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 Manufacturing Technology

[Specialization in Robotic Digital Manufacturing]

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 Manufacturing Technology**

[Specialization in Robotic Digital Manufacturing

Programme of Level: **Bachelors**

Duration for the Course: Full Time (Three Years)

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

PEO-1	**Graduates will impart fundamental scientific principles to solve complex engineering solutions in different domains in mechanical engineering.**
PEO-2	**Graduates will be engineering professionals, innovators or entrepreneurs engaged in technology development, technology deployment, or engineering system implementation in industry.**
PEO-3	**Graduates will be engineering practitioners and leaders, who would help solve industry's technological problems.**
PEO-4	**Graduates will interact with their peers in other disciplines in industry and society and contribute to the economic growth of the country.**
PEO-5	**Graduates will be successful in pursuing higher studies in engineering or management.**

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

PSO-1	**Apply Digital Manufacturing Concepts to define and manage manufacturing process information and support effective collaboration among engineering disciplines.**
PSO-2	**Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.**
PSO-3	**Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems**
PSO-4	**Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.**
PSO-5	**Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.**

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

PO-1	**Engineering/Foundational Knowledge in mathematics, engineering sciences, applied] probability, computer science, humanities, and social science**
PO-2	**Professional Skills to communicate in both oral and written forms and to be proficient in working in diverse teams of individuals**
PO-3	**Manufacturing Engineering Knowledge/Skills in materials and manufacturing processes, process, assembly, and product engineering, manufacturing competitiveness, and manufacturing systems design,**
PO-4	**Confidence in Engineering and professional skills.**
PO-5	**Understanding of Professional and Ethical Behavior to be prepared for ethical decision making, service to the engineering profession, and have the means to continue in the acquisition of knowledge**

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

PO-1	**Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.**
PO-2	**Design Solutions for complex engineering problems and design components or processes that meet the specified needs appropriate consideration for the public health and safety, and the cultural, societal, and**

	environmental considerations.
PO-3	**Having adaptive thinking and adaptability in relation to environmental context and sustainable development**
PO-4	**Having interest and recognize the need for independent and lifelong learning**
PO-5	**Having an ability to design a component or a product applying all the relevant standards and with realistic constraints, including public health, safety, culture, society and environment**
PO-6	**Having a clear understanding of the subject related concepts and of contemporary issues and apply them to identify, formulate and analyze complex engineering problems**
PO-7	**Having adaptive thinking and adaptability in relation to environmental context and sustainable development**
PO-8	**Having a good cognitive load management skill related to project management and finance**
PO-9	**Having an ability to use techniques, skills, resources and modern engineering and IT tools necessary for engineering practice**
PO-10	**Having problem solving ability- to assess social issues (societal, health, safety, legal and cultural) and engineering problems**

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 Manufacturing Technology [Specialization in Robotic Digital Manufacturing].**

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 or equivalent thereto by the Syndicate will be admitted directly in 2nd year of BVoc programme.
- A pass in SSLC + HSC + 2 yrs Diploma in Mechanical / Automobile / Mechatronics / Manufacturing / Aeronautical or equivalent thereto by the Syndicate will be admitted directly in 2nd year of BVoc Programme.
- A pass in SSLC + HSC + 3yrs Diploma in Mechanical / Automobile / Mechatronics / Manufacturing / Aeronautical or equivalent thereto by the Syndicate will be admitted directly admitted in 3rd year of BVoc programme
- A pass in SSLC + HSC + 3yrs Degree in any Field or equivalent thereto by the Syndicate will be admitted directly admitted in 3rd year of BVoc 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 MANUFACTURING TECHNOLOGY

[Specialization in Robotic Digital Manufacturing]

NSQF Level	Sem.	Part	CourseCode	Courses	Course Name	Credits Skill (S) / General (G)		Theory / practical	Hrs. / Week	Marks		Total
						S	G			Int	Ext	
NSQF Level – 4 : Certificate	I	I	60511T/H/F/M/TU/A/S/	T/OL	Tamil/Other Language-I		3	T	3	25	75	100
		II	60512	E	General English-I		3	T	3	25	75	100
		IV	60513	G-I	Life Coping Skills @		4	P	4	25	75	100
			60514		Office Automation - Lab		2	P	2	25	75	100
		III	60515	**CC-I**	Production Technology	5		T	5	25	75	100
			60516	**CC-II**	Basic Electrical and Electronics Engineering - Practical	4		P	4	25	75	100
			60517	**CC-III**	Engineering Graphics - Practical	4		P	4	25	75	100
			60518	**CC-IV**	Engineering Metrology – Practical	5		P	5	100	--	100
					Sub-Total	**18**	**12**					
					Total for Semester - I	**30**			**30**	**--**	**--**	**800**
NSQF Level – 5 : Diploma	II	I	60521T/H/F/M/TU/A/S		Tamil/Other Language-II		3	T	3	25	75	100
		II	60522		General English-II		3	T	3	25	75	100
		IV	60523		Environmental Studies *		2	T	2	25	75	100
			60524		Advanced Communicative English @		2	P	2	100	--	100
			60525		Computing Skills Lab- I		2	P	2	25	75	100
		III	60526	**Core - V**	Quality Engineering	5		T	5	25	75	100
			60527	**Core - VI**	Science and Engineering of materials - Practical	4		P	4	25	75	100
			60528	**Core - VII**	Engineering Mechanics - Practical	4		P	4	25	75	100
			60529	**Core -VIII**	Manufacturing Processes – Practical	5		P	5	100	--	100
					Sub-Total	**18**	**12**					
					Total for Semester – II	**30**			**30**	**--**	**--**	**900**
NSQF Level – 6 : Advanced Diploma	III	III	60531	**Core - IX**	Introduction to Digital Manufacturing	3		T	3	25	75	100
			60532	**Core - X**	Electrical Drives	5		P	5	25	75	100
			60533	**Core – XI**	Operations Research	5		P	5	25	75	100
			60534	**Core – XII**	Computer Aided Design and Manufacturing	5		P	5	25	75	100
		IV	60535		Interview Techniques & Interpersonal Communications @		5	P	5	25	75	100
			60536		Python Programming with Web Frame Work		4	P	4	25	75	100
			60537	NME	Total Quality Management		2	P	3	25	75	100
				MOOCs	Self - Learning Course –I-MOOCs – I %		(E)	--	--	--	--	--
		V			Extension Activities #		1	--	--	100	--	100

