT-V
 REAL TIME OPERATING SYSTEM

Introduction to basic concepts of RTOS – Tasks and Data – Threads – Multiprocessing and Multitasking – Semaphores – Priority Inversion - Priority Inheritance – Queues – Pipes,

Washing machines - Cruise control - antilock braking systems - Automatic chocolate vending machine - Pick and Place Robot – Automatic lubrication of supplier Conveyor belt.

Total Contact Hours:45

Course Outcomes:

On completion of the course students will be able to

- Design 8085 microprocessor based system.
- Design and implement the programs of 8051.
- Design circuits for various applications using microcontrollers.
- Construct the basic architecture and components of embedded system.
- Develop embedded system in real time for simple applications.

Text Book (s):

102	Text Dook (b)		
1	Raj Kamal, —Embedded Systems: Architecture, Programming and Design Tata Mc Graw-Hill, 2015		
2	Muhammad Ali Mazidi, Rolin D. McKinlay and Danny Causey, —PIC Microcontroller And Embedded Systems: Using Assembly And C For Pic 18l, Pearson Education, 2016		
3	Muhammad Ali Mazidi, Rolin D. McKinlay and Janice Gillispie Mazidi, —The 8051 Microcontroller and Embedded Systems Using Assembly and Cl, Pearson Education, 2016		

1	Santanu Chattopadhyay, -Embedded system Design 2nd Edition, PHI Learning Private Limited, 2013.
2	K C Wang, -Embedded and Real time Operating systems Springer, 2017
3	Martin Bates, -PIC Microcontrollers An Introduction to Microelectronics, Third Edition, 2011
4	John B Peatman, —Design with PIC microcontrollersl, Eighth Edition, Pearson Education, 2009
5	Subrata Ghoshal, —8051 Microcontroller: Internals, Instructions, Programming and Interfacing Pearson Education, 2010

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RO19401	BASICS OF ROBOTICS	PC	L	Т	Р	С
			3	0	0	3

Objectives:			
•	To understand the Robot types and its end effectors.		
•	To introduce the concept of robot kinematics.		
•	To understand the methods in trajectory and motion planning.		
•	To impart knowledge on dynamics of robots.		
•	• To learn the sensors and actuators used in robots.		
•	To impart knowledge on dynamics of robots. To learn the sensors and actuators used in robots.		

INTRODUCTION TO ROBOTICS UNIT-I

Introduction to robotics- History, growth; Robot applications- Manufacturing industry, defense, rehabilitation, medical etc., Laws of Robotics, degrees of freedom of planar and spatial manipulator, Robot classifications, work envelope, Internal Grippers and External Grippers; Selection and Design Considerations, resolution, accuracy and repeatability of robot, applications, robot teaching, specification.

UNIT-II **ROBOT KINEMATICS**

Representation of objects in 3-D space-position and orientation, Frame transformations-translation-rotation-translation and rotation combined- translation operator-rotation operator, composite rotation matrix, representation of position in cylindrical, spherical coordinate system, representation of orientation using roll, pitch and yaw angles, representation of orientation using Euler angles. Denavit-Hartenberg notations- link and joint parameters-rules for coordinate assignments, forward and inverse kinematics, velocity analysis.

UNIT-III TRAJECTORY AND MOTION PLANNING

Introduction, Linear trajectory function, polynomial trajectory function, Gross and fine motion planning, motion planning schemes-visibility graph, vornoi diagram ,tangent graph, accessibility graph, path velocity decomposition, incremental planning, relative velocity approach, reactive control strategy and potential field approach.

UNIT-IV **ROBOT DYNAMICS**

Introduction to inverse and forward dynamics, determination of inertia tensor, Lagrange-Euler formation for joint torque, control of robotic joints,

UNIT-V ACTUATORS AND SENSORS

Actuators and types, DC motors, BLDC servo motors. Introduction to sensors, characteristics, sensor types-Touch, Potentiometer, Encoder, Force, Range and proximity. Economic Analysis of Robots.

Total (

Contact Hours	

Course Outcomes:

On completion of the course students will be able to

Select the robot and its grippers based on application. •

• Calculate robot position and orientation.

•	Develop optimal trajectory and path planning of robots.
٠	Determine joint torques and forces in a robot.
٠	Select sensors and actuators for any robotic system.

re	XL BOOKS:
1.	Fu. K.S, Gonzalez. R.C, Lee. C.S.G -Robotics -Control, Sensing, Vision, and Intelligencel, McGraw Hill, 2015
2.	Pratihar.D.K, -Fundamentals of Robotics, Narosa Publishing House, India, 2019.
Re	ference Books / Web links:
1.	Groover Mikell .P, -Industrial Robotics -Technology Programming and Applications, McGraw Hill, 2014
2.	Deb S.R., -Robotics Technology and Flexible Automation Tata McGraw Hill Book Co., 2013.
3.	Koren Y., —Robotics for Engineers", McGraw Hill Book Co., 1992
4.	Maja J Mataric, —The Robotics Primer —Universities Press. 2013.

5. John J. Craig, —Introduction to Robotics Mechanics and Controll, Pearson Education India, 2008

RO19402	MANUFACTURING SCIENCE	PC	L	Т	Р	C
			3	0	0	3

- OD	iecti	ves:
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- To understand the basic concepts of sand casting technique and special casting technique.
- To understand the principles, equipment's of different welding and joining techniques.
- To understand the working principle and applications of Turning machines.
- To understand the working principles of shaper, milling and gear cutting machines.
- To know about Unconventional machining processes.

### UNIT-I METAL CASTING

Sand Casting : Sand Mould – Type of patterns - Pattern Materials – Pattern allowances –Moulding sand Properties and testing – Cores –Types and applications – Moulding machines– Types and applications; Melting furnaces : Blast and Cupola Furnaces; Principle of special casting processes : Shell - investment – Ceramic mould – Pressure die casting - Centrifugal Casting – Continuous casting, Vacuum casting- CO₂ process – Stir casting; Defects in Sand casting.

## UNIT-II METAL JOINING AND FORMING PROCESSES

Operating principle of Fusion welding processes, Gas welding, metal arc welding, Gas Tungsten arc welding Gas metal arc welding, Plasma arc welding, Electron beam welding –Laser welding, Brazing and soldering; Weld defects: types, causes and cure. Adhesive bonding. Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – forging operations. Rolling of metals– Types of Rolling, Extrusion, Principle of rod and wire drawing

### UNIT-III | TURNING MACHINES

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle : Swiss type, automatic screw type – multi spindle, Introduction to CNC machines.

### UNIT-IV SHAPER, MILLING AND GEAR CUTTING MACHINES

Shaper - Types of operations. Drilling ,reaming, boring, Tapping. Milling operations-types of milling cutter. Gear cutting – forming and generation principle and construction of gear milling, hobbing and gear shaping processes –finishing of gears.

## UNIT-V INTRODUCTION TO UNCONVENTIONAL MACHINING PROCESS

Unconventional machining Process-Need-classification-merits, demerits and applications. Abrasive Jet Machining-Water Jet Machining-Abrasive Water Jet Machining-Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working Principles-equipment used-Process parameters-MRR-Applications.

Total Contact Hours:45

**Course Outcomes:** 

On completion of the course students will be able to

•	Prepare patterns and perform casting processes for different applications.
٠	Select the suitable joining and forming processes for an application.
٠	Describe the constructional and operational features of centre lathe and other special purpose lathes.
•	Describe the constructional and operational features of shaper, , milling, and gear cutting machines
٠	Explain non-traditional manufacturing techniques.

Te	xt Books:
1	HajraChoudhary. S.K and Hajra Choudhary. A.K., "Elements of Workshop Technology", volume I and II, Media
	Promoters and Publishers Private Limited, Mumbai, 2014.
2	Kalpakjian. S, —Manufacturing Engineering and Technologyl, 7 th Edition, Pearson Education India Edition, 2018

Re	Reference Books(s) / Web links:		
1	Roy A. Lindberg, "Processes and Materials of Manufacture", PHI / Pearson education, 2016		
2	Black J.T and Ronald A. Kosher, "Degarmos Materials and Processes, in Manufacturing" 12th Edition, Wiley Publishers, 2017.		
3	Sharma, P.C., "A Text book of production Technology", S.Chand and Co. Ltd., 2006.		
4	Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", Vol 1, 4th Edition, Mcgraw Hill-2017.		
5.	https://nptel.ac.in/courses/112107144/		

CS19342	<b>OBJECT ORIENTED PROGRAMMING PARADIGM</b>	PC	L	Т	P	(	7
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	jectives:					
	To und	lerstand Object Oriented Programming concepts and characteristics of Ja	va			
•	To kno	ow the principles of classes, abstraction and inheritance				
•	To crea	ate packages, define exceptions and use strings				
•	To use	I/O streams and collections in applications				
•	To des	ign and build simple GUI programs using generics, AWT, Swings and JI	DBC			
UN	IT-I	INTRODUCTION TO OOP AND JAVA FUNDAMENTALS		9		
Intr	oduction	n to Object Oriented Programming – Basic concepts of OOP - An overvi	iew of Java - Java Architectu	re -		
Dat	a Types	- Variables- Arrays- Operators - Control Statements - Command Line	Arguments.			
UN	IT-II	CLASSES AND INHERITANCE		9		
Def	ining Cl	asses in Java: Methods, Constructors, Garbage Collection - Access Spe	ecifiers - Method Overloadin	g —		
Inhe	eritance	Super keyword, this keyword, Method Overriding, Abstract Classes – S	Static Members -Final Metho	d and		
Clas	ss.					
UN	IT-III	PACKAGES, EXCEPTION HANDLING AND STRINGS		9		
Pac	kages –	Interfaces - Exceptions - Exception Hierarchy - Throwing and Catching	g Exceptions – Built-in Exce	ptions,		
Use	er define	d Exceptions, Stack Trace Elements – Strings - String Buffer.				
UN	IT-IV	I/O AND COLLECTIONS		9		
Inpu	ut / Outp	out Basics – Streams – Byte streams and Character streams – Reading an	d Writing Console – Readin	g and		
Wri	iting File	es – Collection Interfaces – Collection Classes.				
UN	NIT-V	GENERIC PROGRAMMING, MULTITHREADING A PROGRAMMING	ND EVENT DRIVE	N 9		
Gen	neric Pro	pgramming – Generic Classes – Generic Methods - Multithreading: Thre	ad Life Cycle, Thread Creati	on,		
Thr	ead Syn	chronization- Swings - Layout Management - Accessing Databases wi	Thread Synchronization- Swings – Layout Management - Accessing Databases with JDBC.			
			ui JDBC.			
			Total Contact Hours	: 45		
		List of Experiments	Total Contact Hours	: 45		
1	Simple	List of Experiments e programs using command line arguments	Total Contact Hours	: 45		
1 2	Simple Progra	List of Experiments e programs using command line arguments ms using control structures	Total Contact Hours	: 45		
1 2 3	Simple Progra Progra	List of Experiments e programs using command line arguments ms using control structures ms using arrays	Total Contact Hours	: 45		
1 2 3 4	Simple Progra Progra Progra	List of Experiments e programs using command line arguments ums using control structures ms using arrays ums using Programs using classes and objects.	Total Contact Hours	: 45		
1 2 3 4 5	Simple Progra Progra Progra	List of Experiments e programs using command line arguments ums using control structures ms using arrays ums using Programs using classes and objects. ums using inheritance and interfaces	Total Contact Hours	: 45		
1 2 3 4 5 6	Simple Progra Progra Progra Progra	List of Experiments e programs using command line arguments ms using control structures ms using arrays ms using Programs using classes and objects. ms using inheritance and interfaces ms using packages and abstract class	Total Contact Hours	: 45		
1 2 3 4 5 6 7	Simple Progra Progra Progra Progra Progra	List of Experiments e programs using command line arguments ms using control structures ms using arrays ms using Programs using classes and objects. ms using inheritance and interfaces ms using packages and abstract class ms using packages and abstract class ms to handle different types of exceptions ms using extince and free	Total Contact Hours	: 45		
1 2 3 4 5 6 7 8	Simple Progra Progra Progra Progra Progra Progra	List of Experiments e programs using command line arguments ms using control structures ms using arrays ums using Programs using classes and objects. ums using inheritance and interfaces ums using packages and abstract class ums to handle different types of exceptions ums using strings and string buffer ums using LO structures	Total Contact Hours	: 45		
1 2 3 4 5 6 7 8 9	Simple Progra Progra Progra Progra Progra Progra Progra	List of Experiments e programs using command line arguments ms using control structures ms using arrays ms using Programs using classes and objects. ms using inheritance and interfaces ms using packages and abstract class ms to handle different types of exceptions ms using strings and string buffer ms using I/O streams ms using files	Total Contact Hours	: 45		
1 2 3 4 5 6 7 8 9 10 11	Simple Progra Progra Progra Progra Progra Progra Progra Progra	List of Experiments e programs using command line arguments ms using control structures ms using arrays ms using Programs using classes and objects. ms using inheritance and interfaces ms using packages and abstract class ms to handle different types of exceptions ms using strings and string buffer ms using I/O streams ms using files ms using collections	Total Contact Hours	: 45		
1 2 3 4 5 6 7 8 9 10 11	Simple Progra Progra Progra Progra Progra Progra Progra Progra	List of Experiments e programs using command line arguments ms using control structures ms using arrays ums using Programs using classes and objects. ums using inheritance and interfaces ums using packages and abstract class ums to handle different types of exceptions ums using strings and string buffer ums using I/O streams ums using files ms using collections ums using collections ums using multithreading	Total Contact Hours	: 45		
1 2 3 4 5 6 7 8 9 10 11 11 12 13	Simple Progra Progra Progra Progra Progra Progra Progra Progra Progra	List of Experiments         e programs using command line arguments         ums using control structures         ms using arrays         ums using Programs using classes and objects.         ums using inheritance and interfaces         ums using packages and abstract class         ums using strings and string buffer         ums using files         ums using collections         ums using multithreading         ums using Generics	Total Contact Hours	: 45		
1 2 3 4 5 6 7 8 9 10 11 11 12 13 14	Simple Progra Progra Progra Progra Progra Progra Progra Progra Progra Progra	List of Experiments e programs using command line arguments ms using control structures ms using arrays ms using Programs using classes and objects. ms using inheritance and interfaces ms using packages and abstract class ms to handle different types of exceptions ms using strings and string buffer ms using files ms using files ms using collections ms using multithreading ms using Generics ms using swings	Total Contact Hours	: 45		
$ \begin{array}{c} 1\\ 2\\ 3\\ 4\\ 5\\ 6\\ 7\\ 8\\ 9\\ 10\\ 11\\ 12\\ 13\\ 14\\ 15\\ \end{array} $	Simple Progra Progra Progra Progra Progra Progra Progra Progra Progra Progra Simple	List of Experiments e programs using command line arguments ms using control structures ms using arrays ms using Programs using classes and objects. ms using inheritance and interfaces ms using packages and abstract class ms using packages and abstract class ms using strings and string buffer ms using strings and string buffer ms using files ms using collections ms using multithreading ms using Generics ms using swings applications using database connectivity	Total Contact Hours	: 45		
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15	Simple Progra Progra Progra Progra Progra Progra Progra Progra Progra Progra Simple	List of Experiments e programs using command line arguments ms using control structures ms using arrays ums using Programs using classes and objects. ums using inheritance and interfaces ums using packages and abstract class ums to handle different types of exceptions ums using strings and string buffer ums using files ms using files ms using collections ums using multithreading ms using Generics ums using swings e applications using database connectivity	Total Contact Hours	: 45		
1 2 3 4 5 6 7 8 9 10 11 11 12 13 14 15	Simple Progra Progra Progra Progra Progra Progra Progra Progra Progra Simple	List of Experiments e programs using command line arguments ms using control structures ms using arrays ums using Programs using classes and objects. ums using inheritance and interfaces ums using packages and abstract class ums to handle different types of exceptions ums using strings and string buffer ums using files ms using files ms using collections ums using multithreading ms using Generics ums using swings e applications using database connectivity	Total Contact Hours           Total Contact Hours           Contact Hours           Contact Hours           Contact Hours	: 45 		

Course	Outcomes:
On com	pletion of the course, the students will be able to
•	Develop Java programs using OOP principles.
•	Develop Java programs with the concepts inheritance.
•	Build Java applications using exceptions and strings.
•	Develop Java applications using I/O and collections.
•	Develop interactive Java applications using GUI components.

Curriculum and Syllabus | B.E. Robotics and Automation |R 2019

Refere	Reference Books(s):		
1	Paul Deitel, Harvey Deitel, -Java SE 8 for programmersl, 3rd Edition, Pearson, 2015.		
2	Steven Holzner, -Java 2 Black bookl, Dreamtech press, 2011.		
3	Timothy Budd, —Understanding Object-oriented programming with Javal, Updated Edition, Pearson Education, 2000.		
4	SCJP Sun Certified Programmer for Java 6 Study Guide. 6th edition, McGrawHill.		

Text Book (s):				
1	Herbert Schildt, -Java The complete referencel, 8th Edition, McGraw Hill Education, 2011.			
2	Cay S. Horstmann, Gary cornell, -Core Java Volume -I Fundamentals, 9th Edition, Prentice Hall, 2013.			

Web links for Theory & Lab:					
1	https://www.javatpoint.com/java-tutorial				

ME19312		MANUFACTURING TECHNOLOGY LABORATORY	PC	L	Т	P	С		
				0	0	3	1.5		
Ob	Objectives Enable the students								
	To prosting	the molding process using group and							
	To practice	different types of chest matel energy in a							
	To practice	different types of sneet metal operations			• • • •	1			
	no perform milling.	a various machining operations like facing, turning, knurling, thread c	utting, snaping,	grind	ing a	na			
•	To obtain th	he knowledge of different gear manufacturing processes.							
•	To acquire	knowledge on selection of appropriate processes, machines to comple	ete a given job.						
		LIST OF EXPERIMENTS							
1	Preparation	n of sand mould using single piece pattern							
2	Preparation	n of sand mould using split piece pattern							
3	Fabrication	n of tray in sheet metal							
4	Fabrication	n of funnel in sheet metal							
5	Taper turni	ing using lathe							
6	Knurling a	nd external thread cutting using lathe							
7	Step turnin	g and drilling using Capstan / Turret lathe							
8	Drilling an	d Tapping							
9	Cube form	ation using shaper							
10	Study of In	dexing mechanism in milling machine							
11	Hexagonal	milling using vertical milling machine							
12	Spur gear cutting using milling machine								
13	Gear gener	ation in gear hobbing machine							
14	Surface gri	nding							
15	15 Cylindrical grinding								
			Total Contact	Hour	s	:	45		
Cor	irse Outcom	nes:							

On completion of the course students will be able to					
•	Make a mould in green sand using different types of patterns.				
•	Create different objects using sheet metal.				
•	Perform different possible machining processes in lathe, shaper, grinders and milling machines.				
•	• Select and perform different gear generating process based on requirements.				
•	Select suitable manufacturing method, machines, equipment and tools to make a job based on given requirements.				

MT 19411	MICROPROCESSORS AND MICROCONTROLLERS FOR AUTOMATION LABORATORY	PC	L	Т	Р	С
			0	0	3	1.5

Ob	Objectives:				
٠	To focus on the implementation of arithmetic operations using microprocessors and microcontroller.				
•	To simulate assembly language programs.				
٠	To implement various on-chip and off-chip interfacing and algorithms.				
٠	To develop practical knowledge in peripheral interfacing with 8085 microprocessor.				
•	To develop practical knowledge in peripheral interfacing with 8051 microcontroller.				

	List of Experiments					
1	Arithmetic operations (addition, subtraction, multiplication, ascending, descending) using 8085 and 8051.					
2	Generation of specified time delay and display in CRO/ DSO.					
3	Analog to digital conversion in 8085.					
4	Digital to analog conversion in 8085.					
5	Interface MATRIX keyboard with 8085.					
6	Stepper motor control using Microcontroller.					
7	DC motor controller interface using Microcontroller.					
8	Interface an ADC and a temperature sensor to measure temperature using Microcontroller.					
9	Flash a LED connected at a specified output port terminal using 8085.					
10	Interface LCD with Microcontroller.					
11	Interface an ADC and a strain gauge to measure the given load using Microcontroller.					
12	Generation of waveform using embedded C software at a specified port terminal.					
13	Interfacing of traffic light control systems.					
14	Keyboard/Display Interface.					
15	Rolling display and Flashing display.					
16	Controlling AC &DC motors using Arduino and Raspberry Pi controllers					
	Total Contact Hours : 45					
	· · · · · ·					

C	Course Outcomes:				
C	On completion of the course students will be able to				
	Develop simple programs using 8085 and 8051				
	Perform ADC and DAC Conversions				
	Develop interfacing circuits for real time applications				
	Develop simple programs using Embedded C software				
	Develop simple programs for Arduino and Raspberry Pi controllers				

GE 19421	SOFT SKILLS-I	EEC	L	Т	Р	С
			0	0	2	1

Ob	Objectives:			
٠	To help students break out of shyness.			
٠	To build confidence			
٠	To enhance English communication skills.			
٠	To encourage students' creative thinking to help them frame their own opinions,			

### **Course Description:**

The course, **"Soft Skills-I"** intends to enhance the students' confidence to communicate in front of an audience effectively. The emphasis is on improving the spoken skills of the students so that they can communicate both, in the college and in the corporate setting to deliver their message successfully. In today's technology driven world, communicating with confidence is imperative. Hence, this course aims at providing students with the necessary practice in the form of debates, discussions and role plays.

### **Program Learning Goals:**

This program will help our students to build confidence and improve their English communication in order to face the corporate world as well as providing them with opportunities to grow within an organisation.

### Learning and Teaching Strategy:

The program is completely student centric where the focus is on activities led by students which include role plays, discussions, debates other games as well. These activities would be supplemented by interactive use of technology and brief trainer input.

Sl No	Activity Name	Description	Objective
1	Introduction	The trainer and the college facilitator talk to the students about the course and in turn the students introduce themselves.	To set expectations about the course and the students are made aware of the rules and regulations involved in this program
2	If I ruled the world	This is a quick and useful game by getting students to form a circle and provide their point of view. Each student then repeats what the other has said and comes up with their own opinion.	The aim of this activity is to for students to get to know each other and also develop their listening skills as well as learning how to agree and disagree politely.
3	Picture Narrating	This activity is based on several sequential pictures. Students are asked to tell the story taking place in the sequential pictures by paying attention to the criteria provided by the teacher as a rubric. Rubrics can include the vocabulary or structures they need to use while narrating.	The aim of this activity is to make the students develop creative way of thinking.
4	Brainstorming	On a given topic, students can produce ideas in a limited time. Depending on the context, either individual or group brainstorming is effective and learners generate ideas quickly and freely. The good characteristics of brainstorming are that the students are not criticized for their ideas so students will be open to sharing new ideas.	The activity aims at making the students speak freely without the fear of being criticized. It also encourages students to come up with their own opinions.

5	Debate	Is competition necessary in regards to the learning process?	The aim of this activity is to develop the students ability to debate and think out of the box
6	Short Talks	Here the students are given topics for which they take one minute to prepare and two minutes to speak. They can write down points but can't read them out they can only use it as a reference.	The activity aims at breaking the students' shyness and encouraging them to standup in front of the class and speak. It also aims at creating awareness that they are restricted for time so they only speak points that are relevant and important.
7	Debate	Will posting students' grades on bulletin boards publicly motivate them to perform better or is it humiliating?	This activity aims at enhancing the students unbiased thought process when it comes to exams and grades as well as develop their skills to debate
8	The Art of diplomacy	The facilitator proceeds to share multiple concepts of conversation and helps the participants to identify the various methods of being diplomatic and how do deal with misinformation.	The aim of the lesson is to provide an opportunity for the participants to learn about body language and choosing the appropriate words for conversation.
9	Debate	Are humans too dependent on computers?	The aim of this activity is to test the students debating skills and thought process with a topic that affects everybody in daily life.
10	Story Completion	The teacher starts to tell a story but after 2 sentences he/she asks students to work in groups to create the rest of the story which includes the plot and the ending.	This activity aims at building their narrating skills as well as their creativity and ability to work in a team.
11	Role play debate	Students scrutinize different points of view or perspectives related to an issue. For example, a debate about the question —Should students be required to wear uniforms at school? might yield a range of opinions. Those might include views expressed by a student (or perhaps two students – one representing each side of the issue), a parent, a school principal, a police officer, a teacher, the owner of a clothing store, and others.	The aim of this activity is to get students to speak based on other people's perspective instead of their own. The students take the role of various characters and debate accordingly.
12	I Couldn't Disagree More	This is a game where students practice rebuttal techniques where one student provides a thought or an idea and the other students starts with the phrase I couldn't disagree more and continues with his opinion	The aim of this activity is to improve general communication skills and confidence.
	Feedback	At the end of the session in the final week (12) the trainer would provide feedback to the students on best practices for future benefits	The aim is to do both give feedback to students as well as obtain feedback on the course from them.

