HINDUSTHAN COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous Institution, Affiliated to Anna University, Chennai
Approved by AICTE, New Delhi & Accredited by NAAC with 'A' Grade)
Coimbatore – 641 032

B.E. MECHATRONICS ENGINEERING

HINDUSTHAN EDUCATIONAL AND CHARITABLE TRUST

HICET

Curriculum & Syllabus

2019-2020

CHOICE BASED CREDIT SYSTEM

VISION AND MISSION OF THE INSTITUTION

VISION

To become a premier institution by producing professionals with strong technical knowledge, innovative research skills and high ethical values.

MISSION

M1: To provide academic excellence in technical education through novel teaching methods.

M2: To empower students with creative skills and leadership qualities

M3: To produce dedicated professionals with social responsibility.

Chairman - BoS
MCT - HiCET

ACADEMIC COUNCIL * HICET * COLLEGE OF ENGG & TECH * Chairman

Dean (Academics)
HiCET

VISION AND MISSION OF THE DEPARTMENT

VISION

To excel in Mechatronics engineering by imparting technical knowledge, innovation skills and ethics to fulfill the global needs with human values

MISSION

- To impart sound technical knowledge and produce highly proficient professionals in the mechatronics engineering domain.
- To empower students with strong competency skills to solve multi-disciplinary engineering problems using mechatronics approach.
- To inculcate human values and ethical responsibility to the students for social welfare.

S. Nasmadh
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PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO 1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5. **Modern tool usage**: 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 6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

S. Narmadha

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PO 8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10.**Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11.**Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12.**Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

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PROGRAMME SPECIFIED OUTCOMES

PSO1- To provide ability to analyze, design and develop mechatronic systems by integrating knowledge in sensors, actuators and controllers to solve complex engineering problems.

PSO2- To provide smart automation solutions for real time industrial problems using multidisciplinary approach

PROGRAM EDUCATIONAL OBJECTIVES

To produce professional graduates

PEO1: With the ability to synergistically integrate multi-disciplinary domains to solve complex engineering problems with Mechatronics approach.

PEO2: With the acumen for interdisciplinary research, entrepreneurship and higher studies to meet the local and global needs.

PEO3: With ethical and moral values in rendering services to the society.

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CURRICULUM

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.E. MECHATRONICS ENGINEERING (UG)

REGULATION 2019

For the students admitted during the academic year 2019-2020 and onwards

SEMESTER I

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19HE1101	Technical English	HS	2	1	0	3	25	75	100
2	19MA1102	Calculus and Linear Algebra	BS	3	1	0	4	25	75	100
THEORY CUM PRACTICAL										
3	19PH1151	Applied Physics	BS	2	0	2	3	50	50	100
4	19CY1151	Chemistry for Engineers	BS	2	0	2	3	50	50	100
5	19CS1151	Python Programming and practices	ES	2	0	2	3	50	50	100
6	19ME1152	Engineering Drawing	ES	1	0	4	3	50	50	100
PRACTICAL										
7	19HE1071	Value added course I: Language Competency Enhancement Course - I	HS	0	0	2	1	100	0	100
MANDATORY										
8	19MC1001	Induction Program	MC	0	0	0	0	0	0	0
Total:				**12**	**2**	**12**	**20**	**350**	**350**	**700**

SEMESTER II

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19HE2101	Business English for Engineers	HS	2	1	0	3	25	75	100
2	19MA2101	Differential Equations and Complex Variables	BS	3	1	0	4	25	75	100
3	19ME2101	Engineering Mechanics	ES	3	0	0	3	25	75	100
THEORY CUM PRACTICAL										
4	19PH2151	Materials Science	BS	2	0	2	3	50	50	100
5	19CY2151	Environmental Studies	BS	2	0	2	3	50	50	100
6	19MT2153	Basics of Mechatronics Engineering	ES	2	0	2	3	50	50	100
PRACTICAL										
7	19ME2001	Engineering Practices Laboratory	ES	0	0	4	2	50	50	100
8	19HE2071	Language Competency Enhancement Course - II	HS	0	0	2	1	100	0	100
Total:				**14**	**2**	**12**	**22**	**375**	**425**	**800**