				Sub-Total	**18**	**12**						
				Total for Semester - I	**30+ (E)**			**30**	**--**	**--**	**800**
	IV	III	60541	**Core - XIII**	Modern Machining Processes	3		T	4	25	75	100
			60542	**Core – XIV**	CNC Machines and Programming	4		P	4	25	75	100
			60543	**Core - XV**	Additive Manufacturing	4		P	5	25	75	100
			60544	**Core**	Industrial Safety	2		P	--	100	--	100
			60545	**Core -XVI**	Low Cost Automation – Practical	5		P	5	100	--	100
		IV	60546		Professional Etiquettes		4	T	4	25	75	100
			60547		Production Planning and Control		4	P	4	25	75	100
			60548	**NME**	Sensors and Control Systems in Manufacturing		2	P	2	25	75	100
			60549A		Value Education /		2	T	2	25	75	100
			60549B 60549C		Manavalakalai Yoga / Introduction to Gender Studies @			P				
					Self-Learning Course - IV - MOOCs -II **%**		(E)	--	--	--	--	--
				Sub-Total	**18**	**12**						
				Total for Semester – II	**30**			**30**	**--**	**--**	**900**
NSQF Level – 7: B.Voc. Degree	V	III	60551	**Core-XVII**	Rapid Prototyping	5		T	5	25	75	100
			60552	**Core - XVIII**	Robotics and Automation	4		P	4	25	75	100
			60553	**Core –XIX**	Industry 4.0 & IiOT	4		P	4	25	75	100
				Elective	**Practical**	5		P	5	25	75	100
		IV	60555		Entrepreneurship		4	T	4	25	75	100
					Start-up Skills			P				
			60556		Quantitative Aptitude #		4	P	4	100	--	100
			60557		Accounting Skills @		4	P	4	25	75	100
				Sub-Total	**18**	**12**						
				Total for Semester – I	**30**			**30**	**--**	**--**	**700**
	VI	III	60561	**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
			60564		Industrial Internship with Project	6		I	9	25	75	100
		IV	60565		Corporate Grooming and Finishing Skills @		4	P	4	25	75	100
			60566		Micro and Nano Manufacturing Processes		4	T	4	25	75	100
			60567		Comprehensive Study @		4	P	--	100	--	100
					Sub-Total	**18**	**12**					
				Total for Semester – II	**30**			**30**	**--**	**--**	**700**
Total Credits (B.Voc. Degree Programme)					**180**							

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	60554A	Strategic Approaches to Digitalization	P	5	5	25	75	100
	60554B	Data Base Management Systems	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	60562A	Digital Signal Processing and Control	P	4	4	25	75	100
	60562B	Computer Vision & Pattern Recognition	P	4	4	25	75	100
	60562C	Nano Technology	P	4	4	25	75	100
	60563A	Manufacturing Systems	P	4	4	25	75	100
	60563B	Machine Learning Techniques	P	4	4	25	75	100
	60563C	Machine to Machine Communication	P	4	4	25	75	100

Semester - I				
Course code: 60513	**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: 60514	**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:60515	**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., "A Text book of production Technology: manufacturing processes" S.Chand & Company Limited, 7 th Edition (2007).
2. Kalpakjian S. and SCHMID S., "Manufacturing Engineering and Technology", Prentice Hall 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: 60516	**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, 2008.

<table>
<tr><td colspan="2">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: 60517	**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: 60518	**Engineering Metrology - Practical**	**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: 60523	**Environmental Studies**	**T/P**	**Credit**	**Hrs./Week**
		P	**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: 60524	**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, modulation of voice, body language, relevance, fluency and organization of ideas and rubrics for evaluation- Concept and process, pre-interview planning, opening strategies, answering strategies, interview through tele-conference &video-conference and Mock Interviews

Text Book:

1. Technical Communication by Meenakshi Raman and Sangeeta Sharma, 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 .Steve Duck &DavidT. McMahan. Sage South 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 Barry Tomalin 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: 60525	**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 - II				
Course code: core 60526	**Quality Engineering**	**T/P**	**Credit**	**Hrs./Week**
		T	**5**	**5**

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

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Semester - II				
Course code: core 60527	**Science and Engineering of Materials - Practical**	**T/P**	**Credit**	**Hrs./Week**
		P	**4**	**4**