## **Total Contact hours: 30**

Cour	Course Outcomes:	
On co	On completion of the course students will be able to	
• ]	Be more confident	
• 5	Speak in front of a large audience	
• ]	Be better creative thinkers	
• ]	Be spontaneous	
• ]	Know the importance of communicating in English.	

## Learning Resources:

1. Kings Learning work sheets.

R	019421	INTERNSHIP-I*	EEC	0 0	2 1
Ob	Objectives:				
	To enhance	the knowledge of the students in professional engineering practice sought	through industri	ial trainir	ig on
	different cur	rent technologies.			
	To expose s job acumen.	tudents to real work life situations and to equip them with abreast of new	technology that i	ntensify	their
	To employ the students in industrial projects and strengthen the practical skills of the students.				
	To develop a	significant commitment in the students' profession and specialization.			
STR	ATEGY:				
The	students indi	vidually undertake training in reputed Mechanical, Mechatronics and Auto	mation engineerin	ng compa	inies
for t	he specified	luration. At the end of the training, a report on the work done will be prepared	and presented. Th	ne student	s will
be e	valuated thro	ugh a viva-voce examination by a team of internal staff.			
Co	urse Outcon	nes			
	On comple	tion the course, the students will be able to			
	Apply prior	acquired knowledge in a real-life environment.			
	Integrate cla	ssroom theory with workplace practice.			
	Acquire kno	wledge from the experts.			
	Work on a re	esearch project or undertake work experience under the guidance of indust	ry and academic	supervisi	on.
	Extend the k	nowledge through research and development in the chosen fields of specia	lization.		
Two	wooks at the	and of Third Samastar)			

(* Two weeks at the end of Third Semester)

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45

## SEMESTER-V

RO19501	FLUID POWER SYSTEMS	PC	L	Т	Р	С
			3	0	0	3

<b>01</b>	
( )hi	00113/06*
UDI	curves.

To understand the basics of fluid properties and flow characteristics.
To learn about loses in fluid flow through pipes.
To develop hydraulic circuits and systems.
• To know the working principles of pneumatic power system and its components.
To learn the trouble shooting methods in fluid power systems.
UNIT-IFLUID PROPERTIES AND FLOW CHARACTERISTICS9
Properties of fluids-Pressure Measurements-Buoyancy and floatation-Flow characteristics-Eulerian and Lagrangian
Principle of fluid flow-concept of control volume and system -Reynold's transportation theorem-continuity

equation, energy equation and momentum equation-Applications.
UNIT-II FLOW THROUGH PIPES
Reynold's Experiment-Laminar flow through circular conduits-Darcy Welsbach equation –friction factor-Moody
diagram minor lasses Understille and energy gradient. Directing and percently Latradyation to Darity diagram.

diagram-minor losses-Hydraulic and energy gradient –Pipes in series and parallel. Introduction to Positive displacement and non-positive displacement pumps.

### UNIT-III HYDRAULIC ACTUATORS AND CIRCUIT DESIGN

Hydraulic Actuators: Cylinders –Types and construction, Application, Hydraulic cushioning ,Hydraulic motors, Direction Control, Flow control and pressure control valves –Types, Construction and Operation –Accessories ,Fluid Power ANSI Symbols –Problems, Accumulators, Intensifiers, Industrial hydraulic Circuit Design and Analysis, Hydrostatic transmission, Sensors used in Electro hydraulic s y s t e m s , Electro hydraulic circuits,–Servo and Proportional valves –Applications-Mechanical , hydraulic servo systems.

## UNIT-IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS

Properties of air –Air preparation and distribution –Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit –classification-single cylinder and multi cylinder circuits-Cascade method –Integration of fringe circuits, PLC-Architecture and types, Electro Pneumatic System – Elements –Ladder diagram –timer circuits-Problems, Introduction to fluidics and pneumatic logic circuits

## UNIT-V TROUBLE SHOOTING AND APPLICATIONS

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Conditioning of hydraulic fluids Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for metal working, handling, clamping counter and timer circuits. –Low cost Automation –Hydraulic and Pneumatic power packs

Total Contact Hours :

Co	Course Outcomes:		
On	On completion of course students will be able to		
٠	Understand the behavior of fluids.		
•	Calculate losses in fluid flow and Design the effective fluid flow system		
٠	Design hydraulic circuits and systems for various applications.		
•	Design and develop pneumatic and electro pneumatic systems.		
•	Install, Select and Maintain fluid power systems.		

Text Books:		
1	Anthony Esposito, -Fluid Power with Applications, Pearson New International Edition, England, 2014.	
2	Modi P.N. and Seth, S.M. Hydraulics and Fluid Mechanics, Standard Book House, New Delhi, 2017.	

Ref	Reference Books / Web links:		
1	Jagadeesha. T., -Pneumatics Concepts, Design and Applications -, Universities Press, 2015.		
2	Joshi.P., Pneumatic Controll, Wiley India, 2008.		
3	Majumdar, S.R., -Oil Hydraulics Systems -Principles and Maintenancel, TataMcGraw Hill, 2001		
4	Shanmugasundaram.K., -Hydraulic and Pneumatic Controls. Chand & Co, 2006.		
5	Srinivasan.R., -Hydraulic and Pneumatic Controls, Vijay Nicole Imprints, 2008.		

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12

12

RO19502	DYNAMICS AND DESIGN OF MACHINERY	PC	L	Т	Р	C
			3	1	0	4

Ob	Objectives:		
•	To derive the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.		
٠	To interpret the effect of unbalancing of masses and vibrations.		
٠	To understand the concepts in design of machine elements.		
٠	To learn about shaft and fasteners design.		
•	To learn the design principles involved in designing springs and bearings.		

#### UNIT-I **FORCE ANALYSIS**

Dynamic force analysis - Inertia force and Inertia torque- D Alembert's principle -Dynamic Analysis in reciprocating engines - Gas forces - Inertia effect of connecting rod- Bearing loads - Crank shaft torque - Turning moment diagrams - Fly Wheels - Flywheels of punching presses- Dynamics of Cam-follower mechanism.

#### UNIT-II **BALANCING OF ROTATING MASSES AND VIBRATION**

Static and dynamic balancing - Balancing of rotating masses in different planes. Basic concepts of S.H.M, Causes and effects of vibration - Degrees of freedom - Single degree of freedom - Free vibration - Equations of motion - Natural frequency - Types of Damping - Damped vibration - Torsional vibration of shaft - Critical speeds of shafts - Torsional vibration - Two rotor torsional systems. Introduction to Forced vibration. 12

### UNIT-III FUNDAMENTAL CONCEPTS IN DESIGN

Introduction to the design process, factors influencing machine design, standards and codes used in material selection, selection of materials based on mechanical properties, Preferred numbers, design against static loads-Modes of failure -Factor of safety -stresses due to bending and torsion moment-eccentric loading-Eccentric loading, Design against fluctuating loads -curved beams -crane hook and C" frame-theories of failure.

#### SHAFTS AND FASTERNERS DESIGN **UNIT-IV**

Shafts and Axles -Design of solid and hollow shafts based on strength, rigidity and critical speed -Keys and splines -Rigid and flexible couplings. Threaded fasteners -Bolted joints -Simple and eccentrically loaded bolted joints-Welded joints -welded joints subjected to bending, torsional and eccentric loads.

#### SPRINGS AND BEARINGS UNIT-V

Types of springs, design of helical and concentric springs-surge in springs, Sliding contact and rolling contact bearings -Hydrodynamic journal bearings, Sommerfeld Number, Raimondi & Boyd graphs, --Selection of Rolling Contact bearings -Seals and Gaskets.

**Total Contact Hours** 

### : 60

Co On	Course Outcomes: On completion of course students will be able to		
٠	Analyze and predict the effects of force in mechanical system		
٠	Calculate the effect of unbalanced system and determine vibrational effects in a mechanical systems		
٠	Design machine members subjected to static and variable loads		
٠	Analyze bolted and welded joints for various kinds of loads.		
٠	Design and select springs and bearings.		

Text Books:

- Shigley, J., Mischke, C., Budynas, R., and Nisbett, K., -Mechanical Engineering Design, 10thEdition, Tata 1. McGraw-Hill, 2014.
- Bhandari V, —Design of Machine Elementsl, 15th Reprint, Tata McGraw-Hill Book Co, 2014 2.

Re	Reference Books / Web links:		
1.	Bernard Hamrock, Steven Schmid, Bo Jacobson, —Fundamentals of Machine Elementsl,2nd Edition, Tata McGraw Hill, 2006		
2.	Ghosh. A and Mallick, A.K., —Theory of Mechanisms and Machines", 3rd Edition, Affiliated East-West Pvt. Ltd., New Delhi, 2006.		
3.	Design Data Hand Book, PSG College of Technology, 2013-Coimbatore		
4.	Robert C. Juvinall and Kurt M. Marshek, —Fundamentals of Machine component Designl,5th Edition, Wiley, 2011.		
5.	Md. Jalaludeen, Machine Design, Volume II, Design of Transmission Systems, 4th edition, Anuradha Publications, 2014		

RO19503	MECHATRONICS AND MANUFACTURING AUTOMATION	PC	L T P	' C	
			3 0 0	) 3	
<b>Objectives:</b>					
To under	erstand about Mechatronics systems				
To intro	To introduce the concept of PLC programming to establish an automation.				
To learn	about drives and mechanisms				
To know	v about the stages in mechatronics design				
To stud	y about manufacturing systems				
UNIT-I	INTRODUCTION AND SENSORS		9	)	
Introduction	to Mechatronics - Systems - Need for Mechatronics - Emerging areas of Mech	atronics – Class	sification	of	
Mechatronic	s. Sensors and Transducers: Static and Dynamic Characteristics of Sensor, I	otentiometers	– LVDT	` —	
Capacitance	Sensors - Strain Gauges - Eddy Current Sensor - Hall Effect Sensor - Temperatu	re Sensors – Lig	ght Sensor	rs	
UNIT-II	UNIT-II PROGRAMMABLE LOGIC CONTROLLER 9				
Introduction	- Architecture - Input / Output Processing - Programming with Timers, Count	ers and Internal	relays –		
Data Handlin	ng – Selection of PLC.				
UNIT-III	DRIVES AND MECHANISMS		9	)	
Drives: stepp electronic ca	ber motors, servo drives. Ball screws, linear motion bearings, cams, systems coms, indexing mechanisms, tool magazines, and transfer systems.	ontrolled by car	mshafts,		
UNIT-IV	MECHATRONICS SYSTEM DESIGN		9	,	
Stages of Me	chatronics Design Process - Comparison of Traditional and Mechatronics Design	n Concepts with	ı Example	es	
- Case studi	es of Mechatronics Systems - Pick and Place Robot - Engine Management syst	em – Automati	c Car Par	rk	
Barrier.					
UNIT-V	MANUFACTURING SYSTEMS		9	)	
Components of a Manufacturing systems, Classification of Manufacturing Systems, overview of Classification Scheme,					
Single Station Manned Workstations and Single Station Automated Cells. Assembly process and systems assembly line,					
line balancing methods.					
	Total (	Contact Hours	: 4	45	
Course Out	comes:				

00			
On	On completion of course students will be able to		
٠	Select suitable sensors for applications.		
٠	Integrate PLC for an automation system.		
٠	Design suitable drives and mechanisms for mechatronic applications.		
٠	Identify appropriate mechatronic system for an application.		
٠	Classify manufacturing systems.		

Text	Text Books:			
1.	Bolton W., -Mechatronics, Pearson Education, 6th Edition, 2015.			
2.	Frank Lamb, Industrial Automation: Hands On, McGraw-Hill Professional, 2013			

Refe	erence Books / Web links:
1	Groover and Zimmers, CAD/CAM; -Computer Aided Design and Manufacturing, Pearson Educationl, New
1.	Delhi, 2006.
2.	Davis G.Alciatore and Michael B.Histand, —Introduction to Mechatronics and Measurement systems, McGraw Hill Education, 2011.
3.	Nitaigour Premchand Mahalik, —Mechatronics Principles, Concepts and Applicationsl, McGraw Hill Education, 2015.
4.	Bradley D.A., Dawson D., Buru N.C. and Loader A.J., -Mechatronics, Chapman and Hall, 1993.
5.	Yoram Koren,-Computer Control of Manufacturing Systemsl, McGraw Hill Education; 1st edition, 2017.

9

MT19503	SYSTEM DYNAMICS AND CONTROL	PC	L	Т	Р	С
			3	0	0	3

Ob	Objectives:		
•	To introduce the elements of control system and their modeling using various Techniques.		
٠	To perform time domain analysis of control systems required for stability analysis.		
٠	To perform frequency domain analysis of control systems required for stability analysis.		
٠	To design the compensation technique that can be used to stabilize control systems.		
•	To introduce the state variable analysis method		

## UNIT-I CONTROL SYSTEM MODELING

Basic Elements of Control System – Open loop and Closed loop systems - Differential equation - Transfer function, Modeling of Electric systems, Translational and rotational mechanical systems – Modeling of Semi active suspension system, Reduction Techniques - Block diagram – Industrial Automatic Flow Process, Signal flow graph – Automatic telescope Control.

### UNIT-II TIME RESPONSE ANALYSIS

Time response analysis - First Order Systems - Impulse and Step Response - Analysis of second order systems - Steady state errors – P, PI, PD and PID Compensation, Analysis of Compensation in Mechatronics systems.

## UNIT-III FREQUENCY RESPONSE ANALYSIS

Frequency Response - Bode Plot, Polar Plot, Nyquist Plot - Frequency Domain specifications from the plots. Compensators - Lead, Lag, and Lead-Lag Compensators. Case Study: Frequency response Analysis in Robot Manipulator.

## UNIT-IV STABILITY ANALYSIS

Stability, Routh-Hurwitz Criterion, Root Locus Technique, Construction of Root Locus, Stability, Dominant Poles, Application of Root Locus Diagram - Nyquist Stability Criterion - Relative Stability. Case study: Stability Analysis of a Robot.

### UNIT-V STATE VARIABLE ANALYSIS

 $\begin{array}{l} \text{State space representation of Continuous Time systems - State equations - Transfer function from State Variable Representation - Solutions of the state equations - Concepts of Controllability and Observability - State space representation for Discrete time systems. Case Study: Controllability and Observability of an N - Link Robot.\\ \end{array}$ 

Total Contact Hours:45

Co	Course Outcomes:				
On	On completion of course students will be able to				
•	Write mathematical equations for model mechanical, electrical systems and can able to compute transfer function using block diagram and signal flow graph methods.				
٠	Analyse the 1st and 2nd order systems in time domain for Mechatronic Systems.				
•	Perform time domain and frequency domain analysis of control systems required for stability analysis in Robot Control.				
٠	Design the compensation technique that can be used to stabilize Robot control systems.				
•	Design controllability and observability for higher order systems.				

Text Books:

1	Nagrath J and M.Gopal, —Control System Engineeringl, New Age International Publishers, 6th Edition, 2017.
2	Levent Güvenç, Bilin Aksun Güvenç, Burak Demirel, Mümin Tolga Emirler, -Control of Mechatronic Systemsl,
	Institution of Engineering and Technology, 2017.

Ref	Reference Books / Web links:		
1	Benjamin.C.Kuo, -Automatic control systems, Prentice Hall of India, 9th Edition, 2014.		
2	Gopal M, -Control System - Principles and Designl, Tata McGraw Hill, 4nd Edition, 2012.		
3	Schaum's Outline Series, -Feed back and Control Systems Tata McGraw-Hill, 2007.		
4	Georg Pelz, -Mechatronic Systems Modeling and Simulation with HDLs, wiley Publication, 2003.		
5	Richard C. Dorf and Robert H. Bishop,Modern Control Systemsl, 13th Edition, Pearson Education Ltd, 2017.		

RO19511	ROBOTICS LABORATORY	PC	L	Т	Р	С
			0	0	3	1.5

_					
ſ	<b>Objectives:</b> The main learning objective of this course is to prepare the students				
ſ	•	To study the position of links.			
ſ	•	To study the transformation matrix usage.			
ſ	•	To study the robot application for pick and place.			
ſ	•	To understand Trajectory Control.			
Γ	٠	To calculate the joint torque of a robot.			

	List of Experiments						
1	Determination of maximum and minimum position of links.						
2	Verification of transformation (Position and orientation) with respect to gripper and world coordinate system						
3	Estimation of accuracy, repeatability and resolution.						
4	Robot programming and simulation for pick and place						
5	Robot programming and simulation for Colour identification						
6	Robot programming and simulation for Shape identification						
7	Robot programming and simulation for assembly process						
8	Trajectory Control Modeling with Inverse Kinematics						
9	Check for Environmental Collisions with Manipulators						
10	Robot programming for joint torque calculation.						
		Fotal Contact Hours	:	45			
Co	ourse Outcomes: On completion of the course, the student is expected to be able to						
•	Perform modeling of robot based on the link positions.						
•	Determine the orientation and position of robot.						
•	Develop pick and place application system.						
•	Integrate PLC and Robot.						
•	Determine the joint torques of a robot.						

RO19512	FLUID POWER SYSTEMS LABORATORY	PC	L	Т	Р	С		
			0	0	3	1.5		
Objectives: The	<b>Objectives:</b> The main learning objective of this course is to prepare the students							

•	To study the pneumatic simulation software.
•	To study the hydraulic simulation software.
•	To learn PLC programming for fluid power circuits.
•	To understand Pneumatic components and its functions in different pneumatic circuits.
•	To know the functions of electrohydraulic systems.

	List of Experiments						
1	Simulating Cylinder Sequencing hydraulic circuit						
2	Simulating Cylinder Reciprocating System using DCV's						
3	Simulating Cylinder synchronizing circuit.						
4	4 Simulating Speed control of Hydraulic Cylinder.						
5	5 Ladder PLC program using counters for alternate switching of two solenoid DCV						
6	Ladder PLC program using counters for controlling various LED s at different time sequences.						
7	Design and test two cylinders cascading in basic pneumatic trainer kit.						
8	Design and test two cylinders cascading in electro pneumatic trainer kit.						
9	Design and test two cylinders cascading in electro pneumatic trainer kit with P	LC					
10	Design and test two cylinders cascading in basic hydraulic trainer kit.						
		<b>Total Contact Hours</b>	:	45			
Co	urse Outcomes: On completion of the course, the student is expected to be able	to					
•	Perform simulation for various conditions.						
•	Determine the force calculation of hydraulic actuators.						
•	Design and Develop various fluid power circuits.						
•	Integrate PLC with hydraulic and pneumatic components.						
•	Design and test hydraulic trainer kit.						

(	GE 19521	SOFT SKILLS - II	EEC	L	Т	Р	С
				0	0	2	1
Ob	Objectives: This laboratory course enables students to						
•	Help students break out of shyness.						
•	Build confidence						
•	Enhance English communication skills						
٠	Encourage s	tudents' creative thinking to help them frame their own opinions,					

# Learning and Teaching Strategy:

The program is completely student centric where the focus is on activities led by students which include role plays, discussions, debates other games as well. These activities would be supplemented by interactive use of technology and brief Waeler inpuActivity Name Description Objective

brief <b>Wæiele</b> r	inpuActivity Name	Description	Objective	]
1	The News hour	Students are made to read news articles from the English newspapers. The students also have to find words and their meaning from the article they have not come across before and share it with the group. They then use these words in sentences of their own	The aim of this activity is not only to get the students to read the newspaper but also aims at enhancing the students' vocabulary.	
2	Court Case	The facilitator provides the participants the premise of a story and proceeds to convert the story into a court case. The students are required, department-wise to debate and provide their points to win the case for their clients.	The aim of the lesson is to encourage creative and out- of-the -box thinking to ensure a good debate and defense skills.	
3	The ultimate weekend	The students design activities they are going to do over the weekend and they have to invite their classmates to join in the activity. The students move around the class and talk to other students and invite them.	The aim of this activity is to develop the art of conversation among students. It also aims at practicing the grammatical structures of "going to" "have to" and asking questions.	
4	The Four Corners	This is a debate game that uses four corners of the classroom to get students moving. The following is written on the 4 corners of the room "Strongly Agree, Somewhat Agree, Somewhat Disagree and Strongly Disagree". The topics are then given to the class and students move to the corner that they feel best explains their opinions	This activity aims at getting students to come up with their own opinions and stand by it instead of being overshadowed by others and forcing themselves to change based on others opinions.	
5	Debate	Boarding school or day school? Which is more beneficial for a student?	The aim of this activity is to encourage students to draw up feasible points on the advantages and benefits of both. And enhance their debating ability	
6	Grand Master	The facilitator starts the session by keeping an individual in mind, upon which the students guess it only through "Yes or No" questions. Post	The aim of the lesson is designed to teach the art of questioning. It also helps to	
Curriculum a	and Syllabus   B.E. Robo	ticepportunity to do the same with the crowd.	speakinganotlistening	
7	Debate	Does violence on the TV and Video games influence children negatively?	skills. This activity aims at encouraging the students	

to

8	Turn Tables	This is a speaking activity where the students need to speak for and against the given topics when the facilitator shouts out 'Turn Table'.	debate on real life scenarios that most students spend a lot of time on. The aim of this activity is to make the participants become spontaneous and have good presence of
9	Debate	Do marks define the capabilities of a student?	This debate activity aims at allowing the students to argue on this worrisome adage of marks.
10	FictionAD	The Participants are asked to create an Ad for a challenging topic only using fictional characters.	The activity aims at developing their creativity and presentation skills.
11	Debate	Are social networking sites effective, or are they just a sophisticated means for stalking people?	This activity aims at refining the students debating skills on a very real life situation
12	Talent Hunt	Talent Hunt is a fun activity where the students are selected at random and supported to present any of their own skills.	The aim of this activity is designed to evoke their inner talents and break the shyness and the fear of participating in front of a crowd
	Feedback	At the end of the session in the final week (12) the trainer would provide feedback to the students on best practices for future benefits.	The aim is to do both give feedback to students as well as obtain feedback on the course from them.

Со	Course Outcomes: On completion of the course, the student will be able to:				
•	Be more confident				
•	Speak in front of a large audience without hesitation				
•	Think creatively				
•	Speak impromptu				
٠	Communicate in English				

RO19521 INTE		INTERNSHIP-II*	EEC	0 0	2 1			
Ob	jectives:							
	To enhance	the knowledge of the students in professional engineering practice sought	through industri	ial trainii	ng on			
	different current technologies.							
	To expose students to real work life situations and to equip them with abreast of new technology that intensify their job acumen.							
	$\Box$ To employ the students in industrial projects and strengthen the practical skills of the students.							
	To develop a	significant commitment in the students' profession and specialization.						
STR	ATEGY:							
The for the be ev	students indi ne specified d valuated throu	vidually undertake training in reputed Mechanical, Mechatronics and Autouration. At the end of the training, a report on the work done will be prepared ugha viva-voce examination by a team of internal staff.	mation engineeri and presented. T	ng comp he studen	anies its will			
Co	urse Outcon	les						
	On comple	tion of the course, the students will be able to						
	Apply prior	acquired knowledge in a real-life environment.						
	Integrate cla	ssroom theory with workplace practice.						
	Acquire knowledge from the industrial experts.							
	Work on a re	esearch project or undertake work experience under the guidance of indust	ry and academic	supervis	ion.			
	Extend the knowledge through research and development in the chosen fields of specialization.							
<u>∟</u> * Twe	L I I							

(* Two weeks at the end of Fourth Semester)

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### SEMESTER VI

RO19641	CAD/CAM	Category	L	Т	Р	С
	Theory course with Laboratory	PC	3	0	2	4

### **Objectives:**

0~	
•	To introduce the student to the basic tools of computer-aided design (CAD) and computer- aided manufacturing (CAM).
٠	To expose the student to geometric transformation methods.
٠	To expose the construction of solid models and usage of FEM.
٠	To expose the adequate knowledge in CNC System.
٠	To familiarize the student on CNC machine structures.

