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 Production Technology

Regulations and Syllabus

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 Production Technology**
Programme of Level: **Bachelors**
Duration for the Course: Full Time (Three Years)

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

PEO-1	**Will be engineering practitioners and leaders, who would help solve industry's technological problems.**
PEO-2	**Will impart fundamental scientific principles to solve complex engineering solutions in different domains in mechanical engineering.**
PEO-3	**Will be engineering professionals, innovators or entrepreneurs engaged in technology development, technology deployment, or engineering system implementation in industry.**
PEO-4	**Will have successful career in the field of Production Engineering, contributing to the global economy.**
PEO-5	**Will inculcate ethical values and professional integrity, enabling the students to grow and contribute to the world.**

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

PSO-1	**Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.**
PSO-2	**Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.**
PSO-3	**Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.**
PSO-4	**Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.**
PSO-5	**Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.**

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

PO-1	**Identify, formulate, study literature, and analyze complex problems in Engineering reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences**
PO-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.**
PO-3	**Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex Engineering activities with an understanding of the limitations.**
PO-4	**impact of the Engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.**
PO-5	**Apply engineering and management principles to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.**

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

PO-1	**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-2	**Having adaptive thinking and adaptability in relation to environmental context and sustainable development**
PO-3	**Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.**
PO-4	**Having adaptive thinking and adaptability in relation to environmental context and sustainable development**
PO-5	**Having interest and recognise the need for independent and lifelong learning**
PO-6	**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-7	**Having an ability to use techniques, skills, resources and modern engineering and IT tools necessary for engineering practice**
PO-8	**Having problem solving ability- to assess social issues (societal, health, safety, legal and cultural) and engineering problems**
PO-9	**Having a good working knowledge of communicating in English – communication with engineering**

	community and society
PO-10	**Having critical thinking and innovative skills**

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 Production Technology [Specialization in Aerospace Machining, Aerospace Composites Manufacturing, Foundry Process, Machine Tool Manufacturing & Tool and Die]

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.

6. Admission:

Admission is based on the marks in the qualifying examination.

Lateral Entry:

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

7. Duration of the course:

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

8. 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.

9. 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.

10. 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.

11. 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.**

12. 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 PRODUCTION TECHNOLOGY

Course Code: **Year: I**

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	60611T/11H/ 11F	T/OL	Tamil/Other Language		3	T	3	25	75	100
		II	60612	E	General English		3	T	3	25	75	100
		IV	60613	G-I	Life Coping Skills @		4	P	4	25	75	100
			60614		Office Automation - Lab		2	P	2	25	75	100
		III	60615	CC-I	Production Technology	5		T	5	25	75	100
			60616	CC-II	Basic Electrical and Electronics Engineering - Practical	4		P	4	25	75	100
			60617	CC-III	Engineering Graphics - Practical	4		P	4	25	75	100
			60618	CC-IV	Engineering Metrology – Practical	5		P	5	100	--	100
			Sub-Total			**18**	**12**					
			Total for Semester - I			**30**			**30**	**275**	**525**	**800**
NSQF Level – 5 : Diploma	II	I	60621	T/OL	Tamil/Other Language		3	T	3	25	75	100
		II	60622	E	General English		3	T	3	25	75	100
		III	60623	Core - V	Applied Hydraulics and Pneumatics	5		T	5	25	75	100
			60624	Core - VI	Quality Engineering - Practical	4		P	4	25	75	100
			60625	Core - VII	Engineering Mechanics - Practical	4		P	4	25	75	100
			60626	Core -VIII	Manufacturing Processes – Practical	5		P	5	100	--	100
		IV	60627		Environmental Studies *		2	T	2	25	75	100
			60628		Advanced Communicative English @		2	P	2	100	--	100
			60629		Computing Skills Lab- I		2	P	2	25	75	100
					Sub-Total	**18**	**12**					
					Total for Semester – II	**30**			**30**	**375**	**525**	**900**

SYLLABUS UNDER CBCS PATTERN

B.Voc. in PRODUCTION TECHNOLOGY

Course Code: **Year: II**

Degree	Sem	Part	Course Code	Courses	Course Name	Credits Skill (S)/ General (G)		Theory / practical	Hrs. / Week	Marks		Total
						S	G			Int	Ext	
6 : Advanced NSQF Level – Diploma	III	III	60631	**Core - IX**	Welding Technology	3		T	3	25	75	100
			60632	**Core - X**	Mechatronics Engineering	5		P	5	25	75	100
			60633	**Core – XI**	Operations Research	5		P	5	25	75	100
			60634	**Core – XII**	Computer Aided Design and Manufacturing	5		P	5	25	75	100
		IV	60635		Interview Techniques & Interpersonal Communications @		5	P	5	25	75	100
			60636		Nano Technology		4	P	4	25	75	100
			60637	**NME - I**	Total Quality Management		2	P	3	25	75	100
					Self - Learning Course –I-MOOCs –I %		(E)	--	--	--	--	--
		V			Extension Activities #		1	--	--	100	--	100
				Sub-Total		**18**	**12**					
				Total for Semester - I		**30+ (E)**			**30**	**272**	**525**	**800**
	IV	III	60641	**Core - XIII**	CNC Machines and Programming	3		T	4	25	75	100
			60642	**Core –XIV**	Low Cost Automation	4		P	4	25	75	100
			60643	**Core -XV**	Non Destructive Evaluation and Testing	4		P	5	25	75	100
			60644		Industrial Safety	2		P	--	100	--	100
			60645	**Core -XVI**	Micro Electro Mechanical Systems – Practical	5		P	5	100	--	100
		IV	60646		Professional Etiquettes		4	T	4	25	75	100
			60647		Rapid Prototyping		4	P	4	25	75	100
			60648	**NME-II**	Supply Chain Management		2	P	2	25	75	100
			60649A		Value Education* /			T				
			60649B 60649C		Manavalakalai Yoga / Introduction to Gender Studies @		2	P	2	25	75	100
					Self-Learning Course - IV - MOOCs - II **%**		(E)	--	--	--	--	--
				Sub-Total		**18**	**12**					
				Total for Semester – II		**30**			**30**	**375**	**525**	**900**

SYLLABUS UNDER CBCS PATTERN

B.Voc. in PRODUCTION TECHNOLOGY

Course Code: **Year: III**

Degree	Sem	Part	Course Code	Courses	Course Name	Credits Skill (S) / General (G)		Theory /practical	Hrs. / Week	Marks		Total
						S	G			Int	Ext	
NSQF Level – 7: B.Voc. Degree	V	III	60651	**Core-XVII**	Modern Machining Processes	5		T	5	25	75	100
			60652	**Core - XVIII**	**Practical –** Additive Manufacturing	4		P	4	25	75	100
			60653	**Core –XIX**	**Practical –** Production Planning and Control	4		P	4	25	75	100
				Elective I	**Practical**	5		P	5	25	75	100
		IV	60655		Entrepreneurship Start-up Skills@		4	T	4	25	75	100
			60656		Quantitative Aptitude #		4	P	4	100	--	100
			60657		Accounting Skills @		4	P	4	25	75	100
				Sub-Total		**18**	**12**					
				Total for Semester – I		**30**			**30**	**250**	**450**	**700**
		IV	60661		Corporate Grooming and Finishing Skills@		4	P	4	25	75	100
			60662		Industrial Engineering & Management		4	T	4	25	75	100
			60663		Comprehensive Study @		4	P	--	100	--	100
	VI	III		**Elective II**	**Practical**	4		P	4	25	75	100
				Elective III	**Practical**	4		P	4	25	75	100
			60666		Industrial Internship with Project	6		I	9	25	75	100
			60667		**Core –XX - Practical –** Artificial Intelligence & Reasoning	4		P	5	100	--	100
				Sub-Total		**18**	**12**					
				Total for Semester – II		**30**			**30**	**325**	**375**	**700**
				Total Credits (B.Voc. Degree Programme)		**180**		**180**		**1875**	**2925**	**4800**