REGULATION-2016

For the students admitted during the academic year 2018-2019 and onwards

SEMESTER III

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16MA3104	Fourier Analysis and Numerical Methods	3	0	0	3	25	75	100
2	16MT3201	Theory of Machines	3	1	0	4	25	75	100
3	16MT3202	Digital Applications in Mechatronics systems	3	0	0	3	25	75	100
4	16MT3203	Mechanics of Materials	3	0	0	3	25	75	100
5	16MT3204	Control of Electrical Machines	3	0	0	3	25	75	100
6	16MT3205	Production Technology	3	0	0	3	25	75	100
PRACTICAL									
7	16MT3001	Production Technology Laboratory	0	0	4	2	50	50	100
8	16MT3002	Control of Electrical Machines and Electronics Laboratory	0	0	4	2	50	50	100
Total			**18**	**1**	**8**	**23**	**250**	**550**	**800**

SEMESTER IV

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16MT4201	Thermodynamics and Fluid Engineering	3	1	0	4	25	75	100
2	16MT4202	Control of Mechatronics Systems	3	1	0	4	25	75	100
3	16MT4203	Sensors and Signal Conditioning	3	0	0	3	25	75	100
4	16MT4204	Machine Design	3	1	0	4	25	75	100
5	16MT4205	Microcomputer Systems and Microcontroller	3	0	0	3	25	75	100
6	16MT4206	Engineering Metrology and Measurements	3	0	0	3	25	75	100
PRACTICAL									
7	16MT4001	Sensors and Signal Conditioning Laboratory	0	0	4	2	50	50	100
8	16MT4002	Assembly Language Programming Laboratory	0	0	4	2	50	50	100
9	16MT4003	Solid and Fluid Mechanics Laboratory	0	0	4	2	50	50	100
		Total	**18**	**3**	**12**	**27**	**300**	**600**	**900**

For the students admitted during the academic year 2017-2018 and onwards

SEMESTER V

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16MT5201	CAD/CAM & CIM	3	0	0	3	25	75	100
2	16MT5202	Industrial Electronics and Control	3	1	0	4	25	75	100
3	16MT5203	Fluid Power	3	0	0	3	25	75	100
4	16MT5204	Embedded systems Design	3	0	0	3	25	75	100
5	16IT5232	Object Oriented Programming	3	1	0	4	25	75	100

6	16MT53XX	**Professional Elective – I**	3	0	0	3	25	75	100
PRACTICAL									
7	16MT5001	CAD/CAM/CAE Laboratory	0	0	4	2	50	50	100
8	16MT5002	Fluid Power Laboratory	0	0	4	2	50	50	100
Total			**18**	**2**	**8**	**24**	**250**	**550**	**800**

SEMESTER VI

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16MT6201	Industrial Automation and Control	3	0	0	3	25	75	100
2	16MT6202	Virtual Instrumentation and Human Machine Interface	3	1	0	4	25	75	100
3	16MT6203	Vetronics	3	0	0	3	25	75	100
4	16MA6111	Operations Research	3	1	0	4	25	75	100
5	16MT63XX	**Professional Elective – II**	3	0	0	3	25	75	100
6	16XX64XX	**Open Elective – I**	3	0	0	3	25	75	100
PRACTICAL									
7	16MT6001	Industrial Automation and Control Laboratory	0	0	4	2	50	50	100
8	16MT6701	Certification course / Inplant Training / Internship / Technical Publications	0	0	0	2	50	50	100
9	16MT6801	Mini Project	0	0	4	2	50	50	100
Total			**18**	**2**	**8**	**26**	**300**	**600**	**900**