#### **INTRODUCTION TO CAD/CAM UNIT-I**

Fundamentals of CAD / CAM, product cycle and CAD/CAM, Basic components of CIM, Distributed communication system, Computer networks for manufacturing, Role of computer in CAD/CAM. Benefits of CAD/CAM. Concurrent Engineering, Design for Manufacturability.

#### **GEOMETRIC TRANSFORMATION** UNIT-II

Explicit and Implicit Equations, Intrinsic Equations, Parametric Equations, Coordinate Systems. Transformation: a point; Homogeneous coordinates; Representation of points; Transformation matrix; Transformation of General transformation -rotation, reflexion, translation, scaling and sharing; Combined transformation; Solid body transformation; Parallel projections - orthographic, axonometric and oblique; Perspective projections - single-point, twopoint, three-point and vanishing points.

### UNIT-III | SOLID MODELING AND CAD STANDARS

Geometric modeling - wire frame, Surface and Solid models - CSG and B-Rep techniques - Wire frame versus Solid modeling - Assembly Modeling, Standardization of graphics, Standards for computer graphics-Graphical Kernel System (GKS) -Open Graphics Library (OpenGL) -Data exchange standards -IGES, STEP, ACIS and DXF communication standards, Introduction to Finite Element Analysis.

#### **UNIT-IV** 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

UNIT-V STRUCTURE OF CNC MACHINE TOOL

CNC Machine building, structural details, configuration and design - Guide ways Friction - Anti friction and other types of guide ways - Elements used to convert the rotary motion to a linear motion Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller screw, rack and pinion -spindle assembly - torque transmission elements gears, timing belts, flexible couplings - Bearings.

Total C

ontact Hours	:	45

	List of Experiments					
1	Modelling of a part using any CAD package					
2	Modelling and assembling of the mechanical assembly using any CAD pack	age				
3	3 Structural analysis using FEA software – any analysis package					
4	4 Beam deflection analysis using FEA software – any analysis package					
5	Modelling and tool path simulation – turning using any CAM package					
6	6 Modelling and tool path simulation – milling using any CAM package					
7	NC code generation for milling using any CAM package					
8	NC code generation for turning using any CAM package					
		Contact Hours	:	30		
		<b>Total Contact Hours</b>	:	75		
Co	urse Outcomes:					
On	completion of course students will be able to					
٠	Explain the role of cad/cam and perform Solid modeling.					
٠	Explain the fundamentals of parametric curves, surfaces, Solid and their trans	sformations.				
٠	Perform finite element analysis on components modeled in CAD packages.					
٠	Write part programs for machining in NC & CNC Machines.					
٠	Select required components and assemble the CNC machines.					

Tex	Text Books:			
1	Groover.M.P, -Automation Production systems and Computer Integrated Manufacturing, Pearson Education - New			
	Delhi, 2016.			
2	Ibrahim Zeid, R Sivasubramanian CAD/CAM, -Theory and Practicel, Tata McGraw Hill Ed, 2009			
Reference Books / Web links:				
	David F. Rogers and Alan Adams, I.—Mathematical Elements for Computer Graphics, McGraw, Hill Education, New			

1	David F. Rogers and Alan Adams. J, —Mathematical Elements for Computer Graphics, McGraw - Hill Education, New York, 2017.
2	Rao, PN — CAD/CAM: Principles and Applications McGraw Hill Education; 3rd edition 2017
3	Paul G. Ranky, -Computer Integrated Manufacture, Prenticel - Hall International, UK,1986.
4	Radha Krishnan.P and Kothandaraman.C.P, —Comuter Graphics and Designl, Dhanpat Rai and sons, New Delhi, 1991.
5	William M. Newman, Robert F.Sproull, —Principles of Interactive Computer Graphicsl, McGraw-Hill International Book Company, second edition (reprint), 2010.

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RO19642	Machine Vision systems in Robotics	Category	L	Т	Р	C
	Theory course with Laboratory	PC	3	0	2	4

### Objectives:

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٠	To study the basics of the vision systems.
•	To expose the student on the algorithms used in vision systems.
•	To study the recognition technique for objects.
•	To understand the applications and software for vision systems.
•	To introduce the concept on the usage of Fuzzy Logic and Neural network.

#### UNIT-I VISION SYSTEMS

Basic Components - Elements of visual perception, Lenses: Pinhole cameras, Gaussian Optics - Cameras - Camera-Computer interfaces

#### VISION ALGORITHMS UNIT-II

Fundamental Data Structures: Images, Regions, Sub-pixel Precise Contours - Image Enhancement: Gray value transformations, image smoothing, Fourier Transform - Geometric Transformation - Image segmentation -Segmentation of contours, lines, circles and ellipses - Camera calibration - Stereo Reconstruction.

#### UNIT-III **OBJECT RECOGNITION**

Object recognition, Approaches to Object Recognition, Recognition by combination of views - objects with sharp edges, using two views only, using a single view, use of depth values.

#### UNIT-IV VISION TRACKING

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.

### INTRODUCTION TO FUZZY LOGIC AND NEURAL NETWORK UNIT-V

Fuzzy sets, Difference between fuzzy and crisp set, standard operations in fuzzy sets and relations, properties of fuzzy sets, Fuzzy logic controller (Mamdani and Sugeno approach), Biological Neuron, Artificial Neuron, A layer of neurons, multiple layer of neurons, Supervised and unsupervised neural network(NN), Training, Multi-Layer feed forward neural network: forward calculation, Training using Back-propagation algorithm. 45

**Total Contact Hours** 

List of Experiments Counting similar shaped objects from image. 1 Classifying similar objects from image. 2 3 Calculate included angles between Lines in Images Using Hough transform. 4 Detecting cells using Image Segmentation. 5 Texture Segmentation of an image using Filters. 6 Color-Based Segmentation Using K-Means Clustering. 7 Line follower robot control. Study of Navigation control of mobile robot using Neural Network algorithm. 8 9 Navigation control of mobile robot using Fuzzy logic algorithm. Implementing SLAM in Raspberry Pi mobile robot. 10 **Contact Hours** 30 : 75 **Total Contact Hours Course Outcomes:** On completion of course students will be able to Select the vision systems components. • Apply suitable algorithm to recognize objects. • Perform object recognition techniques for detecting the objects. • Design vision system for robot applications. • Implement soft computing techniques in vision systems.

Text Book (s):					
1.	Carsten Steger, Markus Ulrich, Christian Wiedemann, —Machine Vision Algorithms and Applicationsl, WILEY- VCH, Weinheim, 2008.				
2.	Damian m Lyons,-Cluster Computing for Robotics and Computer Vision, World Scientific, Singapore, 2011.				

Ref	Reference Books(s) / Web links:		
1.	Rafael C. Gonzalez and Richard E.woods, —Digital Image Processingl, Addition – Wesley Publishing Company, New Delhi, 2007.		
2.	Shimon Ullman, —High-Level Vision: Object recognition and Visual Cognitionl, A Bradford Book, USA, 2000		
3.	R.Patrick Goebel, — ROS by Example: A Do-It-Yourself Guide to Robot Operating System – Volume II, A Pi Robot Production, 2012.		
4.	Timothy J. Ross, -Fuzzy Logic with Engineering Applicationsl, McGraw Hill Inc, 2010		
5.	Dilip K Pratihar, —Soft Computing fundamentals and applications, Narosa publishing house, India, 2015.		

RO19601	MOBILE ROBOTS	PC	L	Т	Р	С
			3	0	0	3
<b>Objectives:</b>						
To introdu	ce the concept of mobile robots locomotion.					_
To underst	and the mobile robot kinematics and dynamics.					
To expose	the localization and mapping techniques.					
To know a	bout motion control.					
• To learn ac	lvanced mobile robots.					
				<u> </u>		
	NTRODUCTION TO MOBILE ROBOTS	61			9	
Introduction to	mobile robots and mobile manipulators. Principle of locomotion and types	of locomotion.	l ype	es o: robe	I ate	
INIT IL K	TNEMATICS AND DVNAMICS	s and water surfa		.000	<u>ns.</u>	
UNII-II K	INEMATICS AND DTNAMICS	haal madal diff		+ <b>l</b>	9	
configurations	holonomic and non-holonomic robots. Dynamics of mobile robot: Lagrand	a Fular and Nay	vtor	t WI v Eu	leei	
methods Comr	puter based dynamic (numerical) simulation of different wheeled mobile ro	ots	vion	I-LJU	nei	
	OCALIZATION AND MAPPING				9	
Magnetic and o	ptical position sensor, gyroscope, accelerometer, magnetic compass, incline	meter, tactile an	d pr	roxi	mit	v
sensors, ultraso	und rangefinder, laser scanner, infrared rangefinder, visual and motion set	sing systems. L	.oca	liza	tior	, i,
Map based loca	lization, Markov localization, Kalman filter localization Error propagation	model, Probabil	istic	c ma	ıp	<i>,</i>
based localizati	on, Autonomous map building, Simultaneous localization and mapping (SL	AM),			-	
UNIT-IV M	IOTION CONTROL				9	
Collisions free	path planning and sensor-based obstacle avoidance. Motion controlling me	thods, kinemati	c co	ntro	ol.	
dynamic contro	I and cascaded control.				,	
UNIT-V N	IODERN MOBILE ROBOTS				9	
Introduction Swarm robots cooperative and collaborative robots mobile manipulators autonomous mobile robo		ots.	-			
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, _,, _						
Total Contact Hours :				4	5	
Course Outcon	nes:					
On completion	of course students will be able to					
• Differentia	te different types of robots.					
Analyze th	e mobile robot kinematics and dynamics.					
Summarize	e the different types of localization approach.					
	••• •••					

- Design collisions free path planning.
- Summarize the different types of Swarm robots, Cooperative and Collaborative robots.

Text Books:

- • •			
1	Kelly, A — Mobile Robotics: Mathematics, Models, and Methodsl, Cambridge University Press, USA, 2013.		
2	Dudek, M Jenkin, Computational Principles of Mobile Robotics, Cambridge University Press, USA, 2010.		

Re	Reference Books / Web links:		
1	Siegwart, R Nourbakhsh, and Scaramuzza, -Introduction to Autonomous Mobile Robots, MIT Press, USA, 2011.		
2	Tzafestas,Introduction to Mobile Robot Control, Elsevierl, USA, 2014.		
3	Choset, Lynch, S. Hutchinson, G. Kantor, W. Burgard, L. E. Kavraki, and S. Thrun, -Principles of Robot Motion:		
	Theory, Algorithms, and Implementations  , MIT Press, 2005.		
4	Thrun, W Burgard, D Fox, Probabilistic Robotics, MIT Press, USA, 2005.		

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RO19602	<b>RESOURCE MANAGEMENT TECHNIQUES</b>	PE	L	Т	Р	C
			3	0	0	3

Ob	Objectives:		
٠	To expose the students to the concept of linear programming.		
•	To learn various network optimization models.		
•	To understand the various nonlinear optimization approaches.		
•	To model the project management as network model and analyze the critical path.		
•	To understand the nontraditional optimization techniques.		

#### UNIT-I LINEAR PROGRAMMING

Introduction to linear and non-linear programming formulation of different models. Geometry of linear programming, Graphical method, Linear programming (LP) in standard form, Solution of LP by simplex and revised simplex methods, Exceptional cases in LP, Duality theory, Dual Simple method, Sensitivity analysis. 9

#### UNIT-II **NETWORK ANALYSIS**

Transportation problem (with transshipment), Assignment problem, Traveling-Salesman Problem (TSP), Shortest route problem, Minimal Spanning Tree (MST), Maximum flow problem.

#### UNIT-III NON-LINEAR PROGRAMMING

Characteristics, Concepts of convexity, maxima and minima of functions of n-variables using Lagrange multipliers and Kuhn-Tuker conditions, One dimensional search methods, Fibonacci, golden section method and gradient methods for unconstrained problems

### UNIT-IV **PROJECT MANAGEMENT**

Introduction to PERT and CPM, critical Path calculation, float calculation and its importance. Cost reduction by Crashing of activity. 9

### UNIT-V NON TRADITIONAL OPTIMIZATION TECHNIQUES

Concept of Genetic algorithm (GA), Encoding, Fitness function, GA Operators-Crossover, Mutation, Simulated Annealing, Ant colony optimization. Application on optimal AGV shuttle movement.

**Total Contact Hours** 45 :

Co	Course Outcomes:			
On	On completion of the course, the students will be able to			
٠	Formulate and solve the linear model optimization problems.			
•	Calculate optimal solutions to networks and find best route for TSP and MST.			
•	Implement suitable non-linear programming techniques.			
٠	Control the projects and manage the resources.			
•	Apply Genetic algorithm, Simulated Annealing, Ant colony optimization for computationally expensive problems.			

Te	Text Books:		
1	Hillier and Libeberman, -Operations Research, McGraw-Hill Higher Education, New York, 2010.		
2	Kalyanmoy Deb, —Optimization for Engineering DesignAlgorithms and Examples, PHI Learning Private Limited, New Delhi,2012.		

Re	ference Books(s) / Web links:
1	Bazara M.J., Jarvis and Sherali H., -Linear Programming and Network Flowsl, John Wiley, 2009
2	Budnick F.S., -Principles of Operations Research for Managementl, McGraw-Hill Inc., US, 1998
3	Philip D.T. and Ravindran A., —Operations Research ^I , John Wiley, 2007
4	Shennoy G.V. and Srivastava U.K.,—Operation Research for Managementl, New Age International Publishers; India, 2018
5.	Singiresu S.Rao, —Engineering Optimization: Theory and Practicel, New Age International Publishers, India, 2013

R	019621	INTERNSHIP-III*	EEC	0 0	2 1	
Ob	jectives:					
	$_{\neg}$ To enhance the knowledge of the students in professional engineering practice sought through industrial training on					
	different cur	rent technologies.				
	To expose students to real work life situations and to equip them with abreast of new technology that intensify their job acumen.					
	To employ t	he students in industrial projects and strengthen the practical skills of the	e students.			
	To develop a	significant commitment in the students' profession and specialization.				
STR	ATEGY:					
The	students indi	vidually undertake training in reputed Mechanical, Mechatronics and Auto	mation engineerir	ng comp	anies	
for the	he specified of	luration. At the end of the training, a report on the work done will be prepared	and presented. The	students	s will	
be ev	valuated thro	ugh a viva-voce examination by a team of internal staff.				
Co	urse Outcon	nes				
	On comple	tion of the course, the students will be able to				
	Apply prior	acquired knowledge in a real-life environment.				
	Integrate cla	ssroom theory with workplace practice.				
	Acquire knowledge from the industrial experts.					
	Work on a re	esearch project or undertake work experience under the guidance of indust	ry and academic s	upervisi	on.	
	Extend the k	nowledge through research and development in the chosen fields of specia	alization.			
* Two	weeks at the	and of Fifth Semester)				

(* Two weeks at the end of Fifth Semester)

GE19621	PROBLEM SOLVING TECHNIQUES	EEC	L	Т	Р	С
			0	0	2	1

Ob	Objectives: This laboratory course enables students		
•	To improve the numerical ability		
•	To improve problem-solving skills.		
•	To utilize different tools and techniques		
•	To introduce different methodologies for problem solving process		
•	To know the significance of research methodologies for problem solving process		

	Topics covered			
1	Number system			
2	Reading comprehension			
3	Data arrangements and Blood relations			
4	Time and Work			
5	Sentence correction			
6	Coding & Decoding, Series, Analogy, Odd man out and Visual reasoning			
7	Percentages, Simple interest and Compound interest			
8	Sentence completion and Para-jumbles			
9	Profit and Loss, Partnerships and Averages			
10	Permutation, Combination and Probability			
11	Data interpretation and Data sufficiency			
12	Logarithms, Progressions, Geometry and Quadratic equations.			
13	Time, Speed and Distance			
		<b>Total Contact Hours</b>	:	30

Co	Course Outcomes: On completion of the course, the student will be able to:				
•	Recognize what problem solving actually is and why it's important to be good at it.				
•	Describe methods for researching and gathering data needed for problem solving.				
•	Utilize the process, tools and techniques available to determine the best solution to a problem.				
•	Know methodologies you may use when making tough decisions in the problem-solving process, and				
•	Identify your strengths and available resources for determining the most appropriate problem-solving process.				

Re	ference Books / Web links:	
1	S.G. Krantz, -Techniques of Problem Solving, Universities Press, 1997.	
2	Arthur Engel, -Problem-Solving Strategiesl, Springer New York, 2008.	
3	Arthur B. Vangundy, -Techniques of structured problem solvingl, Springer Netherlands, 1988.	
4	James M. Higgins, —101 Creative Problem-Solving Techniques - The Handbook of New Ideas for Businessl, New	
-	Management Publishing Company, 2006.	
5	L. Fernandez, H. Gooransarab, -Solutions Manual for Techniques of Problem Solving, Universities Press, 1997.	

## SEMESTER VII

RO19701	AI IN ROBOTICS	PC	L	Т	P	С
			3	0	0	3

### **Objectives:**

- To study the concepts of Artificial Intelligence. •
- To learn the methods of solving problems using Artificial Intelligence. •
- To introduce the concepts of Probabilistic reasoning and Speech recognition. •
- To understand about learning methods. •
- To understand the role of Artificial intelligence in Robotics •

#### INTRODUCTION UNIT-I

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.

#### **PLANNING UNIT-II**

Planning with forward and backward State space search - Partial order planning - Planning graphs- Planning with propositional logic – Planning and acting in real world.

### UNIT-III REASONING

Uncertainity - Probabilistic reasoning-Filtering and prediction-Hidden Markov models-Kalman filters- Dynamic Bayesian Networks, Speech recognition, making decisions.

### UNIT-IV LEARNING

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Forms of learning - Knowledge in learning - Statistical learning methods -reinforcement learning, communication, perceiving and acting, Probabilistic language processing, perception. Usage of learning algorithms in autonomous driving tasks.

#### **AI IN ROBOTICS** UNIT-V

Introduction to Genetic algorithm (GA) and Artificial Neural Network (ANN). Robotic assembly sequence planning and generation using AND/OR Graph and GA. Robotic perception, localization, mapping- configuring space, planning uncertain movements, Application of ANN in industrial and mobile robots.

**Total Contact Hours** 

:

45

## **Course Outcomes:** On completion of course students will be able to Identify problems that are amenable to solution by AI methods. Identify appropriate AI planning methods to solve a given problem. Implement basic AI algorithms for Speech recognition and making decisions. Develop learning algorithms for autonomous driving tasks. Apply appropriate AI methods to solve assembly problem.

Text Books:				
1	Stuart Russell, Peter Norvig, —Artificial Intelligence: A modern approchl, Pearson Education, India, 2009.			
2	Negnevitsky, M, -Artificial Intelligence: A guide to Intelligent Systemsl, Harlow: Addison-Wesley, 2002.			

1	Cambridge University Press, 2010
2	Raju Bahubalendruni and Bibhuthi Bhushan Biswal, Computer aided Optimal Robotic Assembly Sequence Generation, Lap Lambert Academic Publishing; 1st edition, 2017.
3	Tim Jones M, —Artificial Intelligence: A Systems Approachl, Jones & Bartlett Learning; 1st edition, 2008
4	Ian GoodFellow, Yoshua Bengio & Aaron Courville, Deep Learning, MIT Press, USA,2016.
5	Deepak Khemani, -A first course in Artificial Intelligencel, McGraw Hill, India, 2018.

RO19702	COMPUTER INTEGRATED MANUFACTURING	PC 1	ĹT	P	С
			3 0	0	3
		<u> </u>			
<b>Objectives:</b>					
To study t	he different types of production system.				
To learn the second secon	ne computer aided process planning.				
To introdu	ce the concepts Group Technology and Cellular Manufacturing.				
To unders	tand flexible manufacturing system.				
To know t	he database and CIM communication.				
UNIT-I I	NTRODUCTION			9	
Concepts of C	AD/CAM -CIM concepts and elements -Types of production -Manufacturin	ng Metrics and Ec	onor	nics	
-Production Pe	rformance Metrics – Manufacturing Cost - Simple problems – Basic Elements	of an Automated	i sys	tem	
-Advanced Au	tomation Functions -Levels of Automation –Lean Production and Just-In-T	Time Production.			
Introduction to	reverse engineering.				
UNIT-II I	RODUCTION AND COMPUTER AIDED PROCESS PLANNING			9	
Production pla	nning and Control System -Aggregate Production Planning and Master	Production Sched	lule	_	
Material Requi	rement Planning (MRP I) –Simple Problems –Capacity Planning –Shop Floor	Control –Invento	ry Co	ontro	1
-EOQ, WIP co	sts & Inventory Holding Costs -Simple Problems –Introduction to Manufac	turing Resource P	'lann	ing	
(MRP II) & F	Enterprise Resource Planning (ERP) -Process planning –Manual Process	Planning and ca	se st	udie	S
Computer Aide	ed Process Planning (CAPP)			<del></del>	
UNIT-III (	GROUP TECNOLOGY AND CELLULAR MANUFACTURING			9	
Group Techno	logy(GT) -Part Families –Parts Classification and coding –Simple Proble	ms in OPITZ Pa	rt C	odin	g
system – Produ	ction flow Analysis –Cellular Manufacturing –Composite part concept –M	achine cell desig	n and	1	
layout –Quanti	tative analysis in Cellular Manufacturing –Rank Order Clustering Metho	1 -Arranging Ma	chine	es in	1
a GT cell –Ho	ollier Method –Simple Problems Performance Metrics in Cell Operation –Simple	mple Problems.			
UNIT-IV F	LEXIBLE MANUFACTURING SYSTEM			9	
Types of FMS	& Flexibility –FMS Components –FMS Application & Benefits –FMS Plan	ning and Implem	entat	ion	
Issues –Quanti	tative analysis of Bottleneck Model on simple problems in FMS -Alterna	tive Approach in	ı Fle	xible	•
Manufacturing	-Automated Guided Vehicle System (AGVS) – Types of AGVS - Application	ons – Vehicle Guid	lance	3	
technologies -	Vehicle Management & Safety			<del></del>	
UNIT-V (	COMMUNICATIONS AND DATABASE MANAGEMENT			9	
Information, C	ommunications matrix, Computer communications, Network architecture, T	ools and techniqu	ies,		
Manufacturing	data, database technology, Database management, Management of CIM	-role, cost justifi	catio	n,	
expert systems		~		<del>.</del>	_
	Total	Contact Hours	:	4	5
Course Outco	mes:				

Or	On completion of course students will be able to		
٠	Identify the production systems.		
٠	Select optimal inventory ordering system.		
٠	Group part and machine families for Cellular Manufacturing System.		
٠	Implement flexible manufacturing system.		
•	Design proper database and CIM communication system.		

Te	Text Books:			
1	Mickel P Groover, —Automation production systems and computer integrated manufacturing, PHI, second edition, 2018.			
2	Kant Vajpayee S, —Principles of Computer-Integrated Manufacturing, PHI, 2015.			

1	Groover and Zimmers, CAD/CAM; —Computer Aided Design and Manufacturing, Pearson Education , New Delhi, 2006.
2	Paul G. Ranky, -Computer Integrated Manufacture, Prenticel - Hall International, UK,1986.

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3	Rao, PN — CAD/CAM: Principles and Applications McGraw Hill Education; 3rd edition 2017.
4	Ibrahim Zeid, R Sivasubramanian CAD/CAM, -Theory and Practicel, Tata McGraw Hill Ed, 2009.
5	Yoram Koren,-Computer Control of Manufacturing Systems, McGraw Hill Education; 1st edition, 2017.

RO19703	MATERIAL HANDLING SYSTEM	PC	L	Т	Р	С
			3	0	0	3

Ob	Objectives:	
٠	To introduce the concept of material handling.	
٠	To understand the design principles of belt and chain drives.	
٠	To expose the strength and wear considerations in gears.	
٠	To know the significance of friction in clutch and brakes.	
٠	To familiarize with lifting equipment.	

