ALAGAPPA UNIVERSITY

(Accredited with A+ Grade by NAAC (CGPA : 3.64) in the Third Cycle ,
Graded as Category-I University and granted autonomy by MHRD-UGC)

DIRECTORATE OF COLLABORATIVE PROGRAMMES

B.Voc. in Industrial Automation

[Specialization in Smart Factory]

Regulations and Syllabus

[For those who join the Course in July 2023 and after]

CHOICE BASED CREDIT SYSTEM

ALAGAPPA UNIVERSITY
COLLABORATIVE PROGRAMMES

REGULATIONS AND SYLLABUS-(CBCS-Collaborative programmes)
[For the candidates admitted from the Academic Year 2023 – 2024 onwards]

Name of the Institution: **GKD Institute for Technological Resources**

Name of the Subject Discipline: **B.Voc. in Industrial Automation**

[Specialization in Smart Factory]

Programme of Level: **Bachelor**

Duration for the Course: Full Time (Three Years)

1. **Programme Educational Objectives- (PEO) Minimum 5 objectives are required**

PEO-1	**To enable students to identify, analyze, and solve problems in an advanced contemporary society by using the fundamentals of mathematics and engineering sciences with automation**
PEO-2	**To enable students to plan, design and manufacture engineering components by effective production methodologies with industrial automation and best management practices.**
PEO-3	**To make students capable, to identify opportunities, work in multidisciplinary teams, establish work ethics, thus fulfilling the requirements of Industry and Research.**
PEO-4	**To make students Outshine in professional career/higher studies for achieving global reputation through lifelong learning.**
PEO-5	**To inculcate in our students, healthy interpersonal skills, entrepreneurship skills, communication skills, adhering to good values.**

2. **Programme Specific Objectives-(PSO)- Minimum 5 objectives are required**

PSO-1	**Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.**
PSO-2	**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.**
PSO-3	**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.**
PSO-4	**Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change**
PSO-5	**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.**

3. **Programme Specific Outcome- (PO) Minimum 5 objectives are required**

PO-1	**Identify, analyze, and solve problems in an advanced contemporary society by using the fundamentals of mathematics and engineering sciences with automation.**
PO-2	**Plan, design and manufacture engineering components by effective production methodologies with industrial automation and best management practices**
PO-3	**Identify opportunities, work in multidisciplinary teams, establish work ethics, thus fulfilling the requirements of Industry and Research.**
PO-4	**Healthy interpersonal skills, entrepreneurship skills, communication skills, adhering to good values.**
PO-5	**Outshine in professional career/higher studies for achieving global reputation through lifelong learning**

4. **Programme Outcome-(PO) - Minimum 10 objectives are required**

PO-1	**An ability to apply knowledge of mathematics and engineering sciences to develop mathematical models for industrial problems.**
PO-2	**An ability to design and conduct experiments, as well as to analyze and interpret data obtained through those experiments.**
PO-3	**An ability to design mechanical systems, component, or a process to meet desired needs within the realistic constraints such as environmental, social, political and economic sustainability.**

PO-4	**An ability to identify, formulates, and solve complex engineering problems. with high degree of competence.**
PO-5	**Having critical thinking and innovative skills**
PO-6	**An ability to observe, understand the local industrial problems and to solve them with existing engineering tools for realistic outcomes.**
PO-7	**An ability to adapt quickly to the global changes and contemporary practices**
PO-8	**Having a good cognitive load management skills related to project management and finance**
PO-9	**Having interest and recognise the need for independent and lifelong learning**
PO-10	**An ability to be an active team member in a multidisciplinary team augmenting coordination through all hierarchy**

5. Eligibility:

A pass in Higher Secondary Examination (HSC) /ITI (Two years) / NSQF Level 4 or Equivalent, or an examination accepted as equivalent thereto by the Syndicate for admission to B.Voc. in Industrial Automation.

6. For the Degree:

The candidates shall have subsequently undergone the prescribed programme of study in a institute for not less than three academic years, passed the examinations prescribed and fulfill such conditions as have been prescribed therefore.

7. Admission:

Admission is based on the marks in the qualifying examination.

Lateral Entry:

- A pass in SSLC + 3yrs Diploma in Mechanical / Automobile / Mechatronics / Manufacturing / Aeronautical / Electrical / Electronics / Civil or equivalent thereto by the Syndicate shall be admitted directly in 2nd year of B.Voc programme.
- A pass in SSLC + HSC + 2 / 3 yrs Diploma in Mechanical / Automobile / Mechatronics / Manufacturing / Aeronautical / Electrical / Electronics / Civil or equivalent thereto by the Syndicate shall be admitted directly in 2nd year of B.Voc Programme.

8. Duration of the course:

The course shall extend over a period of **Three years** under Semester pattern.

9. Standard of Passing and Award of Division:

a. Students shall have a minimum of 40% of total marks of the University examinations in each subject. The overall passing minimum is 40% both in aggregate of Continuous Internal Assessment and external in each subject.
b. The minimum marks for passing in each theory / Lab course shall be 40% of the marks prescribed for the paper / lab.
c. A candidate who secures 40% or more marks but less than 50% of the aggregate marks prescribed for three years taken together, shall be awarded **THIRD CLASS.**
d. A candidate who secures 50% or more marks but less than 60% of the aggregate marks prescribed for three years taken together, shall be awarded **SECOND CLASS.**
e. A candidate who secures 60% or more of the aggregate marks prescribed for three years taken together, shall be awarded **FIRST CLASS.**
f. The Practical / Project shall be assessed by the two examiners, by an internal examiner and an external examiner.

10. Continuous internal Assessment:

a. Continuous Internal Assessment for each paper shall be by means of Written Tests, Assignments and Class tests
b. **25 marks** allotted for the Continuous Internal assessment is distributed for Written Test, Assignment and Class test

c. One Internal Tests of 2 hours duration may be conducted during the semester for each course / subject and the best marks may be considered and one Model Examination will be conducted at the end of the semester prior to University examination. Students may be asked to submit at least three assignments in each subject.
d. Conduct of the continuous internal assessment shall be the responsibility of the concerned faculty.
e. The continuous internal assessment marks are to be submitted to the University at the end of every year.
f. The valued answer papers/assignments should be given to the students after the valuation is over and they should be asked to check up and satisfy themselves about the marks they have scored.
g. All mark lists and other records connected with the continuous internal assessments should be in the safe custody of the institution for at least one year after the assessment.

11. Attendance:

Students must have earned 75% of attendance in each course for appearing for the examination.

Students who have earned 74% to 70% of attendance to be applied for condonation in the prescribed form with the prescribed fee.

Students who have earned 69% to 60% of attendance to be applied for condonation in the prescribed form with the prescribed fee along with the medical certificate.

Students who have below 60% of attendance are not eligible to appear for the examination. They shall re-do the semester(s) after completion of the programme.

12. Examination:

Candidate must complete course duration to appear for the university examination. Examination will be conducted with concurrence of Controller of Examinations as per the Alagappa University regulations. **University may send the representatives as the observer during examinations.** University Examination will be held at the end of the each semester for duration of 3 hours for each subject. Certificate will be issued as per the AU regulations. **Hall ticket will be issued to the 1st year candidates and upon submission of the list of enrolled students along with the prescribed course fee subsequent 2nd and 3rd year hall tickets will be issued.**

13. Industrial Exposure:

The course being professional, the students are required to undergo industrial exposure as below;

Option 1: Six Months Institute Training and Six Months Industry Training year wise.

Option 2: Two Years (1st Semester to 4th Semester) Institute training and One Year (5th and 6th Semester) Industry Training.

Option 3: One and Half years Institutional training and One and half years Industry Training.

Option 4: Per week , 5 days On the Job Training, One day class room Theoretical training

SYLLABUS UNDER CBCS PATTERN

B.Voc. in INDUSTRIAL AUTOMATION

[Specialization in Smart Factory]

NSQF Level	Sem.	Part	Course Code	Courses	Course Name	Credits Skill (S) / General (G)		Theory /practical	Hrs. / Week	Marks		Total
						S	G			Int	Ext	
NSQF Level – 4 : Certificate	I	I	60411T	T/OL	Tamil/Other Language		3	T	3	25	75	100
		II	60412	E	General English		3	T	3	25	75	100
		IV	60413	G-I	Life Coping Skills @		4	P	4	25	75	100
			60414		Office Automation - Lab		2	P	2	25	75	100
		III	60415	**Core-I**	Production Technology	5		T	5	25	75	100
			60416	**Core-II**	Basic Electrical and Electronics Engineering - Practical	4		P	4	25	75	100
			60417	**Core -III**	Engineering Graphics - Practical	4		P	4	25	75	100
			60418	**Core -IV**	Engineering Metrology – Practical	5		P	5	100	--	100
					Sub-Total	**18**	**12**					
					Total for Semester - I	**30**			**30**	**275**	**525**	**800**
NSQF Level – 5 : Diploma	II	I	60421T/H/F/M/TU/A/S		Tamil/Other Language		3	T	3	25	75	100
		II	60422		General English		3	T	3	25	75	100
		III	60423	**Core - V**	Applied Hydraulics and Pneumatics	5		T	5	25	75	100
			60424	**Core - VI**	Quality Engineering - Practical	4		P	4	25	75	100
			60425	**Core - VII**	Engineering Mechanics - Practical	4		P	4	25	75	100
			60426	**Core -VIII**	Manufacturing Processes – Practical	5		P	5	100	--	100
		IV	60427		Environmental Studies *		2	P	2	25	75	100
			60428		Advanced Communicative English @		2	P	2	100	--	100
			60429		Computing Skills Lab- I		2	P	2	25	75	100
					Sub-Total	**18**	**12**					
					Total for Semester – II	**30**			**30**	**375**	**525**	**900**
NSQF Level – 6 : Advanced Diploma	III	III	60431	**Core - IX**	Mechatronics	3		T	3	25	75	100
			60432	**Core - X**	Electrical Drives	5		P	5	25	75	100
			60433	**Core – XI**	Operations Research	5		P	5	25	75	100
			60434	**Core – XII**	Computer Aided Design and Manufacturing	5		P	5	25	75	100
		IV	60435		Interview Techniques & Interpersonal Communications @		5	P	5	25	75	100
			60436		Electronics and		4	P	4	25	75	100

					Instrumentation							
			60437	**NME-I**	Total Quality Management		2	P	3	25	75	100
				SLC-I	Self - Learning Course –I- MOOCs –I %		(E)	--	--	--	--	--
		V			Extension Activities #		1	--	--	100	--	100
					Sub-Total	**18**	**12**					
					Total for Semester - I	**30+ (E)**			**30**	**275**	**525**	**800**
	IV	III	60441	**Core - XIII**	Low Cost Automation	3		T	4	25	75	100
			60442	**Core – XIV**	CNC Machines and Programming	4		P	4	25	75	100
			60443	**Core - XV**	Sensors and Controls	4		P	5	25	75	100
			60444		Industrial Safety	2		P	--	100	--	100
			60445	**Core -XVI**	Microprocessor & Micro controller – Practical	5		P	5	100	--	100
		IV	60446		Professional Etiquettes		4	T	4	25	75	100
			60447		Digital Electronics		4	P	4	25	75	100
			60448	**NME-II**	Modern Production Processes		2	P	2	25	75	100
			60449A 60449B 60449C		Value Education / Manavalakalai Yoga / Introduction to Gender Studies @		2	P	2	25	75	100
				SLC-II	Self-Learning Course - IV - MOOCs -II **%**		(E)	--	--	--	--	--
					Sub-Total	**18**	**12**					
					Total for Semester – II	**30**			**30**	**375**	**525**	**900**
NSQF Level – 7: B.Voc. Degree	V	III	60451	**Core-XVII**	Manufacturing Automation	5		T	5	25	75	100
			60452	**Core - XVIII**	**Practical –** Robotics and Automation	4		P	4	25	75	100
			60453	**Core –XIX**	**Practical –** Industry 4.0 & IiOT	4		P	4	25	75	100
				Elective I	**Practical**	5		P	5	25	75	100
		IV	60455		Entrepreneurship / Start-up Skills @		4	P	4	25	75	100
			60456		Quantitative Aptitude #		4	P	4	100	--	100
			60457		Accounting Skills @		4	P	4	25	75	100
					Sub-Total	**18**	**12**					
					Total for Semester – I	**30**			**30**	**250**	**450**	**700**
	VI	III	60461	**Core –XX**	Artificial Intelligence & Reasoning	4		P	5	100	--	100
				Elective II	**Practical**	4		P	4	25	75	100
				Elective III	**Practical**	4		P	4	25	75	100
			60464		Industrial Internship with Project	6		I	9	25	75	100
		IV	60465		Corporate Grooming and Finishing Skills@		4	P	4	25	75	100
			60466		Flexible Manufacturing Systems		4	T	4	25	75	100
			60467		Comprehensive Study @		4	P	--	100	--	100
					Sub-Total	**18**	**12**					
					Total for Semester – II	**30**			**30**	**325**	**375**	**700**
					Total Credits (B.Voc. Degree Programme)	**180**		**180**		**1875**	**2925**	**4800**

Fully-internal Course – Examination will be conducted internally

@ External Examination will be conducted as Viva-voce Examination

% Self-Learning Course – MOOCs – Extra Credits (Voluntary Basis) (E) – Extra credits earned through MOOCs

LIST OF ELECTIVES FOR SEMESTER 5

Sem	Course Code	Title of the Paper	T/P	Cr.	Hrs./ Week	Max. Marks		
						Int.	Ext.	Total
V	60454A	Computer Vision & Pattern Recognition	P	5	5	25	75	100
	60454B	Machine to Machine Communication	P	5	5	25	75	100

LIST OF ELECTIVES FOR SEMESTER 6

Sem	Course Code	Title of the Paper	T/P	Cr.	Hrs./ Week	Max. Marks		
						Int.	Ext.	Total
VI	60462A	Manufacturing Systems	P	4	4	25	75	100
	60462B	LAN and Networking	P	4	4	25	75	100
	60462C	Problem Solving and Python Programming	P	4	4	25	75	100
	60463A	Data Structures and Algorithms	P	4	4	25	75	100
	60463B	Machine Learning Techniques	P	4	4	25	75	100
	60463C	Robotics and Automation	P	4	4	25	75	100

Semester - I				
Course code: 60413	**General – 1**	**T/P**	**C**	**H/W**
	LIFE COPING SKILLS	**P**	**4**	**4**

Objectives	• To understand life skills, its concept, process and practices. • To develop the competence in application of life skills for effective learning and planning for career. • To provide orientation in Life Coping Skills
Unit -I	**Self –Concept, Self-Acceptance and Personality Development:** Concept and definition of Self-Esteem, Factors influence Self-Esteem, Low Vs High Self-Esteem, Step to raise Self Esteem, Definition of Self of Self Concept, Characteristics of the Self-Concept, Introduction, Definition and Theoretical perspective of self-Acceptance, Benefits of Self-Acceptance, Characteristics and Elements of Personality and Identity of the Individual.
Unit -II	**Positive Thinking, Motivation and Self Actualization:** Positive Thinking and Positive Attitude, The power of positive thinking, positive imaging, Concept and Theories of Motivation and Self-Actualization and Factors of Motivation
Unit -III	**Goal Setting:** Definition of Goal Setting, Different types of Goals, Importance of Goal setting, Obstacles to set Goals and Steps to Goal Setting.
Unit -IV	**Coping Skills:** Depression, Fear, Anger and Failure – Definition, Symptoms, Causes and Impact of Depression, How to overcome Depression, Theoretical Input of Fear, Kinds of Fear, Coping with Fear, Ways to overcome Fear, Consequence of Anger, Managing Anger, Steps toward Anger Management, Positive Attitude towards Failure, Coping with Failure
Unit -V	**Leadership:** Emergence and Functions of Leader, Characteristics of Leadership, Attributes of Leadership, Types of Leadership, Characteristics of Successful Leadership

Text Book:

Xavier Alphones, S.J. (2004). *We Shall Overcome - A Textbook on Life Coping Skills*. Chennai: ICRDCE Publication.

Books for Reference:

Frydenberg, E. (2010). *Think positively!: A course for developing coping skills in adolescents*. A&C Black.

Harper, F. G., & LPC-S, A. C. S. (2019). *Coping Skills: Tools & Techniques for Every Stressful Situation*. Microcosm Publishing.

Outcomes	After Completing this course, the students are able to: • Identify their conflict styles and the basic values of self and others • develop meaningful inter-personal relationships in different environments. • Inculcate a positive mind set and a humanistic attitude.

Semester - I				
Course code: 60414	**Office Automation LAB**	**T/P**	**Credit**	**Hrs./Week**
		P	**2**	**2**

Objectives	• To understand Basic Knowledge of Computer • To know windows and application • To understand MS Word, Excel & Power point • To know Internet concept • To understand Outlook
Contents	1. BASIC KNOWLEDGE OF COMPUTER 2. WINDOWS & ITS APPLICATION 3. MS-WORD 4. MS-EXCEL 5. MS-POWERPOINT 6. INTERNET CONCEPT 7. MS-OUTLOOK
Outcomes	• Understand Basic Knowledge of computer • Understand windows and application • Understand MS Word, MS Excel & Power point • Understand Internet Concepts • Understand Outlook

Semester - I				
Course code:60415	**Production Technology**	**T/P**	**Credit**	**Hrs./Week**
		T	**5**	**5**

Objectives	• To know the fundamentals of metal cutting • To understand Machine tools and processes for producing round shapes like lathe etc • To understand Machine tools and processes for producing various shapes like milling, shaping, slotting etc • To understand Abrasive machining and finishing operations like grinding • To know the modern machining processes like EDM, ECM, EBM.LBM etc
Unit -I	**Fundamentals of metal cutting:** Mechanics of orthogonal and oblique cutting-Mechanics of chip formation-Types of chips produced in cutting- Cutting forces and power-Temperature in cutting-Tool life – numerical problems-Wear and failure-surface finish and integrity- Machine tools structures-Vibration and chatters in machining-machining economics - Cutting tools steels, cobalt alloys, coated tools -Diamond tools -Cutting fluids.
Unit-II	**Machine tools and processes for producing round shapes:** Turning parameters-lathes and Lathe operations- -Cutting screw threads-Boring and boring machines-Drilling and drills-Drilling machines-reaming and reamers-tapping and taps-Design considerations for drilling, reaming and tapping- Capstan and Turret lathe-single spindle and multi spindle automats-Swiss type and automatic screw machines.
Unit III	**Machine tools and processes for producing various shapes :** Milling operations-Milling machines-Planning and shaping-Broaching and broaching machines- Sawing-filing and finishing-gear manufactured by machining.
Unit IV	**Abrasive machining and finishing operations:** Abrasives - bonded abrasives – Grinding process- wheel gear grinding operations and machines - grinding fluids - Design Consideration for Grinding - finishing operations-deburring - economics of grinding and finishing operation.
Unit V	**Modern machining :** High speed machining-Ultra precision Machining and Hard turning-Ultrasonic machining- Abrasive jet machining-Abrasive flow machining-Water jet machining - Electro chemical machining-Electric discharge machining-Wire Electric discharge machining-. Electron beam machining-Laser beam Machining.

TEXT BOOKS:

1. Sharma P.C., "AText book of production Technology: manufacturing processes" S.Chand & Company Limited, 7 th Edition (2007).
2. Kalpakjian S. and SCHMID S., "Manufacturing Engineering and Technology", PrenticeHall of India", 50th Edition (2006) , ISBN : 0131489658.

REFERENCES:

1. Krar S.F., "Technology of machine tools" McGraw-Hill, New York. (2011), 7th Edition
2. Brown J.A. "Modern manufacturing processes", Industrial Press Inc., ISBN 0831130342,9780831130343(1991).
3. Paul E.D., Black J.T. and Kosher R.A, "Materials and Processes in Manufacturing", Wiley, 9thEdition (2003), ISBN 0471033065.
4. Lindberg R.A., "Process and Materials of Manufactures" Prentice-Hall of India, Fourth Edition, ISBN 8131701034(1994).