Fully-internal Course – Examination will be conducted internally

@ External Examination will be conducted as Viva-voce Examination

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

LIST OF ELECTIVES FOR SEMESTER 5

Sem	Course Code	Title of the Paper	T/P	Cr.	Hrs./ Week	Max. Marks		
						Int.	Ext.	Total
V	60654A	Industry 4.0 & IiOT	P	5	5	25	75	100
	60654B	Machine Learning Techniques	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	60664A	Composite Materials and Processing	P	4	4	25	75	100
	60664B	Industrial Robotics & Applications	P	4	4	25	75	100
	60664C	Robot Programming	P	4	4	25	75	100
	60664D	Design of Mechatronics System	P	4	4	25	75	100
	60665A	Mould Technology Design	P	4	4	25	75	100
	60665B	Foundry mechanization & Fettling Processes	P	4	4	25	75	100
	60665C	Design of Casting Process	P	4	4	25	75	100
	60665D	Modern Casting Process	P	4	4	25	75	100

Semester - I				
Course code:60613	**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: 60614	**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: 60615	**Production Technology**	**T/P**	**Credit**	**Hrs./Week**
		T	**5**	**5**

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

TEXT BOOKS:

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

REFERENCES:

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

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

Semester - I				
Course code: 60616	**Basic Electrical & Electronics Engineering**	**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.
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.

Outcomes	(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

Semester - I				
Course code: 60617	**Engineering Graphics**	**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: 60618	**Engineering Metrology**	**T/P**	**Credit**	**Hrs./Week**
		P	**5**	**5**

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

TEXT BOOK:

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

REFERENCES:

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

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

Semester - II				
Course code: Core 60623	**Applied Hydraulics and Pneumatics**	**T/P**	**Credit**	**Hrs./Week**
		T	**5**	**5**

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

Textbooks

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

Reference

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

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

Semester - II

Course code: Core 60624	Quality Engineering - Practical	T/P	Credit	Hrs./Week
		P	4	4

Objectives	1. To understand and apply the Quality Engineering principles and process. 2. To understand Tools and Techniques of Quality 3. Understand Quality Management Systems 4. To Know Lean Concepts 5. To understand Six Sigma Concepts
Unit -I	**Introduction** Introduction - Need for quality - Evolution of quality - Definitions and dimensions of quality - Quality cost and Quality circles - Basic concepts of TQM - TQM Framework - Barriers to TQM -TQM Principles: Customer satisfaction, Employee involvement and continuous process improvement.
Unit-II	**Tools and Techniques** The seven traditional tools of quality - New management tools- Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs.
Unit III	**Quality Management System** Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards-AS 9100,TS16949 and TL 9000 - ISO 9001 Requirements-Implementation-Documentation-Internal Audits-Registration. Environmental Management System (EMS) : Introduction-ISO 14000 Series Standards- Concepts of ISO 14001-Requirements of ISO 14001-Benefits of EMS.
Unit IV	**Lean Manufacturing** Conventional Manufacturing versus Lean Manufacturing - Principles of Lean Manufacturing. Basic elements of lean manufacturing - Introduction to LM Tools - Value stream mapping - Procedure and principles.
Unit V	**Six Sigma concepts** Six sigma: Concepts, Methodology, tools for implementation, applications to manufacturing, service sector including IT.

TEXT BOOK:

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

REFERENCES:

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

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

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

60625				
		P	4	4

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

Textbooks

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

Reference

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

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

Semester - II				
Course code: Core 60626	**Manufacturing Processes - Practical**	**T/P**	**Credit**	**Hrs./Week**
		P	**5**	**5**

Objectives	1. Students will gain knowledge of manufacturing processes and the skills to develop and manipulate the operating parameters for a given process to avoid defect and improve quality. 2. Students will gain knowledge to understand basic parts and assemblies manufactured using powered and non-powered machine shop equipment in conjunction with mechanical documentation. 3. To gain knowledge in molding and molding practice 4. To gain knowledge in forging, Rolling and extrusion 5. To gain knowledge in welding processes.
Unit -I	**Molding Practices:** Introduction to casting and foundry industry; basic principles of casting processes; sequence in foundry operations; patterns; molding practice; ingredients of molding sand and coresand, sand testing; different molding processes. **Melting Furnaces:** Types of furnaces used in foundry; furnaces for melting; melting practice for steel, cast iron, aluminum alloys, copper alloys and magnesium alloys; safety considerations; fluxing, degassing and inoculation. **Special Casting Techniques:** Investment casting, Shell molding ,die casting, centrifugal casting, plaster mould casting, magnetic casting, squeeze casting, full mould process, strip casting, CO2 molding. **Casting Defects and Foundry Automation:** Defects in castings and its remedies. Energy saving and quality control in foundries; Cleaning and inspection of castings; Foundry automations-moulding machines automation of sand plant, moulding and fettling sections of foundry – Dust and fume control.
Unit-II	**Theory of Plasticity:** Theory of Plasticity - stress tensor – hydrostatic & deviator components of stress – flow curve – true stress strain – yielding criteria – yield locus – octahedral shear stress and shear strains – invariants of stress strain – slip line field theory plastic deformations of crystals. **Plastic Forming of Metal Forging:** Basics of plastic forming & forging- mechanics of metal working – temperature in metal working – strain rate effects – friction and lubrication – deformation zone geometry. Forging process – classification – equipment – calculation of forging loads – forging defects – residual stresses. Plastic Forming of Metals **Rolling and Extrusion:** Rolling and Extrusion – classification -rolling mills - rolling of bars & shapes – rolling forces – analysis of rolling – defects in rolling- theories of hot & cold rolling – torque power estimation. **Extrusion:** classification-equipment – deformation lubrication and defects – analysis – hydrostatic extrusion – tube extrusion. Plastic Forming of Metals
Unit III	**Drawing and Sheet metal forming:** Drawing & Sheet Metal Forming- rod & wire drawing equipment – analysis – deep drawing – tube drawing – analysis, residual stresses sheet metal forming – methods – shearing and blanking – bending – stretch forming – deep drawing – forming limit criteria – defects - Stretch forming – press brake forming – explosive forming. **Unconventional Forming Methods:** Electro hydraulic forming – magnetic pulse forming – super plastic forming – electro forming – fine blanking – P/M forging-Isothermal forging – HERF.
Unit IV	**Power Sources:** Classification of welding processes - heat sources, power sources, arc characteristics, V-I relationship, different types of electrodes, ingredients and function of electrode coverings, types of weld joints. **Fusion Welding processes:** Shielded metal arc welding, gas welding, TIG welding, MIG welding, Submerged arc welding processes. **Solid State Welding processes:** Resistance, friction, friction stir, ultrasonic, induction pressure, diffusion welding processes, explosive welding.