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE - I

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
1	16MT5301	Non-Traditional Machining Techniques	3	0	0	3	25	75	100
2	16MT5302	Discrete Event System Simulation	3	0	0	3	25	75	100
3	16MT5303	Materials Sciences and Applications	3	0	0	3	25	75	100
4	16MT5304	Automobile Systems	3	0	0	3	25	75	100

5	16MT5305	Process Control Instrumentation Technology	3	0	0	3	25	75	100
6	16MA5309	Probability and Statistics	3	0	0	3	25	75	100

PROFESSIONAL ELECTIVE - II

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
1	16MT6301	Flexible Manufacturing System	3	0	0	3	25	75	100
2	16MT6302	Principles of Management	3	0	0	3	25	75	100
3	16MT6303	Diagnostic Techniques	3	0	0	3	25	75	100
4	16MT6304	Product Design and Development	3	0	0	3	25	75	100
5	16MT6305	Distinctive Electrical Machines	3	0	0	3	25	75	100
6	16MT6306	Medical Mechatronics	3	0	0	3	25	75	100

OPEN ELECTIVES

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
1	16MT6401	Industrial Safety and Environment	3	0	0	3	25	75	100

For the students admitted during the academic year 2016-2017 and onwards

SEMESTER VII

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16MT7201	Design of Mechatronics Systems	3	0	0	3	25	75	100
2	16MT7202	Robotics and Machine Vision	3	0	0	3	25	75	100
3	16MT73XX	**Professional Elective - III**	3	0	0	3	25	75	100
4	16MT73XX	**Professional Elective - IV**	3	0	0	3	25	75	100
5	16XX74XX	**Open Elective – II**	3	0	0	3	25	75	100
PRACTICAL									

6	16MT7001	Robotics Laboratory	0	0	4	2	50	50	100
7	16MT7901	Design and Fabrication Project	0	0	8	4	50	50	100
Total			**15**	**0**	**12**	**21**	**225**	**475**	**700**

SEMESTER VIII

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16MT83XX	**Professional Elective – V**	3	0	0	3	25	75	100
2	16MT83XX	**Professional Elective – VI**	3	0	0	3	25	75	100
PRACTICAL									
3	16MT8902	Project Work	0	0	16	8	100	100	200
Total			**6**	**0**	**16**	**14**	**150**	**250**	**400**

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE - III

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
1	16MT7301	MEMS and Microsystems	3	0	0	3	25	75	100
2	16MT7302	Factory Automation	3	0	0	3	25	75	100
3	16MT7303	Six Sigma and Lean Manufacturing	3	0	0	3	25	75	100
4	16MT7304	Non Destructive Testing	3	0	0	3	25	75	100
5	16MT7305	Intelligent Manufacturing System	3	0	0	3	25	75	100
6	16MT7306	Essentials of Software Project Management	3	0	0	3	25	75	100

PROFESSIONAL ELECTIVE - IV

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
1	16MT7307	Rapid Prototyping and Reverse Engineering	3	0	0	3	25	75	100
2	16MT7308	Computer Control of Manufacturing System	3	0	0	3	25	75	100
3	16MT7309	Total Quality Management	3	0	0	3	25	75	100
4	16MT7310	Engineering Economics and Cost Analysis	3	0	0	3	25	75	100
5	16MT7311	Nano Technology	3	0	0	3	25	75	100
6	16MT7312	Signals and Systems for Mechatronics	3	0	0	3	25	75	100

PROFESSIONAL ELECTIVE – V

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
1	16MT8301	Information System for Engineers	3	0	0	3	25	75	100
2	16MT8302	Industrial IoT	3	0	0	3	25	75	100
3	16MT8303	Entrepreneurship Development	3	0	0	3	25	75	100
4	16MT8304	Mobile Robotics	3	0	0	3	25	75	100
5	16MT8305	Artificial Intelligence for Mechatronics Engineering	3	0	0	3	25	75	100
6	16MT8306	Modern Wireless Communication Systems	3	0	0	3	25	75	100