Outcomes	**Upon successful completion of the course the students will be able to** • Understand the fundamentals of metal cutting • Understand Machine tools and processes for producing round shapes like lathe etc • Understand Machine tools and processes for producing various shapes like milling, shaping, slotting etc • Understand Abrasive machining and finishing operations like grinding. • Understand modern machining processes like EDM, ECM, EBM.LBM etc

Semester - I				
Course code: 60416	**Basic Electrical & Electronics Engineering-Practical**	**T/P**	**Credit**	**Hrs./Week**
		P	**4**	**4**
Objectives	(1) Develop and employ circuit models for elementary electronic components (2) Develop and employ circuit models for circuit analysis, network theorems, (3) Develop and employ circuit models for role of power flow and energy storage in electronic circuits (4) Develop and employ circuit models for AC signal powers, three phase circuits and loads, (5) Brief introduction to diodes and BJTs			
Unit -I	**Electrical circuit elements:** voltage and current sources, R,C,L,M,I,V, linear, non linear, active and passive elements, inductor current and capacitor voltage continuity, Kirchhoff's laws, Elements in series and parallel, superposition in linear circuits, controlled sources, energy and power in elements, energy in mutual inductor and constraint on mutual inductance			
Unit-II	**Network analysis:** Nodal analysis with independent and dependent sources, modified nodal analysis, mesh analysis, notion of network graphs, nodes, trees, twigs, links, co-tree, independent sets of branch currents and voltages			
Unit III	**Network theorems:** voltage shift theorem, zero current theorem, Tellegen's theorem, reciprocity, substitution theorem, Thevenin's and Norton's theorems, pushing a voltage source through a node, splitting a current source, compensation theorem, maximum power transfer			
Unit IV	**RC and RL circuits:** natural, step and sinusoidal steady state responses, series and parallel RLC circuits, natural, step and sinusoidal steady state responses **AC signal measures:** complex, apparent, active and reactive power, power factor			
Unit V	**Introduction to three phase supply:** three phase circuits, star-delta transformations, balanced and unbalanced three phase load, power measurement, two wattmeter method **Semiconductor diodes and application:** PN diodes, rectifiers and filters, clipping and clamping circuits, voltage multiplier circuits **Bipolar Junction Transistors:** DC characteristics, CE, CB, CC configurations, biasing, load line			

TEXT BOOKS:

1. Del Toro 'Electrical Engineering Fundamentals' Pearson Education, New Delhi, 2007.
2. V.KMehtaandRohitMehta'PrincipleofElectricalEngineering'SChand&Company,2008
3. Alan S. Moris, Principles of Measurements and Instruments, Printice-Hall of India Pvt. Ltd., New Delhi, 1999.
4. Smarjit Ghosh 'Fundmentals of Electrical and Electronics Engineering, Second Edition 2007

REFERENCES:

1. Rajendra Prasad 'Fundamentals of Electrical engineering' Prentice Hall of India, 2006.
2. Thereja .B.L 'Fundamentals of Electrical Engineering and Electronics' S chand & Co Ltd,

<table>
<tr><td colspan="2">2008.
3. Sanjeev Sharma ‘basics of Electrical Engineering’ S.K International Publishers, New Delhi 2007.
4. John Bird, Electrical Circuits theory and Technology, Elsevier, First India Edition, 2006.
5. Doebeling, E.O., Measurements Systems – Application and Design’, McGrawHill Publishing Co, 1990.</td></tr>
<tr><td>Outcomes</td><td>(1) The Trainees will be able to Develop and employ circuit models for elementary electronic components , circuit analysis, network theorems,
(2) The Trainees will be able to Develop and employ circuit models for role of power flow and energy storage in electronic circuits
(3) The Trainees will be able to Develop and employ circuit models for step and sinusoidal-steady-state response.
(4) The Trainees will be able to Develop and employ circuit models for AC signal powers, three phase circuits and loads,
(5) The Trainees will be able to Brief about diodes and BJTs</td></tr>
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Semester - I				
Course code: 60417	**Engineering Graphics-Practical**	**T/P**	**Credit**	**Hrs./Week**
		P	**4**	**4**

Objectives	● To state the importance of drawing. ● To practice the methods of dimensioning. ● To draw orthographic views from isometric drawings. ● To draw the development of surfaces. ● To draw sectional views
Unit -I	**Introduction to Engineering Drawing:** Principles of Engineering Graphics and their Significance, Drawing Instruments and their Use, Dimensioning principles, Conventions in Drawing Curves Used in Engineering Practice & their Constructions: Conic Sections including the Rectangular Hyperbola- General method only. Drawing of Projections or Views
Unit-II	**Drawing of Projections or Views:** Principles of Orthographic Projections, Conventions, First angle and third angle projections
Unit III	**Isometric Projection:** Principles of Isometric Projection, Isometric scale, Isometric views, Isometric Projection of Objects
Unit IV	**Sections and Sectional Views:** Right Regular Solids- Prism, Cylinder, Pyramid, Cone. Auxiliary views for true shape of sections.
Unit V	**Development and Interpenetration of Solids :** Development of Surfaces of Right Regular Solids- Prisms, Cylinder, Pyramid, Cone and their parts

TEXT BOOK:

1. N.D.Bhatt and V.M.Panchal, "Engineering Drawing", Charotar Publishing House, 50th Edition, 2010

REFERENCES:

1. K. V.Natrajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2009.
2. K.R.Gopalakrishna., "Engineering Drawing" (Vol I&II combined) Subhas Stores, Bangalore, 2007
3. Luzzader, Warren.J., and Duff,John M.,,'' Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production", Eastern Economy Edition, Prentice Hall of India Pvt Ltd, New Delhi, 2005
4. M.B.Shah and B.C.Rana, "Engineering Drawing", Pearson, 2 nd Edition, 2009
5. K.Venugopal and V.Prabhu Raja, "Engineering Graphics", New Age International (P) Limited ,2008.
6. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi,2008.

Outcomes	● Understand the importance of drawing. ● Understand the methods of dimensioning. ● Understand orthographic views from isometric drawings. ● Understand the development of surfaces. ● Understand sectional views

Semester - I				
Course code: 60418	**Engineering Metrology**	**T/P**	**Credit**	**Hrs./Week**
		P	**5**	**5**

Objectives	• To understand Limits Fits and Tolerances • To know Linear Measurements • To understand various Optical Measuring Instruments • To know Surface Roughness Measurement • To understand Screw Thread Measurement
Unit -I	**Limits Fits and Tolerances:** Introduction, normal size, tolerance limits, deviations, allowance, fits and their types – unilateral and bilateral tolerance system, hole and shaft basis systems – interchangeability and selective assembly. Indian standard Institution system – British standard system, International Standard system for plain ad screwed work.
Unit-II	**Linear Measurements:** Length standard, line and end standard, slip gauges – calibration of the slip gauges, Dial indicator, micrometers. Measurement of Angles And Tapers: Different methods – Bevel protractor – angle slip gauges – spirit levels – sine bar – Sine plate, rollers and spheres used to determine the tapers. Limit Gauges: Taylor's principle – Design of go and No go gauges, plug ring, snap, gap, taper, profile and position gauges.
Unit III	**Optical Measuring Instruments :** Tool maker's microscope and its uses – collimators, optical projector – optical flats and their uses, interferometer. Flat Surface Measurement: Measurement of flat surfaces – instruments used – straight edges – surface plates – optical flat and auto collimator.
Unit IV	**Surface Roughness Measurement :** Differences between surface roughness and surface waviness-Numerical assessment of surface finish – CLA,R, R.M.S Values – Rz values, Rz value, Methods of measurement of surface finish-profilograph. Taly surf, ISI symbols for indication of surface finish. Measurement Through Comparators: Comparators – Mechanical, Electrical and Electronic Comparators, pneumatic comparators and their uses in mass production.
Unit V	**Screw Thread Measurement:** Element of measurement – errors in screw threads – measurement of effective diameter, angle of thread and thread pitch, profile thread gauges. Gear Measurement: Gear measuring instruments, Gear tooth profile measurement. Measurement of diameter, pitch pressure angle and tooth thickness.

TEXT BOOK:

1. Jain R.K., "Engineering Metrology", Khanna Publishers, 19th Edition, 2005.

REFERENCES:

1. Galyer J.F.W. and Shotbolt C.R., "Metrology for Engineers", O.R.Cassel, London,1993.
2. Thomas, "Engineering Metrology", Butthinson & Co., 1984.
3. Bewoor A.K. and Kulkarni V.A., "Metrology and Measurements", Tata McGraw-Hill, 2009.
4. Whitehouse D.J., The Handbook of Surface and Nanometrology, CRC Press, 2011.

Outcomes	• Understand Limits Fits and Tolerances • Understand Linear Measurements • Understand various Optical Measuring Instruments • Understand Surface Roughness Measurement • Understand Screw Thread Measurement

Semester - II				
Course code: core 60423	**Applied Hydraulics and Pneumatics**	**T/P**	**Credit**	**Hrs./Week**
		T	**5**	**5**

Objectives	An appreciation of the fundamental principles, design and operation of hydraulic and pneumatic components and systems and their application in manufacturing and mechanical systems.
Unit -I	**FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS** Introduction to Fluid power- Advantages and Applications- Fluid power systems – Types of fluids- Properties of fluids – Basics of Hydraulics – Pascal's Law- Principles of flow – Friction loss- Work, Power and Torque. Problems Sources of Hydraulic power: Pumping Theory – Pump Classification- Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criterion of Linear, Rotary- Fixed and Variable displacement pumps-Problems
Unit-II	**HYDRAULIC ACTUATORS AND VALVES** Hydraulic Actuators: Cylinders– Types and construction, Application, Hydraulic cushioning – Hydraulic motors Control Components: Direction control, Flow control and Pressure control valves-Types, Construction and Operation- Servo and Proportional valves - Applications – Types of actuation. Accessories: Reservoirs, Pressure Switches-Applications- Fluid Power ANSI Symbols - Problems
Unit III	**HYDRAULIC SYSTEMS** Accumulators, Intensifiers, Industrial hydraulic circuits- Regenerative, Pump Unloading, Double-pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-safe, Speed control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical Hydraulic servo systems.
Unit IV	**PNEUMATIC SYSTEMS** Properties of air– Perfect Gas Laws - Compressors- Filter, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust valves, Pneumatic actuators, Design of pneumatic circuit cascade method- Electro pneumatic circuits, Introduction to Fluidics, Pneumatic logic circuits.
Unit V	**TROUBLE SHOOTING AND APPLICATIONS** Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems. Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for a Pick and Place application and tool handling in a CNC machine. - Low cost Automation – Hydraulic and Pneumatic power packs- case studies.

Textbooks

1. Anthony Esposito, "Fluid Power with Applications", Prentice Hall, 2009.

Reference

1. Shanmugasundaram.K, "Hydraulic and Pneumatic Controls", Chand & Co, 2006.
2. Majumdar, S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw Hill, 2001
3. Majumdar, S.R., "Pneumatic Systems – Principles and Maintenance", Tata Mc Graw Hill, 2007.
4. Dudelyt, A Pease and John J Pippenger, "Basic Fluid Power", Prentice Hall, 1987.
5. Srinivasan.R, "Hydraulic and Pneumatic Controls", Vijay Nicole Imprints, 2008.
6. Joji.P, "Pneumatic Controls", John Wiley & Sons India, 2008

Outcomes	• Understanding operating principles and constructional features of hydraulic and pneumatic systems. • Knowledge with selection of hydraulic / pneumatic components • understanding of designing and layout of Hydraulic Power package and trouble shooting.

Semester - II				
Course code: core 60424	**Quality Engineering - Practical**	**T/P**	**Credit**	**Hrs./Week**
		P	**4**	**4**

Objectives	1. To understand and apply the Quality Engineering principles and process. 2. To understand Tools and Techniques of Quality 3. Understand Quality Management Systems 4. To Know Lean Concepts 5. To understand Six Sigma Concepts
Unit -I	**Introduction** Introduction - Need for quality - Evolution of quality - Definitions and dimensions of quality - Quality cost and Quality circles - Basic concepts of TQM - TQM Framework - Barriers to TQM -TQM Principles: Customer satisfaction, Employee involvement and continuous process improvement.
Unit-II	**Tools and Techniques** The seven traditional tools of quality - New management tools- Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs.
Unit III	**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 (EMS) : Introduction-ISO 14000 Series Standards-Concepts of ISO 14001-Requirements of ISO 14001-Benefits of EMS.
Unit IV	**Lean Manufacturing** Conventional Manufacturing versus Lean Manufacturing - Principles of Lean Manufacturing. Basic elements of lean manufacturing - Introduction to LM Tools - Value stream mapping - Procedure and principles.
Unit V	**Six Sigma concepts** Six sigma: Concepts, Methodology, tools for implementation, applications to manufacturing, service sector including IT.

TEXT BOOK:

1. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
2. Suganthi.L and Anand Samuel,"Total Quality Management", Prentice Hall (India) Pvt. Ltd.,2006.

REFERENCES:

1. Dale H.Besterf iled, Carol B.Michna,Glen H. Besterfieid,Mary
2. B.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.
3. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8
4. th Edition, First Indian Edition,Cengage Learning, 2012.
5. Design and Analysis of Lean Production Systems, Ronald G. Askin& Jeffrey B.
6. Goldberg, John Wiley & Sons, 2003

Outcomes	1. Understand of Quality Engineering principles and process. 2. Understand Tools and Techniques of Quality 3. Understand Quality Management Systems 4. Understand Lean Concepts 5. Understand Six Sigma Concepts

Semester - II				
Course code: core 60425	**Engineering Mechanics - Practical**	**T/P**	**Credit**	**Hrs./Week**
		P	**4**	**4**

Objectives	1. To enable students to apply fundamental laws and basic concepts of rigid body mechanics to solve problems of bodies under rest or in motion. 2. To enable the students to apply conditions of static equilibrium to analyse physical systems. 3. To compute the properties of areas and bodies.
Unit -I	**Basics of Statics** Fundamental Principles – Coplanar forces – Resolution and Composition of forces and equilibrium of particles – Forces of a particle in space – Equivalent system of forces – Principle of transmissibility – Single equivalent force – Free body diagram – Equilibrium of rigid bodies in two dimensions and three dimensions.
Unit-II	**Analysis of Structures & Friction** **Analysis of Structures** Types of supports and their reactions – Plane trusses and frames - Analysis of forces by method of joints and method of sections. **Friction** Characteristics of dry friction – simple contact friction – Wedges and Ladder friction.
Unit III	**Properties of Surfaces and Solids** Centroid - First moment of area – Second moment of area – Moment and product of inertia of plane areas – Transfer Theorems - Polar moment of inertia – Principal axes – Mass moment of inertia.
Unit IV	**Virtual Work** Virtual work – Principle of virtual work – System of connected rigid bodies – Degrees of freedom – Conservative forces – Potential energy – Potential energy criteria for equilibrium.
Unit V	**Kinematics & Energy and Momentum Methods** **Kinematics** Displacements, Velocity and Acceleration – Rectilinear motion – Curvilinear motion – Tangential and Normal components – Radial and Transverse components. **Energy and Momentum Methods** Principle of work and energy for a particle and a rigid body in plane motion – Conservation of energy - Principle of impulse and momentum for a particle and a rigid bodies in plane motion – Conservation of momentum.

Textbooks

1. Beer, Johnston, Cornwell and Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, 10th Edition, McGraw-Companies, Inc., New York, 2013.

Reference

1. Russell C Hibbeler and Ashok Gupta, Engineering Mechanics: Statics and Dynamics (11th Edition), Pearson Education Inc., Prentice Hall, 2010.
2. Meriam J.L and Kraige L.G., Engineering Mechanics, Volume I - Statics, Volume II - Dynamics, 7th Edition, John Wiley & Sons, New York, 2012.
3. Rajasekaran S and Sankarasubramanian G, Fundamentals of Engineering Mechanics, 3rd Edition, Vikas Publishing House Pvt Ltd., India, 2013.

Outcomes	1. Compute the resultant of system of forces in plane and space acting on bodies. 2. Predict the support-reactions and the internal forces of the members of various trusses and frames. 3. Analyse equilibrium problems with friction. 4. Apply transfer theorems to determine properties of various sections. 5. Analyse equilibrium of connected bodies virtual work method. 6. Predict motion parameters of bodies under rectilinear, curvilinear and general plane motion.

Semester - II				
Course code: core 60426	**Manufacturing Processes - Practical**	**T/P**	**Credit**	**Hrs./Week**
		P	**5**	**5**

Objectives	1. Students will gain knowledge of manufacturing processes and the skills to develop and manipulate the operating parameters for a given process to avoid defect and improve quality. 2. Students will gain knowledge to understand basic parts and assemblies manufactured using powered and non-powered machine shop equipment in conjunction with mechanical documentation. 3. To gain knowledge in molding and molding practice 4. To gain knowledge in forging, Rolling and extrusion 5. To gain knowledge in welding processes.
Unit -I	**Molding Practices:** Introduction to casting and foundry industry; basic principles of casting processes; sequence in foundry operations; patterns; molding practice; ingredients of molding sand and coresand, sand testing; different molding processes. **Melting Furnaces:** Types of furnaces used in foundry; furnaces for melting; melting practice for steel, cast iron, aluminum alloys, copper alloys and magnesium alloys; safety considerations; fluxing, degassing and inoculation. **Special Casting Techniques:** Investment casting, Shell molding ,die casting, centrifugal casting, plaster mould casting, magnetic casting, squeeze casting, full mould process, strip casting, CO2 molding. **Casting Defects and Foundry Automation:** Defects in castings and its remedies. Energy saving and quality control in foundries; Cleaning and inspection of castings; Foundry automations-moulding machines automation of sand plant, moulding and fettling sections of foundry – Dust and fume control.
Unit-II	**Theory of Plasticity:** Theory of Plasticity - stress tensor – hydrostatic & deviator components of stress – flow curve – true stress strain – yielding criteria – yield locus – octahedral shear stress and shear strains – invariants of stress strain – slip line field theory plastic deformations of crystals. **Plastic Forming of Metal Forging:** Basics of plastic forming & forging- mechanics of metal working – temperature in metal working – strain rate effects – friction and lubrication – deformation zone geometry. Forging process – classification – equipment – calculation of forging loads – forging defects – residual stresses. Plastic Forming of Metals **Rolling and Extrusion:** Rolling and Extrusion – classification -rolling mills - rolling of bars & shapes – rolling forces – analysis of rolling – defects in rolling- theories of hot & cold rolling – torque power estimation. **Extrusion:** classification-equipment – deformation lubrication and defects – analysis – hydrostatic extrusion – tube extrusion. Plastic Forming of Metals
Unit III	**Drawing and Sheet metal forming:** Drawing & Sheet Metal Forming- rod & wire drawing equipment – analysis – deep drawing – tube drawing – analysis, residual stresses sheet metal forming – methods –

	shearing and blanking – bending – stretch forming – deep drawing – forming limit criteria – defects - Stretch forming – press brake forming – explosive forming. **Unconventional Forming Methods:** Electro hydraulic forming – magnetic pulse forming – super plastic forming – electro forming – fine blanking – P/M forging-Isothermal forging – HERF.
Unit IV	**Power Sources:** Classification of welding processes - heat sources, power sources, arc characteristics, V-I relationship, different types of electrodes, ingredients and function of electrode coverings, types of weld joints. **Fusion Welding processes:** Shielded metal arc welding, gas welding, TIG welding, MIG welding, Submerged arc welding processes. **Solid State Welding processes:** Resistance, friction, friction stir, ultrasonic, induction pressure, diffusion welding processes, explosive welding.
Unit V	**Special Welding Processes:** Electron beam, laser beam welding, plasma arc processes; advantages, limitations, Introduction to Robotic welding, underwater welding. **Weld Metallurgy:** Weld thermal cycles and their effects, effects of pre and post weld heat treatments, concept of HAZ, concept of weldability and its assessment. Welding of different materials, defects in welds, their causes and remedies.