Unit V	**Special Welding Processes:** Electron beam, laser beam welding, plasma arc processes; advantages, limitations, Introduction to Robotic welding, underwater welding. **Weld Metallurgy:** Weld thermal cycles and their effects, effects of pre and post weld heat treatments, concept of HAZ, concept of weldability and its assessment. Welding of different materials, defects in welds, their causes and remedies.

TEXT BOOK:

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

REFERENCES:

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

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

Semester - II				
Course code: 60627	**Environmental Studies**	**T/P**	**Credit**	**Hrs./Week**
		T	**2**	**2**

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

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

Unit IV	**Biodiversity and its conservation** • Introduction – Definition : genetic, species and ecosystem diversity. • Biogeographically classification of India • Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values • Biodiversity at global, National and local levels. • India as a mega-diversity nation • Hot-spots of biodiversity. • Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts. • Endangered and endemic species of India

	• Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.
Unit V	**Environmental Pollution** a) Causes, effects and control measures of :- • Air pollution • Water pollution • Soil pollution • Marine pollution • Noise pollution • Thermal pollution • Nuclear hazards b) Solid waste Management : Causes, effects and control measures of urban and Industrial wastes. c) Role of an individual in prevention of pollution. d) Disaster management • Disasters due to natural calamities such as flood, earthquake, rain, cyclone and landslides. • Manmade disasters – crisis due to fires, accidents, strikes. • Loss of property and life.

Reference and Textbooks

1. Text book of Environmental studies for Undergraduate courses – Dr. Erach Bharucha.

Outcomes	**At the end of the subject the trainees will be able to** 1. Avail public awareness regarding Environment. 2. Conserving Renewable and non-renewable resources: 3. Conserving Natural resources and associated problems. 4. Ecosystem, various aspects related to ecosystem **5.** Understand and explain the biodiversity and its conservation 6. Identify the causes, effects and control measures of pollution and will also explain the nuances of disaster management

Semester - II				
Course code: 60628		**T/P**	**C**	**H/W**
	ADVANCED COMMUNICATIVE ENGLISH	**P**	**2**	**2**

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

Text Book:

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

Books for Reference:

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

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

Semester - II				
Course code: 60629	**Computing Skills LAB - I**	**T/P**	**Credit**	**Hrs./Week**
		P	**2**	**2**

Objectives	• To understand Components of Computer • To know Operating Systems • To understand Internet and web browsers • To know cyber laws • To make presentations
Contents	1. COMPONENTS OF COMPUTER 2. OPERATING SYSTEMS 3. INTRODUCTION TO INTERNET, WWW AND WEB BROWSERS 4. CYBER LAWS 5. MAKING SMALL PRESENTATION
Outcomes	• Understand components of computer • Understand operating systems • Understand Internet and web browsers • Understand cyber laws • Understand presentations

Semester - III				
Course code: Core	**Welding Technology**	**T/P**	**Credit**	**Hrs./Week**
60631		**T**	**3**	**3**

Objectives	• To understand the Power sources for welding process • To understand Fusion Welding Processes • To understand Solid State Welding Processes • To understand special welding processes • To understand welding metallurgy
Unit -I	**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.
Unit-II	**Fusion welding processes:** Shielded metal arc welding, gas welding, TIG welding, MIG welding, Submerged arc welding processes
Unit III	**Solid state welding processes:** Resistance, friction, friction stir, ultrasonic, induction pressure, diffusion welding processes, explosive welding.
Unit IV	**Special welding processes:** Electron beam, laser beam welding, plasma arc processes; advantages, limitations, Introduction to Robotic welding, underwater welding.
Unit V	**Welding 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:

- Larry Jeffus. (2007) Welding Principles and Applications, Thomson Publishers, 6th edition.

References:

- John Geoffrey Hicks. (1999) Industrial Joining Processes, Industrial Press, 3rd edition.
- Howard B Cary and Scott. (2004) Modern welding technology, Prantice hall.
- Peter J Shull (ed). (2001) Nondestructive Evaluation – Theory Practice and Application, Marcel- Decker Inc.

Outcomes	• Understand the Power sources for welding process • Understand Fusion Welding Processes • Understand Solid State Welding Processes • Understand special welding processes • Understand welding metallurgy

Semester - III				
Course code: Core	**Mechatronics Engineering**	**T/P**	**Credit**	**Hrs./Week**
60632		**P**	**5**	**5**

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

Textbooks

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

Reference

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

Outcomes	• Discuss the interdisciplinary applications of Electronics, Electrical, Mechanical and Computer Systems for the Control of Mechanical, Electronic Systems and sensor technology. • Discuss the architecture of Microprocessor and Microcontroller, Pin Diagram, Addressing Modes of Microprocessor and Microcontroller. • Discuss Programmable Peripheral Interface, Architecture of 8255 PPI, and various device interfacing • Explain the architecture, programming and application of programmable logic controller to problems and challenges in the areas of Mechatronic engineering. • Discuss various Actuators and Mechatronics system using the knowledge and skills acquired through the course and also from the given case studies

Semester - III				
Course code: Core	**Operations Research**	**T/P**	**Credit**	**Hrs./Week**
60633		**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	**Computer Aided Design and Manufacturing**	**T/P**	**Credit**	**Hrs./Week**
60634		**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: 60635		**T/P**	**C**	**H/W**
	INTERVIEW TECHNIQUES & INTERPERSONAL COMMUNICATIONS	**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: 60636	**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 depositionJ, 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 nano materials.
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.

Semester III				
Course code: NME - I	**Total Quality Management**	**T/P**	**Credit**	**Hrs./Week**
60637		**P**	**2**	**3**

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

Text Books:

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

Reference:

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

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

<table>
<tr><th colspan="5">Semester - III</th></tr>
<tr><th>Course code:</th><th rowspan="2">Self – Learning Course – I – MOOCs - I</th><th>T/P</th><th>Credit</th><th>Hrs./Week</th></tr>
<tr><td></td><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>

Semester - III				
Course code:	**Extension Activities**	**T/P**	**Credit**	**Hrs./Week**
		--	**1**	**…..**

Objectives

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.

The criteria for evaluation of Extension Activities will be as follows:

S. No.	Criteria	Maximum Marks
1.	Interaction with villagers	10
2.	Participation / Attitude towards work	10
3.	Participation in interaction and discussion	10
4.	Knowledge of problems / issues	10
5.	Organising & decision making ability	20
6.	Expression: a) Cultural programmes	10
	b) Report Writing	20
7.	Ability to adjust and work in a team	10
	Total	**100**

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

60641		T	3	4
Objectives	• 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			
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.			

Textbooks

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

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	**Low Cost Automation**	**T/P**	**Credit**	**Hrs./Week**
60642		**P**	**4**	**4**

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

Text books:

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

Reference books:

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

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

Semester - IV				
Course code: Core	**Non Destructive Evaluation and**	**T/P**	**Credit**	**Hrs./Week**
60643	**Testing**	**P**	**4**	**5**

Objectives	• To acquire familiarity with different types of NDT techniques • To understand the basic principles underlying each NDT technique • To know the advantages and limitations of each technique • To understand the considerations for selection of appropriate NDT technique(s) for various applications • To become familiar with common types of defects arising in different types of manufactured products and the NDT method(s) best suited to evaluate them
Unit -I	**Introduction to NDET and Surface NDT Techniques:** Introduction to non-destructive testing and evaluation, visual examination, liquid penetrant testing and magnetic particle testing. Advantages and limitations of each of these techniques.
Unit-II	**Radiographic Testing:** Radiography principle, electromagnetic radiation sources, X-ray films, exposure, penetrameter, radiographic imaging, inspection standards and techniques, neutron radiography. Radiography applications, limitations and safety.
Unit III	**Eddy Current Testing and Ultrasonic Testing:** Eddy current principle, depth of penetration, eddy current response, eddy current instrumentation, probe configuration, applications and limitations. Properties of sound beam, ultrasonic transducers, inspection methods, flaw characterization technique, immersion testing.
Unit IV	**Special/Emerging Techniques:** Leak testing, Acoustic Emission testing, Holography, Thermography, Magnetic Resonance Imaging, Magnetic Barkhausen Effect. In-situ metallography.
Unit V	**Defects in materials / products and Selection of NDET Methods:** Study of defects in castings, weldments, forgings, rolled products etc. and defects arising during service. Selection of NDET methods to evaluate them. Standards and codes.