#### INTRODUCTION TO MATERIAL HANDLING **UNIT-I**

Overview of Material Handling: Principles of Material, unit load concept, Handling, classification of materials handling equipment- Basic Equipment Type and Classification of Handling Equipment

### **DESIGN OF FLEXIBLE ELEMENTS** UNIT-II

Motor power capacity for various applications -Design of Flat belts and pulleys -Selection of V belts and sheaves, Design of Transmission Chains and Sprocket.

#### SPUR AND HELICAL GEARS UNIT-III

Gear materials -Design of straight tooth spur & helical gears based on speed ratios, number of teeth, Fatigue strength, Factor of safety, strength and wear considerations. Force analysis -Tooth stresses -Dynamic effects -Helical gears -Module -normal and transverse, Equivalent number of teeth -forces. Design of Gear box.

#### UNIT-IV **CLUTCHES AND BRAKES**

Design of single and multi-plate clutches, cone clutches, internal expanding rim clutches and Electromagnetic clutches. Design of brakes: External shoe brakes -Single and Double Shoe, Internal expanding shoe brakes and Band Brakes. 9

#### UNIT-V LIFTING EQUIPMENTS

Hoist Components of Hoist -Load Handling attachments hooks, grabs and clamps, Principle operation of EOT, Gantry and jib cranes Hoisting Mechanisms, Travelling mechanisms, lifting mechanisms -Slewing Mechanisms -Elevators and lifts. Overload protection and drives in cranes, elevators and hoists. Case study in lifting equipment.

> **Total Contact Hours** 45 :

Co	Course Outcomes:		
On	completion of course students will be able to		
•	Differentiate different types of material handling system.		
٠	Design transmission systems using belt and chain drives.		
٠	Design gear drive systems.		
٠	Design and select clutches and brakes for the applications.		
٠	Summarize the different types of lifting equipment.		

**Text Books:** 

1 Bhandari V, --Design of Machine Elementsl, 15th Reprint, Tata McGraw-Hill Book Co, 2014 Siddhartha Ray, --Introduction To Materials Handlingl, New Age International (P) Ltd., India, 2017. 2

1	Bernard Hamrock, Steven Schmid, Bo Jacobson, —Fundamentals of Machine Elementsl,2nd Edition, Tata McGraw Hill, 2006
2	C.S.Sharma, KamleshPurohit, -Design of Machine Elements, Prentice Hall of India, Pvt. Ltd., 2003
3	Design Data Hand Book, PSG College of Technology, 2013-Coimbatore
4	Robert C. Juvinall and Kurt M. Marshek, -Fundamentals of Machine component Design ,5th Edition, Wiley, 2011.
5	Md. Jalaludeen, Machine Design, Volume II, Design of Transmission Systems, 4th edition, Anuradha Publications,
	2014

GE19304 FUNDAMENTALS OF MANAGEMENT FOR ENGINEERS		RS	HS	Ľ	Г	P	С	
					3 (	)	0	3
Objectives	:							
To exp	pose	the students to the basic concepts of management in order to aid in ur	nderstand	ling how an org	aniz	atio	on	
function	ons, a	and in understanding the complexity and wide variety of issues manage	ers face i	n today's busine	ss fi	rm	IS.	
UNIT-I	In	troduction To Management: Definition, Nature and Scope, Fur	nctions,	Managerial Ro	les,		9	
	Le	evels of Management, Managerial Skills, Challenges of Management	; Evoluti	on of managem	ent			
	th	ought. Organization: Types and environmental factors.						
			<b>D1</b> ·	<u> </u>		-	_	
UNIT-II	PI	anning And Decision Making: General Framework for Planning –	Planning	g Process, Type	of		9	
	PI	ans, Management by Objectives; Decision making and Problem	n Solvii	ng - Step	, 1N			
	PI	oblem Solving and Decision Making.						
					0			
Structures: Departmentalization, Delegation: Empowerment, Centralization, Decentralization				9				
Human Resource Management & Business Strategy: Talent Management and Strategic Human								
Resource Planning: Recruitment and Selection: Training and Development: Performance								
Appraisal.								
UNIT-IV	L	eading And Motivation: Leadership, Power and Authority, Leadersh	nip Styles	s, Leadership Sk	ills,		9	
	Le	eader as Mentor and Coach, Team Leadership. Motivation - Types of	of Motiv	ation; Relation	hip			
	be	tween Motivation, Performance and Engagement, Content Motiv	vational	Theories – Nee	ds			
	Hierarchy Theory, Two Factor Theory, Theory X and Theory Y.							
UNIT-V	C	ontrolling: Control, Types and Strategies for Control, Steps in Control	rol Proce	ess, Budgetary a	nd		9	
	N	on- Budgetary Controls. Characteristics of Effective Controls, Est	tablishin	g control system	ns.			
	Managing productivity- Cost control- Purchase control- Maintenance control- Quality control-							
	Planning operations. Managing globally- Strategies for International business.							
ļ			<b>T</b> ( 10					
			Total C	ontact Hours			45	3

Course Outcomes: After completing the course, the Learners should be able to:
Understand and apply the basic principles of management.
Understand and apply the planning, organizing and control processes.
Understand and design organization as well as manage and develop human resource.
• Understand various theories related to the development of leadership skills, motivation techniques and team work.
Understand and apply controlling practices in all applications.

Te	xt Book (s):		
1	Principles of Management, Prakash Chandra Tripathi, Tata McGraw-Hill Education, 2008.		
2	Fundamentals of Management, Stephen P. Robbins, Pearson Education, 2009.		
Re	Reference Books(s) / Web links:		
1	Essentials of Management, Koontz Kleihrich, Tata Mc – Graw Hill.		
2	Management Essentials, Andrew DuBrin, 9e, Cengage Learning, 2012.		

RO 19711	INNOVATION AND DESIGN THINKING FOR ROBOTICS AND AUTOMATION	EEC	L	Т	Р	С
			0	0	4	2

O	bjectives: This course enables students to
•	Has a special focus on skill development through active engagement in real world problems.

Design Thinking		
Introduction to Design Thinking - What Is Design Thinking? - The Good Kite Innovation - Challenges Best-Suited for Design Thinking - Visualization To	chen Story - Business Model ol	
Preparing Your Mind for Innovation		
The Physics of Innovation - The Story of George & Geoff - How Prepared Is	Your Mind? - Storytelling Tool	
Idea Generation		
The Idea Generation Process - The Me You Health Story Part I: What Is? - The What If? - Mind Mapping Tool	he Me You Health Story Part II:	
Experimentation		
The IBM Story - Learning Launch Tool - Strategic Opportunities – case studi Automation	es relevant to Robotics and	
	Total Contact Hours :	60

Co	Course Outcomes: On completion of the course, the student will be able to				
•	Appreciate various design process procedure.				
•	Generate and develop design ideas through different technique.				
•	Identify the significance of reverse engineering to understand products.				
•	Conceive, organize and lead successful projects in any robotics and automation discipline.				
•	Implement, and evaluate successful projects in any robotics and automation discipline.				

RO 19721	PROJECT WORK PHASE -1	EEC	L	Т	Р	С
			0	0	2	1

Objectives: This laboratory course enables students to

- 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

## **GUIDELINE FOR REVIEW AND EVALUATION**

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

Each batch is required to select any new component or an integrated robotics /automation/mechatronics system that involves various sub components which are to be designed in Project Work Phase - I

The project report shall carry a maximum of 30 marks. The project report shall be submitted as per the approved guidelines as given by Dean-Academics. Same mark shall be awarded to every student within the project group for the project report. The viva-voce examination shall carry 50 marks. Marks are awarded to each student of the project group based on the individual performance in the viva-voce examination

ſ				End semester Examinations							
Review I	Review II	Review III	Project Re Submission	Viva-Voce(50)							
				Internal	External	Super	visor	Internal	Exter	mal	
ľ	5	7.5	7.5	15	15	15		20	15		
							Total	Contact Ho	ours	:	

Co	Course Outcomes: On completion of the course, the student will be able to:					
•	Fabricate any components using appropriate manufacturing techniques.					
•	Use of design principles and develop conceptual and engineering design in robotics and automation field.					
•	Demonstrating the function of the fabricated model.					
•	Prepare the project as a technical report and deliver it in oral presentation.					
•	Show their team work and technical skills.					

## SEMESTER VIII

RO19811	PROJECT WORK PHASE -II	EEC	L	Т	Р	С
			0	0	14	7

### **Objectives:** This laboratory course enables students to

•

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

### **GUIDELINE FOR REVIEW AND EVALUATION**

The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

The system designed in Phase-I need to be fabricated/ implemented in Phase II of the project.

The project report shall carry a maximum of 30 marks. The project report shall be submitted as per the approved guidelines as given by Dean-Academics. Same mark shall be awarded to every student within the project group for the project report. The viva-voce examination shall carry 50 marks. Marks are awarded to each student of the project group based on the individual performance in the viva-voce examination

							Total Co	ntact Hours		:	24(	0
	5	7.5	7.5	15 15 15 20 15						í		
				Internal	External	Sı	ipervisor	Internal	Ех	terr	nal	
	Review I	Review II	Review III	Project Report Submission (30)			iva-Voce(50)	)				-
											٦	

Co	Course Outcomes: On completion of the course, the student will be able to:						
•	Fabricate any components using appropriate manufacturing techniques.						
•	Use of design principles and develop conceptual and engineering design in robotics and automation field.						
•	Demonstrating the function of the fabricated model.						
٠	Prepare the project as a technical report and deliver it in oral presentation.						
•	Show their team work and technical skills.						
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# **PROFESSIONAL ELECTIVES**

Subject Code	Subject Name (Theory course)	Category	L	Т	Р	С
ME19603	Total Quality Management	PC	3	0	0	3

Ob	Objectives:		
٠	To facilitate the understanding of basic quality management in engineering.		
•	To facilitate the understanding of various principles of TQM.		
٠	To be acquainted with management tools, six sigma and benchmarking.		
٠	To be acquainted with quality functions, TPM concepts & continuous improvement tools.		
٠	To learn various quality systems and TQM implementation in manufacturing and service sectors.		

### 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 - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

### UNIT-II TQM PRINCIPLES

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen, 8D methodology - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

# UNIT-III TQM TOOLS AND TECHNIQUES I

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

# 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, POKA-YOKE, JIT Concepts.

# 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.

Total Contact Hours:45

Course Outcomes: At the end of this course, students can have the		
٠	Ability to explain the importance of quality in engineering.	
٠	Ability to explain various principles in TQM.	
٠	Explore the knowledge of implementing various TQM tools.	
٠	Ability to create rapport among workers to form a quality team.	
٠	Ability to explain the benefits of implementing ISO-9000 & ISO-14000 in manufacturing and service sectors.	

### **Text Book:**

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

Re	Reference Books(s) / Web links:		
1	James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian		
	Edition, Cengage Learning, 2012.		
2	Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.		
3	Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd.,		
	2006.		
4.	ISO9001-2015 standards-A Complete Guide to Quality Management Systems by ItayAbuhav.		
5.	Poka - Yoke, "Improving Product Quality by Preventing Defects", Productivity Press, 2004.		

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Subject Code     Subject Name (Theory course)     Category     L     T     P		P C			
GE19P73	GE19P73 MARKETING MANAGEMENT PE 3 0 0		0 3		
<b>Objectives:</b>					
To underst	and the basics of marketing process.				
To analyze	, design and implement market segmentation.				
To underst	and the needs and application of marketing research.				
To underst	and marketing planning and strategy formulation.				
• To know a	bout sales promotion, advertising and distribution.				
<b>I</b>					
UNIT-I M	IARKETING PROCESS			9	9
Definition, Marketing process, dynamics, needs, wants and demands, marketing concepts, environment, mix, types.					
Philosophies, se	lling versus marketing, organizations, industrial versus consumer marketing, c	onsumer good	s, indu	Istri	al
goods, product	hierarchy, Services Marketing.				
UNIT-II B	UYING BEHAVIOR AND MARKET SEGMENTATION			Ģ	9
Customer Rela	tionship Marketing - Customer database, Data warehousing and mining	g. Attracting	and re	etair	ning
customers, Con	sumerism in India, Market segmentation and targeting, Positioning and differ	entiation strate	egies,	Pro	duct
life cycle strategies, New product development, Product Mix and Product line decisions, Branding and packaging,					
segmentation factors - demographic - psycho graphic and geographic segmentation, process, patterns. Product and brand					
management					

### UNIT-III PRODUCT PRICING AND MARKETING RESEARCH

Price setting - objectives, factors and methods, Price adapting policies, Initiating and responding to price changes. Introduction, uses and process of marketing research. 7

### MARKETING PLANNING AND STRATEGY FORMULATION UNIT-IV

The 4 Ps of marketing, Components of marketing plan-strategy formulations and the marketing process, implementations, portfolio analysis, BCG, GEC grids.

### SALES PROMOTION AND DISTRIBUTION **UNIT-V**

Characteristics, impact, goals, types of sales promotions - point of purchase - unique selling proposition. Identifying and analysing competitors, Designing competitive strategies for leaders, challengers, followers and nichers. Advertising, types, and case studies. Distribution - Characteristics, impact, goals, types and sales promotions - point of purchase unique selling proposition. Characteristics, wholesaling, retailing, channel design, logistics, and modern trends in retailing. 5

|--|

Course Outcomes: At the end of this course, students can have the		
•	Ability to understand the basics of marketing process.	
•	Ability to analyze, design and implement market segmentation	
•	Ability to understand the needs and application of marketing research.	
•		
•	Ability to understand marketing, planning and strategy formulation.	
•	Ability to implement sales promotion, advertising and distribution.	
•	Ability to understand marketing, planning and strategy formulation.         Ability to implement sales promotion, advertising and distribution.	

Text Books

1 Philip Kolter & Keller, —Marketing Managementl, 14th edition, Prentice Hall of India, 2012.		
2 Rajan Saxena, —Marketing Management - Tata McGraw Hill, 2002.		
Reference Books(s) / Web links:		
1 Adrain Palmer, —Introduction to marketing theory and practicel, Oxford University Press IE, 2004.		
2 Chandrasekar. K.S.,Marketing Management Text and Cases , 1st Edition, Tata McGraw Hill Vijaynicole, 201		
3 Ramasamy & Namakumari, —Marketing Managementl, Macmilan India, 2002.		
4 Ramphal and Gupta, —Case and Simulations in Marketingl, Golgatia, Delhi.		

Subject Code	Subject Name (Theory course)	Category	L	Т	P	C
GE19P72	Entrepreneurship Development	PE	3	0	0	3

Ob	Objectives:		
٠	To understand the types and characteristics of entrepreneurship and its role in economic development.		
٠	To understand the theories of motivation and the principles of entrepreneurship development programs.		
٠	To select the appropriate form of business ownership in setting up an enterprise.		
٠	To mobilize and manage initial and working capital for the enterprise.		
•	To identify sickness in industry, select the appropriate corrective measures and identify the growth strategies for		
	the enterprise.		

UNIT-I	ENTREPRENEUR AND ENTREPRENEURSHIP		9
Entrepreneurship – definition and characteristics - characteristics of entrepreneur - classification of entrepreneurs –			
Danhofi's c	elassification - other classifications - Functions of entrepreneurs - re-	ole of entrepreneurship in eco	nomic
developmen	nt and job creation - Emergence of entrepreneurial class in India - E	ntrepreneurship in ancient peri	iod -
Entrepreneu	urship in pre-Independence era - Entrepreneurship in post-Independen	ce period.	
UNIT-II	ENTREPRENEURIAL MOTIVATION		9
Theories of	entrepreneurship - sociological theories, economic theories, cultural	theories and psychological the	ories -
Entrepreneu	irial motivation: Theories of motivation - Entrepreneurial competence	ies – Entrepreneurship develo	pment
Programs –	need, objectives - Time management - Stress management.		
UNIT-III	BUSINESS		9
Small Enter	prises - Definition, characteristics, project identification and selection -	- Feasibility and profitability an	alysis
– Formulat	ion of project report- significance and content - Types of business	ownership structures- suitab	ility -
Expansion,	diversification, forward and backward integration.		
UNIT-IV	FINANCING AND PROFITABILITY		9
Financing:	Need, capital structure- Sources of finance - internal and external sou	rces of finance - break even a	nalysis
- Capital bu	udgeting - simple problems - Introduction to balance sheet and profi	t and loss statement – Importa	nce of
profitability	- sustainability - Working capital management: significance, assessn	nent, factors, sources, manager	nent.
UNIT-V	SUPPORT TO ENTREPRENEURS AND CASE STUDIES		9
Sickness in	small business: concept, signals, symptoms, magnitude, causes and co	onsequences, corrective measu	res –
Governmen	t policy for small scale enterprises – Growth strategies in small scale	enterprise – Institutional suppo	ort to
entrepreneu	entrepreneurs: need and support - Taxation benefits to small scale industry. Case studies in entrepreneurship.		
		Total Contact Hours	: 45

Co	<b>burse Outcomes:</b> At the end of this course, the student will be able to
•	Analyse the types, characteristics of entrepreneurship and its role in economic development.
٠	Apply the theories of motivation and the entrepreneurial competencies.
٠	Select the appropriate form of business ownership in setting up an enterprise.
٠	Mobilise and manage initial and working capital for the enterprise.
•	Identify sickness in industry, select the appropriate corrective measures and identify the growth strategies in enterprise.

Te	Text Books:		
1	Kurahko & Hodgetts, - Entrepreneurship - Theory, Process and Practices, 6th edition, Thomson learning, 2009.		
2	S.S. Khanka, -Entrepreneurial Development, S.Chand & Co. Ltd., New Delhi, 1999.		

Re	Reference Books(s) / Web links:		
1	Sangram Kesari Mohanti, —Fundamentals of Entrepreneurshipl, PHI Learning Private Ltd., Delhi, 2006.		
2	Charantimath, P. M., -Entrepreneurship Development and Small Business Enterprises, Pearson, 2006.		
3	Hisrich R D and Peters M P, —Entrepreneurshipl, 5th Edition, Tata McGraw-Hill, 2002.		
4	Mathew J Manimala, —Entrepreneurship theory at cross roads: paradigms and praxisl, 2nd edition, Dream Tech.,		
	2006.		
5.	Rabindra N. Kanungo, -Entrepreneurship and Innovationl, Sage Publications, New Delhi, 1998.		
6.	Singh, A. K., -Entrepreneurship Development and Managementl, University Science Press, 2009.		

Subject Code	Subject Name (Theory course)	Category	L	ſ F	<b>?</b> C
ME19P88	SUPPLY CHAIN AND LOGISTICS MANAGEMENT	PE	3 (	) ()	) 3
Objectives: Th	ne students can				
Describe t	he role and drivers of supply chain management in achieving competitiveness	8.			
Understan	d about Supply Chain Network Design.				
• Illustrate	he issues related to Logistics in Supply Chain.				
Appraise :	about Sourcing and Coordination in Supply Chain.				
• Understan	d the application of Information Technology and Emerging Concepts in Sup	ply Chain.			
UNIT-I I	NTRODUCTION TO SUPPLY CHAIN AND LOGISTICS MANAGEM	IENT		9	•
Supply Chain a	and Logistics Management: Scope and Importance - Evolution of Supply Cl	hain – Examples	of su	pply	/
Chains - Decis	sion Phases in Supply Chain - Competitive and Supply chain Strategies	<ul> <li>Drivers of Suj</li> </ul>	pply (	Chai	in
Performance a	nd Obstacles – Relationship of Logistics to Supply Chain Management.				
UNIT-II	SUPPLY CHAIN NETWORK DESIGN			9	)
Role of Distrib	ution in Supply Chain – Factors influencing Distribution network design – De	esign options for	Distri	outi	on
Network- Dist	ribution Network in Practice - Role of network Design in Supply Chair	ı – Framework	for ne	two:	ork
Decisions – In	spact of uncertainty on Network Design – Network design decisions – Netw	ork design decis	ions i	ising	g
Decision Trees					
UNIT-III I	LOGISTICS IN SUPPLY CHAIN			9	) 
Role of transpo	ortation in supply chain – Factors affecting transportations decision – Desig	n option for tran	sporta	tion	1
network – 1 all	ored transportation – Routing and scheduling in transportation -3PL- 4PL- C	Jobal Logistics	- Reve	rse	
Logistics: Rea	Solis, Activities and issues.				
UNIT-IV C	bouncing and countination in supply chain	Callaboration	Cou	<u> </u>	~
Role of Source	ng in supply chain - Supplier selection, assessment and contracts - Design	1 Collaboration -	- Sou	cing	g, in
and obstacles Building strategic partnerships and trust within a supply chain					
INIT-V     IT AND EMERGING CONCEPTS IN SUPPLY CHAIN     9					
The role IT in supply chain The supply chain IT from work Customer Delationship Management Internal Supply					
Chain Manage	Chain Management – Supplier Relationship Management – Future of IT in supply chain – F-Business in supply chain				
- Risks in Supr	- Risks in Supply Chain - Lean supply Chains - Sustainable supply Chains.				
	Tota	Contact Hours	:	(	45
				<u> </u>	

C	Course Outcomes: Upon completion of this course, students will acquire the		
	Ability to understand the scope of Supply Chain & Logistics Management and the drivers of Supply Chain		
•	performance.		
٠	Ability to design suitable Supply Chain network for a given situation.		
٠	Ability to analyze and solve the issues related to Logistics in SCM.		
٠	Ability to understand Sourcing, Coordination and current issues in SCM.		
٠	Ability to appraise about the applications of IT in SCM and apply SCM concepts in selected enterprises.		

# Text Books:

1	Sunil Chopra, Peter Meindl and D.V. Kalra, -Supply Chain Management: Strategy, Planning and Operation",
	Pearson Education, 2016.

Re	Reference Books(s) / Web links:			
1	Ravi Ravindran A, Donald P. Warsing, Jr, -Supply Chain Engineering: Models and Applications, CRC Press, 2012.			
2	Srinivasan G.S, -Quantitative models in Operations and Supply Chain Managementl, PHI, 2010.			
3	Janat Shah, -Supply Chain Management: Text and Casesl, Pearson Education India, 2016.			

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RO19P01	PROJECT MANAGEMENT	PE	L	Т	Р	С
			3	0	0	3

Ob	Objectives:	
•	To familiarize the tasks of planning and implementation of the projects.	
•	To teach the concepts of project monitoring and control.	
•	To impart knowledge on evaluation and selection of the most desirable projects.	
•	To provide knowledge on accounting the rate of return in the projects.	
٠	To learn the source of finance and capital Structure.	

### UNIT-I INTRODUCTION

Objectives of project management: Types of Projects: Project Management Life Cycle: Project Selection: Feasibility study: Estimation of Project Cost, Cost of Capital, Network analysis Techniques : PERT, CPM, Government regulations and statutory for various projects:

### PROJECT MONITORING AND CONTROL UNIT-II

Project representation: Role of project Managers, relevance with objective of organization, preliminary Manipulations, Basic Scheduling concepts: Resource Levelling, Resource Allocation, Setting a base line, Project management information system: Importance of contracts in projects: Team work in Project Management: Formation of Effective terms.

# UNIT-III PROJECT EVALUATION

Project Evaluation: Project auditing: Phase of project audit Project closure reports, computers, e-markets in Project Management:

### WORKING CAPITAL MANAGEMENT AND CAPITAL BUDGETING UNIT-IV

Current assets management: Estimation of working capital requirements: Capital budgeting: Capital budgeting methods: Present value method: Accounting rate of return methods.

### UNIT-V FINANCE AND ACCOUNTING

Source of finance: Term Loans: Capital Structure: Financial Institution Accounting Principles: Preparation and Interpretation of balance sheets, profit and loss statements, Fixed Assets, Current assets, Depreciation methods :Break even analysis: 45

**Total Contact Hours** :

### **Course Outcomes:**

On completion of the course, the students will be able to Analyze the current market trends and choose projects. • Control resource and allocate resources effectively. •

Undertake project auditing and prepare reports. •

- Maintain assets and calculate the asset's revenue. •
- Arrange various sources of finance and Prepare balance sheets. •

Te	Text Books:		
1	Arun Kanda, -Project Management A Life Cycle Approachl, Prentice Hall of India, 2011.		
2	Palanivelu VR, -Accounting for Managementl, Lexmi Publication (P) Ltd., 2007.		