PROFESSIONAL ELECTIVE - VI

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
1	16MT8307	Professional Ethics in Engineering	3	0	0	3	25	75	100
2	16MT8308	Non-conventional Energy Sources	3	0	0	3	25	75	100
3	16MT8309	Foundation Skills in Integrated Product Development	3	0	0	3	25	75	100
4	16MT8310	Digital Image Processing Techniques	3	0	0	3	25	75	100
5	16MT8311	Textile Automation	3	0	0	3	25	75	100
6	16MT8312	Micro Manufacturing	3	0	0	3	25	75	100

OPEN ELECTIVE

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
1	16MT7402	Electric and Hybrid Vehicles	3	0	0	3	25	75	100

CREDIT DISTRIBUTION

R2016

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	27	25	23	27	24	26	21	14	**187**

R2019

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	20	22	20	21	24	24	20	14	**165**

Chairman, Board of Studies

Dean – Academics

Principal

Dr.MAGUDESWARAN P.N
Dean-Academics
Hindusthan College of
Engineering and Technology,
COIMBATORE-641 032.

PRINCIPAL
Hindusthan College of Engineering & Technology
COIMBATORE - 641 032

SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE1101	TECHNICAL ENGLISH	2	1	0	3

Course Objective

1. To facilitate students to communicate effectively with coherence.
2. To train the learners in descriptive communication.
3. To introduce professional communication.
4. To enhance knowledge and to provide the information on corporate environment.
5. To equip the trainers with the necessary skills on critical thinking.

Unit	Description	Instructional Hours
I	**Listening and Speaking** – Opening a conversation, maintaining coherence, turn taking, closing a conversation (excuse, general wishes, positive comments and thanks) **Reading** –Reading articles from newspaper, Reading comprehension **Writing** Chart analysis, process description, Writing instructions **Grammar and Vocabulary-** Tenses, Regular and irregular verb, technical vocabulary	9
II	**Listening and Speaking-** listening to product description, equipment & work place (purpose, appearance, function) **Reading-** Reading technical articles **Writing-** Letter phrases, writing personal letters, **Grammar and Vocabulary-**articles, Cause & effect, Prepositions.	9
III	**Listening and Speaking- -** listening to announcements **Reading-** Reading about technical inventions, research and development **Writing-** Letter inviting a candidate for interview, Job application and resume preparation **Grammar and Vocabulary-** Homophones and Homonyms.	9
IV	**Listening and Speaking- -** Practice telephone skills and telephone etiquette (listening and responding, asking questions).**Reading-** Reading short texts and memos **Writing-** invitation letters, accepting an invitation and declining an invitation **Grammar and Vocabulary-** Modal verbs, Collocation, Conditionals, Subject verb agreement and Pronoun-Antecedent agreement.	9
V	**Listening and Speaking-** listening to technical group discussions and participating in GDs **Reading-** reading biographical writing **- Writing-** Proposal writing, Writing definitions, **Grammar and Vocabulary-** Abbreviation and Acronym, Prefixes & suffixes, phrasal verbs.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Trained to maintain coherence and communicate effectively.
CO2: Practiced to create and interpret descriptive communication.
CO3: Introduced to gain information of the professional world.
CO4: Acquired various types of communication and etiquette.
CO5: Taught to improve interpersonal and intrapersonal skills.

TEXT BOOKS:

T1- Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate",Cambridge University Press,2014
T2- Raymond Murphy, "Essential English Grammar", Cambridge University Press, 2019.

REFERENCE BOOKS:

R1- Meenakshi Raman and Sangeetha Sharma. "Technical Communication- Principles and Practice", Oxford University Press, 2009.
R2- Raymond Murphy, "English Grammar in Use"- 4th edition Cambridge University Press, 2004
R3- KamaleshSadanan "A Foundation Course for the Speakers of Tamil-Part-I &II", Orient Blackswan,2010.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MA1102	CALCULUS AND LINEAR ALGEBRA (COMMON TO AERO, AUTO, MECH, MECHT, FOOD, AGRI & CIVIL)	3	1	0	4

Course Objective

1. Understand the concept of differentiation.
2. Evaluate the functions of several variables which are needed in many branches of engineering.
3. Understand the concept of double integrals.
4. Understand the concept of triple integrals.
5. Develop the skill to use matrix algebra techniques that is needed by engineers for practical applications.