TEXT BOOK:

1. S. Kalpakjian, S. R. Schmidt, Manufacturing Engineering and Technology, 7th edition, Pearson India, 2009. ISBN: 978-0133128741.

REFERENCES:

1. M. P. Groover, Principles of Modern Manufacturing, 5th edition, Wiley, 2014. 978-8126547371.
2. E. P. DeGarmo, J. T. Black, and R. A. Kohser, DeGarmo's materials and processes in manufacturing, 11th edition, John Wiley & Sons, 2013. ISBN: 978-8126540464
3. B. Wulff, H. F. Taylor and M. C. Fleming, Foundry Engineering, Wiley Eastern, 2009.
4. American Welding Society, Welding Handbook, AWS, 2009. 4. G. E Dieter, Mechanical Metallurgy, Tata McGraw Hill, 2007.

Outcomes	1. Students will gain knowledge of manufacturing processes and the skills to develop and manipulate the operating parameters for a given process to avoid defect and improve quality. 2. Students will gain knowledge to understand basic parts and assemblies manufactured using powered and non-powered machine shop equipment in conjunction with mechanical documentation.

Semester - II				
Course code:60427	**Environmental Studies**	**T/P**	**Credit**	**Hrs./Week**
		T	**2**	**2**

Objectives	1. Definition, scope and importance of the subject. 2. Need for public awareness. 3. Conserving Renewable and non-renewable resources: 4. Conserving Natural resources and associated problems. 5. Explain the functions of ecosystem, various aspects related to ecosystem **6.** to understand and explain the biodiversity and its conservation 7. to identify the causes, effects and control measures of pollution and will also explain the nuances of disaster management
Unit -I	**Multidisciplinary nature of environmental studies** • Definition, scope and importance. Need for public awareness.
Unit-II	**Natural Resources** a) Forest resources : Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies. f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification. g) Role of an individual in conservation of natural resources. h) Equitable use of resources for sustainable lifestyles.

Unit III	**Ecosystems**
	• Concept of an ecosystem.
	• Structure and function of an ecosystem.
	• Producers, consumers and decomposers.
	• Energy flow in the ecosystem.
	• Food chains, food webs and ecological pyramids.
	• Introduction, types, characteristic features, structure and function of the following ecosystem :-
	  • Forest ecosystem
	  • Grassland ecosystem
	  • Desert ecosystem
	  • Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit IV	**Biodiversity and its conservation** • Introduction – Definition : genetic, species and ecosystem diversity. • Biogeographically classification of India • Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values • Biodiversity at global, National and local levels.

	• India as a mega-diversity nation • Hot-spots of biodiversity. • Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts. • Endangered and endemic species of India • Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.
Unit V	**Environmental Pollution** a) Causes, effects and control measures of :- • Air pollution • Water pollution • Soil pollution • Marine pollution • Noise pollution • Thermal pollution • Nuclear hazards b) Solid waste Management : Causes, effects and control measures of urban and Industrial wastes. c) Role of an individual in prevention of pollution. d) Disaster management • Disasters due to natural calamities such as flood, earthquake, rain, cyclone and landslides. • Manmade disasters – crisis due to fires, accidents, strikes. • Loss of property and life.
Reference and Textbooks 1. Text book of Environmental studies for Undergraduate courses – Dr. Erach Bharucha.	
Outcomes	**At the end of the subject the trainees will be able to** 1. Avail public awareness regarding Environment. 2. Conserving Renewable and non-renewable resources: 3. Conserving Natural resources and associated problems. 4. Ecosystem, various aspects related to ecosystem **5.** Understand and explain the biodiversity and its conservation 6. Identify the causes, effects and control measures of pollution and will also explain the nuances of disaster management

Semester - II				
Course code: 60428	**ADVANCED COMMUNICATIVE ENGLISH**	**T/P**	**C**	**H/W**
		P	**2**	**2**

Objectives	• To improve the students fluency in English, through a well-developed vocabulary and enable them to listen to English spoken at normal conversational speed by educated English speakers and respond appropriately in different socio-cultural and professional contexts. • Further, they would be required to communicate their ideas relevantly and coherently in writing. • To prepare all the students for their placements.
Unit -I	Listening for writing short answers, identifying topic, context, function, etc
Unit -II	Activities on Fundamentals of Inter-personal Communication and Building Vocabulary - Starting a conversation- responding appropriately and relevantly- using the right body language .Role Play indifferent situations & Discourse Skills-using visuals-Synonyms and antonyms, word roots, one-word substitutes, prefixes and suffixes, study of word origin, business vocabulary, analogy idioms and phrases, collocations & usage of vocabulary.
Unit -III	Activities on Reading Comprehension-General Vs Local comprehension, reading for facts, guessing meanings from context, scanning, skimming ,inferring meaning, critical reading &effective googling, understanding sentence structure/ error identification.
Unit -IV	Activities on Presentation Skills - Oral presentations (individual and group) through JAM sessions/seminars/PPTs and written presentations through posters/projects/reports/emails/assignments etc.
Unit -V	Activities on Group Discussion and Interview Skills - Dynamics of group discussion, intervention,summarizing,modulationofvoice,bodylanguage,relevance,fluencyand organization of ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening strategies,answeringstrategies,interviewthroughtele-conference&video-conference and Mock Interviews

Text Book:

1. Technical Communication by MeenakshiRaman and SangeetaSharma, Oxford University Press2009.
2. Advanced Communication Skills Laboratory Manual by SudhaRani,D,Pearson Education2011.
3. Technical Communication by PaulV.Anderson.2007.CengageLearningpvt.Ltd.NewDelhi.
4. Business and Professional Communication: Keys for Workplace Excellence. Kelly M.Quintanilla & ShawnT.Wahl.SageSouthAsiaEdition.SagePublications.2011.
5. The Basics of Communication: A Relational Perspective .SteveDuck &DavidT. McMahan. SageSouth AsiaEdition.SagePublications.2012.
6. English Vocabulary in Useseries, Cambridge UniversityPress2008.
7. Management Shapers Series by Universities Press (lndia) Pvt.Ltd., Himayatnagar, Hyderabad 2008.
8. Handbook for Technical Communication by David A.McMurrey & JoanneBuckley.2012.Cengage Learning.
9. Communication Skills by LeenaSen, PHI LearningPvtLtd.,NewDelhi,2009.

Books for Reference:

1. Communication Skills by LeenaSen, PHI LearningPvtLtd.,NewDelhi,2009.
2. Handbook for Technical Writing by DavidAMcMurrey & JoanneBuckely CENGAGE Learning2008.
3. Job Hunting by ColmDownes, Cambridge University Press2008.
4. Master Public Speaking by AnneNicholls, JAICOPublishingHouse,2006.
5. English for Technical Communication for Engineering Students, Aysha Vishwamohan, Tata McGraw-Hill 2009.
6. Books on TOEFL/GRE/GMAT/CAT/IELTS by Barron's/DELTA/Cambridge University Press.

7. International English for Call Centres by BarryTomalin and Suhashini Thomas, Macmillan Publishers, 2009.	
Outcomes	After Completing this course, the students are able to: • Accomplishment of sound vocabulary and its proper use contextually. • Flair in Writing and felicity in written expression. • Enhanced job prospects. • Effective Speaking Abilities

Semester - II				
Course code: 60429	**Computing Skills LAB-I**	**T/P**	**Credit**	**Hrs./Week**
		P	**2**	**2**
Objectives	● To understand Components of Computer ● To know Operating Systems ● To understand Internet and web browsers ● To know cyber laws ● To make presentations			
Contents	1. COMPONENTS OF COMPUTER 2. OPERATING SYSTEMS 3. INTRODUCTION TO INTERNET, WWW AND WEB BROWSERS 4. CYBER LAWS 5. MAKING SMALL PRESENTATION			
Outcomes	● Understand components of computer ● Understand operating systems ● Understand Internet and web browsers ● Understand cyber laws ● Understand presentations			

Semester - III				
Course code: core	**Mechatronics**	**T/P**	**Credit**	**Hrs./Week**
60431		**T**	**3**	**3**

Objectives	Impart knowledge about the elements and techniques involved in Mechatronics systems which are very much essential to understand the emerging field of automation.
Unit -I	**INTRODUCTION** Introduction to Mechatronics – Systems – Concepts of Mechatronics approach – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensors – Light sensors
Unit-II	**MICROPROCESSOR AND MICROCONTROLLER** Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes – Instruction set, Timing diagram of 8085 – Concepts of 8051 microcontroller – Block diagram,.
Unit III	**PROGRAMMABLE PERIPHERAL INTERFACE** Introduction – Architecture of 8255, Keyboard interfacing, LED display –interfacing, ADC and DAC interface, Temperature Control – Stepper Motor Control – Traffic Control interface.
Unit IV	**PROGRAMMABLE LOGIC CONTROLLER** Introduction – Basic structure – Input and output processing – Programming – Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC.
Unit V	**ACTUATORS AND MECHATRONIC SYSTEM DESIGN** Types of Stepper and Servo motors – Construction – Working Principle – Advantages and Disadvantages. Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies of Mechatronics systems – Pick and place Robot – Engine Management system – Automatic car park barrier.

Textbooks

- Bolton, “Mechatronics”, Printice Hall, 2008
- Ramesh S Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, 5th Edition, Prentice Hall, 2008.

Reference

- Bradley D.A, Dawson D, Buru N.C and Loader A.J, “Mechatronics”, Chapman and Hall, 1993.
- Clarence W, de Silva, "Mechatronics" CRC Press, First Indian Re-print, 2013
- Devadas Shetty and Richard A. Kolk, “Mechatronics Systems Design”, PWS publishing company, 2007.
- Krishna Kant, “Microprocessors & Microcontrollers”, Prentice Hall of India, 2007.
- Michael B.Histand and Davis G.Alciatore, “Introduction to Mechatronics and Measurement systems”, McGraw Hill International edition, 2007.

Outcomes	• Discuss the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical, Electronic Systems and sensor technology. • Discuss the architecture of Microprocessor and Microcontroller, Pin Diagram, Addressing Modes of Microprocessor and Microcontroller.

	• Discuss Programmable Peripheral Interface, Architecture of 8255 PPI, and various device interfacing • Explain the architecture, programming and application of programmable logic controller to problems and challenges in the areas of Mechatronic engineering. • Discuss various Actuators and Mechatronics system using the knowledge and skills acquired through the course and also from the given case studies

Semester - III				
Course code: core 60432	**Electrical Drives**	**T/P**	**Credit**	**Hrs./Week**
		P	**5**	**5**

Objectives	1. To Conceptualize the basic drive system and analyse it for different types of loads. 2. To Analyse the motor situation during starting and braking. 3. To Develop control circuitry and devices for control of motor. 4. To Estimate the motor rating for different condition of load. 5. To Design the converter circuit for control purpose along with its different configuration. 6. To Use PLC and converter control to drive on the basis of energy efficiency
Unit -I	**Definitions and Dynamics of Electric Drives:** Concept of electric drive and its classifications, Types of loads, Four-quadrant drive, Dependence of load torque on various factors, Dynamics of motor-load combination, Steady state stability of an electric drive system, Load Equalization.
Unit-II	**Drive Features of Importance:** Multi-quadrant operations of DC and AC motors, Energy relations during starting and braking. Static Control of Motors: Contactors and relays for electric drives, Control circuits for automatic starters of DC and AC motors.
Unit III	**Estimation of Motors Rating:** Thermal modeling of motors, Types of duty cycles, Calculation of motor rating for duty cycles, Overload factor calculation for short and intermittent duty cycle, Use of load diagrams.
Unit IV	**Solid State Controlled Drives:** Control of DC drives fed through single-phase and three phase semi-converter and full-converter phase-controlled configurations, their analysis, Regeneration and braking through static power converters, control of three phase induction motors by stator voltage and frequency control for speeds below and above synchronous speed,
Unit V	**Controlled drives** Static rotor resistance control, Static ramer and scherbius drives, V/f and Vector control, Energy efficient drives, losses in electrical drive system, Energy conservation in electric drives.

Textbooks

1. Pillai, S.K., a Course in Electric Drives, New Age International (P) Limited, Publishers (1989).

Reference

2. Dubey, G.K., Power Semiconductor Controlled Drives, Prentice Hall Inc. (1989).
3. Bose, B.K., Modern Power Electronics and AC Drives, Prentice-Hall of India Private Limited (2006).
4. Dubey, G.K., Fundamentals of Electric Drives, Narosa Publications (2001).
5. Sen, P.C., Thyristor DC Drives, John Wiley and Sons (1981).

Outcomes	1. Conceptualize the basic drive system and analyse it for different types of loads. 2. Analyse the motor situation during starting and braking. 3. Develop control circuitry and devices for control of motor. 4. Estimate the motor rating for different condition of load. 5. Design the converter circuit for control purpose along with its different configuration. 6. Use PLC and converter control to drive on the basis of energy efficiency

Semester - III				
Course code: core 60433	**Operations Research**	**T/P**	**Credit**	**Hrs./Week**
		P	**5**	**5**

Objectives	• To provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems. • To Understand Linear Models • To Understand Transportation and Network Models • To understand Inventory Models • To understand Queuing Models & Decision Models
Unit -I	**LINEAR MODELS** The phase of an operation research study – Linear programming – Graphical method– Simplex algorithm – Duality formulation – Sensitivity analysis.
Unit-II	**TRANSPORTATION MODELS AND NETWORK MODELS** Transportation Assignment Models –Traveling Salesman problem-Networks models – Shortest route – Minimal spanning tree – Maximum flow models –Project network – CPM and PERT networks – Critical path scheduling – Sequencing models.
Unit III	**INVENTORY MODELS** Inventory models – Economic order quantity models – Quantity discount models – Stochastic inventory models – Multi product models – Inventory control models in practice.
Unit IV	**QUEUEING MODELS** Queueing models - Queueing systems and structures – Notation parameter – Single server and multi server models – Poisson input – Exponential service – Constant rate service – Infinite population – Simulation.
Unit V	**DECISION MODELS** Decision models – Game theory – Two person zero sum games – Graphical solution- Algebraic solution– Linear Programming solution – Replacement models – Models based on service life – Economic life– Single / Multi variable search technique – Dynamic Programming – Simple Problem.

Textbooks

1. Taha H.A., "Operations Research", Sixth Edition, Prentice Hall of India, 2003.

Reference Books

1. Hillier and Libeberman, "Operations Research", Holden Day, 2005
2. Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", John Wiley,2009.
3. Budnick F.S., "Principles of Operations Research for Management", Richard D Irwin, 1990.
4. Philip D.T. and Ravindran A., "Operations Research", JohnWiley, 1992.
5. Shennoy G.V. and Srivastava U.K., "Operation Research for Management", Wiley Eastern,1994.
6. Tulsian and Pasdey V., "Quantitative Techniques", Pearson Asia, 2002.

Outcomes	• Provide knowledge and training in using optimization techniques under limited resources for the engineering and business problems. • Understand Linear Models • Understand Transportation and Network Models • Understand Inventory Model • Understand Queuing Models & Decision Models

Semester - III				
Course code: core 60434	**Computer Aided Design and Manufacturing**	**T/P**	**Credit**	**Hrs./Week**
		P	**5**	**5**

Objectives	1. To understand 3D-solid representation techniques 2. To understand Parametric curves and surfaces 3. To understand data exchange in CAD CAM 4. To develop CNC programs for machining complex geometries 5. To develop Manufacturing programs using CAM software's
Unit -I	**Overview of CAD/CAM:** Hardware and software requirements in CAD/CAM, Introduction to geometric representation- Implicit, explicit, parametric equations; Transformations in 2D and 3D, projections
Unit-II	**Parametric curves:** Differential geometry of curves, Cubic Hermite curves - Algebraic and geometric form, Blending functions, subdivision, re-parameterization and composite Hermite curves, continuity aspects, Bezier curves - control polygons and Bernstein basis, de Casteljau algorithm, continuity aspects, rational Beziers, B-spline curves - periodic, open and non-uniform knot vectors and corresponding curves, rational B-splines, NURBS curve.
Unit III	**Parametric surfaces:** Hermite surface - algebraic and geometric form, subdivision and reparameterization, continuity of surfaces, Bezier surface - control net representation, continuity aspects, rational Bezier surfaces, B-Spline surfaces - periodic, open and nonuniform knot vectors and corresponding surfaces, rational B-splines, NURBS surface.
Unit IV	**Representation of solids:** Topology of surfaces, Euler and modified form of equations, representations - Quadtree, Octree, Halfspace, Boundary Representation (B-Rep), Constructive Solid Geometry (CSG), Boolean operations in 2D - set membership classification, Union, Difference and Intersection.
Unit V	**Data exchange in CAD/CAM:** CNC part programming for ordinary and complex geometry, CNC Program generation from CAD models, Concepts of native and neutral file formats for data exchange, Interfacing with manufacturing systems, Concepts of reverse engineering, Rapid prototyping, Computer aided process planning

Textbooks

1. I. Zeid, CAD/CAM Theory and Practice, Tata McGraw Hill, 2006.

Reference Books

1. D. F. Rogers and J. A. Adams, Mathematical Elements for Computer Graphics, McGraw Hill, 2002.
2. C. K. Chua, K. F. Leong, C. S. Lim, Rapid prototyping, World Scientific, 2010.
3. D. F. Rogers, An Introduction to NURBS, Morgan Kaufmann, 2001.
4. J. Hoschek and D. Lasser, Computer Aided Geometric Design, AK Peters, 1996.
5. M. E. Mortenson, Geometric Modeling, John Wiley & Sons, 1985. 2. G. E. Farin, Curves and Surfaces for CAGD, Morgan Kaufmann, 2002.