Objectives	1. To develop the knowledge on structure of materials including crystallography, microstructure, defects and phase diagrams 2. To provide an understanding to students on the correlation between structure, processing, mechanical properties and performance of materials 3. To develop the knowledge on mechanical properties of materials and strengthening mechanism 4. To give insight in to advanced materials such as polymers, ceramics and composite and their applications
Unit -I	**Structure of Materials** Introduction to engineering materials – significance of structure property correlations in all classes of engineering materials, Unit Cells, Metallic Crystal Structures, Density Computations, Crystal Systems, Crystallographic Points, Crystallographic Directions, Crystallographic Planes, Linear and Planar Densities, Close-Packed Crystal Structures, Crystalline and Non-crystalline Materials, Single Crystals, Polycrystalline Materials, Imperfection in solids – Point, Line, Surface and Volume defects - Polymorphism and Allotropy.
Unit-II	**Constitution of Alloys** Mechanism of Crystallization- Nucleation-Homogeneous and Heterogeneous Nucleation- Growth of crystals- Planar growth – dendritic growth – Cooling curves - Diffusion - Construction of Phase diagram -Binary alloy phase diagram – Cu-Ni alloy; Cu-Zn alloy and Pb-Sn alloy; Iron-Iron carbide phase diagram – Invariant reactions – microstructural changes of hypo and hyper-eutectoid steel- TTT and CCT diagram.
Unit III	**Heat Treatment and Surface Heat treatment** Heat treatment – Overview – Objectives – Annealing and types, normalizing, quenching, austempering and martempering – microstructure changes –Surface hardening processes - Carburizing – nitriding – cyaniding and carbonitriding, induction and flame hardening, Laser and Electron beam hardening– principles and case depths.
Unit IV	**Ferrous & Non Ferrous Metals** Steels – Types of Steels - HSLA – TRIP - White, Grey, Malleable and Nodular - Properties and application of cast irons, Effect of alloying elements on structure and properties of steels - Properties and uses of Silicon and Hadfield Manganese steels, High speed steels - Stainless steel and Types. Properties and Applications of Aluminum, Magnesium, Copper, Nickel, Titanium and their alloys.
Unit V	**Mechanical behavior of Materials** Strengthening mechanisms – Hardness measurements – Hardenability - Tensile properties of the materials – Fracture of metals – Ductile Fracture, Brittle Fracture, Ductile to Brittle Transition Temperature (DBTT) –Fatigue – Endurance limit of ferrous and non-ferrous metals -Fatigue test, S-N curves, factors affecting fatigue, structural changes accompanying fatigue; Creep and stress rupture– mechanism of creep – stages of creep and creep test.
TEXT BOOK:	

1. Strength of Materials ,R.K. Bansal,, Laxmi Publications Pvt. Ltd., New Delhi, 3rd Edition, 2010.

REFERENCES:

1. W.D. Callister, David G. Rethwisch, Materials Science and Engineering: An Introduction, 9th ed., Wiley & Sons, 2013.
2. Donald R. Askeland, Pradeep P. Fulay, Wendelin J. Wright, The Science and Engineering of Materials 6th Edition, Cenage Publications, 2010.
3. G. F. Carter, Giles F. Carter and Donald E. Paul, Materials Science and Engineering, Digital Printing Edition, ASM International, 2011.
4. Strength of materials, S.S.Rattan, Tata Mcgraw hill, New Delhi,2008, ISBN 9780070668959,
5. Material Science and Metallurgy -O.P. Khanna -S. Chand –1998
6. Material Science and Process -S.K. Hajra Chowdry-Indian Distributing C0, Calcutta, I998
7. Strength of Materials, B K Sarkar, I Edition, 2003 Tata Mcgraw hill, New Delhi.
8. Engineering mechanics, R.K. Bansal, Laxmi Publications Pvt. Ltd., New Delhi.
9. Mechanical Metallurgy – Dieter – McGraw Hill – 1986
10. ASM Metal Hand Book

Outcomes	Upon successful completion of the course the students will be able to 1. Suggest suitable engineering materials for different application 2. Identify various phases of metals and alloys through appropriate phase diagrams 3. Apply suitable heat treatment process based on material properties 4. Evaluate the effect of alloying elements, properties and application of ferrous and non-ferrous metals 5. Evaluate the mechanical behavior of materials for different applications 6. Apply advanced materials such as polymers, ceramics and composites in product design 7. Correlate the structure-property relationship in metals/alloys in as-received and heat treated conditions

Semester - II				
Course code: core 60528	**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. 4. To Understand Kinematics & energy and Momentum methods
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.

TEXT BOOK:

1. Rajasekaran S and Sankarasubramanian G, Fundamentals of Engineering Mechanics, 3rd Edition, Vikas Publishing House Pvt Ltd., India, 2013.

REFERENCES:

1. Beer, Johnston, Cornwell and Sanghi, Vector Mechanics for Engineers: Statics and Dynamics, 10th Edition, McGraw-Companies, Inc., New York, 2013.
2. Russell C Hibbeler and Ashok Gupta, Engineering Mechanics: Statics and Dynamics (11th Edition), Pearson Education Inc., Prentice Hall, 2010.
3. Meriam J.L and Kraige L.G., Engineering Mechanics, Volume I - Statics, Volume II - Dynamics, 7th Edition, John Wiley & Sons, New York, 2012.

Outcomes	Upon successful completion of the course the students will be able to 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 60529	**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 - III				
Course code: core 60531	**Introduction to Digital Manufacturing**	**T/P**	**Credit**	**Hrs./Week**
		T	**3**	**3**

Objectives	**1.** To Articulate the meaning of Digital Manufacturing , the possibility to extend to the industry and the availability of tools and technologies for Industrial Revolution. **2.** To Identify the Technological change and future of Industry 4.0 **3.** To Identify the factors in selecting technologies and implementing digital manufacturing. **4.** To Identify the supply chain, challenges in digital transformation and business models in the industry.
Unit -I	Digital Manufacturing – an overview – basis – CAD, CAM software, CAM, CAPP, factory Layout Planning, Ergonomics, Offline Robot Programming, Production Process simulation, PLM systems and CAE, Drivers for digital transformation
Unit-II	Industry 4.0 – The Pace of technology change – Industry 4.0 – definition – components, characteristics, design principles, building blocks of the fourth industrial revolution, value chain, Today Factory VS Industry 4.0, Government Initiatives
Unit III	Emerging Technologies and trends in the industry -Additive Manufacturing Technologies for on demand production of personalized goods, Self-configuration and self-diagnosis based on IOT, Machine Learning and Artificial Intelligence for manufacturing processes, Big Data Analysis for reconfigurable manufacturing systems, Augmented Reality, Virtual Reality, Collaborative robots, their role in production, design and logistics.
Unit IV	Future of Digital manufacturing – Smart and future supply chains – control algorithms for smart part logistics, Digital Transformation challenges, New and successful business models in Industry, Additional resources and external organizations that can support on digital manufacturing needs.