Unit	Description	Instructional Hours
I	**DIFFERENTIAL CALCULUS** Rolle's Theorem – Lagrange's Mean Value Theorem- Maxima and Minima – Taylor's and Maclaurin's Theorem.	12
II	**MULTIVARIABLE CALCULUS (DIFFERENTIATION)** Total derivatives - Jacobians – Maxima, Minima and Saddle points - Lagrange's method of undetermined multipliers – Gradient, divergence, curl and derivatives.	12
III	**DOUBLE INTEGRATION** Double integrals in Cartesian coordinates – Area enclosed by the plane curves (excluding surface area) – Green's Theorem (Simple Application) - Stoke's Theorem – Simple Application involving cubes and rectangular parellopiped.	12
IV	**TRIPLE INTEGRATION** Triple integrals in Cartesian co-ordinates – Volume of solids (Sphere, Ellipsoid, Tetrahedron) using Cartesian co-ordinates. Gauss Divergence Theorem – Simple Application involving cubes and rectangular parellopiped.	12
V	**MATRICES** Eigen values and Eigen vectors – Properties of Eigen values and Eigen vectors (without proof) - Cayley - Hamilton Theorem (excluding proof) - Reduction of a quadratic form to canonical form by orthogonal transformation.	12
	Total Instructional Hours	60

Course Outcome

On completion of the course the students will be able to

CO1: Apply the concept of differentiation in any curve.

CO2: Identify the maximum and minimum values of surfaces.

CO3: Apply double integrals to compute area of plane curves.

CO4: Evaluation of triple integrals to compute volume of solids.

CO5: Calculate Eigen values and Eigen vectors for a matrix which are used to determine the natural frequencies (or Eigen frequencies) of vibration and the shapes of these vibrational modes

TEXT BOOKS:

T1 - Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Private Ltd., New Delhi, 2018.

T2 - Veerarajan T, "Engineering Mathematics ", McGraw Hill Education(India) Pvt Ltd, New Delhi, 2016.

REFERENCE BOOKS :

R1- Thomas & Finney " Calculus and Analytic Geometry" , Sixth Edition,,Narosa Publishing House, New Delhi.

R2 - Weir,M.D and Joel Hass, ' Thomas Calculus" 12th Edition,Pearson India 2016.

R3 - Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19PH1151	APPLIED PHYSICS	2	0	2	3

Course Objective

1. Enhance the fundamental knowledge in properties of matter
2. Analysis the oscillatory motions of particles
3. Extend the knowledge about wave optics
4. Gain knowledge about laser and their applications
5. Conversant with principles of optical fiber, types and applications of optical fiber

Theory

Unit	Description	Instructional Hours
I	**PROPERTIES OF MATTER** Elasticity – Hooke's law – Stress-strain diagram - Poisson's ratio – Bending moment – Depression of a cantilever – Derivation of Young's modulus of the material of the beam by Uniform bending theory and experiment. **Experimental Components: Determination of Young's modulus by uniform bending method.**	6+3
II	**OSCILLATONS** Translation motion –Vibration motion – Simple Harmonic motion – Differential Equation of SHM and its solution – Damped harmonic oscillation - Torsion stress and deformations – Torsion pendulum: theory and experiment. **Experimental Components: Determination of Rigidity modulus – Torsion pendulum.**	6+3
III	**WAVE OPTICS** Conditions for sustained Interference – air wedge and it's applications - Diffraction of light – Fresnel and Fraunhofer diffraction at single slit –Diffraction grating – Rayleigh's criterion of resolution power - resolving power of grating. **Experimental Components: Determination of wavelength of mercury spectrum – spectrometer grating. Determination of thickness of a thin wire – Air wedge method.**	6+3
IV	**LASER AND APPLICATIONS** Spontaneous emission and stimulated emission – Population inversion – Pumping methods – Derivation of Einstein's coefficients (A&B) – Type of lasers – Nd:YAG laser and CO_2 laser- Laser Applications – Holography – Construction and reconstruction of images. **Experimental Components: Determination of Wavelength and particle size using Laser.**	6+3
V	**FIBER OPTICS AND APPLICATIONS** Principle and propagation of light through optical fibers – Derivation of numerical aperture and acceptance angle – Classification of optical fibers (based on refractive index, modes and materials) – Fiber optical communication link – Fiber optic sensors – Temperature and displacement sensors.	9
	Instructional Hours	33 +12
	Total Instructional Hours	**45**