Outcomes	1. To understand 3D-solid representation techniques 2. To understand Parametric curves and surfaces 3. To understand data exchange in CAD CAM 4. To develop CNC programs for machining complex geometries 5. To develop Manufacturing programs using CAM software's

Semester - III				
Course code: 60435	**INTERVIEW TECHNIQUES & INTERPERSONAL COMMUNICATIONS**	**T/P**	**C**	**Hrs./Week**
		P	**5**	**5**

Objectives	• Communicate effectively (Verbal and Non Verbal) • Effectively manage the team as a team player • Develop interview skills • Develop Leadership qualities and essentials
Unit -I	**Communication Skills:** Introduction, Definition, The Importance of Communication, The Communication Process – Source, Message, Encoding, Channel, Decoding, Receiver, Feedback, Context **Barriers to communication:** Physiological Barriers, Physical Barriers, Cultural Barriers, Language Barriers, Gender Barriers, Interpersonal Barriers, Psychological Barriers, Emotional barriers **Perspectives in Communication:** Introduction, Visual Perception, Language, Other factors affecting our perspective - Past Experiences, Prejudices, Feelings, Environment
Unit -II	**Elements of Communication**: Introduction, Face to Face Communication – Tone of voice, Body Language (Non-Verbal Communication), Verbal Communication Physical Communication. **Communication Styles:** Introduction, The Communication styles Matrix with example for each Direct Communication style, Spirited Communication style, Systematic Communication style, Considerate Communication style.
Unit -III	**Basic Listening Skills:** Introduction, Self-Awareness, Active Listening, Becoming an Active Listener, Listening in Difficult Situations. **Effective Written Communication:** Introduction, When and When Not to Use Written Communication - Complexity of the Topic, Amount of Discussion‘ Required, Shades of Meaning, Formal Communication. **Writing Effectively:** Subject Lines, Put the Main Point First, Know Your Audience, Organization of the Message
Unit -IV	**Interview Skills:** Purpose of an interview, Do‘s and Dont‘s of an interview **Giving Presentations:** Dealing with Fears, Planning your Presentation, Structuring Your Presentation, Delivering Your Presentation, Techniques of Delivery
Unit -V	**Group Discussion:** Introduction, Communication skills in group discussion, Do‘s and Dont‘s of group discussion

Text Book:

1. Basic communication skills for Technology, Andreja. J. Ruther Ford, 2nd Edition,Pearson Education, 2011
2. Communication skills, Sanjay Kumar, Pushpalata, 1st Edition, Oxford Press, 2011
3. Organizational Behaviour, Stephen .P. Robbins, 1st Edition, Pearson, 2013
4. Brilliant- Communication skills, Gill Hasson, 1st Edition, Pearson Life, 2011
5. The Ace of Soft Skills: Attitude, Communication and Etiquette for success, GopalaSwamy Ramesh, 5th Edition, Pearson, 2013
6. Developing your influencing skills, Deborah Dalley, Lois Burton, Margaret, Greenhall, 1st Edition Universe of Learning LTD, 2010
7. Communication skills for professionals, Konar nira, 2ndEdition, New arrivals –PHI, 2011

Books for Reference:

1. Personality development and soft skills, Barun K Mitra, 1st Edition, Oxford Press,2011
2. Soft skill for everyone, Butter Field, 1st Edition, Cengage Learning india pvt.ltd,2011

<table>
<tr><td colspan="2">3. Soft skills and professional communication, Francis Peters SJ, 1stEdition, McGraw Hill Education, 2011
4. Effective communication, John Adair, 4th Edition, Pan Mac Millan,2009
5. Bringing out the best in people, Aubrey Daniels, 2nd Edition, Mc Graw Hill, 1999</td></tr>
<tr><td>Outcomes</td><td>After Completing this course, the students are able to:
Communicate effectively (Verbal and Non Verbal)
Effectively manage the team as a team player
Develop interview skills
Develop Leadership qualities and essentials</td></tr>
</table>

Semester III				
Course code: 60436	**Electronics and Instrumentation**	**T/P**	**Credit**	**Hrs./Week**
		P	**4**	**4**
Objectives	• To study the basics of Electronics. • To study the Characteristics of Semiconductor action and Transistor. • To study the application of Semiconductor Devices like UJT, MOSFET, SCR, UJT. • To study the Basic of Measurement. • To study the use of Primary sensing element and Signal Conditioning Unit			
Unit -I	**Semiconductor diode:** Semiconductor diode – Crystal diode as a rectifier– Equivalent circuit of a Crystal Diode– Half Wave Rectifier – Efficiency of Half Wave Rectifier – Full wave Rectifier – Center tap Full Wave Rectifier – Full Wave Bridge Rectifier Efficiency of Full Wave Rectifier – Zener Diode – Equivalent Circuit of Zener Diode – Zener Diode as Voltage Stabilizer.			
Unit-II	**Transistor & its biasing:** Transistor Symbols – Transistor as an Amplifier – Connections– CB, CE,&CC – Characteristics – Comparison of Transistor Connection. Transistor as an Amplifier in CE arrangement – Transistors Load Line analysis, Operating Point– CE Circuit – Performance of Transistor Amplifier – Cut Off and Saturation points – Transistor biasing: Methods of transistor Biasing– Base resistor method– Biasing with feedback resistor – Voltage divider bias method .			
Unit III	**FET, SCR & UJT:** Types of Field Effect Transistor – JFET – Working Principles of JFET– JFET as an Amplifier and its Output Characteristics – JFET Applications – MOSFET Working Priniciples, SCR – Equivalent Circuit and V-I Characteristics. SCR as a Half wave and full wave rectifier– Application of SCR – Triac and Diac characteristics and its applications. UJT– Equivalent Circuit of a UJT and its Characteristics.			
Unit IV	**Measurement system :** Measurements and its Significance, Methods of Measurements, Classification of Instruments and application, Elements of a Generalized Measurement System, Static and Dynamic Characteristics of an Instruments, Errors in Measurement Systems – Units, System, Dimension and standards			
Unit V	**Primary sensing elements and signal conditioning:** Introduction – Transducers – Advantage of Electric Transducers, Classification Based upon Principle of Transduction, Primary and Secondary transducer, Passive and Active transducers, Analog and Digital transducers, Transducers and inverse transducers and examples for each. Characteristics and Choice of transducers, Input, Transfer and output Characteristics and its application. Operational Amplifier, Characteristics of Operational Amplifier, Attenuator, Amplitude Modulation and Demodulation, Basic Filters, A/D Converters. Simple Types			
Text books: ● Sawhney, A. K., A Course in Electrical and Electronic Measurement and Instrumentation, Dhanpat Rai & Sons, New Delhi,1999. ● V.K, Mehta., and Rohit Metha, Principles of Electronics, S. Chand & Company Ltd., First Edition, 1980. ● Millman, and Halkias, Electronic devices and Circuits, Tata McGraw Hill International Edition, 1994. ● Mithal, G. K., Electronic Devices and Circuits, Khanna Publishers, New Delhi, 1999.				

References books:

- Salivahanan, S., Sureshkumar, N., and Vallavaraj, A., Electronic Devices and Circuits, Tata McGrawHill, New Delhi, 1998.
- Ben G. Streetman and Sanjay Banerjee, Solid State Electronic Devices, Pearson Education, 2000.
- Ernest O. Doebelin, Measurement Systems – Application and Design, Tata McGraw-Hill, New Delhi, 2004

Outcomes	• Study the basics of Electronics. • Study the Characteristics of Semiconductor action and Transistor. • Study the application of Semiconductor Devices like UJT, MOSFET, SCR, UJT. • Study the Basic of Measurement. • Study the use of Primary sensing element and Signal Conditioning Unit

Semester III				
Course code: NME 60437	**Total Quality Management**	**T/P**	**Credit**	**Hrs./Week**
		P	**2**	**3**

Objectives	● To Explain the concept of TQM. ● To Appreciate the use of principles of TQM to meet customer satisfaction. ● To Solve problem using the Quality control tools. ● To Use PDCA cycle for continuous improvement. ● Determine the process capability of a manufacturing process.
Unit -I	**Introduction:** Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM.
Unit-II	**TQM Principles:** Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – Supplier partnership – Partnering, Supplier selection, Supplier Rating.
Unit III	**TQM Tools & Techniques I:** The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.
Unit IV	**TQM Tools & Techniques II:** Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures.
Unit V	**Implementation of TQM:** Steps, KAIZEN, 5S, JIT, POKAYOKE, I - Introduction to Robust Design, Taguchi Principles and Design, Case studies.

Text Books:

1. "Total Quality Management", Date H.Besterfiled, Pearson Education Asia. (Indian reprint 2002)
2. "Total Quality Management", V.Jayakumar, Lakshmi Publications. (reprint 2005)
3. "Training manual on ISO 9001 : 2000 & TQM", Girdhar J.Gyani, Raj Publishing House, Second Edition 2001
4. "Quality Management", Howard Cuitlow, Tata Mc Graw Hill, 1998

Reference:

1. "Total Quality Management", Oakiand.J.S. Butterworth Heinemann Ltd. Oxford 1989.
2. "Quality Management – Concepts and Tasks" Narayana.V and Sreenivasan.N.S., New Age International 1996.
3. "Total Quality Management for engineers", Zeiri. Wood Head Publishers. 1991.
4. "Quality Planning and Analysis", Juran J.M and Frank M.Gryna Jr., TMH. India. 1982
5. ISO 9001, Brain Rethry, Productivity and Quality Publishing Pvt. Ltd. 1993.
6. Quality Auditing D.Mills, Chapman and Hall, 1993.

Outcomes	● Define quality and appreciate its signature. ● Explain the concept of TQM. ● Appreciate the use of principles of TQM to meet customer satisfaction. ● Solve problem using the Quality control tools. ● Apply Brainstorming and quality circle to solve problems. ● Use PDCA cycle for continuous improvement. ● Appreciate the benefits of implementing 5S concepts. ● Collect, classify and present the data. ● Determine the process capability of a manufacturing process. ● Practice on management planning tools. ● Use Bench Mark and JIT concepts. ● To understand DWM (DAILY WORK MANAGEMENT) ● To understand Policy deployment

<table>
<tr><th colspan="5">Semester - III</th></tr>
<tr><th colspan="2">Course code:</th><th rowspan="2">Self – Learning Course – I – MOOCs - I</th><th>T/P</th><th>Credit</th><th>Hrs./Week</th></tr>
<tr><td colspan="2"></td><td>--</td><td>….</td><td>….</td></tr>
<tr><td>Objectives</td><td colspan="5">A massive open online course (MOOC) is a typically free web-based distance learning program that's designed for large numbers of geographically dispersed students.
A MOOC might be patterned on a college or university course, or it can be less structured. Although they don't always offer academic credits, these courses often offer a certification, enhance employment opportunities or further studies. Typically, MOOCs are used for higher education, upskilling and career advancement.</td></tr>
<tr><td></td><td colspan="5">The course provider, which is often a university, supplies the course materials and instructors. The LMS platform, such as EdX, Canvas, Coursera or Udacity, provides the technological infrastructure for course modules, user access and other learning resources.
MOOCs consist of traditional class materials and can include the following:
Filmed or recorded video lectures.
Assessments.
Readings.
Problem sets.
Online quizzes and examinations.
Interactive learning modules.
Interaction with other students via discussion forums.</td></tr>
<tr><td colspan="6">Reference
<u>https://ugcmoocs.inflibnet.ac.in/</u>
<u>https://ugcmoocs.inflibnet.ac.in/index.php/ugccourses_data</u>
<u>https://www.coursera.org/courses?query=mooc</u>
<u>https://www.alagappauniversity.ac.in/links/swayam</u></td></tr>
<tr><td>Outcomes</td><td colspan="5">MOOCs widespread adoption and use of online courses provides the following benefits:
No dependence on a physical location.
Improved access to higher education.
Affordability of higher education
Flexible learning schedule
Collaboration opportunities
Preview of college-level courses
Easy performance evaluation and monitoring</td></tr>
</table>

<table>
<tr><th colspan="5">Semester - III</th></tr>
<tr><td colspan="2" rowspan="2">Course code:</td><td rowspan="2">Extension Activities</td><td>T/P</td><td>Credit</td><td>Hrs./Week</td></tr>
<tr><td>--</td><td>1</td><td>…..</td></tr>
<tr><td>Objectives</td><td colspan="5">Extension Activities will be organized for 2 days in the Third Semester. The programme may be organized in any Saturday and Sunday.
A meeting of all the staff of the College (Teaching, Administrative and Technical Staff) be conducted before departing to the camp in which each and every aspect like Programmes to carried out, accommodation, food, medical aid, transport facilities, etc., should be thoroughly discussed.
One credit will be allotted for this Extension Activities. The marks allotted for each camp will be 100. Each student participating in the camp will be evaluated internally for 100 marks.</td></tr>
<tr><td></td><td colspan="5">The criteria for evaluation of Extension Activities will be as follows:
<table>
<tr><th>S. No.</th><th>Criteria</th><th>Maximum Marks</th></tr>
<tr><td>1.</td><td>Interaction with villagers</td><td>10</td></tr>
<tr><td>2.</td><td>Participation / Attitude towards work</td><td>10</td></tr>
<tr><td>3.</td><td>Participation in interaction and discussion</td><td>10</td></tr>
<tr><td>4.</td><td>Knowledge of problems / issues</td><td>10</td></tr>
<tr><td>5.</td><td>Organising & decision making ability</td><td>20</td></tr>
<tr><td rowspan="2">6.</td><td>Expression: a) Cultural programmes</td><td>10</td></tr>
<tr><td>b) Report Writing</td><td>20</td></tr>
<tr><td>7.</td><td>Ability to adjust and work in a team</td><td>10</td></tr>
<tr><td colspan="2">Total</td><td>100</td></tr>
</table></td></tr>
</table>

Semester - IV				
Course code: core 60441	**Low Cost Automation**	**T/P**	**Credit**	**Hrs./Week**
		T	**3**	**4**
Objectives	• To understand Fluid power principles and hydraulic pumps • To know Hydraulic actuators and valves • To understand Hydraulic systems • To understand Pneumatic systems • Trouble shooting Hydraulic and Pneumatic systems			
Unit -I	**Fluid power principles and hydraulic pumps:** Introduction to Fluid power- Advantages and Applications- Fluid power systems – Types of fluids- Properties of fluids – Basics of Hydraulics – Pascal's Law- Principles of flow – Friction loss- Work, Power and Torque. Problems Sources of Hydraulic power: Pumping Theory – Pump Classification- Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criterion of Linear, Rotary- Fixed and Variable displacement pumps-Problems			
Unit-II	**Hydraulic actuators and valves:** Hydraulic Actuators: Cylinders– Types and construction, Application, Hydraulic cushioning - Hydraulic motors Control Components: Direction control, Flow control and Pressure control valves- Types, Construction and Operation- Servo and Proportional valves - Applications – Types of actuation. Accessories: Reservoirs, Pressure Switches- Applications- Fluid Power ANSI Symbols -Problems			
Unit III	**Hydraulic systems:** Accumulators, Intensifiers, Industrial hydraulic circuits- Regenerative, Pump Unloading, Double pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-safe, Speed control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical Hydraulic servo systems.			
Unit IV	**Pneumatic systems:** Properties of air– Perfect Gas Laws- Compressors- Filter, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust valves, Pneumatic actuators, Design of pneumatic circuit cascade method- Electro pneumatic circuits, Introduction to Fluidics, Pneumatic logic circuits.			
Unit V	**Trouble shooting and applications:** Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems. Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for a Pick and Place application and tool handling in a CNC machine. - Low cost Automation – Hydraulic and Pneumatic power packs- case studies.			

Text books:

1. Anthony Esposito, "Fluid Power with Applications", Prentice Hall, 2009.
2. Majumdar, S.R., "Pneumatic Systems – Principles and Maintenance", Tata Mc Graw Hill, 2007.

Reference books:

3. Shanmugasundaram.K, "Hydraulic and Pneumatic Controls", Chand & Co, 2006.
4. Majumdar, S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata Mc Graw Hill,2001
5. Dudelyt, A Pease and John J Pippenger, "Basic Fluid Power", Prentice Hall, 1987.
6. Srinivasan.R, "Hydraulic and Pneumatic Controls", Vijay Nicole Imprints, 2008.
7. Joji.P, "Pneumatic Controls", John Wiley & Sons India, 2008

Outcomes	• Understand Fluid power principles and hydraulic pumps • Know Hydraulic actuators and valves • Understand Hydraulic systems • Understand Pneumatic systems • Trouble shooting Hydraulic and Pneumatic systems

Semester - IV				
Course code: core	**CNC Machines and**	**T/P**	**Credit**	**Hrs./Week**
60442	**Programming**	**P**	**4**	**4**

Objectives	● To Understand evolution and principle of CNC machine tools ● To Describe constructional features of CNC machine tools ● To Explain drives and positional transducers used in CNC machine tools ● To Write simple programs for CNC turning and machining centres ● To Generate CNC programs for popular CNC controllers ● To Describe tooling and work holding devices for CNC machine tools
Unit -I	**Introduction to NC and CNC:** Conventional Machines – NC Machines – Basic components of NC machines CNC machines - classification of CNC machines, Need, benefits and limitations.
Unit-II	**Construction of CNC Machines:** Constructional features of CNC machines- Machine Structure – Slide ways- Spindle – Drive Units – Feedback control – Feedback devices –Tools and work holding devices – Trouble Shooting - Mechanical, Electrical& Pneumatics - Common Faults and Remedies.
Unit III	**Manual Part Programming:** Manual part Programming – Coordinate systems, Adaptive Control, G codes, M codes, Part Programming – Point to Point –Straight line – Curved path - Simple programming for CNC Lathe – CNC Milling machines.
Unit IV	**Advanced Part Programming:** Canned cycles- Drill – Dwell- Peck drill- Bore- Non standard fixed cycles, Subroutines and Macros.
Unit V	**CNC Programming by CAD/CAM:** CAD Modelling of 3D components- CAM Preparatory commands, transformations, subroutines, canned cycles Verification tools - CNC program generation from CAD model- CNC controller and motion control in CNC system, Applications of CNC - Recent advances in CNC machines.

TEXT BOOKS:

1. "Mechatronics" HMT, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.
2. Mike Mattson., "CNC Programming Principles and Applications", Delmar Cengage learning, 2010.

REFERENCE BOOKS:

1. Evans K., Polywka J. and Stanley Gabrel., "Programming of CNC Machines", Third Edition – Industrial Press Inc, New York, 2007
2. Madison J., "CNC Machining Hand Book", Industrial Press Inc., 1996.
3. Smid P., "CNC Programming Hand book", Industrial Press Inc., 2007 Third Edition
4. Jones B.L., "Introduction to Computer Numerical Control", Pitman, London, 1987.
5. Radhakrishnan P., "Computer Numerical Control Machines", New Central Book Agency, 2002.

Outcomes	● Understand evolution and principle of CNC machine tools ● Describe constructional features of CNC machine tools ● Explain drives and positional transducers used in CNC machine tools ● Write simple programs for CNC turning and machining centres ● Generate CNC programs for popular CNC controllers ● Describe tooling and work holding devices for CNC machine tools

Semester - IV				
Course code: core	**Sensors and Controls**	**T/P**	**Credit**	**Hrs./Week**
60443		**P**	**4**	**5**

Objectives	1. To Understand the working principle of various sensors. 2. To Calibrate a sensor for acquiring data. 3. To Develop a control scheme based on sensor feedback.
Unit -I	**Introduction:** Description of measuring devices and dynamic characteristics, active and passive sensors and transducers, classifications.
Unit-II	**Motion Sensors:** Resistive strain gauge, LVDT, RVDT, capacitive, piezo, seismic pick ups, vibrometers and accelerometers. **Sensors and Transducers :** flow, temperature, force, pressure and torque sensors; Current, torque and speed measurements using digital measurement techniques.
Unit III	**Optical sensors:** Lasers. photo-detectors and optical fiber as sensors **Sensors in Robotics:** Classification, Characteristics, Internal Sensors – position, velocity, acceleration sensors, Force sensors, External sensors – proximity, touch and slip sensors. Robotic vision, Process of Imaging, Architecture of Robotic Vision Systems, Image Acquisition, Components of Vision System, Image Representation, Image Processing.
Unit IV	**Advanced Sensors:** Semiconductor sensors, Hall elements. Silicon sensors for sensing radiation, mechanical, magnetic, chemical and other signals, Catalytic devices, gas sensors and acoustic sensors.
Unit V	**Sensor based Control:** Types of controllers, electrical, pneumatic and hydraulic prime movers and associated control hardware, closed loop control of microcomputer based drives. Relay control systems and PLC systems and programming, control including sequence control. Sensor based control of various actuators, mechatronic devices and autonomous mobile robots

Reference and Textbooks

1. J. Vetelino and A. Reghu, Introduction to sensors, CRC Press, 2010, ISBN 9781439808528.
2. J. Fraden, Handbook of Modern Sensors: Physics, Designs and Applications, 4th edition, Springer, 2010
3. T. G. Beckwith, R. D. Marangoni and J. H. Lienhard V., Mechanical Measurements, Pearson Prentice Hall, 2009.
4. Doebelin, Measurement systems: Applications and Design, 5th edition, McGraw Hill Book, 2004.
5. I. R. Sinclair, Sensors and Transducers, Elsevier, 2001, ISBN: 978-0-7506-4932-2.
6. J. S. Wilson, Sensor Technology Handbook, Newnes, 2004, ISBN: 0750677295.
7. B. K. Ghosh, T. J. Tarn and N. Xi, Control in Robotics and Automation: Sensor-Based Integration, Academic Press, 1999, ISBN: 978-0-12-281845-5
8. C.W. de Silava, Sensors and Actuators, 2nd edition, CRC Press, 2016.