Textbooks

1. Zude Zhou, Shane (Shengquan) Xie, Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer -Verlag London Limited, 2012

Reference

1. Chrisoph Hagg , Torsten Niechoj, Digital Manufacturing: Prospects and Challenges, Metropolis Verlag, 2016
2. Kaushik Kumar, Divya Zindani, J.Paul Davim, Digital Manufacturing and assembly Systems in Industry 4.0, CRC Press, 2019.
3. Asterious Agkathidis, Digital Manufacturing in design and architecture ,BIS Publishers, 2011

Outcomes	• Articulate the meaning of Digital Manufacturing , the possibility to extend to the industry and the availability of tools and technologies for Industrial Revolution. • Identify the Technological change and future of Industry 4.0 • Identify the factors in selecting technologies and implementing digital manufacturing. • Identify the supply chain, challenges in digital transformation and business models in the industry.

Semester - III				
Course code: core 60532	**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	**Control Devices** Static rotor resistance control, Static kramer 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 60533	**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 60534	**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: 60535	**INTERVIEW TECHNIQUES & INTERPERSONAL COMMUNICATIONS**	**T/P**	**C**	**H/W**
		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 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	
Outcomes	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

Semester III				
Course code: 60536	**Python Programming with Web Frame Work**	**T/P**	**Credit**	**Hrs./Week**
		P	**4**	**4**

Objectives	1. To develop python applications using predefined and user defined objects. 2. To develop client server programs and web applications using Django. 3. To develop Object Oriented Programming 4. To develop web Clients and Servers
Unit -I	**Introduction:** Introduction to Python - use IDLE to develop programs - basic coding skills - work with data types and variables, numeric data, string data - Python functions - code control statements **Functions and modules:** Defining and using functions - create and use modules - using standard modules - lists and tuples
Unit-II	**File I/O, Exceptions:** Introduction to file i/o - text files and csv files - handling single and multiple exceptions **Other concepts and skills:** Work with numbers, strings, dates and time - dictionaries - recursion and algorithms
Unit III	**Object Oriented Programming**: Introduction to classes and objects - define class - object composition - encapsulation - inheritance **Internet Client Programming:** internet Clients - Transferring files - Network news - E-mail - Related modules
Unit IV	**Web Clients and Servers:** Introduction - Python Web client tools - Web Clients - Web (HTTP) Servers
Unit V	**Web Frameworks - Django:** Web Frameworks - Django - projects and apps - Blog - Add database service - Python application shell - Django administration app - Blog's user interface - improving output - working with user input - Forms and Model Forms

TEXT BOOK

1. Michael Urban, Joel Murach. Murach's Python Programming, Mike Murach& Associates, First Indian Reprint, 2017

REFERENCES:

1. Wesley J. Chun, Core PYTHON Applications Programming, Prentice Hall, Third Edition,2013.
2. Mark Lutz, Learning Python, O'Reily Media, Fifth Edition, 2013

Outcomes	1. Write programs using predefined python objects and functions 2. Develop functions and modules using standard modules 3. Demonstrate file manipulation and exception handling 4. Operate on string, dictionary objects and develop recursive applications 5. Solve problems using object oriented concepts involving inheritance 6. Develop applications for internet client programming 7. Develop programs for web client and server interaction 8. Design web applications using Django framework

Semester III				
Course Code: NME 60537	**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><td colspan="2" rowspan="2">Course code:</td><td rowspan="2">Self – Learning Course – I – MOOCs - I</td><td>T/P</td><td>Credit</td><td>Hrs./Week</td></tr>
<tr><td>--</td><td>….</td><td>….</td></tr>
<tr><td>Objectives</td><td colspan="4">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="4">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="5">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</td></tr>
<tr><td>Outcomes</td><td colspan="4">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 60541	**Modern Machining Processes**	**T/P**	**Credit**	**Hrs./Week**
		T	**3**	**4**

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: core 60542	**CNC Machines and Programming**	**T/P**	**Credit**	**Hrs./Week**
		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 60543	**Additive Manufacturing**	**T/P**	**Credit**	**Hrs./Week**
		P	**4**	**5**

Objectives	• To know the principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturing technologies • To be familiar with the characteristics of the different materials those are used in Additive Manufacturing. • To be familiar in Reverse Engineering • To understand Medical & Bio Additive Manufacturing
Unit -I	**Introduction** Overview – History - Need-Classification -Additive Manufacturing Technology in product development- Materials for Additive Manufacturing Technology – Tooling - Applications.
Unit-II	**Cad & Reverse Engineering** Basic Concept – Digitization techniques – Model Reconstruction – Data Processing for Additive Manufacturing Technology: CAD model preparation – Part Orientation and support generation – Model Slicing –Tool path Generation – Softwares for Additive Manufacturing Technology: MIMICS, MAGICS.
Unit III	**Liquid Based And Solid Based Additive Manufacturing Systems** Classification – Liquid based system – Stereolithography Apparatus (SLA)- Principle, process, advantages and applications - Solid based system –Fused Deposition Modeling - Principle, process, advantages and applications, Laminated Object Manufacturing
Unit IV	**Powder Based Additive Manufacturing Systems** Selective Laser Sintering – Principles of SLS process - Process, advantages and applications, Three Dimensional Printing - Principle, process, advantages and applications- Laser Engineered Net Shaping (LENS), Electron Beam Melting.
Unit V	**Medical And Bio-Additive Manufacturing** Customized implants and prosthesis: Design and production. Bio-Additive Manufacturing- Computer Aided Tissue Engineering (CATE) – Case studies

TEXT BOOKS:

1. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.
2. Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003.