Text Book:

Baldevraj, Jayakumar T., Thavasimuthu M., (2008) "Practical Non-Destructive Testing", 3rd edition, Narosa Publishers

Reference:

American Society for Metals, "Non-Destructive Evaluation and Quality Control": Metals Hand Book: 1992, Vol. 17, 9th Ed, Metals Park, OH.

Paul E Mix, "Introduction to nondestructive testing: a training guide", Wiley, 2nd edition New Jersey, 2005.

Ravi Prakash, "Nondestructive Testing Techniques", New Age International Publishers, 1st rev. edition, 2010.

Outcomes	• Acquire familiarity with different types of NDT techniques • Understand the basic principles underlying each NDT technique • Know the advantages and limitations of each technique • Understand the considerations for selection of appropriate NDT technique(s) for various applications • Become familiar with common types of defects arising in different types of manufactured products and the NDT method(s) best suited to evaluate them

Semester - IV				
Course code:	**Industrial Safety**	**T/P**	**Credit**	**Hrs./Week**
60644		**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	**Micro Electro Mechanical Systems – Practical**	**T/P**	**Credit**	**Hrs./Week**
60645		**P**	**5**	**5**

Objectives	• To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices. • To educate on the rudiments of Micro fabrication techniques. To introduce various sensors and actuators • To introduce different materials used for MEMS • To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering
Unit -I	**Introduction** Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.
Unit-II	**Sensors and Actuators-I** Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – Comb drive devices – Micro Grippers – Micro Motors - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys
Unit-III	**Sensors and Actuators-II** Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.
Unit-IV	**Micromachining** Silicon Anisotropic Etching – Anisotrophic Wet Etching – Dry Etching of Silicon – Plasma Etching – Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants – Case studies Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistriction methods – LIGA Process - Assembly of 3D MEMS – Foundry process.
Unit-V	**Polymer and Optical Mems** Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

Textbooks

- Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
- Stephen D Senturia, 'Microsystem Design', Springer Publication, 2000.

Reference

- Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.
- Nadim Maluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
- Mohamed Gad-el-Hak, editor, " The MEMS Handbook", CRC press Baco Raton, 2001.
- Julian w. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS and Smart Devices, John Wiley & Son LTD, 2002.
- James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.
- Thomas M.Adams and Richard A.Layton, "Introduction MEMS, Fabrication and Application," Springer, 2010.

Outcomes	• To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices. • To educate on the rudiments of Micro fabrication techniques. To introduce various sensors and actuators • To introduce different materials used for MEMS • To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering

Semester - IV				
Course code:	**Professional Etiquettes**	**T/P**	**Credit**	**Hrs./Week**
60646		**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:	**Rapid Prototyping**	**T/P**	**Credit**	**Hrs./Week**
60647		**P**	**4**	**4**

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 - IV

Course code:	Supply Chain Management	T/P	Credit	Hrs./Week
60648		P	2	2

Objectives	• To improve the overall organization performance and customer satisfaction by improving product or service delivery to consumer. • To fulfill customer demands through the most efficient use of resources, including distribution capacity, inventory and labor.
Unit -I	**Introduction to Supply Chain Management (SCM):** Concept of supply management and SCM, Importance of supply chain flows, Core competency, Value chain, Elements of supply chain efficiency, Key issues in SCM, Decisionphases, Supply chain integration, Process view of a supply chain, Competitive Strategy and supply chain strategies, Uncertainties in supply chain, Supply chain drivers
Unit-II	**Planning & Managing Inventories in a Supply Chain:** The role of cycle inventory in a supply chain –Managing multi echelon cycle inventory – Estimating cycle inventory – related costs in practice – the role of safety inventory in a supply chain – managing safety inventory in a multi echelon supply chain – the role of information technology in inventory management – estimating and managing safety inventory in practice.
Unit III	**Designing Supply Chain Network:** Introduction, Network design, factors influencing network design, Data collection, Data aggregation, Transportation rates, Warehouse costs, Capacities and locations, Models and data validation, Key features of a network configuration, Impact of uncertainty on network design, Network design in uncertain environment, Value of information: Bullwhip effect, Information sharing, Information and supply chain trade-offs, Distribution strategies, Direct shipment distribution strategies, transshipment and selecting appropriate strategies.
Unit IV	**Supply Chain Integration:** Introduction, Push, Pull and Push-pull supply chains, identifying appropriate supply chain strategy. Sourcing and procurement, Outsourcing benefits, Importance of suppliers, evaluating a potential supplier, Supply contracts, Competitive bidding and Negotiation. Purchasing, Objectives of purchasing , Relations with other departments, Centralized and Decentralized purchasing, Purchasing procedure, Types of orders, Tender buying, E procurement, Role of E business in supply chains.
Unit V	**Issues in Supply Chain Management:** Introduction, Risk management, Managing global risk, Issues in international supply chain, regional differences in logistics. Local issues in supply chain, issues in natural disaster and other calamities, issues form SMEs, Organized retail in India, Reverse logistics.

Text Books:

- Designing & Managing the Supply Chain: Concepts, Strategies & Case Studies, Simchi-Levi, D. Kaminsky, P. Simchi-Levi, E. and Ravi Shankar. Third Edition, Tata McGrawHill, Third Edition, 2008.

Reference Books:

- Purchasing & Supply Chain Management, Doebler, D.W. and Burt, D.N. Text and Cases,McGraw- Hill Publishing Company Ltd., New Delhi, 1996.
- Supply Chain Management: Strategy, Planning & Operations, Chopra, S. and Meindl, P.Second Edition, Pearson Education (Singapore) Pte. Ltd. 2004.

Outcomes	• Understand the overall organization performance and customer satisfaction by improving product or service delivery to consumer. • Fulfil customer demands through the most efficient use of resources, including distribution capacity, inventory and labour.

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

60649A		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.
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.