Course Outcome

On completion of the course the students will be able to

CO1: Illustrate the fundamental properties of matter
CO2: Discuss the Oscillatory motions of particles
CO3: Analyze the wavelength of different colors
CO4: Understand the advanced technology of LASER in the field of Engineering
CO5: Develop the technology of fiber optical communication in engineering field

TEXT BOOKS:

T1- Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.
T2- Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2015.

REFERENCE BOOKS:

R1- Arthur Beiser "Concepts of Modern Physics" Tata McGraw Hill, New Delhi – 2015
R2- M.N Avadhanulu and PG Kshirsagar "A Text Book of Engineering physics" S. Chand and Company ltd., New Delhi 2016.
R3- Dr. G. Senthilkumar "Engineering Physics – I" VRB publishers Pvt Ltd., 2016

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19CY1151	CHEMISTRY FOR ENGINEERS	2	0	2	3

Course Objective

1. The boiler feed water requirements, related problems and water treatment techniques.
2. The principles of polymer chemistry and engineering applications of polymers and composites.
3. The principles of electrochemistry and with the mechanism of corrosion and its control.
4. The principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.
5. The important concepts of spectroscopy and its applications

Theory

Unit	Description	Instructional Hours
I	**WATER TECHNOLOGY** Hard water and soft water- Disadvantages of hard water- Hardness: types of hardness, simple calculations, estimation of hardness of water – EDTA method – Boiler troubles - Conditioning methods of hard water – External conditioning - demineralization process - desalination: definition, reverse osmosis – Potable water treatment – breakpoint chlorination. **Experimental Components: Estimation of total, permanent and temporary hardness of water by EDTA.**	9
II	**POLYMER & COMPOSITES** Polymerization – types of polymerization – addition and condensation polymerization – mechanism of free radical addition polymerization – copolymers – plastics: classification – thermoplastics and thermosetting plastics, preparation, properties and uses of commercial plastics – PVC, Bakelite – moulding of plastics (extrusion and compression); Composites: definition, types of composites – polymer matrix composites (PMC) –FRP	6
III	**ELECTROCHEMISTRY AND CORROSION** Electrochemical cells – reversible and irreversible cells - EMF- Single electrode potential – Nernst equation (derivation only) – Conductometric titrations. Chemical corrosion – Pilling – Bedworth rule – electrochemical corrosion – different types – galvanic corrosion – differential aeration corrosion – corrosion control – sacrificial anode and impressed cathodic current methods - protective coatings – paints – constituents and functions. **Experimental Components: Conductometric titration of strong acid vs strong base (HCl vs NaOH). Conductometric titration (Mixture of strong acid and base). Conductometric precipitation titration using $BaCl_2$ and Na_2SO_4**	15
IV	**ENERGY SOURCES AND STORAGE DEVICES** Introduction- nuclear energy- nuclear fission- controlled nuclear fission- nuclear fusion differences between nuclear fission and fusion- nuclear chain reactions- nuclear reactor power generator- classification of nuclear reactor- light water reactor- breeder reactor. Batteries and fuel cells: Types of batteries- alkaline battery- lead storage battery- lithium battery- fuel cell H_2 -O_2 fuel cell applications.	6
V	**ANALYTICAL TECHNIQUES** Beer-Lambert's law – UV-visible spectroscopy and IR spectroscopy – principles – instrumentation (block diagram only) – flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry – atomic absorption	

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opy – principles – instrumentation (block diagram only) – estimation of nickel by atomic absorption spectroscopy. 9

Experimental Components: Determination of iron content of the water sample using spectrophotometer.(1,10 phenanthroline / thiocyanate method).