Re	Reference Books(s) / Web links:		
1	Panneerselvam R and Senthilkumar P, -Project Managementl, Prentice Hall of India, 2009.		
2	Khanna R B, -Project Managementl, Prentice Hall of India, 2011.		
3	Bhattacharya. S.K. and John Deardon, —Accounting for Management –Text and cases, Vikas publishing House,		
	New Delhi, 1996.		
4	James, Van Horne, -Fundamental of Financial Management Pearson Education, 12th Edition, 2012		
5	Prasanna Chandra, -Financial Managementl, Tata McGraw-Hill,2008		

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RO19P02	LEADERSHIP AND ORGANIZATIONAL BEHAVIOUR	PE	L	Т	Р	С
			3	0	0	3

### **Objectives:**

- To learn about Organizational Structure.
- To familiarize with Motivation and Leadership skills.
- To understand the effects on work and individual behavior.
- To know about Group decision making techniques.
- To impart knowledge on Organizational culture and climate.

### UNIT-I INTRODUCTION

Organizational Behaviour- Meaning, Need and Importance – Organization and individuals – Organizational culture – Societal Culture and organizations. Organizational Structure – Importance of Structure – Learning – Learning styles and process.

# UNIT-II MOTIVATION AND LEADERSHIP

Motivation and Leadership – Need – Theories of Motivation – Importance of Motivation – Motivation, Morale and Productivity. Leadership – Styles of Leader – Effective leadership.

# UNIT-III INDIVIDUAL BEHAVIOUR

Personality – types – Factors influencing personality – Theories – Learning – Types of learners – The learning process – Learning theories – Organizational behaviour modification. Misbehavior – Types – Management Intervention. Emotions - Emotional Labour – Emotional Intelligence – Theories. Attitudes – Characteristics – Components – Formation – Measurement- Values. Perceptions – Importance – Factors influencing perception – Interpersonal perception- Impression Management. Motivation – importance – Types – Effects on work behavior.

### UNIT-IV GROUP BEHAVIOUR

Organization structure – Formation – Groups in organizations – Influence – Group dynamics – Emergence of informal leaders and working norms – Group decision making techniques – Team building - Interpersonal relations – Communication – Control.

### UNIT-V DYNAMICS OF ORGANIZATIONAL BEHAVIOUR

Organizational culture and climate – Factors affecting organizational climate – Importance. Job satisfaction – Determinants – Measurements – Influence on behavior. Organizational change – Importance – Stability Vs Change – Proactive Vs Reaction change – the change process – Resistance to change – Managing change. Stress – Work Stressors – Prevention and Management of stress – Balancing work and Life. Organizational development – Characteristics – objectives –. Organizational effectiveness.

Total Contact Hours:45

Co	Course Outcomes:		
On	On completion of the course, the students will be able to		
٠	Understand the importance of Organizational Behaviour.		
٠	Analyze Theories of Motivation and Styles of Leader.		
٠	Investigate the impact of emotional labor on workplace behavior.		
٠	Analyze the complexities associated with management of the group behavior in the organization.		
٠	Identify the Organizational effectiveness		

Te	Text Books:		
1	Robbins, S. P., & Judge, T. (2013). Organizational behavior (15th ed.). Boston: Pearson.		
2	Pareek. U. (2010). Understanding Organizational Behavior (2nd ed.). Oxford University Press		

Re	Reference Books(s) / Web links:		
1	Newstrom J. W., & Davis, K. (2011). Human behavior at work (12th ed.). Tata McGraw Hill		
2	Nelson, D, Quick, J.C., & Khandelwal, P., (2011). ORGB . Cengage Learning.		
3	Schermerhorn, J. R., Osborn, R.N., Hunt, M.U.J (2016). Organizational Behavior (12th ed.). Wiley		
4	Gupta C.B.(2018). A Textbook Of Organisational Behaviour, S Chand & Company, New Delhi.		
5	Prasad L.M.(2019). Organizational Behaviour, Sultan Chand & Sons, New Delhi.		

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RO19P03	ACCOUNTING AND FINANCE FOR ENGINEERS	PE	L	Т	P	C
			3	0	0	3

# **Objectives:**

- To understand the concepts in finance. • To learn about the systems of accounting. •
- •
- To familiarize on financial analysis. .
- To understand the financial planning options. •
- To impart knowledge on rate or return.

### INTRODUCTION **UNIT-I** Basic Accounting and concepts in finance, Book keeping: definitions, objectives, elements, journal and ledger. **UNIT-II** ACCOUNTING Accounting & Concepts in Finance I: definitions, objectives, characteristics, limitations, basic terms GAAP (Generally Accepted Accounting Principles), Accounting & Concepts in Finance II: Systems of accounting, cash book, bank book, depreciation, provisions, reserves, accounting equation, journal & ledger entries, trial balance, profit & loss account, balance sheet, cash flow statement)

# UNIT-III FINANCIAL ANALYSIS

Analysis of financial statements I: Financial leverage, financial ratios, Analysis of financial statements II: Significance and applications. 9

### UNIT-IV BUDGETING

Financial planning including capital budgeting I: Definition, financial planning options and objectives, time value of money. Financial planning including capital budgeting II: simple and compound interest, rule of 72, methods of capital budgeting - payback period

### FINANCIAL PLANNING **UNIT-V**

Financial planning including capital budgeting III: Accounting rate of return (ARR), net present value (NPV), internal rate of return (IRR) 45

**Total Contact Hours** :

Co	Course Outcomes:		
On	On completion of the course, the students will be able to		
٠	Classify different accounting methods.		
٠	Prepare balance sheet and cash flow statements.		
٠	Analyze the financial statements.		
٠	List out various financial planning options.		
٠	Determine the revenue generated by the assets.		

Te	Text Books:			
1	Chandra, Prasanna (2018). Financial management, Tata Mc Graw Hill, Delhi.			
2	Van Horne, J.C. and Wachowicz Jr. (2008) Fundamentals of Financial Management, Prentice-Hall, Delhi.			
Re	ference Books(s) / Web links:			
1	Block, Stanley B, Geoffrey A Hilt .(2016). Foundations of Financial Management, McGrawhill, India			
2	Khan M.Y, Jain P.K (2011). Financial Management, Tata McGraw Hill, New Delhi.			
3	Bhattacharya. S.K. and John Deardon, —Accounting for Management –Text and cases, Vikas publishing House,			
	New Delhi, 1996.			
4	Palanivelu VR, -Accounting for Managementl, Lexmi Publication (P) Ltd., 2007.			

5 Pandey I.M.(2016). Financial Management, Vikas Publishing House;11th edition,India

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RO19P04	STRATEGIC MANAGEMENT	PE	L	Т	Р	С
			3	0	0	3

# **Objectives:**

•	To learn the Concept of Corporate Stra	tegy and management.
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- To familiarize on environmental analysis. • .
- To know about Strategy Formulation and its Analysis. .
- To impart knowledge on Mergers and Acquisions in companies.
- To understand the Evaluation and Control strategies.

### INTRODUCTION **UNIT-I**

Introduction to Strategic Management, Concept of Corporate Strategy, Strategic Management Process, The 7-S Framework, Corporate Policy and Planning in India. Board of Directors - Role and Functions, Top Management - Role and Skills, Board Functioning - Indian Context.

### **ENVIRONMENTAL ANALYSIS** UNIT-II

Environmental Scanning, Industry Analysis, The synthesis of External Factors, External Factors Analysis Summary (EFAS), Internal Scanning, Value Chain Analysis, Synthesis of Internal Factors, Internal Factors Analysis Summary (IFAS) 9

### STRATEGY FORMULATION AND ANALYSIS UNIT-III

Strategy Formulation, Strategic Factors Analysis Summary (SFAS) Matrix, Business Strategy, Corporate Strategy, Functional Strategy, Strategic Choice.

### STRATEGY IMPLEMENTATION UNIT-IV

Strategy Implementation, Organization Structure, Corporate Culture, Diversification, Mergers and Acquisitions

### UNIT-V **EVALUATION AND CONTROL**

Evaluation and Control, Strategic Information Systems, Other Strategic Issues, Small and Medium Enterprises, Nonprofit Organizations 45

**Total Contact Hours** :

Course Outcomes:		
On completion of the course, the students will be able to		
Describe the Strategic Management Process.		
Perform the Environmental Scanning and Analysis.		
Implement the Business Strategy and Corporate Strategy.		
• Select the appropriate corporate strategy in diversification and mergers.		
• Control and evaluate the issues in Small and Medium Enterprises and Nonprofit Organizations.		

Te	Text Books:		
1	Srinivasan R.(2018). Strategic Management - The Indian Context, 3rd Edition, Prentice Hall of India.		
2	RobertA Pitts an David Lei (2016), Strategic Management, 4th Edition Cengage Learning, USA.		

# **Reference Books(s) / Web links:**

1	Srinivasan R.(2018). Case Studies in Marketing - The Indian Context, 4th Edition, Prentice Hall of India.
2	Wheelen Thomas L. (2018). Strategic Management and Business Policy, Pearson Education India.
3	Forest R. David, Fred R. David. (2015)Strategic Management: A Competitive Advantage Approach, Concepts &
	Cases, Pearson
4	Sinha Pradip Kumar. (2017). Strategic Management, Nirali Prakhashan, New Delhi.
5	Azhar Kazmi, Adela Kazmi.(2015) .Strategic Management, McGraw Hill Education, India

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Subject Code	WELDING TECHNOLOGY	Category	L	Т	Р	С
ME19P78		PE	3	0	0	3

# **Objectives:**

٠	To understand the principles, types, merits, demerits and applications of gas and arc welding processes.
٠	To understand the principles, types, merits, demerits and applications of resistance welding processes.
•	To understand the principles, types, merits, demerits and applications of solid state welding processes.
•	To understand different other welding processes for the automation in aerospace, nuclear and surface transport
	vehicles.
٠	To be familiar with the weldability of various materials and testing of weldments.

### UNIT-I GAS AND ARC WELDING PROCESSES

Fundamental principles – Oxy-acetylene welding, Types of Flames, Carbon arc welding, Shielded metal arc welding, Submerged arc welding, TIG & MIG welding, Plasma arc welding, CO₂ welding and Electro slag welding processes – Welding Defects - advantages, limitations and applications.

### UNIT-II RESISTANCE WELDING PROCESSES

Spot welding, Seam welding, Projection welding, Resistance Butt welding, Flash Butt welding, Percussion welding and High frequency resistance welding processes - advantages, limitations and applications.

# UNIT-III SOLID STATE WELDING PROCESSES

Cold welding, Diffusion bonding, Explosive welding, Ultrasonic welding, Friction welding, Forge welding, Roll welding and Hot pressure welding processes - advantages, limitations and applications.

### UNIT-IV OTHER WELDING PROCESSES

Thermit welding, Atomic hydrogen welding, Electron beam welding, Laser Beam welding, Friction stir welding, Under Water welding, Welding automation in aerospace, nuclear and surface transport vehicles.

# UNIT-V DESIGN OF WELD JOINTS, WELDABILITY AND TESTING OF WELDMENTS

Various weld joint designs – Weldability of Aluminium, Copper, and Stainless steels. Destructive - (Tensile, Bend, Impact, Nick break, Hardness, Etch tests) and Non Destructive testing of weldments - (Leak, Stethoscope, X-ray and  $\gamma$  ray radiography, Magnetic particle testing, Liquid (Dye) penetrate test, Fluorescent penetrate, Ultrasonic inspection and Eddy current testing). Welding safety, Virtual reality in welding.

Total Contact Hours :

# Course Outcomes: On successful completion of this course, the students will be able to Select appropriate type of gas and arc welding type for an application. Select appropriate type of resistance welding type for an application. Select appropriate type of solid-state welding type for an application. Explain about other advanced welding methods and its automation in industries.

• Identify and select various non-destructive testing of weldments.

# Text Books:

1	Parmer R.S., -Welding Engineering and Technologyl, 1st edition, Khanna Publishers, New Delhi, 2008.
3	Little R.L., —Welding and Welding Technologyl, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 34th reprint, 2008.

# Reference Books(s) / Web links: 1 Schwartz M.M. —Metals Joining Manuall. McGraw Hill Books, 1979.

1	Soliwald Mini. Meeting Manaan, Meeting Mini Books, 1977.
2	Tylecote R.F. — The Solid Phase Welding of Metalsl. Edward Arnold Publishers Ltd. London, 1968.
3	AWS- Welding Hand Book. 8th Edition. Vol- 2. —Welding ProcessI.
4	Nadkarni S.V Modern Arc Welding Technologyl, 1st edition, Oxford IBH Publishers, 2005.
5.	Christopher Davis Laser Welding- Practical Guidel. Jaico Publishing House, 1994.
6.	Davis A.C., -The Science and Practice of Welding, Cambridge University Press, Cambridge, 1993.
7.	P.N.Rao – —Manufacturing Technology – Tata McGraw Hill Publishing Company, 2003.
8.	S.K.Garg – Welding Technology - University Science press.

Subject Code	Subject Name (Theory course)	Category	L	Т	Р	С
ME19P67	INDUSTRIAL SAFETY	PE	3	0	0	3
		•				
Objectives:						
To und	erstand the Fundamental concept and Principle of Industrial Safety					
□ To app	ly the principle of Maintenance Engineering					
To Stu	dy about various types of wear and methods to reduce it.					
To know about various fault-finding methods of machine tools						
□ To und	erstand about preventive and periodic maintenance methods.					
UNIT-I	Industrial Safety				10	
Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe						
salient points of	of factories act 1948 for health and safety, wash rooms, drinking w	vater layouts, light,	clean	liness, f	ire, gua	rding,
pressure vessel	s, etc., Safety colour codes. Fire prevention and firefighting, equipme	ent and methods.				
UNIT-II	Physical and Chemical Hazards				11	
Noise, comper	isation aspects, noise exposure regulation, properties of sound, occupa	ational damage, risk	factor	rs, sound	l measur	ring
instruments. Prevention and control of noise. Recognition of chemical hazards-dust, fumes, mist, vapour, fog, gases, types,						
concentration,	Exposure vs. Dose, TLV - Methods of Evaluation, process or operatio	n description, Field	Surve	y, Samp	oling	
methodology, I	ndustrial Hygiene calculations, Comparison with OSHAS Standard.					
UNIT-III	ENVIRONMENTAL CONTROL				8	<del></del>
Industrial Heal	th Hazards – Environmental Control – Industrial Noise - Noise measur	ring instruments, Co	ontrol	of Noise	, Vibrat	ion,
- Personal Prote	ection.					
UNIT-IV	HAZARD ANALYSIS				8	
System Safety	Analysis – Techniques – Fault Tree Analysis (FTA), Failure Modes ar	nd Effects Analysis	(FME	A), HAZ	ZOP ana	ılysis
and Risk Asses	sment.					

UNIT -VSAFETY REGULATIONS8Explosions – Disaster management – catastrophe control, hazard control, Safety education and training - Factories Act, Safety<br/>regulations Product safety – case studies.8

Total contact Hours: 45

Ref	Reference Books(s) / Web links:		
1	Charles D. Reese, Occupational Health and Safety Management: A Practical Approach, CRC Press, 2003.		
2	L M Deshmukh, Industrial Safety Management, Tata McGraw-Hill Education, 2005.		
3	David L.Goetsch, —Occupational Safety and Health for Technologistsl, 5th Edition, Engineers and managers, Pearson Education Ltd., 2005.of Asia, Springer, 20175		
4	J Maiti, Pradip Kumar Ray, Industrial Safety Management: 21st Century Perspectives of Asia, Springer, 2017.		
5.	https://nptel.ac.in/courses/110/105/110105094/		

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Subject CodeSubject Name (Theory course)Category				L	Т	Р	С
N	AE19601	FINITE ELEMENT ANALYSIS	PC	3	0	0	3
Ob	Objectives: To introduce the students about the						
٠	Mathemati	cal formulation and solution for engineering problem.					
٠	Fundament	als of 1D Finite elements for structural analysis					
٠	Application	n of 1D finite element to Heat transfer and Vibration domain					
•	Fundament	als of 2D Finite elements for structural analysis.					

• Need for Isoparametric formulation and numerical integration.

### UNIT-I **INTRODUCTION**

Historical Background - Mathematical Modeling of field problems in Engineering -Governing Equations - Discrete and continuous models - Boundary, Initial and Eigen Value problems- Weighted Residual Methods - Variational Formulation of Boundary Value Problems - Ritz Technique - Basic concepts of the Finite Element Method. 9

### **ONE DIMENSIONAL ANALYSIS** UNIT-II

One Dimensional Second Order Equations - Discretization - Element types- Linear and Higher order Elements -Derivation of Shape functions and Stiffness matrices and force vectors-Assembly of Matrices - Solution of problems from solid mechanics. Fourth Order Beam Equation- Problems on it.

### UNIT-III APPLICATION OF ONE-DIMENSIONAL ELEMENT TO HEAT TRANSFER AND VIBRATION

Derivation of matrices and vector for heat transfer. Problems on Heat transfer. Natural frequencies of longitudinal vibration and mode shapes. Transverse Natural frequencies of beams.

### TWO-DIMENSIONAL ANALYSIS UNIT-III

Second Order 2D Equations involving Scalar Variable Functions - Variational formulation - Finite Element formulation - Triangular elements and Quadrilateral elements- Shape functions and element matrices and vectors. Application to Field Problems. Equations of elasticity - Plane stress, plane strain and axisymmetric problems - Constitutive matrices and Strain displacement matrices - Stiffness matrix - Stress calculations.

UNIT-IV ISOPARAMETRIC FORMULATION and NUMERICAL INTEGRATION 9 Natural co-ordinate systems - Isoparametric elements - Shape functions for isoparametric elements - One and two dimensions - Serendipity elements - Numerical integration - Introduction to non-linearity.

|--|

Co	Course Outcomes: On successful completion of the course, the student will be able to		
٠	Develop mathematical models for Boundary Value Problems and their numerical solution		
٠	Apply the concepts of Finite Element Analysis to solve one dimensional problem in structural analysis		
•	Apply the concepts of Finite Element Analysis to solve one dimensional problem in Heat transfer and Dynamics		
•	Apply the concepts of Finite Element Analysis to solve two dimensional problems in structural analysis		
٠	Apply the Isoparametric transformation and the use of numerical integration for various analysis		

Te	xt Books:
1	Rao, S.S., -The Finite Element Method in Engineering, 6th Edition, ButterworthHeinemann,2018.
2	Tirupathi R.Chandrupatla and Ashok D.Belegundu, —Introduction to Finite Elements in Engineeringl, International Edition, Pearson Education Limited, 2014.

Ref	Reference Books(s) / Web links:	
1	David Hutton, -Fundamentals of Finite Element Analysisl, Tata McGrawHill, 2017	
2	Reddy, J.N Introduction to the Finite Element Methodl, 4thEdition, Tata McGrawHill, 2018.	
3	Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, -Concepts and Applications of Finite	
	Element Analysis, 4th Edition, Wiley Student Edition, 2007.	
4	Seshu.P, -Text Book of Finite Element Analysisl, PHI Learning Pvt. Ltd., NewDelhi, 2013.	
6	https://nptel.ac.in/content/storage2/courses/112104116/ui/Course_mod_1.htm	

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Subject Code	Subject Name (Theory course)	Category	L	Т	Р	С
ME 19P64	INDUSTRY 4.0	PE	3	0	0	3

Ob	Objectives:		
•	To understand the basics, drivers and enablers of Industry 4.0		
٠	To learn about the smartness in smart manufacturing factories, smart devices, smart cities and smart services.		
٠	To learn about the different enabling technologies and its role in establishing Industry 4.0		
٠	To study different design principles of Industry 4.0		
٠	To understand the impact of industry 4.0 on different sectors and challenges in implementing 4.0.		

### UNIT-I Introduction to Industry 4.0

Introduction to Industry 4.0- The Various Industrial Revolutions, Digitalisation and the Networked Economy, Drivers, Enablers, Comparison of Industry 4.0 Factory and Today's Factory, Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation.

### UNIT-II Road to Industry 4.0

Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services, Big data, Value chains in Manufacturing companies, Smart factories, Smart Devices and Products, Smart Logistics, Smart Cities, smart services, Predictive Analytics, Case studies.

### UNIT-III Technologies for enabling Industry 4.0

Cyber Physical Systems, Robotic Automation and Collaborative Robots, Support System for Industry 4.0, Mobile Computing, Cyber Security, Augmented / Virtual reality, Artificial Intelligence, System integration, digital twin, 3D printing, Case studies.

# UNIT-IV Industry 4.0 Design principles

Introduction to Industry 4.0 design principles – Interoperability, Communication systems and standards for Industry 4.0, virtualization, Decentralization, Modularity, real time capability, information transparency – Foundation of Industry 4.0 - Could Manufacturing and the connected factories.

### UNIT-V Impact of Industry 4.0

Impact of Industry 4.0 on – service and business models, IT security, manufacturing, machine safety, product life cycle, socio economic factors, textile industries, healthcare industries, real estate industries, maritime industries, tourism industries - Compelling Forces and Challenges in implementing Industry 4.0. Case studies.

Total Contact Hours :

Course Outcomes: At the end of this course, students will have
 The basic knowledge on Industry 4.0, its drivers, enablers, and difference between Industry 4.0 factories with today's factory.
 An idea of IoT, IIoT, smart manufacturing factories, smart devices, smart cities and smart services.
 The basic understanding of different technologies enabling Industry 4.0 with some case studies.
 The awareness on different design principles could manufacture and connected factories.
 The ability to understand the impact of Industry 4.0 in different sectors including challenges in implementing Industry 4.0.

Te	xt Books:
1	Alasdair Gilchrist, -Industry 4.0: The Industrial Internet of Things, Apress, 2016.
2	Bruno S.Sergi, Elena G.popkova, et al. — Understanding Industry 4.0: AI, The internet of things, and the future of
	workl, 2019, Emerald publishing limited.

Re	Reference Books(s) / Web links:		
1	Kaushik kumar, DivyaZindani, J. Paulo Davim, — Digital manufacturing and assembly systems in Industry 4.0 ^{II} , CRC Press, Taylor and Francis group, 2020.		
2	Antonio sartal, Diego Carou, J.PauloDavim, — Enabling technologies for the successful deployment of Industry 4.0, CRC press, 2020.		
3	Alp Ustundag, Emrecavikcan, — Industry 4.0 : Managing the digital transformation , springer internation publishing , 2018.		
4	https://onlinecourses.nptel.ac.in/noc20_cs69/preview		
5	https://www.udemy.com/course/intro-to-industry-4/		

Subject Code	Subject Name (Theory course)	Category	LI	P	C
ME19P72	ADDITIVE MANUFACTURING	PE	3 0	0	3
<b>Objectives:</b>					
To familiar	ize the development of Additive Manufacturing, various business opportunitie	es and application	ons.		
To underst	and various software tools, techniques and file formats to create 3D mod	lels that helps	in pro	duc	t
developme	nt / prototyping requirements using AM.				
• To be fami	liar with Liquid and Solid based AM processes.				
• To be fami	liar with Powder and Wax based processes.				
To understa	and the use of Bio Additive manufacturing and 4D printing.				
UNIT-I IN	VTRODUCTION			9	
Need, Fundame	ntals of Additive and digital Manufacturing, Advantages and Applications,	Comparison of	Addit	ive	
Manufacturing	with traditional Manufacturing, Additive Manufacturing (AM) process chain	: 3D model, con	vertin	g in	to
STL file, transfe	r to system, checking, machine setup and building, Post process. Classification	of AM process.	Mate	rials	\$
used in Additiv	e Manufacturing Processes, Need for AM in product development and rapid	tooling.		-	
UNIT-II R	EVERSE ENGINEERING AND DESIGN FOR ADDITIVE MANUFAC	<b>FURING (DFA</b>	<b>M</b> )	9	
Introduction to	Reverse Engineering: Applications, Steps in reverse Engineering. Design for	or additive man	ıfactu	ring	<u>;</u> :
CAD model pre	paration, Part orientation and support generation and removal, Model slicing	and software's -	- Tool	pat	h
generation. File	formats in AM. Data Processing and Controllers.				
UNIT-III L	IQUID AND SOLID BASED ADDITIVE MANUFACTRING PROCESS	SES		9	
Guidelines for p	rocess selection, Liquid based AM process - Stereo lithography apparatus, Po	olyjet printing, I	)igital	Lig	ght
Processing - Pr	inciple, Process, Machine parameters, Process parameters, Materials use	d, Strength and	wea	kne	ss,
Applications, C	ase studies. Solid Based AM process - Fused Deposition Modeling (FDM), S	olid Ground Cu	ring (	SGG	_),
Laminated Obje	tet Manufacturing (LOM) - Principle, Process, Machine parameters, Process	parameters, Ma	terials	use	ed,
Strength and we	eakness, Applications, Case studies.				
UNIT-IV P	OWDER BASED AND OTHER ADDITIVE MANUFACTRING PROCI	ESSES		9	
Selective Laser	Sintering (SLS), Selective Laser Melting (SLM) and Electron Beam Melting	g (EBM), Laser	Engi	ieer	ed
Net Shaping (I	LENS): Principle, Process, Machine parameters, Process parameters, Ma	terials used, S	rengt	h ai	nd
weakness, Appl	ications, Case studies. Wax printing– Principle, Process, materials used and	applications.			
UNIT-V B	IO ADDITIVE MANUFACTURING AND 4D PRINTING	<u> </u>		9	
Bio-Additive N	lanufacturing, Computer Aided Tissue Engineering (CATE) – Processing	g Steps and Ca	se Stu	idie	S.
Customized Im	plants and Prostnesis, Materials used in bio printing and limitations. Design	and Production	of Me	dica	al
devices. Sustair	addity in AIVI processes – introduction to 4D printing and Smart materials i		<u> </u>	<u> </u>	45
	Total	ontact Hours	:	4	15

Co	urse Outcomes: At the end of this course, students can have the
•	Ability to explain the development of AM technology and how AM technology propagated into various businesses
	and developing opportunities.
٠	Ability to explain the process of transforming a concept / existing product into 3D model used in AM technology.
•	Ability to explain Liquid and Solid based AM processes.
•	
•	Ability to explain Powder and Wax based processes.
•	Ability to evaluate the advantages, limitations, applications and use of Bio Additive manufacturing and 4D printing.