Outcomes	• 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

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

60649B		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:	Introduction to Gender Studies	T/P	Credit	Hrs./Week
60649C		P	2	2

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

Textbooks

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

Reference

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

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

<table>
<tr><td colspan="5">Semester - IV</td></tr>
<tr><td colspan="2">Course code:</td><td rowspan="2">Self – Learning Course – IV – MOOCs - II</td><td>T/P</td><td>Credit</td><td>Hrs./Week</td></tr>
<tr><td colspan="2"></td><td>--</td><td>…</td><td>…</td></tr>
<tr><td>Objectives</td><td colspan="5">A massive open online course (MOOC) is a typically free web-based distance learning program that's designed for large numbers of geographically dispersed students.
A MOOC might be patterned on a college or university course, or it can be less structured. Although they don't always offer academic credits, these courses often offer a certification, enhance employment opportunities or further studies. Typically, MOOCs are used for higher education, upskilling and career advancement.</td></tr>
<tr><td></td><td colspan="5">The course provider, which is often a university, supplies the course materials and instructors. The LMS platform, such as EdX, Canvas, Coursera or Udacity, provides the technological infrastructure for course modules, user access and other learning resources.
MOOCs consist of traditional class materials and can include the following:
Filmed or recorded video lectures.
Assessments.
Readings.
Problem sets.
Online quizzes and examinations.
Interactive learning modules.
Interaction with other students via discussion forums.</td></tr>
<tr><td colspan="6">Reference

https://ugcmoocs.inflibnet.ac.in/

https://ugcmoocs.inflibnet.ac.in/index.php/ugccourses_data

https://www.coursera.org/courses?query=mooc

https://www.alagappauniversity.ac.in/links/swayam

https://www.mooc.org/</td></tr>
<tr><td>Outcomes</td><td colspan="5">MOOCs widespread adoption and use of online courses provides the following benefits:
No dependence on a physical location.
Improved access to higher education.
Affordability of higher education
Flexible learning schedule
Collaboration opportunities
Preview of college-level courses
Easy performance evaluation and monitoring</td></tr>
</table>

Semester - V				
Course code: Core	**Modern Machining Process**	**T/P**	**Credit**	**Hrs./Week**
60651		**T**	**5**	**5**

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 V				
Course code: Core	**Additive Manufacturing**	**T/P**	**Credit**	**Hrs./Week**
60652		**P**	**4**	**4**

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.
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

Textbooks

1. Liou L.W. and Liou F.W., "Rapid Prototyping and Engineering applications : A tool box for prototype development", CRC Press, 2007.

Reference

1. Kamrani A.K. and Nasr E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
2. Hilton P.D. and Jacobs P.F., "Rapid Tooling: Technologies and Industrial Applications", CRC press, 2000.
3. Chua C.K., Leong K.F., and Lim C.S., "Rapid prototyping: Principles and applications", Third Edition, World Scientific Publishers, 2010.
4. Gebhardt A., "Rapid prototyping", Hanser Gardener Publications, 2003.

Outcomes	• 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.

Semester - V				
Course code: Core	**Production Planning and Control**	**T/P**	**Credit**	**Hrs./Week**
60653		**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 - V				
Course code:	**Entrepreneurship & Start up Skills**	**T/P**	**Credit**	**Hrs./Week**
		T		
60655			**4**	**4**

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

Text books:

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

Reference books:

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

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

Semester - V				
Course code:	**Quantitative Aptitude**	**T/P**	**Credit**	**Hrs./Week**
60656		**P**	**4**	**4**

Objectives

Quantitative Aptitude is the most important requisite for clearing any competitive exam. Quantitative Aptitude skills form the bulk of most of the graduate level papers. Let us jump this hurdle through an exhaustive coverage of all the Quantitative Aptitude topics and an in-depth understanding of this subject

Topics

Arithmetic

- Profit and Loss
- Time and Work
- Time Speed and Distance
- Mixtures
- Ratio and Proportion
- Mixtures and Allegation
- Percentage
- Averages
- Simple and Compound Interest
- Real Numbers
- Irrational Numbers
- Complex Numbers
- HCF and LCM
- Unit's Digit
- Remainders

Algebra

- Quadratic Equations
- Inequalities
- Series
- Functions
- Surds and Indices
- Logarithm
- Polynomials

Geometry and Mensuration

- Lines and Angles
- Circles
- Triangles
- Quadrilaterals
- Polygons
- Coordinate Geometry
- Area & Volume of 2D and 3D figures

Modern Math

- Set Theory
- Permutation and Combination
- Probability
-

Links:

https://www.toppr.com/guides/quantitative-aptitude/
https://testbook.com/objective-questions/mcq-on-quantitative-aptitude--5eea6a1039140f30f369e7e7
https://pdf.exampundit.in/quantitative-aptitude
https://www.indiabix.com/aptitude/questions-and-answers/

Outcomes	Participants develop critical thinking, numerical reasoning, and logical problem-solving skills required for various professions, such as finance, consulting, and data analysis.

Semester - V				
Course code:	**Accounting Skills**	**T/P**	**Credit**	**Hrs./Week**
60657		**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:	**Corporate Grooming and Finishing Skills**	**T/P**	**Credit**	**Hrs./Week**
60661		**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:	**Industrial Engineering & Management**	**T/P**	**Credit**	**Hrs./Week**
60662		**T**	**4**	**4**

Objectives	● To Explain the different types of layout and compare them. ● To Appreciate the safety aspects and its impacts on an organization. ● To Compare different productivity improvement technique. ● To Explain different work measurement techniques. ● To Estimate standard time for a job. ● To Explain production planning and control and its functions. ● To Study the role of PPC as a tool for cost control. ● To Prepare process control charts..
Unit -I	**Demand Forecasting and Elements of Cost:** Macro and micro economics - Demand and supply – Factors influencing demand – Elasticity of demand – Demand forecasting – Time series - Exponential smoothing casual forecast - Delphi method – Correlation and Regression - Barometric method – Long run and Short run forecast. Elements of cost – Determination of Material cost - Labour cost - Expenses – Types of cost – Cost of production - Over head expenses – Problems.
Unit-II	**Industrial Organisation:** Introduction to Industrial Engineering – Concepts - History and Development of Industrial engineering – Roles of Industrial Engineer – Applications – Productivity – Factors affecting productivity – Increasing productivity of resources – Kinds of productivity measures.
Unit III	**Work Design:** Introduction to work study – Method study – Time study – stopwatch time study – Standard data - Method Time Measurement (M-T-M) – Work sampling – Ergonomics.
Unit IV	**Plant Layout and Group Technology:** Plant location - Factors - Plant layout - Types - Layout design process – Computerized Layout Planning – Construction and Improvement algorithms -ALDEP - CORELAP and CRAFT. Group technology-Problem definition - Production flow analysis - Heuristic methods of grouping by machine matrices – Flexible Manufacturing System - FMS work stations-Material handling and Storage system-Cellular Manufacturing System.
Unit V	**Production Planning and Control:** Types of productions, Production cycle-Process planning, Forecasting, Loading, Scheduling, Dispatching, Routing- Simple problems. Materials Planning – ABC analysis – Incoming materials control – Kanban system – Just in time. MRP systems- Master Production Schedule – Bill of Materials – MRP calculations - MRP II.

Text Books:

- Industrial Engineering and Management, O.P. Khanna, Revised Edition Publications (P) Ltd – 2004, 67/4 Madras House, Daryaganj, New Delhi – 110002.
- Engineering Economics and Management, T.R. Banga & S.C. Sharma, McGraw Hill Editiion. 2 – 2001, New Delhi.

References:

- Management, A global perspective, Heinz Weihrich, Harold Koontz, 10th Edition, McGraw Hill International Edition 1994.
- Essentials of Management, 4th Edition, Joseph L.Massie, Prentice-Hall of India, New Delhi 2004.

Outcomes	● Explain the different types of layout and compare them. ● Appreciate the safety aspects and its impacts on an organization. ● Compare different productivity improvement technique. ● Explain different work measurement techniques. ● Prepare process control charts. ● Explain the principles of management and function of management. ● Compare different organizational structure. ● Explain the selection and training of staff. ● Analyse inventory control system and the tools used in stock control. ● Explain the procurement and consumption cycle.