Outcomes	1. understand the working principle of various sensors. 2. calibrate a sensor for acquiring data. 3. develop a control scheme based on sensor feedback.

Semester - IV				
Course code:	**Industrial Safety**	**T/P**	**Credit**	**Hrs./Week**
60444		**P**	**2**	**….**

Objectives	• To Effectively communicate information on Health safety and environment facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering activities. • To Competent safety Engineer rendering expertise to the industrial and societal needs at national and global level. • To Provide knowledge on safety in various maintenance situations, personal protective equipment and fire safety.
Unit -I	**Safety in Metal Working Machinery and Wood Working Machines** General safety rules, principles, maintenance, Inspections of turning machines, boring machines, milling machine, planning machine and grinding machines, CNC machines.
Unit-II	**Principles of Machine Guarding** Guarding during maintenance, Zero Mechanical State (ZMS), Definition, Policy for ZMS – guarding of hazards - point of operation protective devices, machine guarding, types, fixed guard, interlock guard, automatic guard, trip guard, electron eye, positional control guard, fixed guard fencing- guard construction- guard opening. Selection and suitability: lathe-drilling-boring-milling -grinding-shaping
Unit III	**Safety in Welding and Gas Cutting** Gas welding and oxygen cutting, resistances welding, arc welding and cutting, common hazards, personal protective equipment, training, safety precautions in brazing, soldering and metalizing – leak detection-pipe line safety-storage and handling of gas cylinders.
Unit IV	**Safety in Cold Farming and Hot Working Of Metals** Cold working, power presses, point of operation safe guarding, auxiliary mechanisms, feeding and cutting mechanism, hand or foot-operated presses, power press electric controls. Hot working safety in forging, hot rolling mill operation, safe guards in hot rolling mills Safety in gas furnace operation.
Unit V	**Safety in Finishing, Inspection and Testing** Heat treatment operations, electro plating, sand and shot blasting, safety in inspection and testing, dynamic balancing, hydro testing. Health and welfare measures in engineering industry-pollution control in engineering industry .industrial waste disposal.

TEXT BOOKS:

1. "Safety Management by John V. Grimaldi and Rollin H. Simonds, All India Travelers Book seller, New Delhi, 1989.
2. "Safety in Industry" N.V. Krishnan Jaico Publishery House, 1996.

REFERENCES:

1. "Accident Prevention Manual" – NSC, Chicago, 1982.
2. "Occupational safety Manual" BHEL, Trichy, 1988.
3. Indian Boiler acts and Regulations, Government of India.
4. Safety in the use of wood working machines, HMSO, UK 1992.
5. Health and Safety in welding and Allied processes, welding Institute, UK, High Tech. Publishing Ltd., London, 1989.

Outcomes	• Effectively communicate information on Health safety and environment facilitating collaboration with experts across various disciplines so as to create and execute safe methodology in complex engineering activities.

	• Competent safety Engineer rendering expertise to the industrial and societal needs at national and global level. • Provide knowledge on safety in various maintenance situations, personal protective equipment and fire safety.

Semester - IV				
Course code: core	**Microprocessor & Microcontroller**	**T/P**	**Credit**	**Hrs./Week**
60445		**P**	**5**	**5**

Objectives	• Understand fundamental operating concepts behind microprocessors and microcontrollers. • Emphasis on the hardware features of Microprocessor 8085, 8086 and Microcontroller 8051 with their functions • Understand commonly used peripheral / interfacing
Unit -I	**8085 PROCESSOR** Hardware Architecture, pin diagram – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Timing Diagram – Interrupts.
Unit-II	**PROGRAMMING OF 8085 PROCESSOR** Instruction - format and addressing modes – Assembly language format – Data transfer, data manipulation& control instructions – Programming: Loop structure with counting & Indexing – Look up table - Subroutine instructions - stack.
Unit III	**8051 MICRO CONTROLLER** Hardware Architecture, pin diagram – Functional Building Blocks of Processor – Memory organization – I/O ports and data transfer concepts– Serial Communication – Interrupts-Introduction to Arduino.
Unit IV	**PERIPHERAL INTERFACING** Introduction on Architecture, configuration and interfacing, with ICs: 8255 , 8259 , 8254,8237,8251, 8279 ,- A/D and D/A converters.
Unit V	**MICRO CONTROLLER PROGRAMMING & APPLICATIONS** Data Transfer, Manipulation, Control Algorithms& I/O instructions – Simple programming exercises- key board and display interface – Closed loop control of servo motor- stepper motor control – Washing Machine Control

Textbooks

- Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice Hall of India, New Delhi, 2007.

Reference

- Muhammad Ali Mazidi & Janice Gilli Mazidi, R.D.Kinely 'The 8051 Micro Controller and Embedded Systems', PHI Pearson Education, 5th Indian reprint, 2003.
- R.S. Gaonkar, 'Microprocessor Architecture Programming and Application', with 8085, Wiley Eastern Ltd., New Delhi, 2013
- N.Senthil Kumar, M.Saravanan, S.Jeevananthan, 'Microprocessors and Microcontrollers', Oxford, 2013.
- Soumitra Kumar Mandal, Microprocessor & Microcontroller Architecture, Programming & Interfacing using 8085,8086,8051,McGraw Hill Edu,2013.
- Valder – Perez, "Microcontroller – Fundamentals and Applications with Pic," Yeesdee Publishers, Tayler & Francis, 2013.

Outcomes	1. Distinguish the feature of the 8085 microprocessor, Hardware Architecture and PIN diagram. 2. Demonstrate programming proficiency using the various addressing

	modes and data transfer instructions of 8085 microprocessor 3. Acquaint the knowledge on architecture and programming of Microcontroller 8051. 4. Illustrate the interrupts handling and demonstrate peripherals applications in different IC and Know about A/D and D/A converters. 5. Apply the programming concepts to interface the hardware units with microprocessor and Microcontroller

Semester - IV				
Course code: 60446	**Professional Etiquettes**	**T/P**	**Credit**	**Hrs./Week**
		T	**4**	**4**
Objectives	• To Demonstrate an understanding of professionalism in terms of workplace behaviours and workplace relationships. • To Adopt attitudes and behaviours consistent with standard workplace expectations. • To Present oneself with finesse and making others comfortable in a business setting. • To Develop basic life skills or etiquettes in order to succeed in corporate culture.			
Unit -I	**Business Etiquettes:** An Overview - Significance of Business Etiquettes in 21st Century Professional Advantage - Need and Importance of Professionalism -Leveraging the Use of technology in social media **Workplace Etiquette** Personal Appearance - Formal Dressing, Casual Dressing, Accessories for Men & Women, Footwear, General Appearance, What To Wear for Different Occasions. Using the Right Tone of Voice, Managing your volume in Business Settings, Sounding Confident. Dealing with Body Odour, Dealing with Bad Breath, Using Perfume -Etiquette for Personal Contact- Introductions, Getting the names right, Handshakes, Facial Expressions, Eye Contact, Hand gestures & Posture - Etiquette in and around the Office- Conversations at Work, Dealing with Colleagues, Difficult People and Issues Professionally ; Dealing with Confidential Issues in the Office, Dealing with Ethical Dilemmas - Office Party Etiquette- alcohol, attire, attendance, food, conversations, introductions, entertaining customers.			
Unit-II	**E-Mail Etiquette** Significance of Netiquette - Enforcement of email etiquettes in the organization - E-mail: Way of professional communication - Basic Email Etiquettes: Proper Grammar, Spelling, Punctuation, Styling and Formatting, Body of Email, Response, Privacy - What every official mail should contain- Professional email address, Salutation, Subject line, concise body, closing the email, CC & BCC. **Telephone Etiquette** Telephone Communication Techniques -Placing Telephone calls, Answering Calls, Transferring Calls, Putting Calls on Hold, Taking Messages, Handling Rude Callers, Tactful Responses, Leaving Professional Messages -Developing Cell Phone Etiquettes -Voicemail Etiquette - Telephonic Courtesies			
Unit III	**Meeting Etiquette** Managing a Meeting-Meeting agenda, Meeting logistics, Minute taking, protocols during the meeting; Duties of the chairperson - Ground rules for conducting meeting - Effective Meeting Strategies - Preparing for the meeting, Conducting the meeting, Evaluating the meeting - Business Card Etiquette - Carrying business cards, Exchanging business cards, Receiving and storing business cards. **Dining Etiquette** Basics of Dining Etiquettes -Basic essentials of dining table etiquettes - Napkin Etiquette, Drinking Soup, seating arrangements, laying the table, how to use Cutlery, Posture & Behavior, Do's and Don'ts - International Dining Etiquettes: Dining essentials in other countries, American & Continental Styles of Eating - Business Meal Etiquette			

Unit IV	**Interview Etiquette For Applicants** What employers are looking for - Types of interviews - Top interview tips - preparing for an interview - Recommended interview attire - Interview checklist - Preparing for a telephonic interview - Frequently Asked Questions (FAQs) during interview - Common reasons for applicant rejection **Public Speaking Etiquette** Speak hands-free, inject humor, Encourage Q and A's - Understand the power in a pause, - Stay mindful of the sound of your own voice - Understand your audience
Unit V	**Presentation Etiquette** How to design great presentations – Colour scheme, font size, content, spellings, animation - How to make effective presentations – Body language, confidence, Eye contact - Common mistakes during presentations **Multi-Cultural Challenges** Multi-cultural Etiquette - Examples of Cultural Insensitivity- Cultural Differences and their Effects on Business Etiquette

Textbooks

1. Raghu Palat, 'Indian Business Etiquette' , Jaico Books

Reference Books

1. Barbara Pachter & Marjorie Brody, 'Complete Business Etiquette Handbook', Prentice Hall
2. Nancy Mitchell, 'Etiquette Rules : A Field Guide to Modern Manners', Wellfleet Press
3. Dorothea Johnson & Liv Tyler,' Modern Manners: Tools to take up to the top', Potter Style

Outcomes	• Demonstrate an understanding of professionalism in terms of workplace behaviours and workplace relationships. • Adopt attitudes and behaviours consistent with standard workplace expectations. • Presenting oneself with finesse and making others comfortable in a business setting. • Developing basic life skills or etiquettes in order to succeed in corporate culture.

Semester - IV				
Course code: 60447	**Digital Electronics**	**T/P**	**Credit**	**Hrs./Week**
		P	**4**	**4**
Objectives	• To Analyze different methods used for simplification of Boolean expressions. • To Design and implement Combinational circuits. • To Design and implement synchronous and asynchronous sequential circuits. • To Write simple HDL codes for the circuits.			
Unit -I	**Minimization Techniques and Logic Gates:** Minimization Techniques: Boolean postulates and laws – De-Morgan's Theorem - Principle of Duality - Boolean expression - Minimization of Boolean expressions — Minterm – Maxterm - Sum of Products (SOP) – Product of Sums (POS) – Karnaugh map Minimization – Don't care conditions – Quine - Mc Cluskey method of minimization. Logic Gates: AND, OR, NOT, NAND, NOR, Exclusive–OR and Exclusive–NOR Implementations of Logic Functions using gates, NAND–NOR implementations – Multi level gate implementations- Multi output gate implementations. TTL and CMOS Logic and their characteristics – Tristate gates			
Unit-II	**Combinational Circuits:** Design procedure – Half adder – Full Adder – Half subtractor – Full subtractor – Parallel binary adder, parallel binary Subtractor – Fast Adder - Carry Look Ahead adder – Serial Adder/Subtractor BCD adder – Binary Multiplier – Binary Divider - Multiplexer/ Demultiplexer – decoder - encoder – parity checker – parity generators – code converters - Magnitude Comparator.			
Unit III	**Sequential Circuits :** Latches, Flip-flops - SR, JK, D, T, and Master-Slave – Characteristic table and equation –Application table – Edge triggering – Level Triggering – Realization of one flip flop using other flip flops – serial adder/subtractor- Asynchronous Ripple or serial counter – Asynchronous Up/Down counter Synchronous counters – Synchronous Up/Down counters – Programmable counters – Design of Synchronous counters: state diagram- State table –State minimization –State assignment - Excitation table and maps-Circuit implementation - Modulo–n counter, Registers – shift registers - Universal shift registers – Shift register counters – Ring counter – Shift counters - Sequence generators.			
Unit IV	**Memory Devices:** Classification of memories – ROM - ROM organization - PROM – EPROM – EEPROM –EAPROM, RAM – RAM organization – Write operation – Read operation – Memory cycle - Timing wave forms – Memory decoding – memory expansion – Static RAM Cell- Bipolar RAM cell – MOSFET RAM cell – Dynamic RAM cell – Programmable Logic Devices – Programmable Logic Array (PLA) Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using ROM, PLA, PAL			
Unit V	**Synchronous And Asynchronous Sequential Circuits** Synchronous Sequential Circuits: General Model – Classification – Design – Use of Algorithmic State Machine – Analysis of Synchronous Sequential Circuits Asynchronous Sequential Circuits: Design of fundamental mode and pulse mode circuits – Incompletely specified State Machines – Problems in Asynchronous Circuits – Design of Hazard Free Switching circuits. Design of Combinational and Sequential circuits using VERILOG			

Text books:

- M. Morris Mano, "Digital Design", 4th Edition, Prentice Hall of India Pvt. Ltd., 2008 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.
- John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.
- Donald D.Givone, "Digital Principles and Design", TMH, 2003.

Reference books:

- John F.Wakerly, "Digital Design", Fourth Edition, Pearson/PHI, 2008
- Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
- Donald P.Leach and Albert Paul Malvino, "Digital Principles and Applications", 6th Edition, TMH, 2006.
- Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011

Outcomes	• Analyze different methods used for simplification of Boolean expressions. • Design and implement Combinational circuits. • Design and implement synchronous and asynchronous sequential circuits. • Write simple HDL codes for the circuits.

Semester - IV				
Course code: NME 60448	**Modern Production Processes**	**T/P**	**Credit**	**Hrs./Week**
		P	**2**	**2**

Objectives	• To learn about various unconventional machining processes, • To Know the various process parameters and their influence on performance • To Understand their applications
Unit -I	**Introduction** Unconventional machining Process – Need – classification – Brief overview .
Unit-II	**Mechanical Energy Based Processes** 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.
Unit III	**Electrical Energy Based Processes** Electric Discharge Machining (EDM)- working Principle-equipments-Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications.
Unit IV	**Chemical And Electro-Chemical Energy Based Processes** Chemical machining and Electro-Chemical machining (CHM and ECM)-Etchants – Maskant - techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications. Principles of ECM- equipments-Surface Roughness and MRR Electrical circuit-Process Parameters- ECG and ECH - Applications.
Unit V	**Thermal Energy Based Processes** Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications.

TEXT BOOKS:

1. Vijay.K. Jain "Advanced Machining Processes" Allied Publishers Pvt. Ltd., New Delhi, 2007
2. Pandey P.C. and Shan H.S. "Modern Machining Processes" Tata McGraw-Hill, New Delhi, 2007.

REFERENCES:

1. Benedict. G.F. "Nontraditional Manufacturing Processes", Marcel Dekker Inc., New York, 1987.
2. Mc Geough, "Advanced Methods of Machining", Chapman and Hall, London, 1998.
3. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, "Material and Processes in Manufacturing" Prentice Hall of India Pvt. Ltd., 8thEdition, New Delhi , 2001.

Outcomes	• Learn about various unconventional machining processes, • Know the various process parameters and their influence on performance • Understand their applications

Semester - IV				
Course code: 60449A	**Value Education**	**T/P**	**Credit**	**Hrs./Week**
		P	**2**	**2**

Objectives	• To understand the meaning of value education • To interpret Indian culture in a scientific manner • To assess the values of health, mind, aestheticism, spiritualism, • To evaluate the impact of society • To appraise moral values in the society
Unit -I	**NATURE AND CONCEPT OF VALUES** Values: Meaning and Definitions- Nature and Concept of Values-Classification of Values- Instrumental Values: Personal values, Social values, Family values, Cultural values, Democratic values, Aesthetic Values, institutional values, spiritual values and Spirituality Spiritual Self-sufficiency- Terminal values: Happiness, Self-Contentment, Self-Actualisation, Peace, Wisdom.
Unit-II	**SOURCES OF VALUES** Sources of Values: Socio-Cultural Tradition: Demographic values, Values of Society and Culture-Religion: Hinduism, Christianity, Muslim and Jainism and Constitutional Values: Preamble of Indian Constitution, Democratic values, Secularism, Unity in Diversity-Universal Values: International Understanding, Universal Brotherhood, Eternal Bliss, Truth and Peace.
Unit III	**INDIVIDUAL AND COLLECTIVE VALUES** Individual Values: Self-respect, Self-motivation, Self Confidence, Self-Motivation, Honesty, Integrity, regularity, punctuality and Truthfulness- Psychological Values: Understanding Self: Innate Self and Acquired Self and Powers of Self, Purity in thoughts/words/deeds, Self-esteem, self-Recognition, Emotional Intelligence, Cognitive Ability- Collective values: Societal Values, Social Responsibilities of Individuals- - Healthy Responsibilities-Corporate Social Responsibility-Environmental Values-Eradication of Child Labour and bonded Labour and Child Marriage.
Unit IV	**VALUE EDUCATION** Aims and Objectives of Value Education- Comments of the Various Committees on Value Education- Need for Value Education at the Tertiary Level (HEI): Anti ragging, Antidrug, Harassment and Violence against Women -Value Education in 21st Century: Humanistic values for the 21st century, secular, democratic, and pluralistic, familial and global.
Unit V	**ROLE OF VARIOUS AGENGIES IN FOSTERING VALUES** Role of Parents-Role of Teachers: Personal Values and Code of Conduct for teachers Role of Society- Role of Peer Group- Role of Religion- Role of Mass Media- Role of Voluntary Organizations- Role of Government

Textbooks

1) Dr. Kiruba Charles., & V.Arul SelviValue Education, Neel Kamal Publications PVT. LTD. Educational Publishers, New Delhi, 2012.