REFERENCES:

1. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications : A tool box for prototype development", CRC Press, 2007.
2. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
3. Hilton P.D. and Jacobs P.F., "Rapid Tooling: Technologies and Industrial Applications", CRC press, 2000.

Outcomes	• Understand principle methods, areas of usage, possibilities and limitations as well as environmental effects of the Additive Manufacturing technologies • Familiar with the characteristics of the different materials those are used in Additive Manufacturing. • Familiar in Reverse Engineering • Understand Medical & Bio Additive Manufacturing

Semester - IV				
Course code: 60544	**Industrial Safety**	**T/P**	**Credit**	**Hrs./Week**
		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 60545	**Low Cost Automation - Practical**	**T/P**	**Credit**	**Hrs./Week**
		P	**5**	**5**

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: 60546	**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: 60547	**Production Planning and Control**	**T/P**	**Credit**	**Hrs./Week**
		P	**4**	**4**

Objectives	• To get clear idea about various types of production like job, batch and continuous. • To find out the sales forecasting, various types of demands and different methods. • To acquire knowledge in product planning and process planning, value analysis and value engineering and bread even analysis. • To learn about various types of controls toward inventory planning. • To be familiar in operation scheduling, ie loading, scheduling and routing etc
Unit -I	**PPC performance:** PPC – Requirements, Benefits, Factors influencing PPC performance, 3 types of decisions – 3 Phases of PPC – Aggregate and Disaggregate Planning – Master Production Schedule (MPS) – Techniques & Hour Glass Principle – Bill of Material (BOM) structuring
Unit-II	**MRP:** Material Requirements Planning (MRP) System – Inputs, Outputs, Benefits, Technical issues – MRP system nervousness – Manufacturing Resources Planning (MRP II) – Resource Planning - Final assembly scheduling.
Unit III	**Capacity management:** Capacity Planning using overall factors (CPOF) – Capacity Bills – Resource Profiles – Capacity requirements planning (CRP) – I/O Control - Shop floor control – Basic concepts, Gantt Chart, Priority sequencing rules and Finite Loading – Inventory models.
Unit IV	**Shop floor control:** Shop floor control – Just in time (JIT) – Key elements, techniques – JIT & PPC – Pull & Push Systems – Kanban system – Types, number of kanban calculations, Design, advantages and disadvantages
Unit V	**ERP System:** ERP systems – Components, Modules, Implementation, advantages and disadvantages - Technical aspects of SAP - Supply Chain Management (SCM) – Components, stages, Decision phases – Supply chain macro processes in a firm.

Textbooks

1. Vollmann, T.E., Berry, W.L., Whybark, D.C., and Jacobs, F.R., (2005),'Manufacturing Planning and Control for Supply Chain Management' (5th ed.), Irwin.

Reference Books

1. Curran, T. and Keller, G.,(2009), 'SAP R/3 Business Blueprint' Prentice-Hall.
2. Sipper D, Bulfin, R.L,(2007), 'Production Planning,Control,and Integration,McGraw Hill.
3. S.K. Mukhopadhyay (2009), Production planning and control – Text and Cases, PHI Ltd.

Outcomes	• Understanding about various types of production like job, batch and continuous. • Understand the sales forecasting, various types of demands and different methods. • Knowledge in product planning and process planning, value analysis and value engineering and bread even analysis. • Understanding about various types of controls toward inventory planning. • Familiar in operation scheduling, ie loading, scheduling and routing etc

Semester - IV				
Course code: NME 60548	**Sensors and Control Systems in Manufacturing**	**T/P**	**Credit**	**Hrs./Week**
		P	**2**	**2**
Objectives	To introduce concepts of sensors and control systems and their applications in Manufacturing.			
Unit -I	**INTRODUCTION** Sensor Fundamental , Classification and Types of Sensors, Desirable Sensor Attributes, Sensor Performance and Power dissipation -a trade off, Self Checking and Self Compensating Sensors- Sensor for Work Pieces and Product Monitoring.			
Unit-II	**SENSOR IN PRECISION MANUFACTURING** Identification of Manufactured Components, Digital Encoders, Opto Electronic Color Sensors- Principles, Properties, Features and Control Applications in Robotics.			
Unit III	**SENSORS AND CONTROL IN CIM AND FMS** Design of CIM, Decision Support System For CIM , Analysis and Design of CIM , and Development of CIM Strategy with Sensor and Control . FMS- Robot Control with Vision Sensors, Multi Sensor Controlled Robots, Measurement of Robot Density, Robot Programming.			
Unit IV	**NETWORKING OF SENSORS AND CONTROL SYSTEM IN MANUFACTURING** Sensor Network Architecture , Sensor Tracking, Sensors to Detect Machinery Faults, Networks in Manufacturing, Computer Communications- Interface of Sensors With Single Board Computer for PLC, and Numerical Control. Networking with Electro Optic Link using Fiber Sensors.			
Unit V	**RECENT TRENDS IN SENSOR AND CONTROL SYSTEM** Fiber Optics in Sensor and Control System.- Fibre Optics Parameters, Configurations, Photo Electric Sensor for Long Distance, Sensor Alignment Techniques, Sensors for Biomedical Technology.			
TEXT BOOK: 1. Sabrie Soloman, Sensors and Control systems in manufacturing, Mc Graw hill publications, second edition 2010. **REFERENCE:** 1. H.K Tonshoff, &I.Inasaki, Sensor Applications, vol 1 sensors in manufacturing, wileyvch publications 2001.				
Outcomes	The students will be able to design and control various manufacturing process using suitable sensors and control techniques.			