Semester - VI				
Course code:	**Comprehensive Study**	**T/P**	**Credit**	**Hrs./Week**
60663		**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.			

Semester - VI				
Course code:	**Industrial Internship with Project**	**T/P**	**Credit**	**Hrs./Week**
60666		**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: Core	**Artificial Intelligence & Reasoning**	**T/P**	**Credit**	**Hrs./Week**
60667		**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

ELECTIVES:

Elective				
Course code:	**Industry 4.0 & IiOT**	**T/P**	**Credit**	**Hrs./Week**
60654A		**P**	**5**	**5**

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

Elective				
Course code:	**Machine Learning Techniques**	**T/P**	**Credit**	**Hrs./Week**
60654B		**P**	**5**	**5**

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:	**Composite Materials and Processing**	**T/P**	**Credit**	**Hrs./Week**
60664A		**P**	**4**	**4**

Objectives	• To understand Composite materials structure • To Understand Composite processing
Unit -I	Types of reinforcements, their mechanical properties and functions – ceramics, glass, carbon, boron, silicon carbide, metal, aramid. Forms of reinforcements – particulate, fibre, filaments, whiskers, flakes. Pre-fabricated forms – preforms, prepegs, fabrics, honeycomb. Type of matrix, its mechanical properties and functions – polymers (thermosets and thermoplastics), metals, ceramics, glass and carbon. Basic principles in the design of composites and selection of matrix and reinforcement. Bonding mechanisms.
Unit-II	Anisotropic Behaviour and relationship between structure-mechanical properties. Mechanical testing – tensile, compressive, Intra-laminar shear, Inter-laminar shear and fracture.
Unit-III	Polymer Matrix Composites: Types of thermoset and thermoplastic resins. Principles in the selection of matrix and the reinforcements. Process selection criteria. Mould and tool making. Basic manufacturing steps – impregnation, lay-up, consolidation and solidification.
Unit-IV	Manufacturing processes for polymer composites – lay-up, compression moulding, extrusion, injection moulding, sheet forming, pultrusion, hot press & autoclave techniques and filament winding. Applications – industrial, automotive and aerospace. Metal and ceramic matrix composites – wettability of reinforcement to matrix and bonding, methods of manufacturing reinforcements with intermediate wetting layer.
Unit-V	Manufacturing processes for metal matrix composites: casting methods – gravity & low pressure die, investment, squeeze, spray forming, compression moulding and thixo-moulding. Manufacturing processes for ceramic matrix composites: reaction sintering, electro-deposition, spray forming, infiltration. Applications – industrial, automotive and aerospace

Textbooks

- Clyne T. W. and Withers P. J. – 'An Introduction to Metal Matrix Composites' – Cambridge University Press – 1993

Reference

- Matthews F. L. and Rawlings R. D. – 'Composite Materials: Engineering and Science' – Chapman & Hall, London – 1994
- Suresh S., Martensen A., and Needleman A. – 'Fundamentals of Metal Matrix Composites' – Butterworth, Heinemann – 1993
- Mallick P. K. – 'Fiber-reinforced Composites: Materials, Manufacturing and Design' – Marcel Dekker – 1993
- Mazumdar S. K. – 'Composites Manufacturing – Materials, Product & Process Engineering' – CRC Press – 2002

Outcomes	• To understand Composite materials structure • To Understand Composite processing

Elective				
Course code:	**Industrial Robotics & Applications**	**T/P**	**Credit**	**Hrs./Week**
60664B		**P**	**4**	**4**

Objectives	• To get an overview of basics of Robotics. • To understand Robot End Effectors • To study Robot Mechanics. • To learn Machine Vision Fundamentals • To study Robot Programming.
Unit -I	**Basics of Robotics:** Introduction- Basic components of robot-Laws of robotics- classification of robot-work space accuracy-resolution –repeatability of robot. Power transmission system: Rotary to rotary motion, Rotary to linear motion, Harmonics drives
Unit-II	**Robot End Effectors:** Robot End effectors: Introduction- types of End effectors- Mechanical gripper- types of gripper mechanism- gripper force analysis- other types of gripper- special purpose grippers.
Unit-III	**Robot Mechanics:** Robot kinematics: Introduction- Matrix representation- rigid motion & homogeneous transformation forward & inverse kinematics- trajectory planning. Robot Dynamics: Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation
Unit-IV	**Machine Vision Fundamentals:** Machine vision: image acquisition, digital images-sampling and quantization-levels of computation Feature extraction-windowing technique- segmentation- Thresholding- edge detection- binary morphology -grey morphology
Unit-V	**Robot Programming:** Robot programming: Robot Languages- Classification of robot language-Computer control and robot software-Val system and Languages- application of robots – Robot welding – Laser robot cutting – Assembly Robot – Painting Robot

Textbooks

- M.P.Groover, M.Weiss ,R.N. Nagal, N.G.Odrey, "Industrial Robotics - Technology, programming and Applications" Tata , McGraw-Hill Education Pvt Limited, 2008

Reference

- Sathya Ranjan Deb, "Robotics Technology & flexible Automation" Sixth edition, Tata McGrawHill Publication, 2003.
- K.S.Fu, R.C.Gonzalez, C.S.G.Lee, "Robotics: Sensing, Vision & Intelligence", Tata McGrawHill Publication, 1987.
- John.J.Craig, "Introduction to Robotics: Mechanics & control", Second edition, 2002.

Outcomes	• To get an overview of basics of Robotics. • To understand Robot End Effectors • To study Robot Mechanics. • To learn Machine Vision Fundamentals • To study Robot Programming.

Elective				
Course code:	**Robot Programming**	**T/P**	**Credit**	**Hrs./Week**
60664C		**P**	**4**	**4**

Objectives	• To understand basics of robots • To understand robot input and output of robot • To understand Joint & XYZ co-ordinate system • To understand Automation Circular interpolation Relative positions
Contents	• Robot component recognition • Manipulating the robot-Recording the position • Writing and running robot programs • Pick & Place tasks-Inputs (Digital, Analog, Sensors) & Output • Joint & XYZ co-ordinate system • Point-to-Point control • Linear interpolation • Circular interpolation • Relative positions • Writing the programs using Loops • Writing the programs using Delay

Textbooks

- M.P.Groover, M.Weiss ,R.N. Nagal, N.G.Odrey, "Industrial Robotics - Technology, programming and Applications" Tata , McGraw-Hill Education Pvt Limited 2ndEdition, 2012.