Reference

1) Government of India, National Policy on Education (1968), New Delhi, 1968.
2) Atkin, J., Values and Beliefs about Learning to Principles and Practice, Seminar Series no. 54. Incorporated Association of Registered Teachers of Victoria, Melbourne, 1996.
3) Bhardwaj, I., Value-oriented Education, Journal of Value Education, Volume 5, Page 9-24, 2005.
4) Prof.S.P.Rubela & Prof.Raj Kumar Nayak, Value Education and Human Rights Education,

<table>
<tr><td colspan="2">Neel Kamal Publications PVT. LTD, New Delhi, 2011.
5) Dr. Sarojini - Biographical Values, Arasi Publishing House, Dindigul • Ananda Valli Mahadevan and Rs. Jaya Kothaipillai (Editors) - Feminism, Mother Teresa Women's University, Kodaikanal, 2004.
6) Ramathal,K.M. and Others, Protection of Women from Domestic Violence Act, 2005.
7) ElamadhiJannakiraman.K, and Others, Tamil and World Unity, Subramania Bharathiar Tamil Field, University of New Delhi, Pondicherry,2006.
8) Eraianbu. Et. Al - Seventh Knowledge (Part 2), Thirst Publication, Chennai, 2002.
9) Sinivasan.N.A.,Microeconomics(Part 2), Meenakshi Publishing, Madurai, 1998
10) Saroja Pandian, Non-violent Resources and Ways of Violence in the Fourteenth Century, Pandian Publishing, Madurai, 2002.</td></tr>
<tr><td>Outcomes</td><td>• Gain knowledge on nature and classification of values
• Understand the sources of values and values of society and culture-Religion
• Acquire knowledge on individual and collective values
• Attain knowledge on need for value Education
• Understand the importance of role of Parents-Role of Teachers</td></tr>
</table>

Semester - IV				
Course code: 60449B	**Manavalakalai Yoga**	**T/P**	**Credit**	**Hrs./Week**
		P	**2**	**2**

Objectives	The subject entitled 'Foundation of Yoga' has the following objectives • Students of the UG course will have an understanding about origin, History and Development of Yoga. • They will have an idea about the insights of Indian philosophy and Astika & Nastika darshanas. • Introduction about Yoga according to various yogic texts.
Unit -I	General introduction to yoga :Brief about origin of Yoga: Psychological aspects and Mythological concepts; History and Development of Yoga: Pre classic, classic and Post classic prior to the Vedic period.
Unit-II	General introduction to yoga :Brief about origin of Yoga: Psychological aspects and Mythological concepts; History and Development of Yoga: Pre classic, classic and Post classic prior to the Vedic period.
Unit III	General introduction to Indian philosophy :Philosophy: meaning, definitions and scope; Indian Philosophy: Salient features, Branches (Astika and Nastika Darshanas), Distinction from Religion and Science, Brief introduction to Prasthanatrayee and Purushartha Chatushtaya; Relationship between Yoga and Indian Philosophy, Yogic perspective to Shad-darshanas.
Unit IV	Yoga in Texts–I:Brief to Vedas, Upanishads and Yoga in Principal Upanishads, Yoga in Yogopanishad; Yogic perspective of Epics: Ramayana, Adhyatma Ramayana and Mahabharata; Yogic perspective: Bhagavad Gita, Yoga Vasishtha, Narada Bhakti Sutras.
Unit V	Schools of Yoga:Ashtanga Yoga in Patanjali, Yogic perspective: Smritis, Puranas with emphasis to Bhagavat Purana; Emphasis to Vedantic approach of Shankara, Ramanuja, Madhva and Vallabha; Brief: Agamas, Tantras, Shaiva Siddhanta, Anthranga yoga, Thirumoolar Thirumanthiram. Paths of Yoga: Hatha yoga, Bhakti yoga, Jnana yoga, Sarina yoga, Raja yoga, Mahtra yoga, Laya yoga, Yantra yoga

Textbooks

1) Lal Basant Kumar. (2013). Contemporary Indian Philosophy. Delhi: Motilal Banarsidas Publishers Pvt. Ltd. Dasgupta S. N. (2012). History of Indian Philosophy. Delhi Motilal Banarsidas.
2) Singh S. P. (2010). History of Yoga. PHISPC, Centre for Studies in Civilization Ist.
3) Singh S. P & Yogi Mukesh. (2010). Foundation of Yoga. New Delhi Standard Publication.

Reference

1) Agarwal, M.M. (2010). Six systems of Indian Philosophy. VaranaiChowkhambha Vidya Bhawan.
2) Swami Bhuteshananda. (2009). II Edition. Nararad Bhakti Sutra. Kolkata Advaita Ashrama Publication-Dept.
3) Hiriyanna, M. (2009). Outlines of Indian Philosophy. Delhi Motilal Banarsidas.
4) Hiriyanna, M. (2008). Essentials of Indian Philosophy. Delhi Motilal Banarsidas.
5) Radhakrishnan, S. (2008).Indian Philosophy. UK (Vol. I & II) II Edition. Oxford University.
6) Max Muller, K. M. (2008). The six system of Indian Philosophy. Varanasi 6th Edition. Chukhambha, Sanskrit series.

Outcomes	The Students can learn origin, history, procedure, foundation and values of yoga through Foundation of yoga subjects.

Semester - IV				
Course code: 60449C	**Introduction to Gender Studies**	**T/P**	**Credit**	**Hrs./Week**
		P	**2**	**2**

Objectives	• To introduce gender studies as an academic discipline • To understand the basic concept of gender studies • To explain changing trend in gender relations • To study the significance of gender and education • To identify sexual identity in media portrayals
Unit -I	Gender Studies: Definition - Scope of Gender Studies - Differences between sex and gender, Interdisciplinary nature of Gender Studies, Gender Studies Vs Women‟s Studies.
Unit-II	Gender concepts: Social construction of gender – Stereotypes - Gender roles – Gender Ideology - Sexual Minorities – LBGTQ – Understanding Patriarchy.
Unit III	Gendering Institutions: Formal and Informal Institutions – Family – Class – Caste - Religion
Unit IV	Education and Economic institutions: Gender and Education – Enrolment pattern – Primary to Higher Education – literacy Rates - Drop-out Rates – Gender gap - Sexual Division of Labour: Pay gap- Wage differentials.
Unit V	Gender and Media: Concept and types - Mass Media – Portrayal of Gender in Print and Audio Visual Media

Textbooks

1) Oakley, Ann (1972). Sex and Gender and Society. London; Temple smith.
2) Richardson, Diane (Eds). (1983). Introducing Women's Studies. Hong Kong: Macmillan.
3) Suryakumari (1993). Women's Studies an Emerging Discipline. New Delhi: Gyan Publising House.

Reference

1) Krishnaraj, Maithreyi (1995). Remaking Society for Women: Visions Past and Present. New Delhi: Indian Association for Women‟s Studies.
2) Robinson, Victoria., & Diane, Richardson (Eds.). (1993). Introducing Women's Studies: Feminist Theory and Practice. London: Macmillan
3) Judith (2001). Encyclopaedia of Women and Gender. Vol. 2. Academic press.

Outcomes	• Can realize the importance of Women‟s Studies as an academic discipline. • Can promote knowledge about the concept of gender studies • Can familiarize with key issues, questions and debates in women and gender studies • Can realize the importance of gender and education • Understand the sexual identity in media portrayals

<table>
<tr><td colspan="5">Semester - IV</td></tr>
<tr><td colspan="2">Course code:</td><td rowspan="2">Self – Learning Course – IV – MOOCs - II</td><td>T/P</td><td>Credit</td><td>Hrs./Week</td></tr>
<tr><td colspan="2"></td><td>--</td><td>…</td><td>…</td></tr>
<tr><td>Objectives</td><td colspan="5">A massive open online course (MOOC) is a typically free web-based distance learning program that's designed for large numbers of geographically dispersed students.
A MOOC might be patterned on a college or university course, or it can be less structured. Although they don't always offer academic credits, these courses often offer a certification, enhance employment opportunities or further studies. Typically, MOOCs are used for higher education, upskilling and career advancement.</td></tr>
<tr><td></td><td colspan="5">The course provider, which is often a university, supplies the course materials and instructors. The LMS platform, such as EdX, Canvas, Coursera or Udacity, provides the technological infrastructure for course modules, user access and other learning resources.
MOOCs consist of traditional class materials and can include the following:
• Filmed or recorded video lectures.
• Assessments.
• Readings.
• Problem sets.
• Online quizzes and examinations.
• Interactive learning modules.
• Interaction with other students via discussion forums.</td></tr>
<tr><td colspan="6">Reference
https://ugcmoocs.inflibnet.ac.in/
https://ugcmoocs.inflibnet.ac.in/index.php/ugccourses_data
https://www.coursera.org/courses?query=mooc
https://www.alagappauniversity.ac.in/links/swayam
https://www.mooc.org/</td></tr>
<tr><td>Outcomes</td><td colspan="5">MOOCs widespread adoption and use of online courses provides the following benefits:
• No dependence on a physical location.
• Improved access to higher education.
• Affordability of higher education
• Flexible learning schedule
• Collaboration opportunities
• Preview of college-level courses
• Easy performance evaluation and monitoring</td></tr>
</table>

Semester - V				
Course code: core	**Manufacturing Automation**	**T/P**	**Credit**	**Hrs./Week**
60451		**T**	**5**	**5**

Objectives	• To give a brief exposure to automation principles and control technologies. • To introduce the concept of fixed automation using transfer lines. • To train the students in the programmable automation such as CNC and industrial robotics. • To provide knowledge on the use of automated material handling, storage and data capture
Unit -I	**MANUFACTURING OPERATIONS** Automation in production systems, principles and strategies, Product/production relationships, Production concepts and mathematical models, manufacturing economics.
Unit-II	**CONTROL TECHNOLOGIES** Automated systems – elements, functions, levels, Continuous Vs discrete control, Computer process control, Sensors, Actuators, ADC, DAC, Programmable logic controllers – ladder logic diagrams.
Unit III	**TRANSFER LINES** Automated production lines – applications, Analysis – with and without buffers, automated assembly systems, line unbalancing concept.
Unit IV	**NUMERICAL CONTROL AND ROBOTICS** NC - CNC – Part programming – DNC – Adaptive control – Robot anatomy – Specifications –End effectors – Industrial applications.
Unit V	**AUTOMATED HANDLING AND STORAGE** Automated guided vehicle systems, AS/RS, Carousel storage, Automatic data capture - Bar code technology.

Textbooks

1. Mikell P.Groover, Automation, "Production Systems and Computer Integrated Manufacturing" PHI, 2008.

Reference

1. Mikell P.Groover, Emory W. Zimmers, Jr., "CAD/CAM: Computer - Aided Design and Manufacturing", PHI, 2007

Outcomes	• Ability to understand the requirements of automation in manufacturing systems. • Knowledge in the techniques of machinery automation, shop floor automation. • Selection of material handling systems for automated industries. • Gaining basic knowledge in CAD systems.

Semester - V				
Course code: core	**Robotics and Automation**	**T/P**	**Credit**	**Hrs./Week**
60452		**P**	**4**	**4**

Objectives	1. To integrate various electromechanical devices in manufacturing. 2. To automate a manufacturing system with various sensors, actuators and controllers 3. To understand Robotics in Automation
Unit -I	**Mechatronic Systems:** Overview of mechatronic systems and devices in manufacturing, overview of sensors, transducers and control systems in manufacturing,
Unit-II	**Measurement Systems** : Elements and Analysis of Electric Circuits, Diode, transistor, and thyristor Circuits, operational Amplifier (Op-Amp) Circuits, digital Logic and logic Families
Unit-III	**Data Monitoring using Arduino:** Basic structure - Input / Output processing - Programming -Mnemonics Timers, Internal relays and counters - Analog-to-Digital (A/D) and Digital-to-Analog (D/A) Conversion - Analog input / output, Programming and interfacing with Sensors in manufacturing applications.
Unit-IV	**Robotics in Automation:** Robot classification and anatomy, forward and inverse kinematics, DH matrix transformation, Jacobian and differential motion, Trajectory planning, Static and dynamic analysis, applications in manufacturing
Unit-V	**Recent Trends in Robotics and Automation :** Recent Trends developed in Robotics and Automation - Case studies – Industrial Visit to local Industries to study about the recent trends in robotics and Automation.

Textbooks

1. M. P. Groover, Industrial Robotics: Technology, Programming and Applications, 2nd edition, McGraw- Hill, 2012. ISBN: 9780070265097.

Reference

1. A. Smaili and F. Mrad, Applied Mechatronics, 1st edition, Oxford University Press, 2007. ISBN: 9780195307023.
2. J. Nussey, Arduino for Dummies, 1st edition, Wiley, 2013. ISBN: 9781118446379.
3. W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 4th edition, Pearson India, 2008. ISBN: 9788131732533.
4. D. G. Alciatore, M. B. Histand, Introduction to Mechatronics and Measurement Systems, 3rd edition, Tata Mcgraw Hill Education, 2007. ISBN: 9780070648142.

Outcomes	1. Integrate various electromechanical devices in manufacturing. 2. Automate a manufacturing system with various sensors, actuators and controllers 3. Understand Robotics in Automation 4. recent Tends in robotics and Automation

Semester - V				
Course code: core	**Industry 4.0 & IIOT**	**T/P**	**Credit**	**Hrs./Week**
60453		**P**	**4**	**4**

Objectives	1. Understand the scope of Industry 4.0 and Industrial loT strategies 2. comprehend the influence of Industrial IOT in Design, Operations, maintenance and logistics 3. Describe the technology of SCADA's Building blocks and recognise its benefits to any operation
Unit -I	**FUNDAMENTALS OF INDUSTRY 4.0 and llOT:** Cyber Physical Systems- system architecture, Industrial Sensing and Actuation- Industrial Internet , Benefits of Industrial Internet- Use cases- Healthcare, Commercial Aviation, Oil and Gas industry- Industrial Processes-Cyber security
Unit-II	**OPERATIONS TECHNOLOGY:** Automation circuits with sensors -Industrial Sensing - RFID,Telemetric sensing, Humidity-Process Control - PIO Control - Real Time Embedded Systems and PLC-SCADA -Elements, Layout, RTU communication and control - Digital Twins, Digital twins in Automation system design and simulation -Augmented Reality
Unit-III	**INFORMATION TECHNOLOGY :** Industrial Network of PLCs - Actuator-Sensor Interface (ASI) Network, SCADA system- Communication architecture- llOT Networking and Protocol llOT connectivity- M2M communications-Cloud Computing - service models, Big Data Analytics. Python and Node-RED Programming - Simple Examples.
Unit-IV	**SYSTEMS INTEGRATION AND APPLICATION:** ERP and Manufacturing Execution Systems -SCADA Application - Energy Management Systems, Automobile Industry Smart Factories, Integrated Management Systems.
Unit V	**INDUSTRY INTEGRATION OF IiOT & INDUSTRY 4.0** Recent Trends in Industry – Case studies - Industry Integration and transformation of Industries to Industry 4.0.

Textbooks

1. A. McEwen and H. Cassimally, Designing the Internet of Things, 1st edition, Wiley, 2013, ISBN-10: 111843062X.
2. N. Vengurlekar and P. Bagal, Database Cloud Storage: The Essential Guide to Oracle Automatic Storage Management, 1st edition, McGraw-Hill Education, 2013, ISBN-10: 0071790152.

Reference

1. M. Kuniavsky, Smart Things: Ubiquitous Computing User Experience Design, 1st edition, Morgan Kaufmann, 2010, ISBN-10: 0123748992.
2. F. Lamb, Industrial Automation: Hands on, 1st edition, McGraw-Hill Education, 2013, ISBN-10:0071816453.
3. Gilchrist, Alasdair. "Industry 4.0: the industrial internet of things". Apress, 2016.
4. Evans, P.C. and Annunziata, M, 2012. "Industrial internet: Pushing the boundaries". General Electric Reports, pp.488-508.
5. Manesis, Stamatios, and George Nikolakopoulos. "Introduction to Industrial Automat ion. CRC Press, 2018.
6. Boyer, Stuart A."SCADA: supervisory control and data acquisition". International Society of Automation, 2009.
7. Rayes, Ammar , and Samer Salam. "Internet of things from hype to reality." The Road to Digitization; River Publisher Series in Communications; Springer: Basel, Switzerland 49 (2017).

Outcomes	1. Remember and recall the fundamentals of Industry 4.0 and IiOT 2. Asses the evolution of technology from Industry 3.0 to Industry 4.0 3. Choose information flow, storage, processing and security in Industrial IOT 4. Apply method of integrating operations technology and information technology in various Use cases

Semester - V				
Course code:		**T/P**	**Credit**	**Hrs./Week**
60455	**Entrepreneurship Start up Skills**	**P**	**4**	**4**

Objectives	• To learn the concepts, principles of entrepreneurship and to develop entrepreneurial interest and qualities • To impart the process and procedure involved in setting up of a small enterprise and to acquire the necessary managerial skills to run a small-scale industry
Unit -I	**Concept of Entrepreneurship and basics of selection of project/business** Qualities of an entrepreneur – Classification of industries as tiny, small, medium and large Infrastructure facilities, threats and Opportunities-Corporate Social Responsibility
Unit-II	**Preparation of Project Proposal** Introduction to nature of business – techniques of market survey – goal setting, funding institution, departmental licenses and clearance – production capacity – fixed capital – working capital and total investment – costing, pricing, profit assessment – return on capital investment, Break Even Point and Cash Flow
Unit III	**Marketing skills** Salesmanship, credit sales, customer management, negotiation skills, business tie ups, export possibilities and policies
Unit IV	**Management of Men, Materials, Money, Machine and Methods (the 5Ms)** Management of man power, problem solving, purchasing techniques, inventory management– Quality control and standards – resource mobilization – Financial planning, record keeping and accounting, knowledge of employees' welfare measures – plant selection and layout.
Unit V	**Industrial Management** Technology up gradation – value addition – diversification – utilization of waste and by products – concepts of zero discharge

Text books:

1. S.S.Khanna , Entrepreneurial Development, S.Chand & Co, 2012

Reference books:

1. CED ,Entrepreneurial & Management of Small Business – CED, Madurai – 10, 2010
2. S.P.Saravanan , Entrepreneurship Development , 2012

Outcomes	• Students will learn the concepts, principles of entrepreneurship and to develop entrepreneurial interest and qualities • Will impart the process and procedure involved in setting up of a small enterprise and to acquire the necessary managerial skills to run a small-scale industry

Semester - V				
Course code:	**Quantitative Aptitude**	**T/P**	**Credit**	**Hrs./Week**
60456		**P**	**4**	**4**
Objectives	Quantitative Aptitude is the most important requisite for clearing any competitive exam. Quantitative Aptitude skills form the bulk of most of the graduate level papers. Let us jump this hurdle through an exhaustive coverage of all the Quantitative Aptitude topics and an in-depth understanding of this subject			
Topics	**Arithmetic** • Profit and Loss • Time and Work • Time Speed and Distance • Mixtures • Ratio and Proportion • Mixtures and Allegation • Percentage • Averages • Simple and Compound Interest • Real Numbers • Irrational Numbers • Complex Numbers • HCF and LCM • Unit's Digit • Remainders **Algebra** • Quadratic Equations • Inequalities • Series • Functions • Surds and Indices • Logarithm • Polynomials **Geometry and Mensuration** • Lines and Angles • Circles • Triangles • Quadrilaterals • Polygons • Coordinate Geometry • Area & Volume of 2D and 3D figures **Modern Math** • Set Theory • Permutation and Combination • Probability			
Links: https://www.toppr.com/guides/quantitative-aptitude/ https://testbook.com/objective-questions/mcq-on-quantitative-aptitude--5eea6a1039140f30f369e7e7				

https://pdf.exampundit.in/quantitative-aptitude https://www.indiabix.com/aptitude/questions-and-answers/	
Outcomes	Participants develop critical thinking, numerical reasoning, and logical problem-solving skills required for various professions, such as finance, consulting, and data analysis.

Semester - V				
Course code:	**Accounting Skills**	**T/P**	**Credit**	**Hrs./Week**
60457		**P**	**4**	**4**

Objectives	• To introduce basic Accounting principles, ethics in accounting and preparation of financial statements. • To analyze the business problem by incorporating diverse perspective of accounting techniques and to develop competent decision skills in the areas of accounting
Unit -I	Introduction to Accounting – Accounting principles – Accounting equation – Double entry system – Characteristics – Classification of Accounting principles.
Unit-II	Books of Accounting – Journal – Accounting Process – Classification of Accounts –Compound Journal Entries – Important consideration for recording transaction Ledger: Difference between Journal & Ledger – Cashbook and Subsidiary Books – Purchase Books – Invoice, Sales Book, Return Book, Debit and Credit notes
Unit III	Trial balance: Meaning of Trial Balance, Objective and Importance of Trial Balance Errors: Meaning and location of Errors.
Unit IV	Financial Accounts: Meaning and typing of Financial Statements, procedure for preparing accounts – Profit and Loss Accounts – Balance Sheet – Manufacturing Account – Adjustment and treatment of adjustment.
Unit V	Introduction to Accounting Package – Introduction to Tally: Features, advantages, defining the cells, format the data, entering data, functional keys and simple calculation – Excel: features, advantages, defining the cell range, functional keys, entering the data, defining the functions and simple calculations.