Total Instructional Hours 45

Course Outcome

On completion of the course the students will be able to

CO1: Differentiate hard and soft water and to solve the related problems on water purification and its significance in industries and daily life

CO2: Acquire the basic knowledge of polymers, composites and FRP and their significance.

CO3: Develop knowledge on the basic principles of electrochemistry and understand the causes of corrosion, its consequences to minimize corrosion to improve industrial design.

CO4: Develop knowledge about the renewable energy resources and batteries along with the need of new materials to improve energy storage capabilities.

CO5: Identify the structure and characteristics of unknown/ new compound with help of spectroscopy

TEXT BOOKS:

T1- P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2018).

REFERENCE BOOKS:

R1- B.Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2012).
R2- S.S.Dara "A Text book of Engineering Chemistry" S.Chand & Co. Ltd., New Delhi (2017).

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19CS1151	PYTHON PROGRAMMING AND PRACTICES	2	0	2	3

Course Objective

1. To know the basics of algorithmic problem solving
2. To read and write simple Python programs
3. To develop Python programs with conditionals and loops and to define Python functions and call them
4. To use Python data structures — lists, tuples, dictionaries
5. To do input/output with files in Python

Theory

Unit	Description	Instructional Hours
I	**ALGORITHMIC PROBLEM SOLVING** Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation(pseudo code, flow chart, programming language), algorithmic problem solving, simple strategiesfor developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert acard in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.	9
II	**DATA, EXPRESSIONS, STATEMENTS** Python interpreter and interactive mode; values and types: int, float, boolean, string, and list;variables, expressions, statements, tuple assignment, precedence of operators, comments;modules and functions, function definition and use, flow of execution, parameters and arguments. **Experimental Components: Exchange the values of two variables, circulate the values of n variables, distance between two points**	7+2
III	**CONTROL FLOW, FUNCTIONS** Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: returnvalues, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. **Experimental Components: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.**	5+4
IV	**LISTS, TUPLES, DICTIONARIES** Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, listparameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations andmethods; advanced list processing - list comprehension; **Experimental Components: Selection sort, insertion sort, merge sort, histogram.**	3+6
V	**FILES, MODULES, PACKAGES** Files and exception: text files, reading and writing files, format operator; command line arguments,errors and exceptions, handling exceptions, modules, packages. **Experimental Components: word count, copying file contents**	5+4
	Instructional Hours	29+16
	Total Instructional Hours	**45**

Course Outcome

On completion of the course the students will be able to

CO1: Develop algorithmic solutions to simple computational problems
CO2: Read, write, execute by hand simple Python programs
CO3: Structure simple Python programs for solving problems and Decompose a Python program into functions
CO4: Represent compound data using Python lists, tuples, dictionaries
CO5: Read and write data from/to files in Python Programs.

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BOOKS:

T1- Guido van Rossum and Fred L. Drake Jr, An Introduction to Python – Revised andupdated for Python 3.6.2, Shroff Publishers. First edition (2017).

T2- S. Annadurai, S.Shankar, I.Jasmine, M.Revathi, Fundamentals of Python Programming, Mc-Graw Hill Education (India) Private Ltd, 2019

REFERENCE BOOKS:

R1- Charles Dierbach, —Introduction to Computer Science using Python: A ComputationalProblem-Solving Focus, Wiley India Edition, 2013.

R2- Timothy A. Budd, —Exploring Pythonl, Mc-Graw Hill Education (India) Private Ltd., 2015

R3- Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming inPython: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19ME1152	ENGINEERING DRAWING	1	0	4	3

Course Objective

1. To gain the knowledge of Engineer's language of expressing complete details about objects and construction of conics and special curves.
2. To learn about the orthogonal projections of straight lines and planes.
3. To aquire the knowledge of projections of simple solid objects in plan and elevation.
4. To learn about the projection of sections of solids and development of surfaces.
5. To study the isometric projections of different objects.