Semester - IV				
Course code: 60549A	**Value Education**	**T/P**	**Credit**	**Hrs./Week**
		T	**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, 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.

<table>
<tr><td colspan="2">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: 60549B	**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: 60549C	**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><th colspan="5">Semester - IV</th></tr>
<tr><td colspan="2" rowspan="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>--</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 60551	**Rapid Prototyping**	**T/P**	**Credit**	**Hrs./Week**
		T	**5**	**5**

Objectives	1. Able to understand the Principles of Additive manufacturing and Rapid Prototyping 2. Understand Process parameters, process details and data preparation for each processes 3. Understand Rapid Tooling 4. Understand RP Process Optimization
Unit -I	**Introduction:** Need for the compression in product development, history of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems.
Unit-II	**Stereo Lithography Systems:** Principle, Process parameter, Process details, Data preparation, data files and machine details, Application.
Unit III	**Selective Laser Sintering and Fusion Deposition Modeling:** Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications, Principle of Fusion deposition modeling, Process parameter, Path generation, Applications
Unit IV	**Solid Ground Curing:** Principle of operation, Machine details, Applications. **Laminated Object Manufacturing:** Principle of operation, LOM materials. Process details, application.
Unit V	**Rapid Tooling:** Indirect Rapid tooling -Silicone rubber tooling –Aluminum filled epoxy tooling Spray metal tooling, Cast kirksite, 3Q keltool, Direct Rapid Tooling Direct. AIM, Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft Tooling vs. hard tooling.

Textbooks

1. Rapid Manufacturing - Flham D.T &Dinjoy S.S - Verlog London2001.

Reference

1. Stereo lithography and other RP & M Technologies -Paul F. Jacobs - SME, NY1996.
2. Rapid automated - Lament wood - Indus press NewYork
3. Wohler's Report 2000 - Terry Wohlers - Wohler's Association -2000

Outcomes	1. To know the Principles of Additive manufacturing and Rapid Prototyping 2. To understand Process parameters, process details and data preparation for each processes 3. To understand Rapid Tooling 4. To understand RP Process Optimization

Semester - V				
Course code: core 60552	**Robotics and Automation**	**T/P**	**Credit**	**Hrs./Week**
		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 60553	**Industry 4.0 & IIOT**	**T/P**	**Credit**	**Hrs./Week**
		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 llOT 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: 60555		**T/P**	**Credit**	**Hrs./Week**
	Entrepreneurship	**T**	**4**	**4**
	Start up Skills	**P**		

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: 60556	**Quantitative Aptitude**	**T/P**	**Credit**	**Hrs./Week**
		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: 60557	**Accounting Skills**	**T/P**	**Credit**	**Hrs./Week**
		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: 60561	**Artificial Intelligence & Reasoning**	**T/P**	**Credit**	**Hrs./Week**
		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: 60564	**Industrial Internship with Project**	**T/P**	**Credit**	**Hrs./Week**
		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: 60565	**Corporate Grooming and Finishing Skills**	**T/P**	**Credit**	**Hrs./Week**
		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: 60566	**Micro and Nano Manufacturing Processes**	**T/P**	**Credit**	**Hrs./Week**
		T	**4**	**4**

Objectives	1. To Understand about Nano materials 2. To know the synthesis of Nanomaterials 3. To Understand of Characterisation of Nano materials 4. To Understand applications of nano materials 5. To Know Nano materials fabrication
Unit -I	**Introduction to Nanomaterials** Amorphous, crystalline, microcrystalline, quasi-crystalline and nano-crystalline materials. Classification of Nanomaterials – Size Effects – Surface to volume ratio, Strain confinement, Quantum Effects – Properties – Mechanical, Thermal, Electrical, Optical, Magnetic, Acoustic.
Unit-II	**Synthesis of Nanomaterials** Methods of production of Nanoparticles – Top–Down processes, Bottom-Up Processes – Solgel synthesis, Inert gas condensation, Sonochemical processing, Molecular self assembly, High energy Ball milling, Plasma synthesis, Electro deposition, Chemical vapour deposition, Physical vapour deposition, and other techniques. Synthesis of Carbon Nanotubes – Solid carbon source based production techniques, Gaseous carbon source based production techniques - Issues in fabrication of nanomaterials Nano wires.
Unit-III	**Characterisation of Nanomaterials** Scanning Probe Microscopy (SPM) – Scanning tunneling microscope, Transmission electron microscope, Scanning transmission electron microscope, Atomic force microscope, Scanning force microscopy, Electrostatic force microscopy , Dynamic force microscopy, Magnetic force microscopy, Scanning thermal microscopy, Peizo force microscopy, scanning capacitance microscopy, Nano indentation - Issues in characterization of nanomaterials.
Unit-IV	**Applications of Nanomaterials** Applications in Mechanical, Electronics engineering industries – Use of nanomaterials in automobiles, aerospace, defense and medical applications – Metallic, polymeric, organic and ceramic nanomaterials.
Unit V	**Nano Fabrication and Machining** LIGA, Ion beam etching, Molecular manufacturing techniques – Nano machining techniques – Top/Bottom up Nano fabrication techniques - Sub micron lithographic technique, conventional film growth technique, Chemical etching, Quantum materials.