Reference

- John.J.Craig, " Introduction to Robotics: Mechanics & control"Pearson Publication, Fourth edition, 2018.
- Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer, 2ndEdition, 2010 Sathya.
- Ranjan Deb, "Robotics Technology & flexible Automation" Second edition, Tata McGraw-Hill Publication, 2009

Outcomes	• To understand basics of robots • To understand robot input and output of robot • To understand Joint & XYZ co-ordinate system • To understand Automation Circular interpolation Relative positions

Elective

Course code:	Design of Mechatronics System	T/P	Credit	Hrs./Week
60664D		P	4	4

Objectives	• Design mechatronics system in Labview Environment • Design mechatronics system Vim –Sim Environment • Applications of micro mechatronic components
Unit -I	**Introduction to Mechatronics System:** Key elements – Mechatronics Design process –Design Parameters – Traditional and Mechatronics designs – Advanced approaches in Mechatronics - Industrial design and ergonomics, safety.
Unit-II	**Basic System Modelling :** Introduction – model catagories – model development – Simulation using softwares – verification and validation – Mathematical modelling : Basic system modelling – mechanical electrical, fluid and thermal.
Unit-III	**Mechatronics System Modeling** Engineering systems: Rotational – translational, electro-mechanical, pneumatic-mechanical, hydraulic-mechanical, micro electro mechanical system – Dynamic responses of system: first order, second order system – Performance measures
Unit-IV	**Real Time Interfacing:** Introduction-selection of interfacing standards Elements of Data Acquisition & control Systems- Over view of I/O process, General purpose I/O card and its installation, Data conversion process, Application Software- Lab view Environment and its applications, Vim-Sim Environment & its applications -Man machine interface.
Unit-V	**Case Studies on Mechatronics System:** Introduction –Fuzzy based Washing machine – pH control system – Autofocus Camera, exposure control– Motion control using D.C.Motor & Solenoids – Engine management systems.– Controlling temperature of a hot/cold reservoir using PID- Control of pick and place robot – Part identification and tracking using RFID – Online surface measurement using image processing

Textbooks

- Devdas shetty, Richard A. Kolk, “Mechatronics System Design”, 2nd Edition ,Cengage Learning 2011.

Reference

- Georg pelz, "Mechatronic Systems: Modeling and simulation" with HDL’s, John wiley and sons Ltd, 2003
- Bishop, Robert H, "Mechatronics Hand book", CRC Press, 2002.
- Bradley, D.Dawson, N.C. Burd and A.J. Loader, "Mechatronics: Electronics in Products and Processes", CRC Press 1991 , First Indian print 2010.
- De Silva, "Mechatronics: A Foundation Course", Taylor & Francis, Indian Reprint, 2013

Outcomes	• Design mechatronics system in Labview Environment • Design mechatronics system Vim –Sim Environment • Applications of micro mechatronic components

Elective

Course code:	Mould Technology Design	T/P	Credit	Hrs./Week
60665A		P	4	4

Objectives	• To learn the design concepts for various mould elements. • To learn the basic design aspects related to Injection Mould and Blow Mould • To learn the basic design aspects related to Extrusion Dies. • To learn the basic design aspects related to rotational moulds • To learn the basic design aspects related to thermoforming dies
Unit -I	**INJECTION MOULD DESIGN** Introduction to Molding process and Moulds – Classification of moulds- Factors considered for Mould Design-Shot Capacity-Plasticizing Rate-Clamping Force- Injection Time – Cooling Time - Number of Cavities –Layout of Cavities. Classification - Cold Runner – Hot Runner – Hand – Semi Automatic – Automatic -Two plate - Three Plate – Moulds for Internal & External Undercuts Elements of Injection Mould - Parting surface and its types , Core, Cavity , Bolsters ,Guide pillar, Guide bush, Sprue bush, Locating Ring -Standard Mould System – Mould alignment – Mould Assembly – Mould Clamping.
Unit-II	**DESIGN OF FEED SYSTEMS** Sprue – types of sprue – Runner – types of runner - cross section and size of runner –runner layout – balancing of runners – Gates - Gate location and balancing - types of gates – Mould Venting.
Unit-III	**DESIGN OF EJECTION SYSTEMS** Requirements – Elements of Ejection system - Ejector grid, Ejector plate assembly, Ejection techniques – Ejection from fixed half - Sprue Pullers- Ejection Force Calculation - Ejection Assembly Actuation
Unit-IV	**DESIGN OF MOULD TEMPERATURE CONTROL SYSTEM** Introduction - Heat Transfer Fluids- Chillers- Temperature Controllers- Factors affecting the Cooling Cycle -Cooling Efficiency - Mould Cooling Variables -Cooling Calculations -Cooling of Integer type mould plates - Cooling of Insert Bolster assembly -cooling of other mould parts connections of cooling channels and seals
Unit-V	**DESIGN OF OTHER MOULDS & DIES** Blow Mould Design: Introduction- Types of blow moulds - Blow ratio - Parison design –Pinch off design - parting line - Mould cooling - Mould alignment- Advantages, Disadvantages and Applications Rotational Mould Design: Introduction– Construction- Advantages, Disadvantages and Applications. Extrusion Die Design: Principles of extrusion - construction of die - die geometry - die swell – die land design - sizing die -Advantages, Disadvantages and Applications. Thermoforming: Principles of thermoforming- Mould Design & Layout- Applications

Textbooks

- Peter Jones, The Mould Design Guide, Smithers Rapra Technology Limited, 2008, Shawbury, Shrewsbury, Shropshire, SY4 4NR, UK
- Injection Mould Design for Thermoplastic - By Pye, R.G.W.,2000.

Reference

- Glanvill & Denton, Injection Mould Design Fundamentals (Vol. I& II), Sors et al., Plastics Moulds & Dies , Second Edition
- Sanjay K Nayak, Pratap Chandra Padhi and Y.Hidayathullah, Fundamentals of plastics mould design, 2012.
- Gastrow., Injection Moulds 130 Proven Design 2006.
- Dym J.B Injection Mould& Molding, A practical manual, Springer, Second Edition.

Outcomes	• Apply the basics of Plastics mould design. • Decide moulds for different processing techniques. • Apply design aspects related to related to Injection Mould and Blow Mould • Apply design aspects related to Extrusion and thermoforming Dies. • Apply design aspects related to rotational moulds

Elective

Course code:	Foundry Mechanization & Fettling Processes	T/P	Credit	Hrs./Week
60665B		P	4	4

Objectives	• To know about the Foundry mechanization and material handling • To know about the Material handling equipments • To know about the Fettling • To know about the Dressing, salvaging and surface treatment of castings • To know about the Defects in castings
Unit -I	**Mechanization :** Introduction – Foundry Industry-Types-Different sections of a foundry-Foundry layout- layout of a Manual foundry- Layout of a Mechanized Foundry-mechanization – modernization mechanization advantages – disadvantages – Disamatic mechanized foundry – processing steps in mechanized foundry –flow chart for sand circulation. Material Handling Equipments: Trucks and Cranes - Introduction –Classification of Material handling equipments Industrial trucks-Manual wheeled type- Powered type-Platform type-pallet lift- forklift truck- Cranes-Over head bridge crane- Jib crane -Gantry crane- Hoists-Chain type manual-Pneumatic –Electrical-Working – applications. Conveyors, Slides and Chutes: Belt conveyor- Roller conveyor-Bucket conveyor-Chain conveyor-Apron conveyor-Flight conveyor-Pallet conveyor- Working – applications- Slides and chutes- Working – applications.
Unit-II	**Fettling :** Shakeout/Cleaning/Finishing –modern developments – fettling and finishing of castings – removal cores – cleaning of casting surface – hand method – mechanical equipment methods tumbling– blast cleaning – air blasting – mechanical blast cleaning – hydro blasting – safety consideration during blast cleaning -chemical cleaning – removal gates and risers – removal of fins and other unwanted projections from castings– finishing the casting.
Unit-III	**Modern Developments:** Punch out machines-Shakeout tables and decks-High frequency shakeouts-Vibrating shakeout Conveyors Rotary separators. Robot sand manipulators. Dressing of Castings: Introduction-Methods of dressing castings-Grinding-Flash removal-Special operations-Ancillaries-Equipment used to dress castings-High frequency electrical hand grinders. Pneumatic grinders-stationary pedestal grinders-Abrasive used in dressing castings Salvaging: Salvage of defective castings-Introduction – factors affecting salvage of casting – salvage techniques – repair of gray iron castings – repair of S.G. cast iron – repair of steel castings – repair of aluminum alloy castings – repair of copper alloy castings
Unit-IV	**Surface Treatment of Castings:** Painting-Enamelling-Electroplating-galvanising-Polishing Anodising-pickilng
Unit-V	**Defects In Casting :** Defect in Casting: Introduction – classification of defects – defects caused by patterns and molding box equipments – defects due to improper molding and core making materials – defects due to improper sand mixing and distribution – defects caused by molding, core, gating -defects due to improper mold drying and core baking – defects occurring while closing and poring the mold – defects caused molten metal – defects occurring during fettling – defects due to faulty heat treatment – defect due to cast metal -warpage – main types of defects their causes and remedies