 Text Books:

 1
 Andreas Gebhardt and Jan-Steffen Hötter — Additive Manufacturing: 3D Printing for Prototyping and Manufacturing, Hanser publications, United States, 2015.

 2
 Ian Gibson, David W. Rosen and Brent Stucker — Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 2nd edition, Springer., United States, 2015.

Ref	Reference Books(s) / Web links:		
1	Amit Bandyopadhyay and Susmita Bose, —Additive Manufacturingl, 1st Edition, CRC Press., United States, 2015.		
2	Andreas Gebhardt, —Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing, Hanser Gardner Publication, Cincinnati., Ohio, 2011		
3	Kamrani A.K. and Nasr E.A., -Rapid Prototyping: Theory and practicel, Springer., United States, 2006.		

4	Liou, L.W. and Liou, F.W., —Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press., United States, 2011.
5.	Milan Brandt, -Laser Additive Manufacturing: Materials, Design, Technologies, and Applications, Woodhead
	Publishing., United Kingdom, 2016.

MT 19303	FLUID MECHANICS AND THERMAL SCIENCES	PC	L	Т	Р	С
			3	1	0	4

# **Objectives:**

•	To introduce the basic concepts of fluid mechanics.
٠	To make students understand the working principle of different types of pumps and Hydraulic turbines.
•	To make students understand the basic laws of thermodynamics.
•	To introduce various mechanisms of heat transfer

UNIT-I	PROPERTIES OF FLUIDS AND FLUID STATICS		12		
Fluid - defin	Fluid - definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific				
weight, spec	cific volume, specific gravity, temperature, viscosity, compressibility,	vapor pressure, capillary and su	rface		
tension. Flu	id statics: Pascal law - Hydrostatic law - Pressure measurements using	g Manometers and pressure gaug	ges.		
UNIT-II	FLIUD KINEMATICS AND FLUID DYNAMICS		12		
Fluid Kinen	natics - Types of flow - velocity and acceleration - continuity equation. F	luid dynamics - equations of mot	ion		
- Euler's eq	uation along streamline - Bernoulli's equation - Applications - Ver	turi meter, Orifice meter, Pitot	tube.		
Hagen Poise	euille Equation - Darcy Weisbach equation - Friction factor – Major ar	d minor energy losses - Flow the	rough		
pipes in seri	es and in parallel. Basics of dimensional analysis.				
UNIT-III	HYDRAULIC MACHINES		12		
Introduction	and classification of hydraulic machines. Reciprocating pump: const	ructional details, working princi	iple,		
co-efficient	of discharge, slip, power required. Centrifugal pump: classification ar	d working principle, specific sp	eed.		
Turbines: cl	assification, working principle of a Pelton wheel turbine.				
UNIT-IV	LAWS OF THERMODYNAMICS		12		
Thermodyn	amic system and surroundings – properties of system – STATE AND	EQUILIBRIUM - Forms of en	ergy –		
Quasi static	$process-Zeroth\ law\ of\ thermodynamics-Work\ and\ heat\ transfer-$	Path and point functions – First	law of		
thermodyna	mics applied to open systems - SFEE equation and its applications. Se	econd law of thermodynamics a	pplied		
to Heat eng	to Heat engines, Refrigerators& Heat pumps. Carnot's theorem and Clausius inequality – Concept of entropy applied to				
reversible a	reversible and irreversible processes – Third law of thermodynamics.				
UNIT-V	HEAT TRANSFER MECHANISMS		12		
Heat transfe	Heat transfer mechanisms: Conduction - Fourier's Law, thermal resistance. Convection - Newton's law of cooling.				
Radiation –	Radiation – Wien's law, Kirchhoff's law, Stefan-Boltzmann law. Heat exchangers – LMTD – NTU – Fins.				
		Total Contact Hours :	60		

Co	ourse Outcomes: After the successful completion of the course, the student will be able to:
•	Describe the properties of fluids and its importance in selection of fluid for suitable application
•	Identify the major and minor losses involved in the fluid flow through pipes
•	Differentiate the types of hydraulic machines and describe the working principle.
•	Apply the basic laws of thermodynamics for different applications.
٠	Distinguish various modes of heat transfer and determine the heat transfer rate.

<ol> <li>White FM., —Fluid Mechanicsl, 7th Edition, Tata McGraw-Hill, New Delhi, 2011</li> <li>Rajput R.K., —Heat and Mass transferl, S.Chand and Co Publishing, 2008</li> </ol>	
2 Rajput R.K., —Heat and Mass transferl, S.Chand and Co Publishing, 2008	
3 Modi PN., Seth SM., —Hydraulics and fluid mechanics including hydraulic machinesl, 20thedition publishers, 2015	tion, Standard

Re	ference Books(s) / Web links:
1	Cengel YA., Cimbala J M., —Fluid Mechanics – Fundamentals and applicationsl, 2nd Edition, McGraw Hill higher education, 2010
2	Bansal RK., —Fluid Mechanics and Hydraulics Machinesl, 9th edition, Laxmi publications (P) Ltd., New Delhi, 2011.
3	Holman, J.P,   Heat Transfer , 3rd Edition, McGraw-Hill, 2007.
4	Ramamirtham S., -Fluid Mechanics and Hydraulics and Fluid Machinesl, Dhanpat Rai and Sons, Delhi, 2006
5	Nag P.K., -Engineering thermodynamicsl, Tata McGraw hill, 2005.

Subject Code	Subject Name (Theory course)		Category	L	Т	Р	С
ME19P76	Process Planning and Cost Estimation	n	PE	3	0	0	3
Objectives:							
To create	a process plan for a given Product.						
To underst	and the purpose, functions and procedure for Estimating.						
To determ	ine cost elements, overheads and depreciation for a given P	roduct.					
To estimat	e cost for the casting, forging and welding processes.						
To calcula	te the machining times and costs for various machining pro	cesses.					
·							
UNIT-I	INTRODUCTION TO PROCESS PLANNING					10	1
Outlining to pro	cess planning - Drawing interpretation –Material selection	process and metho	ds, Selection	of Pro	du	ctio	n
Processes – st	andardization, simplification –Break even analysis –Fac	ctors to be conside	ered in select	ing:	Pro	ces	s
Sequencing; O	peration Sequencing; Process parameters Equipment &	Tool Selection; I	l'ool Material	eval	uat	ion	-
Selection of jig	s and fixtures – Computer Aided Process Planning – Mani	ial, Retrieval CAPF	and Generati	ve C	AP	P -	
Case Study in I	Process Planning.					_	
UNIT-II	FUNDAMENTAL OF ESTIMATING				_	7	
Concept and Pu	rpose of Estimating, Functions of Estimating department, C	Costing versus Estim	nating, Types of	of Est	1ma	ites	,
Importance of	Estimates, Estimating Procedure, Case Study in Estimating	g.				10	
	FUNDAMENTAL OF COSTING	<u> </u>	C I I I		1.1	10	
Aims, Function	is and Importance of costing–methods of costing-elements	of cost estimation –	Cost Estimato	ors an	d tr	leir	
Qualifications,	Principal Constituents in a Cost Estimate – Allocation of	Cost Elements –Ma	iterial Cost, La	abour	· Co	ost,	
Expenses and C	COST DESTINATION OF CASTING FOR CINC & N	t and Methods to Ca	alculate the De	preci	anc	$\frac{n}{n}$	
	COST ESTIMATION OF CASTING, FORGING & W	ELDING COSIS				9	
Estimation of C	ost for various production processes - Estimation of Forg	ing Shop– Losses in	n forging –Foi	rging	co	st,	
Estimation of V	verding Shop-Electric werding cost – Gas werding cost,	Estimation of Foun	idry Shop– Pa	ttern	cos	st -	
Casting cost.	ECTIMATION OF MACHINING TIME AND COSTS	1				0	
	ESTIMATION OF MACHINING TIME AND COSTS		<b>F</b> ' <b>C</b> .1. 1.4	· (		9	
Estimation of	Machining Time - Importance of Machining Time Calcul	ation- Machining	i ime Calculat	$a \mathbf{P}$	or	the	
Milling and Gr	inding	Cost for Lattle oper	auons, Dimm	і <u></u> , вс	лШ	g,	
	inding.	Total Cont	act Hours		•	4	5

**Total Contact Hours** 

: 45

Co	urse Outcomes: At the end of this course, students can have the
٠	Dexterity to make a standard and detailed process plan for a given product.
٠	Capability to differentiate estimation and costing.
٠	Capacity to allocate cost elements, distribute over heads and calculate depreciation for a given Product.
•	Agility to estimate cost for various production processes like casting, forging and welding processes for a given product.
٠	Ability to calculate the machining times and costs for various conventional machining processes.

# Text Books:

1 Adithen M. Dresses Diaming and Cast Estimation. New Asy International Dublishers 2007			
Adunan, M, —Process Planning and Cost Estimationi, New Age International Publishers, 2007.			
2 Peter Scallan, -Process Planning, The Design/Manufacture Interfacel, Butterworth Heinemann, 2003.			

Re	Reference Books(s) / Web links:		
1	Chitale A. K., and Gupta R. C., -Product Design and manufacturing, Prentice Hall of India, New Delhi, 1997.		
2	Gideon Halevi, -Process and operation planningl, Kluwer academic publishers (Printed ebook), 2003.		
3	Narang G.B.S. & Kumar. V, -Production and Costingl, Khanna Publishers, 2000.		
4	Phillip F. Ostwald & Jairo Munoz, —Manufacturing Processes and Systems ^{II} , 9th Edition, Wiley student edition, 2002.		
5.	Robert Creese, Adithan M. & Pabla B. S., —Estimating and Costing for the Metal Manufacturing Industries, Marcel Dekker, 1992.		

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Subject Code	Subject Name (Theory course)	Category	L	Т	Р	С
ME19P86	RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS	PE	3	0	0	3

Obj	jectives:
•	To inculcate the importance of research methodology.
•	To understand how to undergo the literature review and write a technical paper.
•	To inculcate the importance of Intellectual Property Rights and aware of the rights for the protection of the invention.
•	To understand the patent rights and recent developments in IPR.
•	To understand the industrial design and geographical indication procedures to get patents, copy right, trademarks and designs.

### UNIT-I **FUNDAMENTALS OF RESEARCH**

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations, analysis of qualitative and mixed-methods research.

### **REVIEW OF LITERATURE AND TECHNICAL WRITING** UNIT-II

Effective literature studies approach, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal.

### UNIT-III INTELLECTUAL PROPERTY RIGHTS

Nature of Intellectual Property: Patents, Designs, Trade and Copyright, copyright registration in India Process of Patenting and Development: technological research, innovation, patenting and development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under Patent Cooperation Treaty.

### **UNIT-IV** PATENT RIGHTS AND RECENT DEVELOPMENTS IN IPR

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies. 0

UNIT-V INDUSTRIAL DESIGNS AND GEOGRAPHICAL INDICATIONS

Industrial designs and IC Layout design, Registrations of designs, conditions and procedures of industrial designs Cancellation of Registration, International convention of design-types and functions. Semiconductor Integrated circuits and layout design Act- Geographical indications-potential benefits of Geographical Indications. 45

**Total Contact Hours** :

Co	urse Outcomes: At the end of this course, students can have the
٠	Ability to Apply knowledge on research problem formulation and analyze research related information.
•	Ability to write the literature review and technical paper.
•	Ability to apply IPR concept to important place in growth of individuals & nation.
٠	Ability to Apply patent right to new products developed.
٠	Ability to describe the procedure and the tools to get patent copy right for their innovative work.

Te	Text Books:			
1	Neeraj Pandey and Khushdeep Dharni, -Intellectual Property Rights, First edition, PHI learning Pvt. Ltd., Delhi, 2014.			
2	Uma Sekaran and Roger Bougie, —Research methods for Businessl, 5th Edition, Wiley India, New Delhi, 2012.			

Re	Reference Books(s) / Web links:			
1	Stuart Melville and Wayne Goddard, —Research Methodology: An Introduction For Science & Engineering Students, 2nd edition, Juta Academic, 2001.			
2	Ramakrishna B & Anilkumar H S, —Fundamentals of Intellectual Property Rightsl, 1st edition, Notion Press, 2017.			
3	William G Zikmund, Barry J Babin, Jon C.Carr, Atanu Adhikari, Mitch Griffin, —Business Research methods: A South Asian Perspective, 8th Edition, Cengage Learning, New Delhi, 2012.			

Subject (	Code	Subject Name (Theory course)	Category	L T P	С	
<b>ME19P8</b>	2	DESIGN OF JIGS, FIXTURES AND PRESS TOOLS	PE	3 0 0	3	
Objectives:						
1 Tou	ndersta	and the principles of locating and clamping in Jigs and fixtures and various co	mponents relat	ed to Press	tools	
2 To k	To know about DesigningvarioustypesofJigsforgivencomponentsanddrawmultipleviewsofthesamewith dimensions and					
² parts	s List.					
3 Tok	now th	e design of various type of Fixtures for given components and draw multiple	views of the sa	me with		
dime	ensions	and parts List.				
4 Tou	ndersta	and the various parts of cutting dies and draw the standard dimensioned views				
5 Tou	ndersta	and the Designing of various parts of forming dies and draw the standard dime	ensioned views			
UNITI	PRI	NCIPLES OFJIGS, FIXTURESAND PRESSWORKING			9	
Objectives and importance of tool design—work holding devices- Basic elements of jigs and fixtures-location-clamping- indexing-operationalchart-FitsandTolerancesToolsforpressworking- 					ong- ogies– teria l ct – lparts– n - oke. <u>9</u> post	
UNITIII	DES	SIGN OF FIXTURES			9	
Design an	nd dev	elopment of fixtures for a given component-General principles of milling,	Lathe, boring	, broaching	g and	
grinding	fixture	s-Assembly, Inspection and Welding fixtures-Modular fixturing systems- Q	uick change fiz	ctures.		
UNITIV	D	ESIGNOF CUTTINGDIES			9	
Complete	e desig	n and preparation of standard views of simple blanking, piercing, compour	nd and progres	ssive dies -	fine	
Blanking	dies.					
UNITV	D	ESIGNOF BENDING, FORMING, DRAWING ANDMISCELLANEOUS	SDIES		9	
Differenc	ebetwe	enbendingforminganddrawing-Blankdevelopmentforaboveoperations-Types	of Ben	ding dies	-Press	
capacity-	Spring	back-Variables affecting Metal flow indrawing operations-draw die insert	ts-draw beads-	ironing-De	esign	
and devel	lopmer	at of bending, forming, drawing, reverse redrawing and combination dies - I	Blank develop	ment for		
axisymm	etric, r	ectangular and elliptic parts–Single and double action dies		-		
			Total No. o	of Periods	45	

Co	Course Outcomes: On completion of this course, the students will be able to		
1	Able to apply the principles of locating and clamping in Jigs and fixtures and various components related to Press tools.		
2	Able to design various types of Jigs for given components and draw multiple views of the same with dimensions and parts list.		
3	Able to Design various types of Fixtures forgiven components and draw multiple views of the same with dimensions and parts List.		
4	Able to design the various part of cutting dies and draw the standard dimensioned views.		
5	Able to design the various parts of forming dies and draw the standard dimensioned views.		
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 Text Books:

 1
 Joshi, P.H. —Jigs and Fixturesl, Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi,2010.

 2
 Joshi P.H— Press tools-Design and Constructionl, S.Chand&CoLtd.2001.

Ref	Reference Books(s) / Web links:		
1	ASTM–Fundamentals of tool designl, Prentice Hall of India, 1984.		
2	Donaldson, Lecain and Goold, -Tool Design ^I , Tata McGrawHill,2000.		
3	Hoffman —Jigs and Fixture Designl-Thomson Delmar Learning, Singapore,2004.		
4	K.Venkataraman, —Design of Jigs Fixtures&PressToolsl,AnnePublications,2015		
5.	https://nptel.ac.in/courses/112/105/112105127/		

St	ıbject Code	Subject Name (Theory course)	Category	L T P C		
R	019P13	ELECTRONICS MANUFACTURING TECHNOLOGY	PE	3 0 0 3		
0	Objectives:					
٠	To understand wafer preparation and PCB fabrication					
٠	To know the	types of Mounting Technologies and components for electronics assembly				
٠	To appreciat	e SMT process in detail.				
٠	To know var	ious Defects, Inspection Equipment's SMT assembly process.				
٠	To learn repa	ir, rework and quality aspects of Electronics assemblies.				
U	NITI INT	RODUCTION TO ELECTRONICS MANUFACTURING		9		
Hi cle ma	History, definition, wafer preparation by growing, machining, and polishing, diffusion, microlithography, etching and cleaning, Printed circuit boards, types- single sided, double sided, multi-layer and flexible printed circuit board, design, materials, manufacturing, inspection.					
U	NITII CO	MPONENTS AND PACKAGING		9		
lea lea Ul	Introduction to packaging, types-Through hole technology(THT) and Surface mount technology(SMT), Through hole components – axial, radial, multi leaded, odd form. Surface- mount components- active, passive. Interconnections – chip to lead interconnection, die bonding, wire bonding, TAB, flip chip, chip on board, multi-chip module, direct chip array module, leaded, leadless, area array and embedded packaging, miniaturization and trends.					
In	troduction to t	he SMT Process SMT equipment and material handling systems handling o	of components	and assemblies -		
moisture sensitivity and ESD, safety and precautions needed, IPC and other standards, stencil printing process – solder paste material, storage and handling, stencils and squeegees, process parameters, quality control. Component placement- equipment type, flexibility, accuracy of placement, throughput, packaging of components for automated assembly, Cp and Cpk and process control. soldering- reflow process, process parameters, profile generation and control, solder joint metallurgy, adhesive, underfill and encapsulation process – applications, materials, storage and handling, process and parameters						
Ū	NITIV IN	SPECTION AND TESTING		9		
Inspection techniques, equipment and principle - AOI, X-ray. Defects and Corrective action - stencil printing process, component placement process, reflow soldering process, underfill and encapsulation process, electrical testing of PCB assemblies- In circuit test, functional testing, fixtures and jigs.						
U	NITV Q	UALITY AND RELIABILITY OF ELECTRONICS ASSEMBLIES		9		
Re fu	epair tools, me ndamentals, re d environmen	ethods, rework criteria and process, thermo-mechanical effects and thermal reliability testing, failure analysis, design for manufacturability, assembly, rew t.	nanagement, H orkability, tes	Reliability ting, reliability,		
				f Dorioda   45		

Co	Course Outcomes: On completion of this course, the students will be able to		
1	Discuss about wafer preparation.		
2	Implement different packaging methods.		
3	Develop and control process in manufacturing.		
4	Inspect and perform testing in electronics components.		
5	Rectify mistakes in assembly methods.		

Te	Text Books:		
1	Ray Prasad, —Surface Mount Technology: Principles and Practicel, Second Edition, Chapman and Hall ,1997, New York, ISBN 0-41-12921-3		
2	Rao. R .Tummala, -Fundamentals of Microsystem Packagingl, McGraw Hill, 2001, ISBN 00-71-37169-9		

Ref	Reference Books(s) / Web links:		
1	Puligandla Viswanadham and Pratap Singh, —Failure Modes and Mechanisms in Electronic Packagesl, Chapman and Hall, New York, N.Y. ISBN 0-412-105591-8		
2	Paul Totta and Karl Puttlitz, and Kathleen Stalter, —Area Array Interconnection Handbookl, Kluwer Academic Publishers, Norwell, MA, USA, 2001. ISBN 0-7923 7919-5.		
3	Ning-Cheng Lee, —Reflow Soldering Process and Trouble Shooting SMT,BGA, CSP and Flip Chip Technologies ,Elsevier Science, ISBN 0-7506-7218-8.		

4	Phil Zarrow, —Surface Mount Technology Terms and Concepts, Elsevier Science and Technology, 1997. ISBN 0750698756
5.	C.A.Harper, —Electronic Packaging and Interconnection Handbookl, Second Edition, McGraw Hill Inc., New York, N.Y., 1997, ISBN 0-07-026694-8

RO19P05	HUMANOID ROBOTICS	PE	L	Т	P	C
			3	0	0	3

Ob	Objectives:		
٠	To know the basic knowledge about Humanoid robots.		
٠	To impart knowledge in kinematics of humanoids.		
٠	To learn about the dynamics in humanoid robots.		
٠	To understand the basic in biped walking.		
٠	To know about the different walking patterns.		

UNIT-I	INTRODUCTION		9			
Historical de	Historical development of Humanoids, Human Likeness of a Humanoid Robot, Trade-Offs in Humanoid Robot Design,					
Human-Frie	ndly Humanoid Robot Design, characteristics of humanoid robots.		•			
UNIT-II	KINEMATICS		9			
Kinematic s	tructure, forward and inverse kinematic problems, differential kinema	tics, Twist, Spatial Velocity, an	ıd			
Spatial Tran	sform, Inverse Differential Kinematic Relations. Differential kinemat	ics at singular configurations.				
UNIT-III	ZMP AND DYNAMICS		9			
ZMP Overv	iew,2D Analysis,3D Analysis, Measurement of ZMP, General Discus	sion- ZMP of Each Foot, ZMP	for			
Both Feet Co	ontact, Dynamics of Humanoid Robots, Humanoid Robot Motion and G	round Reaction Force, Moment	um,			
Angular Mo	mentum, Angular Momentum and Inertia Tensor of Rigid Body, Calc	ulation of Robot's Center of Ma	iss,			
Link Speed	and Angular Velocity, Calculation of Robot's Momentum and Angula	ar Momentum.				
UNIT-IV	BIPED WALKING		9			
Two Dimen	sional Walking Pattern Generation, Two Dimensional Inverted Pen-	dulum, Behavior of Linear Inv	erted			
Pendulum, (	Drbital Energy, Support Leg Exchange, Planning a Simple Biped Ga	ait, Extension to a Walk on Ur	leven			
Terrain.						
UNIT-V	WALKING PATTERN GENERATION		9			
ZMP Based Walking Pattern Generation, Cart-Table Model, Off-Line Walking Pattern Generation, Stabilizer, Principles						
of Stabilizin	g Control, Stabilizing Control of Honda Humanoid Robot, Advanced	Stabilizers.				
		Total Contact Hours :	45			

Course Outcomes:	
On completion of the course, the students will be able to	
• Describe about the evolution of Humanoid robots.	
• Expose the basic knowledge in kinematics of humanoids.	
Calculate the Humanoid Robot Motion and Ground Reaction Force.	
• Identify Two Dimensional Walking pattern on different terrain.	
Summarize the Walking Pattern models.	