Text books:

1. M.C.Shakla, T.S.Grawal and S.C.Gupta – "Advanced Accounts" S. Chand & Company Ltd, New Delhi, Fourteenth Edition, 1999.

Reference books:

1. Mukesh Mahajan, P.S.Gills, V.P.Sharma and H.S.Punia, Fundamentals of Accountancy, Unistar Books Pvt. Ltd., Chandigarh, 2001.
2. Sundeep Sharma, Principles of Accounting (A Complete Hand Book), Shree Niwas Publication, Jaipur, First Edition, 2004.
3. Douglas Garbutt, Accounting Foundation (An Introductory), Pitman, Publishing Limited, London, First Edition, 1980.

Outcomes	• Understand basic Accounting principles, ethics in accounting and preparation of financial statements. • Analyze the business problem by incorporating diverse perspective of accounting techniques and to develop competent decision skills in the areas of accounting

Semester - VI				
Course code: core	**Artificial Intelligence & Reasoning**	**T/P**	**Credit**	**Hrs./Week**
60461		**P**	**4**	**5**
Objectives	1. To examine computational approaches for modeling uncertainty using probabilistic models and solving decision problems. 2. To learn various methods of solving problems using artificial intelligence.			
Unit -I	**Introduction:** Al- The state of the art - Intelligent Agents - Agents and environments - Good behavior - Nature of environments - Structure of agents. Quantifying Uncertainty: Acting Under Uncertainty - Summarizing uncertainty , Uncertainty and rational decisions, Basic Probability Notation - What probabilities are about, The language of propositions in probability assertions, Probability axioms and their reasonableness, Independence - Bayes' Rule and its use - Applying Bayes' rule: The simple case, Using Bayes' rule: Combining evidence			
Unit-II	**Probabilistic Reasoning:** Representing knowledge in an uncertain domain - The semantics of Bayesian networks - Efficient representation of conditional distributions - Exact inference in Bayesian networks - Approximate inference in Bayesian networks - Direct sampling methods, Inference by Markov chain simulation, Relational and First-Order probability models - Possible worlds, Relational probability models, Open-universe probability models, Other approaches to uncertain reasoning - Rule-based methods for uncertain reasoning, **Representing Ignorance:** Dempster-Shafer theory, Representing vagueness: Fuzzy sets and fuzzy logic			
Unit-III	**Probabilistic Reasoning Over Time** Time and Uncertainty - States and observations, Transition and sensor models, Inference in Temporal Models - Filtering and prediction, Smoothing, Finding the most likely sequence, Hidden Markov Models- Simplified matrix algorithms, Hidden Markov model example: Localization, Kalman Filters -Updating Gaussian distributions, A simple one-dimensional example, The general case - Dynamic Bayesian Networks, Keeping track of many objects. **Making Simple Decisions:** Combining beliefs and desires under uncertainty - The basis of utility theory - Constraints on rational preferences, Utility functions - Multiattribute utility functions			
Unit-IV	**Decision Networks** Representing a decision problem with a decision network - Evaluating decision networks, the value of information. Making Complex Decisions: Sequential Decision Problems - Value iteration - Policy iteration - Partially observable MDPs - Definition of POMDPs.			
Unit-V	**Decisions with multiple agents:** Game theory, Single-move games, repeated games, Sequential games, Mechanism design - Auctions , Common goods			

Textbooks

1. Stuart Russell and Peter Norvig. Artificial Intelligence - A Modern Approach. Pearson Education I Prentice Hall of India,3•d Edition, 2014.

Reference

1. George F. Luger. Artificial Intelligence-Structures and Strategies for Complex Problem Solving. Pearson Education I Prentice Hall of India,2002.

Outcomes	1. Classify categories of agents based on their relationship with the environment 2. Judge the uncertain environments based on probability 3. Determine the exact inferences using Bayesian networks 4. Discuss the probability models to solve the problem in uncertainty 5. Estimate unobservable and noisy states through the supports of realistic temporal models 6. Determine simple decisions in uncertainty on the basis of utility theory 7. Represent a decision problem with a decision network using value information 8. Discuss the ways and means to take complex decisions with multi agents

Semester - VI				
Course code:	**Industrial Internship with Project**	**T/P**	**Credit**	**Hrs./Week**
60464		**I**	**6**	**9**

Objectives

Internships are educational and career development opportunities, providing practical experience in a field or discipline. They are structured, short-term, supervised placements often focused around particular tasks or projects with defined timescales. An internship may be compensated, non-compensated or some time may be paid. The internship has to be meaningful and mutually beneficial to the intern and the organization. It is important that the objectives and the activities of the internship program are clearly defined and understood. Following are the intended objectives of internship training:

- Will expose Technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
- Exposure to the current technological developments relevant to the subject area of training. • Experience gained from the 'Industrial Internship' in classroom will be used in classroom discussions.
- Create conditions conducive to quest for knowledge and its applicability on the job.
- Learn to apply the Technical knowledge in real industrial situations.
- Gain experience in writing Technical reports/projects.
- Expose students to the engineer's responsibilities and ethics.
- Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control.
- Promote academic, professional and/or personal development.
- Expose the students to future employers.
- Understand the social, economic and administrative considerations that influence the working environment of industrial organizations
- Understand the psychology of the workers and their habits, attitudes and approach to problem solving.

Guidelines

The candidate should submit a synopsis of the proposed work to be done during Internship programme/ Industrial Project/ Dissertation/ Industrial Dissertation. The synopsis received should be examined or evaluated by the departmental committee to ensure that the proposed work is equivalent to Degree. dissertation work. This synopsis should be submitted to the department before the candidate is relived.

2. Intimation of commencement of internship shall be submitted to the HOD concerned before the commencement of the ongoing semester.
3. The Industrial project work done during 6-month/one-year internship program is equivalent to their Degree. one semester/ two semester thesis work.
4. Two guides will supervise the internship project work, one from the department and another one from industry.
5. Industry/Educational Organization must submit the month-wise satisfactory attendance of the students to the department.
6. Candidate should regularly visit the institute and present his/her project progress report to their respective guide(s).
7. The final project presentation is evaluated on the basis of the recommendation given by outside supervisor, and further can be evaluated by institute guide.
8. If the internship project is not found to be of high quality, then the student will have to reappear in the next semester for their Degree. dissertation work.

	9. If the student feels that the internship work is not of high quality/not-related to their field of interest, then he/ she should submit the application to the department within three weeks and can re-join the institute. 10. Industry/ Institute should allow to produce results obtained during project/ internship period in the project report. The written certificate to this effect from the industry/ institute is mandatory before consideration of the proposed project/ internship.
Internship Report	After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period. The student may contact Industrial Supervisor/ Faculty Mentor/TPO for assigning special topics and problems and should prepare the final report on the assigned topics. Daily diary will also help to a great extent in writing the industrial report since much of the information has already been incorporated by the student into the daily diary. The training report should be signed by the Internship Supervisor, TPO and Faculty Mentor. The Internship report will be evaluated on the basis of following criteria: i. Originality. ii. Adequacy and purposeful write-up. iii. Organization, format, drawings, sketches, style, language etc. iv. Variety and relevance of learning experience. v. Practical applications, relationships with basic theory and concepts taught in the course.
Outcomes	• An opportunity to get hired by the Industry/ organization. • Practical experience in an organizational setting. • Excellent opportunity to see how the theoretical aspects learned in classes are integrated into the practical world. On-floor experience provides much more professional experience which is often worth more than classroom teaching. • Helps them decide if the industry and the profession is the best career option to pursue. • Opportunity to learn new skills and supplement knowledge. • Opportunity to practice communication and teamwork skills. • Opportunity to learn strategies like time management, multi-tasking etc in an industrial setup. • Opportunity to meet new people and learn networking skills.

Semester - VI				
Course code:	**Corporate Grooming and Finishing Skills**	**T/P**	**Credit**	**Hrs./Week**
60465		**P**	**4**	**4**

Objectives	This course helps students groom themselves with a cutting edge to become industry ready professionals. It emphasizes social grooming and cultural intelligence along with training in all-around personality development, imparting technical skills, social and business etiquettes along with international protocols, art of decision making, smart work life balance, with an aim to mould people who will lead the corporate world in the future
Unit I	**Employability Quotient:** 1. Acing the Personal Interview 2. Art of Participating in GD 3. Resume Building 4. Psychometric Analysis 5. Mock Interview **Science of Body Language:** 1. The First Impression 2. Winning gestures 3. Non-verbal messages
Unit II	**Corporate Soft Skills:** 1. Leadership 2. Team Building 3. Time Management 4. Stress Management 5. Emotional Intelligence 6. Customer Relationship Management **Communication Strategy for Managers:** 1. Persuasive Messages 2. Team communication 3. Cross Cultural Communication 4. Corporate communication with Stakeholders
Unit III	**Digital Communication:** 1. Telephonic conversation 2. Teleconferencing 3. Email 4. Instant Messages 5. Social Media **Public Exposure:** 1. PowerPoint Presentation 2. Debate 3. Speech 4. Impromptu Presentation
Unit IV	**Social Graces and Etiquettes:** 1. Dining 2. High Tea 3. Work Place 4. Social gathering **Smart Work Life Balance:** • Flexible Work Options • Benefits of a healthy balance

	• Signs of Imbalance
Unit V	**Health and Wellness:** 1. Meditation 2. Personal Hygiene **Art of Decision Making:** 1.Image Consulting: 2. In order to elevate your impression
Outcomes	Proper grooming and professional appearance are important to gain not just a positive impression but also respect in the workplace. First impressions matter and the way employees look and carry themselves create impact with customers, and potential clients.

Semester - VI				
Course code:	**Flexible Manufacturing Systems**	**T/P**	**Credit**	**Hrs./Week**
60466		**T**	**4**	**4**

Objectives	• Modern manufacturing systems • To understand the concepts and applications of flexible manufacturing systems
Unit -I	**PLANNING, SCHEDULING AND CONTROL OF FLEXIBLE MANUFACTURING SYSTEMS** Introduction to FMS – development of manufacturing systems – benefits – major elements – types of flexibility – FMS application and flexibility –single product, single batch, n – batch scheduling problem – knowledge based scheduling system.
Unit-II	**COMPUTER CONTROL AND SOFTWARE FOR FLEXIBLE MANUFACTURING SYSTEMS** Introduction – composition of FMS– hierarchy of computer control –computer control of work center and assembly lines – FMS supervisory computer control – types of software specification and selection – trends.
Unit III	**FMS SIMULATION AND DATA BASE** Application of simulation – model of FMS– simulation software – limitation – manufacturing data systems – data flow – FMS database systems – planning for FMS database.
Unit IV	**GROUP TECHNOLOGY AND JUSTIFICATION OF FMS** Introduction – matrix formulation – mathematical programming formulation –graph formulation – knowledge based system for group technology – economic justification of FMS- application of possibility distributions in FMS systems justification.
Unit V	**APPLICATIONS OF FMS AND FACTORY OF THE FUTURE** FMS application in machining, sheet metal fabrication, prismatic component production – aerospace application – FMS development towards factories of the future – artificial intelligence and expert systems in FMS – design philosophy and characteristics for future.

Textbooks

1. Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India Pvt., New Delhi, 1996.
2. Kalpakjian, "Manufacturing Engineering and Technology", Addison-Wesley Publishsing Co., 1995.

Reference

1. Radhakrishnan P. and Subramanyan S., "CAD/CAM/CIM", Wiley Eastern Ltd., New Age International Ltd., 1994.
2. Raouf, A. and Ben-Daya, M., Editors, "Flexible manufacturing systems: recent development", Elsevier Science, 1995.
3. Taiichi Ohno, "Toyota Production System: Beyond large-scale Production", Productivity Press (India) Pvt. Ltd. 1992.
4. Jha, N.K. "Handbook of flexible manufacturing systems", Academic Press Inc., 1991.

Outcomes	• Ability to perform Planning, Scheduling and control of Flexible Manufacturing systems • Perform simulation on software's use of group technology to product classification

Semester - VI				
Course code:	**Comprehensive Study**	**T/P**	**Credit**	**Hrs./Week**
60467		**P**	**4**	**…..**
Objectives	The Comprehensive Studies offers courses and learning experiences that are designed to give the skills and confidence needed for success in curriculum programs. It is recommended to take Comprehensive Studies (developmental) courses depending on the students placement test scores. Or, may elect to take one or more courses on your own. Regardless, your skills will be carefully evaluated when you enroll, and a plan of study will be developed that's customized to your needs.			
Topics	• Technology. • Religion. • Social Media. • Music. • Education. • Health. • Social issues. • Environment.			
Outcomes	The Comprehensive Studies provides the skills and confidence needed for success in curriculum programs.			

ELECTIVES:

Elective				
Course code:	**Computer Vision & Pattern Recognition**	**T/P**	**Credit**	**Hrs./Week**
60454A		**P**	**5**	**5**
Objectives	To formulate and solve computer vision and pattern recognition problems using scientific, statistical and engineering approaches.			
Unit -I	**Computer Vision Overview:** introduction to Computer Vision - History - Image Information - Geometric Primitives and Transformations - Photometric Image Information - The Digital Camera - Image Processing - Point Operators - Linear Filtering - Neighborhood Operators			
Unit-II	**Image Transformation and Feature Detection:** Fourier Transforms - Pyramids and Wavelets - Global Optimization - Feature Detection and Matching - Points and Patches - Edges - Lines - Patterns to Features - Features Scaling - Evaluation and Selection of Features			
Unit-III	**Segmentation:** Active Contours - Split and Merge - Mean Shift and Mode Finding - Normalized Cuts - Graph Cuts • Object Detection			
Unit-IV	**Pattern Recognition** Face Recognition - Instance Recognition - Category Recognition - Context and Scene Understanding			
Unit-V	**Pattern Classifiers and Clustering :** Nearest Neighbors • Support Vector Machines- Decision Tree - Ensemble Classifiers - Rejecting Architectures - Native Patterns-based Rejection - Cast Study • Fuzzy C-Means - K-Means • Hierarchical Clustering • Data Imputation Concepts and Key Problems - Imputation Methods • Use of Information Granules Granular Imputation - Data Imputation - Imbalanced Data			

Textbooks

1. Szeliski, Richard. Computer Vision: Algorithms and Appl/cations, Springer Science & Business Media, First Edition, 2010.

Reference

1. Homenda, Wladyslaw and Witold Pedrycz . Pattern Recognition: A Quality of Data Perspective, John Wiley & Sons, First Edition, 2018.
2. Forsyth DA and Ponce J. Computer Vision: a Modern Approach, Pearson,2012.
3. Chen CH. Handbook of Pattern Recognition & Computer Vision, World Scientific, Fifth Edition,2016.

Outcomes	• Model 2D,3D rotations and projections of images • Analyse and format images using light, reflection, shading, color and compression functions • Discover the ways to transform images with pixel, color, composition and histogram equalization • Identify and filter noisy data using linear and non-linear filtering • Interpret Fourier, Pyramids, Wavelet and Geometric Transformations • Select map patterns with features • Evaluate the selected features • Illustrate and segment image with active contours, split and merge, mean shift and mode • Find normalized and graph cuts • Determine object, face, instance and categories from images • Inspect the hidden context and scene behind images • Modify the work with rejection architectures • Justify the rejection of images using native patterns

	• Improve quality of data bv imputation and balancing

Elective				
Course code:	**Machine to Machine**	**T/P**	**Credit**	**Hrs./Week**
60454B	**Communication**	**P**	**5**	**5**

Objectives	1. To Identify the main challenges associated with M2M Communications today. 2. Able to list the main standards, protocols, algorithms, and research activities which address these challenges of today. 3. Can able to identify limits of standards/protocols and algorithms with respect to M2M communications
Unit -I	Introduction to M2M; M2M Current Landscape; Early implementations and deployment of M2M communications.
Unit-II	M2M Architecture and Protocols –M2M Requirements and High Level Architectural Principles. High Level Architecture Principles for M2M Communications.
Unit-III	M2M Service Architectures – High Level Service Architecture; ETSI TC M2M Service Capabilities Framework, M2M service Capabilities, M2M Resource based M2M Commuication and Procedures.
Unit-IV	M2M Terminals and Modules – Hardware Interfaces – Power, USB, UART, Antenna, UICC, GPIO, SPI, I2C, ADC, PCM, PWM and Analog Audio, Service, Software Interface.
Unit-V	Smart Cards in M2M Communication – Security and Privacy issues in M2M communication, hardware based security solutions, Smart Card Properties for M2M environments.

Textbooks

1. D. Boswarthick, O. Elloumi, and O. Hersent, M2M Communications - A System Approach, Wiley, ISBN 978-1-119-99475-6.

Reference

1. C. Anton-Haro, M. Dohler, Machine-to-Machine (M2M) Communications- Architecture, Performance and Applications, Woodhead, ISBN 978178242102.
2. D. Minoliauth, Building the Internet of Things with IPv6 and MIPv6 The Evolving World of M2M Communications, Wiley, ISBN: 978-1-118-47347-4.
3. O. Hersent, D. Boswarthick and O. Elloumi, The Internet of Things: Key Applications and Protocols, Wiley, 2nd edition, 2012, ISBN: 978-1-119-99435-0.
4. J. Brazell, L. Donoho, J. Dexheimer, R. Hanneman and Langdon, M2M The Wireless Revolution, technical report, Innovation - Creativity – Capital Institute, University of Texas at Austin.
5. W. Webb, Understanding Weightless Technology, Equipment, and Network Deployment for M2M Communications in White Space, Cambridge, ISBN-13: 9781107027077

Outcomes	1. Students can able to Identify the main challenges associated with M2M Communications today 2. Can able to list the main standards, protocols, algorithms, and research activities which address these challenges of today. 3. Can able to identify limits of standards/protocols and algorithms with respect to M2M communications

Elective				
Course code:	**Manufacturing Systems**	**T/P**	**Credit**	**Hrs./Week**
60462A		**P**	**4**	**4**

Objectives	1. To recognize manufacturing systems, including job shops, flow lines, assembly lines, work cells. 2. To have a basic understanding of performance measurement and management in modern day manufacturing systems. 3. To have a basic understanding of current manufacturing control theories, such as lean thinking, agile, responsive systems and JIT. 4. Able to analyze manufacturing systems to improve performance of assembly lines and job shops
Unit -I	Introduction, overview, and components of manufacturing systems, Design, operation, and control of manufacturing systems.
Unit-II	Types of manufacturing systems, single station cells, manual assembly lines, automated production lines, transfer lines, analysis automated assembly systems.
Unit-III	Performance of manufacturing system - productivity, quality, reliability, agility, responsiveness, sustainability, utilization & availability, flexibility, reconfigurability, resiliency, efficiency and effectiveness of manufacturing system, metrics and key performance indicators.
Unit-IV	Group technology and cellular manufacturing, flexible manufacturing systems, changeable manufacturing systems, Just-In-Time and lean production, automation.
Unit-V	Agile/demand driven manufacturing, Quick response manufacturing, world class manufacturing and holonic manufacturing systems Computer Integrated Manufacturing, Enterprise Integration (ISA-95 and other standards), Digital Manufacturing and smart manufacturing systems.

Textbooks

1. M. P. Groover, Automation, Production systems and Computer Integrated Manufacturing. 3rd edition, Pearson Education, 2015. ISBN: 978-9332549814.