Textbooks

- Foundry Technology -O.P. Khanna -S. Chand –1996

Reference

- Principles of Metal casting – Richard W Heine, Philip C Rosenthal -McGraw-Hill, 1967
- Foundry Engineering – R. B. Gupta --S. Chand –1986
- Principles of Foundry Technology - P. L. Jain ,Tata McGraw-Hill Education, 2003

Outcomes	• To know about the Foundry mechanization and material handling • To know about the Material handling equipments • To know about the Fettling • To know about the Dressing, salvaging and surface treatment of castings • To know about the Defects in castings

Elective

Course code:	Design of Casting Process	T/P	Credit	Hrs./Week
60665C		P	4	4

Objectives	• To know about the Risers and riser design • To know about the Gating system design • To know about the Patterns Draft • To know about the Patterns allowance • To know about the Design Consideration in Castings
Unit -I	**Risers and Riser Design**- General design rules for riser necks used in iron castings; general riser b. side riser for plates c. top round riser- Gating System Design- Un-pressurized system reduces metal velocity and turbulence- Pressurized systems usually reduce size and weight of gating system (pressure at constriction (gate) causes metal to completely fill runner more quickly)
Unit-II	**Patterns – Shrink Allowance-** 2 types of Casting Process - Expendable & Reusable Mould- Expendable mould requires pattern- Similar to final product- Modified in dimension based on material and process- Shrinkage allowance (pattern to be larger than part at room temp)- Done by using shrink rules which take into account the shrinkage allowance (1' will be 1' 3/16'' in a shrink rule for brass
Unit-III	**Patterns – Draft-** Facilitate withdrawal from mould, patterns may be split at parting line- Location of parting line important - the plane at which 1 section of the mould mates with other section(s)- Flat line is preferred, but casting design and mould may require complex parting lines- To effect withdrawal Draft is given- Depends on mould material and procedure- 1/8th to 1/16th of an inch per feet is standard- Can be reduced by increasing mould strength and automatic withdrawal
Unit-IV	**Patterns – Parting Line-** Good castings require good design. - Simple, simple, simple! - Communicate with foundry. - Location of Parting Plane - effect: - number of cores - use of effective gating - weight of final casting - method of supporting cores -final dimensional accuracy - ease of moulding. -Minimize cores if possible.
Unit-V	**Patterns – Cores-** Cores to be big to compensate for shrinkage - Core prints to be added in pattern - Machining allowance to be reduced from core Size – machining increases hole size

Textbooks

- Yusuf Altintas, "Manufacturing Automation", Cambridge University Press, 2nd Edition, 2012.

Reference

- Beno Benhabib, "Manufacturing Design, Production, Automation and Integration", Taylor-Fancis Publications, 2005.
- Mikell P.Groover, Automation, Production Systems and Computer Integrated Manufacturing, Princice HI, 2003.

Outcomes	• To know about the Risers and riser design • To know about the Gating system design • To know about the Patterns Draft • To know about the Patterns allowance • To know about the Design Consideration in Castings

Elective

Course code:	Modern Casting Process	T/P	Credit	Hrs./Week
60665D		P	4	4

Objectives	• To understand the modern foundry process • To know about the special casting techniques
Unit -I	**Modern Foundry Processes** - Process details, ingredients used, process variables and economy of the process using sodium silicate binder and organic binder process e.g. hot box, cold box ABC, silicate ester, catalysed no-bake, wann box processes. Fluid Sand, full mould, magnetic molding, investment casting, frozen mold, vacuum sealed molding, high pressure molding, impact molding, explosion moulding and squeeze casting processes. Continuous casting.
Unit-II	**Die Casting Techniques** – Introduction – Various die casting Techniques
Unit-III	**Special Casting Techniques-** classification of special casting techniques –gravity die or permanent mold casting -pressure die casting –die casting dies – hot chamber die casting – gooseneck injection type-submerged plunger type-cold camber die casting – Advantages of die casting-limitations of die casting.
Unit-IV	**Centrifugal casting methods** – true centrifugal casting –De lavaud process-advantages-disadvantages-applications-semi centrifugal casting – centrifuge casting –advantages of centrifugal casting methods
Unit-V	**Other Special Casting Techniques:** carbon di oxide molding – investment mold casting – shell molding – plaster mold casting – Antioch process – slush casting – continuous casting – squeeze casting.

Textbooks

- Foundry Technology -O.P. Khanna -S. Chand –1996

Reference

- Principles of Metal casting – Richard W Heine, Philip C Rosenthal -McGraw-Hill,1967
- Foundry Engineering – R. B. Gupta --S. Chand –1986
- Principles of Foundry Technology - P. L. Jain ,Tata McGraw-Hill Education, 2003

Outcomes	• To understand the modern foundry process • To know about the special casting techniques

UG Programme

Passing minimum

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

18.2 Grading of the Courses

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

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

RANGE OF MARKS	GRADE POINTS	LETTER GRADE	DESCRIPTION
0 - 100	**9.0 – 10.0**	**O**	**Outstanding**
0 - 89	**8.0 – 8.9**	**D+**	**Excellent**
5 - 79	**7.5 – 7.9**	**D**	**Distinction**
0 - 74	**7.0 – 7.4**	**A+**	**Very Good**
0 - 69	**6.0 – 6.9**	**A**	**Good**
0 - 59	**5.0 – 5.9**	**B**	**Average**
0 - 49	**4.0 – 4.9**	**C**	**Satisfactory**
0 - 39	**0.0**	**U**	**Re-appear**
BSENT	**0.0**	**AAA**	**ABSENT**

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

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

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

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

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

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

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

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

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

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

These two are calculated by the following formulate

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

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

Sum of the credits of the courses in a Semester

18.3 Classification of the final result

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

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

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

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

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

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

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

Final Result

CGPA	Grade	Classification of Final Result
9.5 – 10.0 9.0 and above but below 9.5	**O+** **O**	First Class – Exemplary*
8.5 and above but below 9.0 8.0 and above but below 8.5 7.5 and above but below 8.0	**D++** **D+** **D**	First Class with Distinction*
7.0 and above but below 7.5 6.5 and above but below 7.0 6.0 and above but below 6.5	**A++** **A+** **A**	First Class
5.5 and above but below 6.0 5.0 and above but below 5.5	**B+** **B**	Second Class
4.5 and above but below 5.0 4.0 and above but below 4.5	**C+** **C**	Third Class
0.0 and above but below 4.0	**U**	Re-appear

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

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

Sum of the credits of the course for the entire Programme

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

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

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