Tey	Text Books:		
1	Dragomir N. Nenchev, Atsushi Konno, HUMANOID ROBOTS Modeling and Control, Butterworth-		
	Heinemann, Tokyo, 2018		
2	Shuuji K, Hirohisa H,Kensuke H, Kazuhito ,Introduction to Humanoid Robotics, Springer, London,2013.		

Reference Books(s) / Web links:		
1	A. Goswami, P. Vadakkepat (Eds.), Humanoid Robotics: A Reference, Springer, Netherlands, Dordrecht, 2018.	
2	] K. Harada, E. Yoshida, K. Yokoi (Eds.), Motion Planning for Humanoid Robots, Springer London, London, 2010.	

RO19P06	WIRELESS SENSORS NETWORKS FOR ROBOTICS	PE	L	Т	Р	С
			3	0	0	3

### **Objectives:**

٠	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.

### UNIT-I **OVERVIEW OF WIRELESS SENSOR NETWORKS** 0 Challenges for Wireless Sensor Networks, Enabling Technologies For Wireless Sensor Networks. ARCHITECTURES UNIT-II 9 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. UNIT-III NETWORKING SENSORS 9 Physical Layer and Transceiver 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. **UNIT-IV** INFRASTRUCTURE ESTABLISHMENT 9 Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control. SENSOR NETWORK PLATFORMS AND TOOLS **UNIT-V** 9 Sensor Node Hardware - Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming. **Total Contact Hours** : 45

Co	Course Outcomes:	
On	On completion of the course, the students will be able to	
٠	Know about the different techniques used in networking.	
٠	Expose basic knowledge about wireless sensor networks.	
٠	Know about the tools in networking.	
٠	Understand the basic in wireless architecture.	
٠	Know about the protocols used in networking.	

Te	Text Books:		
1	Holger Karl & Andreas Willig. Protocols And Architectures for Wireless Sensor Networks, John Wiley, 2015.		
2	Swami Ananthram .Wireless Sensor Networks, Wiley India Pvt. Ltd, New Delhi, 2014.		

# Reference Books(s) / Web links:

1	KazemSohraby, Daniel Minoli, &TaiebZnati, —Wireless Sensor Networks-Technology, Protocols, And Applications ^{II} , John Wiley, 2007.
2	Anna Hac — Wireless Sensor Network Designsl John Wiley 2003

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RO19P07	FIELD AND SERVICE ROBOTICS	PE	L	Т	Р	C
			3	0	0	3

Objectives:	
•	To study the various parts of robots and fields of robotics.
•	To learn the concept of localization.
•	To familiarize the concept on planning and navigation.
•	To understand the different field robots.
•	To study about the humanoid robots.

### 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.

### LOCALIZATION UNIT-II

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.

### PLANNING AND NAVIGATION UNIT-III

Introduction-Path planning, Road map path planning, Cell decomposition path planning, Potential field path planning-Obstacle avoidance-Case studies: tiered robot architectures.

### **UNIT-IV FIELD ROBOTS**

Ariel robots-Collision avoidance-Robots for agriculture, mining, exploration, underwater, civilian and military applications, nuclear applications, Space applications.

### **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. 45

**Total Contact Hours** :

Co	Course Outcomes:	
On	On completion of the course, the students will be able to	
٠	Explain the basic concepts of working of robot.	
٠	Analyze the challenges in the localization of robot.	
٠	Implement the required path planning methods.	
٠	Describe the role of robots in civilian, military and other applications.	
٠	Describe on motion capture/learning techniques for humanoid robots.	

Te	Text Books:	
1	Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, —Introduction to Autonomous Mobile Robotsl, Bradford Company Scituate, USA, 2004	
2	Zaier, -The future of Humanoid Robots-Research and applications, Intech Publications, 2012	

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

MT19P83	PROGRAMMING FOR ROBOT OPERATING SYSTEM	PC	L T	P C
			3 0	0 3
<b>Objectives:</b>				
To be fami	liar with robot operating system programming			
UNIT-I U	BUNTU LINUX FOR ROBOTICS			10
GNU/Linux – In	nstalling Ubuntu - Installing VirtualBox - Playing with the Ubuntu – U	seful Ubuntu	Applic	ations
- Shell Comma	nds.			
UNIT-II C	++ FOR ROBOTICS PROGRAMMING			9
Started with C	C++ C/C++ in Ubuntu Linux – Learning OOP Concepts – Building a C++ Pr	oject.		
UNIT-III P	YTHON FOR ROBOTICS PROGRAMMING			9
Python - Timeli	ine: The Python Language – Python in Ubuntu Linux – Introduction to Python	hon Interprete	er – Inst	alling
Python on Ubu	ntu 16.04 LTS – Verifying Python Installation - Writing First Code	- Understand	ling Py	thon
Basics				
UNIT-IV K	ICK-STARTING ROBOT PROGRAMMING USING ROS			9
Robot Progra	mming - The ROS Equation - Robot Programming Before and	After ROS In	nstalling	3
ROS - Robots	and Sensors Supporting ROS – Popular ROS Computing Platforms – RO	S Architectur	e and	
Concepts				
UNIT-V P	ROGRAMMING WITH ROS			8
Programming	Using ROS – Creating a ROS Workspace and Package - Using ROS Clie	ent Libraries -	-	
Programming E	mbedded Boards			
	Total (	Contact Hour	s :	45

Co	urse Outcomes:
On completion of course students will be able to	
•	Work with Ubuntu and Linux operating systems
•	Use C++ for programming Robot Operating System
٠	Use Python for programming Robot Operating System
٠	Program ROS Libraries.
•	Create ROS workspace and package

# **Text Books:**

1.	Lentin Joseph, —Robot Operating System (ROS) for Absolute Beginners: Robotics Programming Made Easyl,
	Apress, 2018.

# Reference Books / Web links:

-	
1.	Aaron Martinez, Enrique Fernández, -Learning ROS for Robotics Programming, Packt Publishing Ltd, 2013.
2.	Anis Koubaa, -Robot Operating System (ROS): The Complete Referencel, Volume 3, Springer, 2018.
3.	Morgan Quigley, —Programming Robots With Ros:: A Practical Introduction To The Robot Operating Systeml,
	Shroff Publishers & Distributors Pvt Ltd, 2016

RO19P08	FARM AUTOMATION	PE	L	Т	P	C
			3	0	0	3

Ob	Objectives:		
•	To learn about Farming related Machines.		
•	To understand the global position and information system in machines.		
•	To know about traction and testing.		
•	To familiarize the concept on weed management.		
•	To learn about machinery selection.		

UNIT-I	INTRODUCTION		9	
History of M Harvesting,	History of Mechanized Agriculture - Farming Operations and Related Machines - Tillage, Planting Cultivation, and Harvesting, Agricultural Automation - Agricultural Vehicle Robot.			
UNIT-II	PRECISION AGRICULTURE		9	
Sensors – ty Carrier-pha Application	Sensors – types and agricultural applications, Global Positioning System (GPS) - GPS for civilian use, Differential GPS, Carrier-phase GPS, Real-time kinematic GPS, Military GPS, Geographic Information System, Variable Rate Applications and Controller Area Networks.			
UNIT-III	UNIT-III TRACTION, AND TESTING 9			
Hitching-P Traction mo	Hitching- Principles of hitching, Types of hitches, Hitching and weight transfer, Control of hitches, Tires and Traction- Traction models, Traction predictor spreadsheet, Soil Compaction, Traction Aids, Tractor Testing.			
UNIT-IV	SOIL TILLAGE AND WEED MANAGEMENT		9	
Tillage Methods and Equipment, Mechanics of Tillage Tools, Performance of Tillage Implements, Hitching of Tillage Implements, Weed Management - Conventional Cropping Systems, Tools, Crop Rotation, Mechanical Cultivation.				
Implements	Weed Management - Conventional Cropping Systems, Tools, Crop	Rotation, Mechanical Cultivation	n.	
Implements UNIT-V	Weed Management - Conventional Cropping Systems, Tools, Crop MACHINERY SELECTION	Rotation, Mechanical Cultivation	n. 9	
Implements UNIT-V Screw Conv Selection -	Weed Management - Conventional Cropping Systems, Tools, Crop MACHINERY SELECTION eyors, Pneumatic Conveyors, Bucket Elevators, Forage Blowers and M field Capacity and Efficiency, Draft and Power Requirements, Machi	Rotation, Mechanical Cultivation iscellaneous Conveyors, Machin nery Costs.	n. 9 ery	

Co	Course Outcomes:		
On	On completion of the course, the students will be able to		
٠	Design robot for agriculture purposes.		
٠	Integrate sensor and system for a required agricultural applications.		
٠	Develop suitable testing and tracking devices.		
٠	Implement suitable Weed Management system.		
٠	Develop and select suitable machinery for specific tasks.		
•	Implement suitable Weed Management system. Develop and select suitable machinery for specific tasks.		

Te	Text Books:		
1	Ajit K. Srivastava, Carroll E. Goering, Roger P. Rohrbach, Dennis R. Buckmaster, "Engineering Principles of Agricultural Machines", ASAE Publication, 2006.		
2	Myer Kutz, "Handbook of Farm, Dairy and Food Machinery Engineering", Academic Press, 2013		
Re	ference Books(s) / Web links:		
1	Qin Zhang, Francis J. Pierce, "Agricultural Automation Fundamentals and Practices", CRC Press, 2013.		
2	StephenL. Young, Francis J.Pierce, "Automation: The Future of Weed Control in Cropping Systems", Springer, Dordrecht Heidelberg New York London, 2014.		
3	R.A.Kepner, Roy Bainer, E.L.Barger, "Principles of Farm Machinery", 3rd Edition, CBS Publishers, New Delhi, 2017.		

4	Guangnan Chen.	"Advances in Agricultur	al Machinery and	Technologies", 1st E	Edition, CRC Press, 2018.
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RO19P09	TOTALLY INTEGRATED AUTOMATION	PE	L	Т	Р	С
			3	0	0	3

-			
Ob	Objectives:		
•	To gain knowledge on 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		

### TOTALLY INTEGRATED AUTOMATION UNIT-I

Need, components of TIA systems, advantages, Programmable Automation Controllers (PAC), Vertical Integration structure.

### **UNIT-II** HMI SYSTEMS

Necessity and Role in Industrial Automation, Need for HMI systems. Types of HMI- Text display - operator panels -Touch panels - Panel PCs - Integrated displays (PLC & HMI). Check with PLC 502 and remove

### UNIT-III SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA)

Overview – Developer and runtime packages – architecture – Tools – Tag – Internal & External graphics, Alarm logging - Tag logging - structured tags- Trends - history- Report generation, VB & C Scripts for SCADA application. UNIT-IV COMMUNICATION PROTOCOLS of SCADA 9 Proprietary and open Protocols - OLE/OPC - DDE - Server/Client Configuration - Messaging - Recipe - User administration - Interfacing of SCADA with PLC, drive, and other field device DISTRIBUTED CONTROL SYSTEMS (DCS) UNIT-V 9 DCS - architecture - local control unit- programming language - communication facilities - operator interface -

engineering interfaces. APPLICATIONS OF PLC & DCS: Case studies of Machine automation, Process automation, Introduction to SCADA Comparison between SCADA and DCS. 45

**Total Contact Hours** :

**Course Outcomes:** On completion of the course, the students will be able to Implement PLC & PAC in an automation system. • Develop HMI systems and integrate it with other systems. • Develop SCADA system and generate reports. • Acquire information's on communication protocols in automation systems. . Design and develop automatic control system using distributed control systems. •

Text Books:			
1	John.W.Webb & Ronald A. Reis, —Programmable logic controllers: Principles and Applications, Prentice Hall India, 2003.		
2	Michael P. Lukas, -Distributed Control systems, -Van Nostrand Reinfold Company 1995 .		

Re	Reference Books(s) / Web links:		
1	Win C C Software Manual, Siemens, 2003		
2	RS VIEW 32 Software Manual, Allen Bradly, 2005		
3	CIMPLICITY SCADA Packages Manual, Fanuc India Ltd, 2004		

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KO19P10	
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# **ROBOTICS: ADVANCED CONCEPTS AND ANALYSISPE**

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( )h	IOCTIVOC!
<b>\</b> ///	ICULIVES.

•	To understand th	e basics of	parallel man	ipulators.

• To learn about the dynamics of serial and parallel manipulators.

- To learn the modeling of flexible robots.
- To familiarize with wheeled mobile robots.
- To teach the concepts of Non-linear dynamics and chaos in robot.

### UNIT-I VELOCITY AND STATIC ANALYSIS OF ROBOT MANIPULATORS

Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Loss and gain of degree of freedom, Statics of serial and parallel manipulators, Statics and force transformation matrix of a GoughStewart platform, Singularity analysis and statics

# UNIT-II DYNAMICS OF SERIAL AND PARALLEL MANIPULATORS

Mass and inertia of links, Lagrangian formulation for equations of motion for serial and parallel manipulators, Generation of symbolic equations of motion using a computer, Simulation (direct and inverse) of dynamic equations of motion, Examples of a planar 2R and four-bar mechanism, Recursive dynamics,

### UNIT-III MODELING AND CONTROL OF FLEXIBLE ROBOTS

Models of flexible links and joints, Kinematic modeling of multilink flexible robots, Dynamics and control of flexible link manipulators, Numerical simulations results, Experiments with a planar two-link flexible manipulator.

# UNIT-IV MODELING AND ANALYSIS OF WHEELED MOBILE ROBOTS

Introduction and some well-known wheeled mobile robots (WMR), two and three-wheeled WMR on flat surfaces, Slip and its modeling, WMR on uneven terrain, Design of slip-free motion on uneven terrain, Kinematics, dynamics and static stability of a three-wheeled WMR's on uneven terrain, Simulations

### UNIT-V PARALLEL MANIPULATOR

Introduction to chaos, Non-linear dynamics and chaos in robot equations, Simulations of planar 2 DOF manipulators, Analytical criterion for unforced motion. Gough Stewart platform and its singularities, use of near singularity for fine motion for sensing, design of Gough-Stewart platform based sensors

Total Contact Hours:45

Co	urse Outcomes:		
On	On completion of course students will be able to		
٠	Explain the about various manipulators.		
٠	Perform dynamic analysis on serial and parallel manipulators.		
٠	Develop and control flexible robots.		
٠	Design and control wheeled mobile robots.		
٠	Perform simulation of various manipulators.		

# Text Books:

102			
1	Ghosal, A., Robotics: Fundamental Concepts and Analysis, Oxford University Press, 2nd reprint, 2008.		
2	Fu,K., Gonzalez, R. and Lee, C. S. G., Robotics: Control, S e n sin g,Visio n a n d Intelligence, McGraw - Hill, 1987.		

Re	Reference Books / Web links:		
1.	Groover Mikell .P, -Industrial Robotics -Technology Programming and Applicationsl, McGraw Hill, 2014		
2.	Deb S.R., -Robotics Technology and Flexible Automation Tata McGraw Hill Book Co., 2013.		
3.	Koren Y., —Robotics for Engineers", McGraw Hill Book Co., 1992		
4.	Maja J Mataric, —The Robotics Primer —Universities Press. 2013.		
5.	John J. Craig, -Introduction to Robotics Mechanics and Controll, Pearson Education India, 2008		

MT19P61	INTERNET OF THINGS FOR MECHATRONICS	PE	L	Т	Р	(	7
			3	0	0		;

Objectives:		
٠	To understand the basics of Internet of Things.	
٠	To understand different applications of Internet of Things.	
٠	To understand the fundamental aspects of IoT.	

	BIEDODLICIDION	0
UNIT-I	INTRODUCTION	9
Definitions	and Functional Requirements – Motivation – Architecture - IoT architecture and platforms - IoT Device	s vs.
Computers -	Trends in the Adoption of IoT - Societal Benefits of IoT – IoT Information Security	
UNIT-II	EMBEDDED AND SENSORS SYSTEMS	9
Embedded	1 Systems. Sensing methods - Sensors types – Active, Passive sensors – Environmen	tal
sensing m	ethods.Sensor Fusion	
UNIT-III	IOT SENSORS	9
Evolving Se	nsor Technologies - Leveraging Sensor Fusion for the IoT - IoT Sensor Manufacturers - IoT Sensor I	Data
Platforms		
UNIT-IV	CONTROLLERS	9
Basics of Co	ontrollers - Interfacing methodologies - Controllers selection – GPIO interfaces – SPI interfaces – I2C	
interfaces -	RTC interfaces – IDE usage – Bootloader – Memory utilization (EEPROM /Flash)	
UNIT-V	PROGRAMMING	9
Basic programing of controllers – Controllers Expansion boards (breakouts). Hardware Platforms - Intel Galileo,		
Edison, Arduino, Beaglebone Black & Raspberry Pi. Software Platforms - Intel XDK, Node-RED, VISUINO,		
Fritzing, 123d Circuits, Scratch		

Co	urse Outcomes:		
On	On completion of course students will be able to		
٠	Explain the basic architecture and platform of IoT.		
٠	Explain the working principle of IoT.		
٠	Develop, test & analyse a new IoT system.		
٠	Design systems for Real-Time Processing.		
٠	Program for IoT applications.		

Text Books:	
1	MaciejKranz, -Building Internet of Thingsl, John Wiley and Sons, 2016
2	Peter Waher, -Learning Internet of Thingsl, Packt Publishing, 2015

# **Reference Books / Web links:**

1	Michael Miller, -The Internet of Thingsl, Que Publishing, 2015
2	Samuel Greengard, -The Internet of Things, Second Edition, MIT Press, 2015

**Total Contact Hours** 

: 45

RO19P11	INDUSTRIAL DATA COMMUNICATION	PE	L	Т	Р	С
			3	0	0	3

### **Objectives:**

- To give an overview of the Industrial data communications systems.
- To provide a fundamental understanding of common principles, various standards, protocols.
- To provide insight into some of the new principles those are evolving for future industrial data networks.

# UNIT-I DATA NETWORK FUNDAMENTALS

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ISO/OSI Reference model - TCP/IP Protocol Stack- EIA 232 interface standard – EIA 485 interface standard - Media access protocol: Command/response, CSMA/CD — IEEE 802.3 Ethernet standard Bridges –Routers – TCP/IP - Gateways – Standard ETHERNET Configuration.

### UNIT-II MODBUS AND HART

Evolution of industrial data communication standards - MODBUS:- Protocol structure, Function codes - HART communication protocol, Communication modes, HART Networks, HART commands, HART applications & Troubleshooting.

## UNIT-III PROFIBUS AND FF

Fieldbus: Fieldbus architecture, Basic requirements of Fieldbus standard, Fieldbus topology, Interoperability and Interchangeability. Introduction – Profibus protocol stack – Profibus communication model – Communication objects – Foundation fieldbus versus Profibus.

# UNIT-IV | AS –INTERFACE (AS-i), DEVICENET AND INDUSTRIAL ETHERNET

AS interface: Introduction – Physical layer – Data link layer – Operating characteristics. Devicenet: Introduction – Physical layer – Data link layer and Application layer. Industrial Ethernet: Introduction – 10Mbps Ethernet – 100Mbps Ethernet- Gigabit Ethernet.

# UNIT-V WIRELESS COMMUNICATION

Wireless sensor networks: Hardware components – energy consumption of sensor nodes – Network architecture– sensor network scenario. Wireless MAC Standards– IEEE 802.11- IEEE 802.15.4– Zigbee Wireless HART –Wireless Standard for Process Industry – ISA100 – Introduction to Industrial IOT.– Zigbee Wireless HART –

Total Contact Hours:45

Co	Course Outcomes:		
On	On completion of the course, the students will be able to		
•	Differentiate various types of industrial data network standards and the associated protocols based on their specifications and applications.		
٠	Analyze the various characteristics of the protocol stack pertaining to different Industrial data network standards.		
•	Compare the performance of the standards and infer the advantages and drawbacks of each for a given industrial application.		
٠	Select and use the most appropriate networking technologies and standards for a given application.		
٠	Identify procedures for fault-free operations in the data communications links and select a wired or wireless solution for installing Industrial data network.		

Te	Text Books:	
1	Mackay, S., Wright, E., Reynders, D., and Park, J., — Practical Industrial Data Networks: Design, Installation and	
	Troubleshooting, Newnes Publication, 1st edition, Elsevier, 2004.	
2	Buchanan, W., -Computer Busses: Design and Applicationl, CRC Press, 2000.	

Re	Reference Books(s) / Web links:		
1	Bowden, R., -HART Application Guidel, HART Communication Foundation, 1999.		
2	Berge, J., -Field Buses for Process Control: Engineering, Operation, and Maintenancel, ISA Press, 2004.		
3	Lawrence (Larry) M. Thompson and Tim Shaw, —Industrial Data Communications, 5th Edition, ISA Press, 2015.		
4	Bela G.Liptak, —Instrument Engineers' Handbook, Volume 3 : Process Software and Digital Networks, 4th Edition, CRC Press, 2011.		

RO19P12	MEDICAL ROBOTICS	PE	L	T P	' C
			3	0 0	3
<b>Objectives:</b>					
To learn	n about medical robots				
To under	erstand sensors for medical application				
To intro	duce the concepts of surgical and design of medical robots				
UNIT-I	INTRODUCTION			9	1
Types of me	dical robots - Navigation - Motion Replication - Imaging - Rehabilitation and Pr	osthetics - Sta	ate of	art o	f
robotics in the	ne field of healthcare-DICOM				
UNIT-II	LOCALIZATION AND TRACKING			9	
Position sense	sors requirements - Tracking - Mechanical linkages - Optical - Soundbased - Elect	romagnetic - I	Impec	lance	;-
based - In-be	ore MRI tracking-Video matching - Fiber optic tracking systems - Hybrid system	ns.			
UNIT-III	SURGICAL ROBOTICS			9	
Minimally in	Minimally invasive surgery and robotic integration - surgical robotic sub systems - synergistic control - Control Modes				
- Radiosurgery - Orthopedic Surgery - Urologic Surgery and Robotic Imaging -Cardiac Surgery - Neurosurgery - case					
studies					
UNIT-IV	REHABILITATION			9	1
Rehabilitatio	Rehabilitation for Limbs - Brain-Machine Interfaces - Steerable Needles - case studies				
UNIT-V	DESIGN OF MEDICAL ROBOTS			9	1

Assistive robots –types of assistive robots - case studies Characterization of gestures to the design of robots - Design methodologies - Technological choices - Security.

 Total Contact Hours
 :
 45

Course Outcomes:	
On completion of the course, the students will be able to	
• Classify the robot application in medical system.	
Develop mechanical linkages for medical usage.	
• Discuss on surgical robots.	
• Describe about rehabilitation of limbs.	
Design gesture controlled robots.	

Tey	xt Books:		
1	A 1.1	<b>F1</b>	<b>C</b>

1	Achim Schweikard, Floris Ernst, "Medical Robotics", Springer, 2015.
2	Paula Gomes, "Medical robotics Minimally invasive surgery", Woodhead, 2012

Re	Reference Books(s) / Web links:		
1	Jaydev P Desai, Rajni V Patel, "The Encyclopedia of Medical Robotics", World Scientific Publishing Co. Pvt.		
	Ltd, 2018.		
2	Jocelyne Troccaz, "Medical Robotics", Wiley-ISTE, 2012.		
3	Vanja Bonzovic, "Medical Robotics", I-tech Education publishing, Austria, 2008.		
4	Farid Gharagozloo, Farzad Najam, "Robotic Surgery", 1st Edition, McGraw-Hill Education, 2008.		

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RO19P14	FUZZY LOGIC AND NEURAL NETWORKS	PE	L	Т	Р	С
			3	0	0	3

# **Objectives:**

٠	To understand the fuzzy operations and fuzzy rules compositions.
٠	To Familiarize and create awareness on fuzzy logic controller.
•	To learn the neural network models.
•	To impart knowledge on modeling non-linear systems using ANN.
•	To know the hybrid systems of ANN.