TEXT BOOKS:

1. Bhushan B., "Handbook of Nanotechnology", Springer, Germany, 2004.
2. Ashby M.F., Ferreira P.J. and Schodek D.L., "Nanomaterials, Nanotechnologies and Design", Elsevier Ltd., 2009.

REFERENCES:

1. Ratner M. and Ratner D., "Nano Technology", Pearson Education, New Delhi, 2003.
2. Timp G., "Nanotechnology", Springer, India, 2005.
3. Busnaina A., "Nanomanufacturing Handbook", CRC Press, London, 2006.
4. Lakhtakia A., "Nanometer Structures – Theory, Modeling and Simulation", PHI Learning Private Limited, NewDelhi, 2009.

Outcomes	• Understand about Nano materials

	• Understand the synthesis of Nanomaterials • Understand of Characterisation of Nano materials • Understand applications of nano materials • Know Nano materials fabrication

Semester - VI				
Course code: 60567	**Comprehensive Study**	**T/P**	**Credit**	**Hrs./Week**
		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: 60554A	**Strategic Approaches to Digitalization**	**T/P**	**Credit**	**Hrs./Week**
		P	**5**	**5**
Objectives	To understand the business cultural change, opportunities and challenges of the digital revolution in manufacturing domain			
Unit -I	**Introduction** Introduction -opportunities for value capturing from digital manufacturing - Barriers to value capture for firms - Strategies for mitigating the barriers - Steps to digital transformation - Driving competitive advantage through transformative technologies - Digital transformation scenarios - Shoestring approach for Small to Medium sized Enterprise (SME) manufacturers.Concept of Digital Twins and Internet of Twins.			
Unit-II	**Manufacturing Digitalization** Digitalization of Modern manufacturing - Smart Manufacturing - M2M communication - Internet of Things (loT) in factory environment - Stages in the Industry 4.0 Development Path Barriers in the implementation - Impact on productivity from digitalization of manufacturing. Anticipated Value Drivers from Digital Manufacturing Technology Implementations - Smart Manufacturing Standards- Manufacturing Automation Investment Decisions - Manufacturing Support Programs.			
Unit-III	**Operations In Digital Plant** Logistics in digital age - Hybrid supply chain - Digital supply chain - Supply chain transformation - Cloud management, geolocation and data analytics - Dynamic scheduling and data driven planning techniques.			
Unit-IV	**Maintenance** Reliability Centered Maintenance (ACM) programme - Maintenance strategy - Reactive; Preventative; Predictive/Condition-Based; Proactive. Lean manufacturing practices in digital plant - Five Wastes.			
Unit-V	**Challenges and Case Study** Challenges - Strategy formulation; Leadership Skills; Accessing Required Digital Skills; Process Optimization Through Digital; Supply Chain Security and Assurance; Managing IT/OT Convergence - Case studies revealing strategies for gaining value from digital technologies.			
Textbooks 1. Tardieu H., Daly D., Esteban-Lauzan J., Hall J., Miller G. (2020) Case Study 6: The Digital Transformation of Manufacturing. In: Deliberately Digital. Future of Business and Finance. Springer, Cham. **Reference** 1. Michael Fitzgerald, MAn Internet for Manufacturing," MIT Technology Review, January 28,2013 2. Antonella Petrillo ,Raffaele Cioffi, Fabio De Felice, "Digital Transformation in Smart Manufacturing", BoD - Books on Demand, 2018.				
Outcomes	1. Identify the opportunities, barriers and strategies for digital transformation 2. Identify the approaches to digitization in Manufacturing domain 3. Identify the operations in digital age 4. Identify the challenges involved in implementation in strategies to digitization			

Elective				
Course code: 60554B	**Data Base Management Systems**	**T/P**	**Credit**	**Hrs./Week**
		P	**5**	**5**

Objectives	Learner would appreciate the systematic design and principles involved in any database development
Unit -I	Introduction to Database Systems, Database System Architecture, Schema, Database Models, Relational Model, ER Modelling and case studies.
Unit-II	Expressive power of relational databases, Relational Algebra. Database Languages, DDL, DML, Query Languages, case studies.
Unit-III	Transaction Processing and Concurrency control.
Unit-IV	Internal schema Design, Indexing, Introduction to advanced concepts, XML, Datamining, Data warehousing.
Unit-V	Problem sessions, hands on query languages

Textbooks

1. R. Elmasri and S. B. Navathe, Fundamentals of Database Systems, 4th edition, Pearson, 2007.

Reference

1. A. Silberschatz, H. F. Korth, and S. Sudharsan, Database System Concepts, 5th edition, Tata McGraw Hill, 2006.
2. C. J. Date, A. Kannan, and S. Swamynathan, An Introduction to Database Systems, 8th edition, Pearson, 2006.
3. L. Koch, Oracle – The complete reference, Tata McGraw Hill, 2002

Outcomes	Learn the systematic design and principles involved in any database development

Elective				
Course code: 60562A	**Digital Signal Processing and Control**	**T/P**	**Credit**	**Hrs./Week**
		P	**4**	**4**