Reference

1. N. Singh, Systems Approach to Computer Integrated Design and Manufacturing, 1st edition, Wiley India, 2011. ISBN: 978-8126530410.
2. G. Chryssolouris, Manufacturing Systems: Theory and Practice. 2nd edition, Springer, 2006. ISBN: 978-1441920676.
3. W. J. Hopp, M. L. Spearman, Factory Physics, 3rd edition, Waveland Press, 2011.
4. E. Turban, L. Volonino, Information Technology for Management: Transforming Organizations in the Digital Economy, 7th edition, Wiley India Private Limited, 2010. ISBN: 978-8126526390.
5. R. Askin and C. Standridge, Modeling and Analysis of Manufacturing Systems, 1st edition, John Wiley, 1992. ISBN: 978-0-471-51418-3.

Outcomes	1. Students will recognize manufacturing systems, including job shops, flow lines, assembly lines, work cells. 2. Students will have a basic understanding of performance measurement and management in modern day manufacturing systems. 3. Students will have a basic understanding of current manufacturing control theories, such as lean thinking, agile, responsive systems and JIT. 4. Students will be able to analyze manufacturing systems to improve performance of assembly lines and job shops

Elective				
Course code:	**LAN and Networking**	**T/P**	**Credit**	**Hrs./Week**
60462B		**P**	**4**	**4**

Objectives	• To describe communication protocols and layered network architecture • Design basic network system • To analyse data communication Technology
Unit -I	Introduction to computer networks, reference models: OSI model, TCP/IP model, Evolution of Internet.
Unit-II	Fundamentals of MAC layer, Data Link layer, Transmission media: Guided and Unguided, Twisted pair cable (STP&UTP), coaxial cable, fiber optic cable, radio waves, infrared, microwaves links.
Unit-III	LAN technologies: Traditional Ethernet (Concept of CSMA/CD),Fast Ethernet, Gigabit Ethernet IEEE802.4(Tokenbus),IEEE802.5(Tokenring),IEEE802.11(WirelessLAN), Working of repeater, hub, bridge and switch.
Unit-IV	Network layer concepts and routing algorithms, IPV6 and IPV4, sub netting and subnet masking, working of routers in LAN. Concept of Virtual LAN
Unit-V	Introduction to encryption and compression of data, network security issues, working of dialup connection, role of internet service provider(ISP)and working of ISDN and broadband internet connection etc, Application layer protocol:DNS, HTTP, FTP, telnet.

Reference and Textbooks

1. Gerd E. Keiser, "Local AreaNetworks",3rdedition,TataMcGrawHill,2001.
2. Forouzan. B. A, "DataCommunicationandNetworking",4theditionTataMcGrawHill,2001
3. Tanenbaum. A. S., "Computer Networks",3rdedition, Prentice Hall India,2002.
4. Comer D. V, "Internet working with TCP/IP" Vol.1.3rdEdition, Prentice Hall India,2001.
5. Micheal, A. Miller,"Data and Network Communications", Vikas Publications, 2001
6. William, A. Shay, "Understanding Data Communication and Networks", Vikas Publications, 2001
7. Stallings W., "Computer Communications Networks", 5thEdition, Prentice Hall India

Outcomes	• Explain the characteristics and function of the OSI model • Explain the configuration for TCP/IP configuration • Explain the fundamentals of networking process • Explain the data transfer through networks.

Elective				
Course code:	**Problem Solving and Python Programming**	**T/P**	**Credit**	**Hrs./Week**
60462C		**P**	**4**	**4**

Objectives	• To know the basics of algorithmic problem solving • To read and write simple Python programs. • To develop Python programs with conditionals and loops. • To define Python functions and call them. • To use Python data structures –- lists, tuples, dictionaries. • To do input/output with files in Python.
Unit -I	**ALGORITHMIC PROBLEM SOLVING** Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.
Unit-II	**DATA, EXPRESSIONS, STATEMENTS** Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.
Unit III	**CONTROL FLOW, FUNCTIONS** Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.
Unit IV	**LISTS, TUPLES, DICTIONARIES** Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.
Unit V	**FILES, MODULES, PACKAGES** Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

Textbooks

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated
for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

Reference

1. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd.,, 2015.

4. Kenneth A. Lambert, “Fundamentals of Python: First Programs”, CENGAGE Learning, 2012. 5. Charles Dierbach, “Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013. 6. Paul Gries, Jennifer Campbell and Jason Montojo, “Practical Programming: An Introduction to Computer Science using Python 3”, Second edition, Pragmatic Programmers, LLC, 2013.	
Outcomes	• Develop algorithmic solutions to simple computational problems • Read, write, execute by hand simple Python programs. • Structure simple Python programs for solving problems. • Decompose a Python program into functions. • Represent compound data using Python lists, tuples, dictionaries. • Read and write data from/to files in Python Programs.

Elective				
Course code:	**Data Structures and Algorithms**	**T/P**	**Credit**	**Hrs./Week**
60463A		**P**	**4**	**4**

Objectives	1. To provide the knowledge of basic data structures and their implementations. 2. To understand importance of data structures in context of writing efficient programs. 3. To develop skills to apply appropriate data structures in problem solving. 4. To study about Algorithms. 5.To study about Sorting Techniques.
Unit -I	Development of Algorithms - Notations and analysis - Storage structures for arrays - Sparse matrices - Stacks and Queues: applications. Applications of linked lists - Operations on polynomials - Doubly linked lists - Circularly linked lists - Dynamic storage management - Garbage collection and compaction.
Unit-II	Binary Trees - Binary search trees - Tree traversal - Expression manipulation - Height balanced trees - AVL trees. Hashing- Priority queue-Heaps Graphs - Representation of graphs - BFS, DFS - Topological sort - Shortest path problems, Pattern matching.
Unit III	Sorting Techniques – Divide and Conquer – Merge – Quick sort; Heap sort, Counting sort and Radix sort.
Unit IV	Introduction to Algorithmic Paradigms: Dynamic programming; case studies such as Fibonacci, optimal BST, knapsack, matrix chain multiplication, etc.
Unit V	Introduction to Greedy Algorithms: Container Loading, 0/1 Knapsack, minimum spanning tree, etc.

Textbooks

1. S. Sahni, Data Structures, Algorithms and Applications in C++, Universities Press India Private Limited.

Reference

1. T. Corman, C.E.Leiserson, R.L.Rivest, C.Stein, Introduction to Algorithms, Third Edition, Prentice Hall, 2010
2. J. P. Tremblay and P. G. Sorenson, An Introduction to Data Structures with applications, 2nd edition, Tata McGraw Hill, 1981
3. M. Tenenbaum and Augestien, Data Structures using C, 3rd edition, Pearson Education, 2007.

Outcomes	• Ability to write programs to implement stacks, queues, linked lists • Application of trees and graphs in real world scenarios • Technical knowhow on the implementation of sorting searching algorithms

Elective				
Course code:	**Machine Learning Techniques**	**T/P**	**Credit**	**Hrs./Week**
60463B		**P**	**4**	**4**
Objectives	1. Introducing the basics of Machine Learning, its scope and applications. 2. To understand and analyse simplest algorithms such as linear regression to recent deep learning algorithms			
Unit -I	**Machine Learning Basics:** Why probability? Random Variables, Probability Distributions, Marginal Probability, Conditional Probability, The Chain Rule of Conditional Probabilities, Independence and Conditional Independence, Expectation, Variance and Covariance, Common Probability Distributions, Useful Properties of Common Functions. Learning Algorithms - Capacity - Overfitting and Under fitting -Hyperparameters and Validation Sets - Estimators, Bias and Variance - Maximum Likelihood Estimation - Bayesian Statistics - Supervised Learning Algorithms - Unsupervised Learning Algorithms - Gradient- Based Optimization - Constrained Optimization - Example: Linear Least Squares, Stochastic Gradient Descent			
Unit-II	**Linear Models for Classification:** Discriminant Functions - Two classes - Multiple classes - Least squares tor classification - Fisher's linear discriminant - Relation to least squares - Fisher's discriminant for multiple classes - The perceptron algorithm **Probabilistic Generative Models:** Continuous inputs - Maximum likelihood solution - Discrete features - Exponential family **Probabilistic Discriminative Models**: fixed basis functions - Logistic regression – Iterative reweighted least squares - Multiclass logistic regression - Probit regression - Canonical link functions - The Laplace Approximation - Model comparison and BIC - Bayesian Logistic Regression - Laplace approximation - Predictive distribution **Sparse Kernel Machines**: Maximum Margin Classifiers - Overlapping class distributions - Relation to logistic regression - Multiclass SVMs - SVMs for regression - Computational learning theory - Relevance Vector Machines: RVM for regression - Analysis of sparsity - RVM for classification			
Unit-III	**Neural Networks:** Feed -forward Network Functions - Weight -space symmetries - Network Training - parameter optimization - Local quadratic approximation - Use of gradient information - Gradient descent optimization - Error Backpropagation - A simple example. **Regularization for Deep Learning:** Dataset Augmentation - Noise Robustness - Semi - Supervised Learning - Multi -Task Learning - Early Stopping - Parameter Tying and Parameter Sharing - Sparse Representations - Bagging and Other Ensemble Methods - Dropout. **Convolutional Networks:** The Convolution Operation - Motivation - Pooling - Convolution and Pooling as an Infinitely Strong Prior - Variants of the Basic Convolution Function - Structured Outputs			
Unit-IV	**Sequence Modeling:** Markov Models - Hidden Markov Models - Maximum likelihood for the HMM - The forward-backward algorithm - The sum-product algorithm for the HMM - Scaling factors - The Viterbi algorithm - Extensions of the hidden Markov model			
Unit-V	**Recurrent and Recursive Nets :** Unfolding Computational Graphs - Recurrent Neural Networks - Bidirectional RNNs - Encoder-Decoder Sequence-to-Sequence Architectures - Deep Recurrent Networks - Recursive Neural Networks - The Challenge of Long-Term Dependencies - Echo State Networks - Leaky Units and			

	Other Strategies for Multiple Time Scales - The Long Short-Term Memory and Other Gated RNNs

Textbooks

1. C. M. Bishop. Pattern Recognition and Machine Learning. Springer: 2006

Reference

1. Ian Good Fellow, YoshuaBeng io, and Aaron Courville, Deep Learning. The MIT Press: 2016
2. Nlkhll Buduma. Fundamentals of Deep Learning, O'REILLY Media, 181Edition: 2017
3. M. Mohrl, A. Rostamlzadeh, and A. Talwalkar, Foundations of Machine Learning. MIT Press: 2012
4. Kevin P. Murphy. Machine Learning: A Probabilistic Perspective. MIT Press: 2012
5. D. Barber. Bayesian Reasoning and Machine Learning. Cambridge University Press: 2012

Outcomes	1. Describe the nature of different categories of machine learning techniques 2. Apply and analyse any generative and discriminative learning algorithms 3. Implement simple neural network, deep learning techniques and evaluate results 4. Demonstrate the use of a basic sequential data modelling technique

Elective				
Course code:	**Robotics and Automation**	**T/P**	**Credit**	**Hrs./Week**
60463C		**P**	**4**	**4**

Objectives	1. To integrate various electromechanical devices in manufacturing. 2. To automate a manufacturing system with various sensors, actuators and controllers 3. To understand Robotics in Automation
Unit -I	**Basic concepts** Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and control issues- Various manipulators – Sensors - work cell - Programming languages. **Direct and inverse kinematics** Mathematical representation of Robots - Position and orientation – Homogeneous transformation- Various joints- Representation using the Denavit Hattenberg parameters - Degrees of freedom-Direct kinematics-Inverse kinematics- SCARA robots- Solvability – Solution methods-Closed form solution
Unit-II	**Manipulator differential motion and statics** Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse - Wrist and arm singularity - Static analysis - Force and moment Balance. **Path planning** Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation planning.
Unit-III	**Mechatronic and Measurement Systems:** Overview of mechatronic systems and devices in manufacturing, overview of sensors, transducers and control systems in manufacturing, Elements and Analysis of Electric Circuits, Diode, transistor, and thyristor Circuits, operational Amplifier (Op-Amp) Circuits, digital Logic and logic Families
Unit -IV	**Data Monitoring using Arduino:** Basic structure - Input / Output processing - Programming -Mnemonics Timers, Internal relays and counters - Analog-to-Digital (A/D) and Digital-to-Analog (D/A) Conversion - Analog input / output, Programming and interfacing with Sensors in manufacturing applications.
Unit -V	**Robotics in Automation:** Robot classification and anatomy, forward and inverse kinematics, DH matrix transformation, Jacobian and differential motion, Trajectory planning, Static and dynamic analysis, applications in manufacturing

Textbooks

1. A. Smaili and F. Mrad, Applied Mechatronics, 1st edition, Oxford University Press, 2007. ISBN: 9780195307023.

Reference

1. J. Nussey, Arduino for Dummies, 1st edition, Wiley, 2013. ISBN: 9781118446379.
2. M. P. Groover, Industrial Robotics: Technology, Programming and Applications, 2nd edition, McGraw- Hill, 2012. ISBN: 9780070265097.
3. W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, 4th edition, Pearson India, 2008. ISBN: 9788131732533.
4. D. G. Alciatore, M. B. Histand, Introduction to Mechatronics and Measurement Systems, 3rd edition, Tata Mcgraw Hill Education, 2007. ISBN: 9780070648142.

Outcomes	1. Integrate various electromechanical devices in manufacturing. 2. Automate a manufacturing system with various sensors, actuators and controllers 3. Understand Robotics in Automation

UG Programme

Passing minimum

- A candidate shall be declared to have passed in each course if he/she secures not less than 40% marks in the End Semester Examinations and 40% marks in the Internal Assessment and not less than 40% in the aggregate, taking Continuous assessment and End Semester Examinations marks together.
- The passing minimum for CIA shall be 40% out of 25 marks (i.e.10 marks) in Theory/ Practical Examinations.
- The passing minimum for University Examinations shall be 40% out of 75 marks (i.e. 30 marks) for Theory /Practical papers.
- The candidates not obtain 40% in the Internal Assessment are permitted to improve their Internal Assessment marks in the subsequent semesters (2 chances will be given) by writing the CIA tests or by submitting assignments.
- Candidates, who have secured the pass marks in the End-Semester Examination and in the CIA but failed to secure the aggregate minimum pass mark (E.S.E + C I.A), are permitted to improve their Internal Assessment mark in the following semester and/or in University examinations.
- A candidate shall be declared to have passed in the Dissertation/Project report/Internship report if he/she gets not less than 40% marks in the Internal Assessment and End Semester Examinations and not less than 40% in the aggregate, taking Continuous assessment and End Semester Examinations marks together.
- A candidate who gets less than 40% in the Dissertation / Internship/ Project Report must resubmit the thesis. Such candidates need to take again the Viva-Voce on the resubmitted report/thesis.

18.2 Grading of the Courses

The following table gives the marks, Grade points, Letter Grades, and classifications meant to indicate the overall academic performance of the candidate.

Conversion of Marks to Grade Points and Letter Grade (Performance in Course / Paper)

RANGE OF MARKS	GRADE POINTS	LETTER GRADE	ESCRIPTION

0 - 100	**9.0 – 10.0**	**O**	**utstanding**
0 - 89	**8.0 – 8.9**	**D+**	**xcellent**
5 - 79	**7.5 – 7.9**	**D**	**istinction**
0 - 74	**7.0 – 7.4**	**A+**	**ery Good**
0 - 69	**6.0 – 6.9**	**A**	**ood**
0 - 59	**5.0 – 5.9**	**B**	**verage**
0 - 49	**4.0 – 4.9**	**C**	**ıtisfactory**
0 - 39	**0.0**	**U**	**e-appear**
BSENT	**0.0**	**AAA**	**BSENT**

a) Successful candidates passing the examinations and earning a GPA between 9.0 and 10.0 and marks from 90 – 100 shall be declared to have Outstanding (O).

b) Successful candidates passing the examinations and earning GPA between 8.0 and 8.9 and marks from 80 - 89 shall be declared to have Excellent (D+).

c) Successful candidates passing the examinations and earning GPA between 7.5 – 7.9 and marks from 75 - 79 shall be declared to have Distinction (D).

d) Successful candidates passing the examinations and earning GPA between 7.0 – 7.4 and marks from 70 - 74 shall be declared to have Very Good (A+).

e) Successful candidates passing the examinations and earning GPA between 6.0 – 6.9 and marks from 60 - 69 shall be declared to have Good (A).

f) Successful candidates passing the examinations and earning GPA between 5.0 – 5.9 and marks from 50 - 59 shall be declared to have Average (B).

g) Successful candidates passing the examinations and earning GPA between 4.0 – 4.9 and marks from 40 - 49 shall be declared to have Satisfactory (C).

h) Candidates earning GPA between 0.0 and marks from 00 - 39 shall be declared to have Re-appear (U).

i) Absence from an examination shall not be taken as an attempt.

From the second semester onwards the total performance within a semester and continuous performance starting from the first semester are indicated respectively **by** Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA).

These two are calculated by the following formulate

GRADE POINT AVERAGE (GPA) = $\Sigma_i C_i \; G_i / \Sigma_i C_i$

GPA = Sum of the multiplication of grade points by the credits of the courses

Sum of the credits of the courses in a Semester

18.3 Classification of the final result

The final result of the candidate shall be based only on the CGPA earned by the candidate.

a) Successful candidates passing the examinations and earning CGPA between 9.5 and 10.0 shall be given Letter Grade (O+) and those who earned CGPA between 9.0 and 9.4 shall be given Letter Grade (O) and declared to have First Class –Exemplary*.

b) Successful candidates passing the examinations and earning CGPA between 7.5 and 7.9 shall be given Letter Grade (D), those who earned CGPA between 8.0 and 8.4 shall be given Letter Grade (D+) and those who earned CGPA between 8.5 and 8.9 shall be given Letter Grade (D++) and declared to have First Class with Distinction*.

c) Successful candidates passing the examinations and earning CGPA between 6.0 and 6.4 shall be given Letter Grade (A), those who earned CGPA between 6.5 and 6.9 shall be given Letter Grade (A+), and those who earned CGPA between 7.0 and 7.4 shall be given Letter Grade (A++) and declared to have First Class.

d) Successful candidates passing the examinations and earning CGPA between 5.0 and 5.4 shall be given Letter Grade (B) and those who earned CGPA between 5.5 and 5.9 shall be given Letter Grade (B+) and declared to have passed in the Second Class.

e) Successful candidates passing the examinations and earning CGPA between 4.0 and 4.4 shall be given Letter Grade (C) and those who earned CGPA between 4.5 and 4.9 shall be given Letter Grade (C+) and declared to have passed in the Third Class.

f) Absence from an examination shall not be taken as an attempt.

Final Result

CGPA	Grade	Classification of Final Result
9.5 – 10.0	**O+**	First Class – Exemplary*
9.0 and above but below 9.5	**O**	
8.5 and above but below 9.0	**D++**	First Class with Distinction*
8.0 and above but below 8.5	**D+**	
7.5 and above but below 8.0	**D**	

7.0 and above but below 7.5 6.5 and above but below 7.0 6.0 and above but below 6.5	**A++** **A+** **A**	First Class
5.5 and above but below 6.0 5.0 and above but below 5.5	**B+** **B**	Second Class
4.5 and above but below 5.0 4.0 and above but below 4.5	**C+** **C**	Third Class
0.0 and above but below 4.0	**U**	Re-appear

CUMULATIVE GRADE POINT AVERAGE (CGPA) = $\Sigma_n \Sigma_i C_{ni} G_{ni} / \Sigma_n \Sigma_i C_{ni}$

CGPA = Sum of the multiplication of grade points by the credits of the entire programme

Sum of the credits of the course for the entire Programme

Where '**Ci**' is the Credit earned for Course i in any semester; '**Gi**' is the Grade Point obtained by the student for Course i and 'n' refers to the semester in which such courses were credited.

CGPA (Cumulative Grade Point Average) = Average Grade Point of all the Courses passed starting from the first semester to the current semester.

Note: * The candidates who have passed in the first appearance and within the prescribed Semesters of the UG Programme (Major, Allied, and Elective courses alone) are eligible for this classification.