### FUZZY SET THEORY UNIT-I

Fuzzy set theory - Fuzzy sets - Operation on fuzzy sets - Scalar cardinality, fuzzy cardinality, union and intersection, complement (Yager and Sugeno), equilibrium points, aggregation, projection, composition, cylindrical extension, fuzzy relation - Fuzzy membership functions

### UNIT-II **FUZZY LOGIC FOR MODELING**

Modelling 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 9

### ARTIFICIAL NEURAL NETWORK UNIT-III

Review of fundamentals - Biological neuron, artificial neuron, activation function, single layer perceptron Limitation – Multi layer perceptron – Back propagation algorithm (BPA) – Recurrent neural network (RNN) – Adaptive resonance theory (ART) based network - Radial basis function network - online learning algorithms, BP through time - RTRL algorithms - Reinforcement learning.

### NEURAL NETWORKS FOR MODELING AND CONTROL UNIT-IV

Modelling 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.

### HYBRID CONTROL SCHEMES **UNIT-V**

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 study - Familiarization with ANFIS toolbox **Total Contact Hours** 45

Co	Course Outcomes:	
On	On completion of the course, the students will be able to	
٠	Apply fuzzy composition rules for different problems.	
٠	Implement different fuzzy models for prediction of operating parameters.	
٠	Implement supervised and unsupervised neural networks.	
٠	Design and control any non-linear systems using ANN.	
٠	Develop an optimal hybrid control models.	

Text Books:	
1	Timothy J. Ross, -Fuzzy Logic with Engineering Applications, McGraw Hill Inc, 2010
2	Laurence Fausett, -Fundamentals of Neural Networksl, Prentice Hall, Englewood Cliffs, N.J., 2012

Re	ference Books(s) / Web links:
1	Zhang Huaguang and Liu Derong, —Fuzzy Modeling and Fuzzy Control Series: Control Engineeringl, 2000
2	Millon W.T., Sutton R.S. and Webrose P.J., -Neural Networks for Controll, MIT press, 1992
3	Kevin M. Passino and Stephen Yurkovich, Fuzzy Control, Addison Wesley Longman, Menlo Park, 1998.
4	Poznyak A.S., E. N. Sanchez and Wen Yu, Differential Neural Networks for Robust Nonlinear Control, World Scientific, 2001.
5.	ErdalKayacan, MojtabaAhmadiehKhaneswar, — Fuzzy neural networks for Real time control applicationsl, Elsevier, 2015

RO19P15	PYTHON PROGRAMMING FOR AUTOMATION	PC	L T	P
			3 0	0 3
Objectives				
Objectives:	he header of algorithmic much law calcing			
• To know t	ne basics of algorithmic problem solving.			
• To develo	p Python programs with conditionals and loops.			
• To define	Python functions and call them.			
• To use Py	thon data structures — lists, tuples, dictionaries.			
• To do inpu	ut/output with files in Python.			
	ALCODITHMIC PDORLEM SOLVINC			0
Introduction to	a computers abaracteristics basic organization of a computer algorith	ma building	blook	9
algorithms (ins	structions/statements state control flow functions) - notation (pseudo code	flow chart prog	ramm	ing
language) - alg	corithmic problem solving - simple strategies for developing algorithms (iter:	ation, recursion)	,i aiiiii	шş
UNIT-II	DATA EXPRESSIONS STATEMENTS AND CONTROL FLOW	ation, recuision)	•	9
Python interpr	eter and interactive mode - values and types - data types - variables $-k$	evwords - expre	ession	s and
statements - py	thon I/O - operators - precedence of operators – comments. Conditionals: c	onditional (if) -	alterna	tive
(if-else) - chai	ned conditional (if-elif-else) – nested conditional. Iteration: while – for	- break – conti	nue –	pass.
Illustrative pro	grams: exchange the values of two variables - circulate the values of n varial	oles - test for lea	p yeai	
UNIT-III F	FUNCTIONS			9
Function calls	- type conversion - math function - composition - definition and use - flo	w of execution -	para	neters
and arguments.	. Fruitful functions: return values - parameters - scope: local and global - rec	ursion. Strings:	string	slices
- immutability	v - string functions and methods - string comparison. Illustrative program	ns: square root	– G0	CD –
exponentiation	- sum the array of numbers, to find collision of 2D motion objects using	ray tracing alg	orithn	1 and
generating visi	bility graph.			
UNIT-IV (	COMPOUND DATA: LISTS, TUPLES AND DICTIONARIES			9
Lists - list oper	ations - list slices - list methods - list loop – mutability – aliasing - cloning li	sts - list paramet	ers. T	uples
– immutable - t	tuple assignment - tuple as return value. Dictionaries: operations and method	s – dictionaries a	and tup	ples –
dictionaries an	nd lists. Advanced list processing - list comprehension. Introduction to	Visualization wi	th Py	thon.
Illustrative pro	grams: Drawing shear force and bending moment diagram for beams, simulat	ing planar two d	egree	robot
motion.				
UNIT-V F	TILES, MODULES AND PACKAGES			9
Files and excep	otion: file operation - text files - reading and writing files - format operator- c	ommand line arg	gumer	its -
errors and exce	ptions - handling exceptions – writing modules – packages. Illustrative progra	ims: word count	- copy	file
– case studies.	Extracting feature information from STEP and STL files.	Contract II		15
	Total	Contact Hours	:	45
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Co	Course Outcomes:	
On	On completion of the course students will be able to	
٠	Develop algorithmic solutions to simple computational problems.	
٠	Structure simple Python programs for solving problems.	
٠	Decompose a Python program into functions.	
•	Represent compound data using Python lists, tuples and dictionaries.	
٠	Read and write data from/to files in Python programs	

Charles Dierbach Introduction to Computer Science using Python: A Computational Problem-	
Charles Dierbach Introduction to Computer Science using Python: A Computational Problem-S	
1       Wiley India Edition, 2013.	Solving Focus,
2         Allen B. Downey, Think Python: How to Think Like a Computer Scientist, Second edition, Upda Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)	ated for Python 3,

# Reference Books(s) / Web links:

1	Anita Goel, Ajay Mittal, Computer Fundamentals and programming in C, Pearson India Publisher, First edition,
1	2013.

2	John V Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press, 2013
3	Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
4	Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd. 2015.
5	Kenneth A. Lambert, Fundamentals of Python: First Programs, CENGAGE Learning, 2012

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Subject Code	Subject Name (Lab Oriented Theory Course)	Category	L	Т	Р	С
CS19P08	COMPUTER GRAPHICS	PE	2	0	2	3

Ob	Objectives:		
٠	To Gain knowledge about graphics hardware devices and software used.		
٠	To understand the two dimensional graphics and their transformations, familiar with clipping techniques.		
٠	To understand the three dimensional graphics and their transformations, familiar with clipping techniques.		
٠	To understand and Appreciate illumination and color models.		
٠	To understand the basic of animation techniques.		

# UNIT-I INTRODUCTION

Application areas of Computer Graphics, overview of graphics systems, Video -display devices, Raster - scan systems, random scan systems, graphics monitors and work stations. Output primitives: Points and lines, line drawing algorithms, mid – point circle and ellipse algorithms.

### UNIT-II 2 - D GEOMETRICAL TRANSFORMS

Translation, scaling, rotation, reflection and shear transformations, matrix representations and homogeneous coordinates, composite transforms. 2-D Viewing: The viewing pipeline, window to view - port coordinate transformation, point clipping, Text Clipping, Cohen-Sutherland, NLN and Liang basky line clipping algorithms, Sutherland –Hodgeman and Weiler Atherton polygon clipping algorithm.

### UNIT-III 3-D OBJECT REPRESENTATION

Polygon surfaces, quadric surfaces, spline representation, Bezier curve and surfaces, 3-D Geometric transformations: Translation, rotation, scaling, reflection and shear transformations, composite transformations. 3-D viewing: Viewing pipeline, viewing coordinates, view volume, projection and clipping.

### UNIT-IV ILLUMINATION AND COLOR MODELS

Light sources – basic illumination models – halftone patterns and dithering techniques; Properties of light – Standard primaries and chromaticity diagram; Intuitive color concepts – RGB color model – YIQ color model – CMY color model – HSV color model – HLS color model; Color selection.

### UNIT-V COMPUTER ANIMATION AND REALISM

Design of animation sequence, general computer animation functions, raster animation, computer animation languages, key frame systems, motion specifications, Morphing and Tweening – Fractals – Grammar based models.

**Contact Hours** 

:

List of Experiments					
1	1 Implementation of Bresenham's Line drawing Algorithm				
2	2 Implementation of Mid-point Circle drawing Algorithm				
3	Two Dimensional transformations - Translation, Rotation, Scaling, Reflection,	Shear			
4	Composite 2D Transformations				
5	Implementation of Cohen Sutherland 2D line clipping Algorithm				
6	6 Window to viewport Mapping				
7	7 Three dimensional transformations - Translation, Rotation, Scaling				
8	8 Parallel and Perspective Projections				
9	Generation of fractal images				
10	Creating Animation using any tool				
		Contact Hours	:	30	
	Total Contact Hours:60				

Co	Course Outcomes:		
On completion of the course, the students will be able to			
٠	Understand overview of graphics system and various output primitives algorithms.		
٠	Design two dimensional graphics, apply two dimensional transformations and clipping		
٠	Design three dimensional graphics, apply three dimensional transformation and clipping.		
٠	Apply Illumination and color models in real time.		
٠	Design animation sequences.		

# Text Books(s):

1 Donald Hearn and M. Pauline Baker, —Computer Graphics C versionl, Pearson education, Second edition, 2002.

Re	Reference Book(s) / Web link(s):		
1	Zhigang xiang, Roy Plastock, —Computer Graphics Second editionl, Schaum's outlines, Tata Mc Graw hill edition,2003		
2	John F. Hughes, Andries Van Dam, Morgan Mc Guire ,David F. Sklar , James D. Foley, Steven K. Feiner and Kurt Akeley , Computer Graphics: Principles and Practicel, , 3rd Edition, AddisonWesley Professional,2013		
3	Jeffrey McConnell, -Computer Graphics: Theory into Practicel, Jones and Bartlett Publishers, 2006.		
4	William M. Newman and Robert F.Sproull,Principles of Interactive Computer Graphics, Mc Graw Hill 1978.		
5	http://nptel.ac.in/		

RO19P16	MACHINE LEARNING FOR ROBOTICS	PE	L	Т	Р	C
			3	0	0	3
<b>Objectives:</b>						
To unders	tand the concepts of evaluation, cross-validation and over fitting of models.		-			
To familia	rize on Probability and Bayes learning.					
To know f	he popular supervised learning algorithms					

	To know the popular supervised rearring argonalins.
•	To understand neural networks.
•	To learn about clustering techniques.

### UNIT-I INTRODUCTION

Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation, Linear regression, Decision trees, over fitting.

# UNIT-II LEARNING

UNIT-II	LEARNING			9
Instance bas	sed learning, Feature reduction, Collaborative filtering based recon	nmendation, Probability and	Bay	yes
learning.				
UNIT-III	SUPERVISED LEARNING MODELS			9
Logistic Reg	gression, Support Vector Machine, Kernel function and Kernel SVM.			
UNIT-IV	UNIT-IV NEURAL NETWORK 9			
Neural netw	ork: Perceptron, multilayer network, back propagation, ANN for invers	se kinematics of robot.		
UNIT-V	UNIT-V CLUSTERING 9			
Clustering: k	x-means, adaptive hierarchical clustering, and Gaussian mixture model.	Clustering-Based Robot Navi	gati	ion
and Control.				
		Total Contact Hours	:	45

Co	Course Outcomes:		
On	On completion of the course, the students will be able to		
٠	Evaluate the model parameters.		
٠	Apply Baye's theorem in machine learning.		
٠	Implement supervised learning models.		
٠	Design ANN model for robot controls.		
٠	Perform clustering and apply machine learning for robotic applications.		

# Text Books:

1 Tom Mitchell, Machine Learning, McGraw Hill, 1997.	
2 Ian J. Goodfellow, YoshuaBengio and Aaron Courville. "Deep learning." An MIT Press book in preparation (2015).	

Re	Reference Books(s) / Web links:		
1	Josh Patterson, —Deep Learning: A Practitioner's Approach , Shroff/O'Reilly; First edition, 2017.		
2	Ethem Alpaydin, Introduction to Machine Learning, The MIT Press, USA, 2014.		
3	Millon W.T., Sutton R.S. and Webrose P.J., -Neural Networks for Controll, MIT press, 1992.		
4	Christopher M. Bishop, —Pattern Recognition and Machine Learningl, Springer, 2006		
5.	Dilip K Pratihar, -Soft Computing fundamentals and applicationsl, Narosa publishing house, India, 2015.		

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RO19P17	INTRODUCTION TO VIRTUAL REALITY AND AUGMENTED	PE	L	Т	Р	С
	REALITY					
			3	0	0	3

Ob	Objectives:		
•	To introduce the classic components of a VR system.		
•	To understand the VR modeling process.		
•	To understand virtual reality, augmented reality applications.		

### UNIT-I INTRODUCTION

 The three I's of virtual reality-commercial VR technology and the five classic components of a VR system -Input Devices: (Trackers, Navigation, and Gesture Interfaces): Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback

 UNIT-II
 VR DEVELOPMENT PROCESS

Geometric modeling -kinematics modeling-physical modeling –behaviour modeling -model Management.

UNIT-III CONTENT CREATION CONSIDERATIONS FOR VR

Methodology and terminology-user performance studies-VR health and safety issues-Usability of virtual reality system-cyber sickness -side effects of exposures to virtual reality environment

## UNIT-IV VR ON THE WEB & VR ON THE MOBILE

JS-pros and cons-building blocks (WebVR, WebGL, Three.js, device orientation events)-frameworks (A-frame, React VR)-Google VR for Android-Scripts, mobile device configuration, building to android-cameras

and interaction-teleporting-spatial audio-Assessing human parameters-device development and drivers-Design Haptics, Haptic sense. Haptic devices. Algorithms for haptic rendering, characteristics of augmented reality (AR), AR software development -. Camera parameters and camera calibration. Marker-based augmented reality. Pattern recognition. AR Toolkit

### UNIT-V APPLICATIONS

Medical applications-military applications-robotics applications-Advanced Real time Tracking-other applications-games, movies, simulations, therapy.

Total Contact Hours:45

Co	Course Outcomes:		
On	On completion of the course, the students will be able to		
٠	Analyse & Design a process to meet given specifications with realistic engineering constraints.		
٠	Identify the procedures in model building.		
٠	Conduct different studies of exposures to virtual reality environment.		
٠	Integrate web and mobile systems to AR and VR.		
٠	Extract knowledge from various applications.		

# Text Books:

1	Burdea & Philippe Coiffet, —Virtual Reality Technologyl, Second Edition, Gregory, John Wiley & Sons, Inc., 2008.
2	Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY, USA

### Reference Books(s) / Web links:

1	Hollier and Schmalstieg, —Augmented Reality: Principles & Practice —, Pearson Education India; First edition,
	India, 2016.
2	Steve Aukstakalnis, —Practical Augmented Reality: A Guide to the Technologies, Applications, and Human
	Factors for AR and VRI, Addison-Wesley Professional; 1 ^s t edition, USA,2016.
3	Tony Parisi, —Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for Web
	Pagesl, O'Reilly Media; 1 edition, 2014.
4	Chetankumar G. Shetty, — Augmented Reality - Theory, Design and Developmentl, McGraw Hill; First
	edition,India,2020

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RO19P18	ADVANCED OPTIMIZATION TECHNIQUES	PE	L	Т	Р	С
			3	0	0	3

Ob	Objectives:	
•	To understand the basics of Optimization	
٠	To know about constraints in optimization problems	
•	To introduce the concept of Nonlinear programming	
•	To learn about different nonlinear models.	
٠	To create awareness about advanced methods	

### UNIT-I INTRODUCTION

Introduction, Historical Development, Engineering Applications of Optimization, Statement of an Optimization Problem, Design Vector, Design Constraints, Constraint Surface, Objective Function, Objective Function Surface, Classification of Optimization Problems, Classification Based- Existence of Constraints- Design Variables - Physical Structure of the Problem- Equations Involved- Permissible Values of the Design Variables- the Deterministic Nature of the Variables-the Separability of the Functions - Number of Objective Functions.

# UNIT-II CLASSICAL OPTIMIZATION TECHNIQUES

Introduction, Single-Variable Optimization, Multivariable Optimization with Constraints, Saddle Point, Multivariable Optimization with Equality Constraints, Solution by Direct Substitution, Solution by the Method of Constrained Variation, Solution by the Method of Lagrange Multipliers.

### UNIT-III NONLINEAR PROGRAMMING I

Unrestricted Search, Search with Fixed Step Size, Search with Accelerated Step Size, Exhaustive Search, Dichotomous Search, Interval Halving Method, Fibonacci Method, Golden Section Method, Comparison of Elimination Methods. Direct Root Methods- Newton Method- Quasi-Newton Method - Secant Method.

# UNIT-IV NONLINEAR PROGRAMMING II

Random Search Methods, Random Jumping Method, Random Walk Method, Random Walk Method with Direction Exploitation, Advantages of Random Search Methods, Grid Search Method, Univariate Method, Pattern Directions, Powell's Method.

### UNIT-V ADVANCED METHODS

Zoutendijk's Method of Feasible Directions, Determination of Step Length, Rosen's Gradient Projection Method, Firefly Algorithm, Artificial Bee Colony (ABC) algorithm.

### Total Contact Hours:45

Co	Course Outcomes:		
On	On completion of the course, the students will be able to		
•	Differentiate between Optimization models.		
•	Apply suitable techniques for constrained and unconstrained models.		
•	Formulate and solve One-Dimensional Minimization Methods.		
٠	Understand the problem and Solve using Unconstrained Optimization Techniques.		
•	Provide solution to complex models.		

Text Books:	
1	Singiresu S.Rao, —Engineering Optimization: Theory and Practicel, New Age International Publishers, India,
	2013
2	Kalyanmoy Deb, —Optimization for Engineering DesignAlgorithms and Examples, PHI Learning Private
	Limited, New Delhi,2012.

Reference Books(s) / Web links:	
1	Bazara M.J., Jarvis and Sherali H., -Linear Programming and Network Flowsl, John Wiley, 2009
2	Budnick F.S., -Principles of Operations Research for Managementl, McGraw-Hill Inc., US, 1998
3	Philip D.T. and Ravindran A., -Operations Researchl, John Wiley, 2007
4	Shennoy G.V. and Srivastava U.K.,—Operation Research for Management, New Age International Publishers;
	India, 2018
5.	Hillier and Libeberman, -Operations Researchl, McGraw-Hill Higher Education, New York, 2010.
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RO19P20	DATA SCIENCE USING R PROGRAMMING	Category	L	Т	Р	С
			2	0	2	3

### **Objectives:**

- To analyse data by applying basic data science techniques
- Understand basic constructs of R
- . Learning and applying basic classification techniques
- Learning various black box techniques of classification, market basket analysis and clustering •
- Evaluating performance of the models •

### INTRODUCTION UNIT-I

Introduction to Machine Learning – Need of machine learning – Kinds of machine learning – Steps of machine learning - choosing a machine learning algorithm – Using R for Machine Learning – Probability Distributions – Basis Statistics. (T1: Chapter - 1)

#### UNIT-II **R DATA STRUCTURES**

Managing and understanding data - Console input and output - Data Types - operators - Functions - R Data Structures - Vectors - Factors - Lists - Data Frames - Matrices and arrays - import and export files - Exploring and understanding data – Visualization – Categorical variables exploration – Relations between variables. (T1: Chapter – 2)

### UNIT-III CLASSIFICATION AND REGRESSION METHODS

Classification - Lazy Learner - K-Nearest Neighbor - Probabilistic Learner - Naïve Bayes - Divide and Conquer -Decision Trees - Understanding classification rules - Forecasting numerical data - Regression. (T1: Chapter - 3,4,5 & 6) 6

### NEURAL NETWORKS AND CLUSTERING **UNIT-IV**

Neural Networks - SVM - Finding Maximum Margin - Using Kernels for non-linear spaces, OCR with SVM - Market Basket Analysis – Understanding association rules – Apriori Algorithm – K-Means Algorithm. (T1: Chapter – 7, 8 & 9) 6

### UNIT-V **EVALUATING MODEL PERFORMANCE**

Measuring performance for classifier - Beyond Accuracy - Kappa - Sensitivity and Specificity - Precision and recall - F-Measure - Visualization with ROC Curve - Estimate future performance - Improving Model Performance -Improving model performance with meta learners. (T1: Chapter -10 & 11)

> **Contact Hours** : 30

	List of Experiments			
1.	Basics of R – data types, vectors, factors, list and data frames.			
2.	Program to implement Breast Cancer with KNN.			
3.	Program to implement Filtering Mobile phone spam using Naïve Bayes			
4.	Program to implement Risky Bank Loans using Decision Trees			
5.	Program to implement Predict medical Expense with Linear Regression.			
6.	Program to implement Modelling strength of concrete			
7.	Program to implement Identification of frequently Purchased groceries w	ith apriori Clustering		
8.	Program to implement Finding Teen Segments of Market.			
9.	Program to implement Tuning stock models for better performance			
		Contact Hours	:	30
		Total Contact Hours	:	60

# Course Outcomes

	Course Outcomes.		
On completion of the course, the students will be able to			
•	Understand the application and uses of data science techniques.		
•	Apply basic constructs of R.		
•	Apply data science by various classification techniques.		
•	Apply market basket analysis and clustering techniques.		
•	Evaluate the performance of the models built and fine tune the models to improve them.		

Text Books:			
1	Brett Lantz,Machine Learning with RI, ISBN 978-1-78216-214-8, 2013 Packt Publishing.		
2	Beginning R: The Statistical Programming Language , Mark Gardener, Wrox Wiley Publication, First Edition, 2012		

Reference Books:		
1	Nina Zumel, John Mount, —Practical Data Science with Rl, Manning Publications, 2014	
2	W. N. Venables, D. M. Smith and the R Core Team, -An Introduction to RI, 2013	
3	Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, —Practical Data Science Cookbookl, Packt Publishing Ltd., 2014	

Web link:

1. http://www.johndcook.com/R_language_for_programmers.html

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45 :

RO19P21	DEEP LEARNING FOR ROBOTICS	PE	L	Т	Р	С
			3	0	0	3

## **Objectives:**

,		
•	To understand the basics of machine and deep learning.	
•	To know about Multilayer Perceptron.	
•	To introduce the concept of principle component analysis and autoencoder.	
•	To learn Convolutional Neural Networks models.	
•	To create awareness about RNN model.	

#### UNIT-I INTRODUCTION

	L'IROD CONTON	/	
History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron			
UNIT-II		9	

Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent, FeedForward Neural Networks, Backpropagation, Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD. 9

# UNIT-III PCA AND AUTOENCODER

Principal Component Analysis and its interpretations, Singular Value Decomposition, Auto encoders and relation to		
CA, Regularization in auto encoders, Denoising auto encoders, Sparse autoencoders		
INIT-IV CNN	9	
onvolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet		
INIT-V RECURRENT NEURAL NETWORK	9	
Recurrent Neural Networks, Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated		
BP11, GRU, LS1Ms		

**Total Contact Hours** 

Co	Course Outcomes:		
On	On completion of the course, the students will be able to		
٠	Differentiate between of machine and deep learning.		
٠	Apply the Multilayer Perceptron.		
٠	Implement principle component analysis and autoencoder for the applications.		
•	Understand and Implement Convolutional Neural Networks models.		
٠	Work on deep architectures used for solving various Vision and NLP tasks.		

Te	Text Books:			
1	Ian J. Goodfellow, YoshuaBengio and Aaron Courville. "Deep learning." An MIT Press book in preparation, 2015.			
2	Bengio, Yoshua. "Learning deep architectures for AI." Foundations and trends in Machine Learning 2.1,2009.			

## Reference Books(s) / Web links:

1	Tom Mitchell, —Machine Learningl, McGraw Hill, USA, 1997.	
2	Josh Patterson, —Deep Learning: A Practitioner's Approach , Shroff/O'Reilly; First edition, 2017.	
3	Ethem Alpaydin, -Introduction to Machine Learning, The MIT Press, USA, 2014.	
4	Millon W.T., Sutton R.S. and Webrose P.J., -Neural Networks for Controll, MIT press, 1992.	
5.	Christopher M. Bishop, -Pattern Recognition and Machine Learningl, Springer, 2006.	