Objectives	1. To train the students to be proficient in the area of digital signal processing and control systems for industrial applications 2. To enable learners to analyze the performance of digital control systems using various linear systems tools
Unit -I	**Fundamentals of Digital Signal Processing &Control** Review of Discrete LTI systems and its properties-Introduction to Discrete convolution – Discrete Fourier transforms and frequency spectrums-Sampling theory and reconstruction- Aliasing-Introduction to Z Transforms- Pulse transfer functions
Unit-II	**Digital Feedback Control** Difference equations -Feedback systems- Impact of the poles on the closed loop system- Fundamental modes- First and second order discrete system closed loop analysis- Impact of feedback on the dynamic behavior based on the location of closed loop poles using DC Motors
Unit III	**Frequency Response** Bode Plots-Gain and Phase plots-significance of Nyquist plot-Introduction to loop shaping controllers based on performance measures using Bode Plot-Transient
Unit IV	**Performance Analysis** Steady state performance design specifications for a second order systems- case studies using closed loop DC motor control
Unit V	**Design of Digital Control** Digital controller design - Root locus-based design- Digital PIO controllers- Dead beat control design - Case study examples using DC Motor control

Textbooks

1. Gopal M, Digital Control and State Variable Methods, 3rd Edition, Tata McGraw Hill Publishing Company, 2009.

Reference

1. Franklin G.F, Powell J.D, Workman M.L, Digital control of Dynamic Systems, 3rd
2. Edition, Addison Wesley Longman,Inc., Menlo Park, CA,1998.
3. Kuo B.C, Digital Control Systems, 2nd Edition, Oxford University Press, Inc., New York, 1992.
4. Philips C.L, Nagle H.T, Aranya Chakrabortty, Digital Control System Analysis and Design,4th Edition, Pearson,2015.
5. Ogata K, Discrete time control systems, 2nd Edition, Prentice Hall Inc., New Jersey,1992.

Outcomes	1. Analyze the Mathematical modeling of digital control system elements using Z transform techniques 2. Appreciate the role of Digital signal processing in sampling theory and in Jhe construction of anti-aliasing filters 3. Mathematically analyze the closed loop discrete time systems using Z transform 4. Apply linear systems tools in the design of various digital control algorithms 5. Design of Discrete PIO controllers using Root locus for applications

Elective				
Course code: 60562B	**Computer Vision & Pattern Recognition**	**T/P**	**Credit**	**Hrs./Week**
		P	**4**	**4**

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:60562C	**Nano Technology**	**T/P**	**Credit**	**Hrs./Week**
		P	**4**	**4**

Objectives	1. To understand Methods for production of Nanoparticles 2. To understand Characteristic techniques of Nano materials 3. To understand Nano Fabrication and Machining. 4. To Know the applications of Nano materials.
Unit -I	**Introduction to Nano materials** Amorphous, crystalline, microcrystalline, quasi-crystalline and nano-crystalline materials. Classification of Nano materials – Size Effects – Surface to volume ratio, Strain confinement, Quantum Effects – Properties – Mechanical, Thermal, Electrical, Optical, Magnetic, Acoustic.
Unit-II	**Synthesis of Nano materials** Methods of production of Nanoparticles – Top–Down processes, Bottom-Up Processes – Solgel synthesis, Inert gas condensation, Sono chemical processing, Molecular self-assembly, High energy Ball milling, Plasma synthesis, Electro deposition, Chemical vapour deposition, Physical vapour deposition, and other techniques. Synthesis of Carbon Nanotubes – Solid carbon source based production techniques, Gaseous carbon source based production techniques - Issues in fabrication of nano materials Nano wires.
Unit III	**Characterisation of Nano materials** Scanning Probe Microscopy (SPM) – Scanning tunneling microscope, Transmission electron microscope, Scanning transmission electron microscope, Atomic force microscope, Scanning force microscopy, Electrostatic force microscopy , Dynamic force microscopy, Magnetic force microscopy, Scanning thermal microscopy, Peizo force microscopy, scanning capacitance microscopy, Nano indentation - Issues in characterization of nanomaterials.
Unit IV	**Applications of Nanomaterials** Applications in Mechanical, Electronics engineering industries – Use of nanomaterials in automobiles, aerospace, defense and medical applications – Metallic, polymeric, organic and ceramic nanomaterials.
Unit V	**Nano Fabrication and Machining** LIGA, Ion beam etching, Molecular manufacturing techniques – Nano machining techniques – Top/Bottom up Nano fabrication techniques - Sub micron lithographic technique, conventional film growth technique, Chemical etching, Quantum materials.

Textbooks

1. Bhushan B., “Handbook of Nanotechnology”, Springer, Germany, 2004.

Reference

1. Ashby M.F., Ferreira P.J. and Schodek D.L., “Nanomaterials, Nanotechnologies and Design”, Elsevier Ltd., 2009.
2. Ratner M. and Ratner D., “Nano Technology”, Pearson Education, New Delhi, 2003.
3. Timp G., “Nanotechnology”, Springer, India, 2005.
4. Busnaina A., “Nanomanufacturing Handbook”, CRC Press, London, 2006.
5. Lakhtakia A., “Nanometer Structures – Theory, Modeling and Simulation”, PHI Learning Private Limited, NewDelhi, 2009.

Outcomes	1. Familiarize Methods for production of Nanoparticles 2. Familiarize Characteristic techniques of Nano materials 3. Understand Nano Fabrication and Machining. 4. Understand the applications of Nano materials.

Elective				
Course code: 60563A	**Manufacturing Systems**	**T/P**	**Credit**	**Hrs./Week**
		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. Agile/demand driven manufacturing, Quick response manufacturing, world class manufacturing and holonic manufacturing systems.
Unit-V	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: 60563B	**Machine Learning Techniques**	**T/P**	**Credit**	**Hrs./Week**
		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: 60563C	**Machine to Machine Communication**	**T/P**	**Credit**	**Hrs./Week**
		P	**4**	**4**

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