Unit	Description	Instructional Hours
I	**PLANE CURVES** Importance of engineering drawing: drafting instruments; drawing sheets – layout and folding; Lettering and dimensioning, BIS standards, scales. Geometrical constructions, Engineering Curves Conic sections – Construction of ellipse, parabola and hyperbola by eccentricity method. Construction of cycloids and involutes of square and circle – Drawing of tangents and normal to the above curves.	12
II	**PROJECTIONS OF POINTS, LINES AND PLANE SURFACES** Introduction to Orthographic projections- Projection of points. Projection of straight lines inclined to both the planes, Determination of true lengths and true inclinations by rotating line method. Projection of planes (polygonal and circular surfaces) inclined to both the planes by rotating object method (First angle projections only).	12
III	**PROJECTIONS OF SOLIDS** Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is perpendicular and inclined to one plane by rotating object method.	12
IV	**SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES** Sectioning of simple solids with their axis in vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other – Obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids, cylinder and cone. Development of lateral surfaces of truncated solids.	12
V	**ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS** Isometric views and projections simple and truncated solids such as - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions. Free hand sketching of multiple views from a pictorial drawing. Basics of drafting using AutoCAD software.	12
	Total Instructional Hours	60

Course Outcome

On completion of the course the students will be able to

CO1: Understand and interpret the engineering drawings in order to visualize the objects and draw the conics and special curves.
CO2: Draw the orthogonal projections of straight lines and planes.
CO3: Interpret the projections of simple solid objects in plan and elevation.
CO4: Draw the projections of section of solids and development of surfaces of solids.
CO5: Draw the isometric projections and the perspective views of different objects.

TEXT BOOKS:

T1- K.Venugopal, V.Prabu Raja, "Engineering Drawing, AutoCAD, Building Drawings", 5th Edition New Age International Publishers, New delhi 2016.
T2- K.V.Natarajan, "A textbook of Engineering Graphics", Dhanlaksmi Publishers, Chennai.

REFERENCE BOOKS:

R1- Basant Agrawal and C.M.Agrawal, "Engineering Drawing", Tata McGraw Hill Publishing Company Limited,New Delhi 2008.
R2- N.S. Parthasarathy, Vela Murali, "Engineering Drawing", Oxford University PRESS, India 2015.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE1071	VALUE ADDED COURSE I: LANGUAGE COMPETENCY ENHANCEMENT COURSE- I (COMMON TO ALL BRANCHES)	0	0	2	1

Course Objective

- ✓ To enhance student language competency
- ✓ To identify individual students level of communication skills
- ✓ To develop English Vocabulary and spoken communication skills.
- ✓ To revive the fundamentals of English Grammar.

Unit	Description	Instructional Hours
I	**Listening** Language of Communication- English listening- Hearing Vs Listening- Verbal and Non-verbal communication – Listening strategies-Sounds of English.	3
III	**Reading** English Language Enhancement – Indianism in English – Role of Reading in effective communication – Techniques for good reading (skimming and scanning) Reading articles from newspaper, magazine. Reading and interpreting a passage.	3
III	**Speaking** Common errors in Pronunciation – Signposts in English (Role play) – Public Speaking skills – Social Phobia – Eliminating fear – Common etiquette of speaking - Debate and Discuss.	3
IV	**Writing** Writing genre – Enhancement of basic English Vocabulary; Parts of Speech, Noun, Verbs, and Tenses – combining sentences, sentence formation and completion.	3
V	**Art of Communication** Communication process – Word building and roleplay – Exercise on English Language for various situations through online and offline activities.	3
	Total Instructional Hours	**15**

Course Outcome

CO1- Trained to maintain coherence and communicate effectively.
CO2- Practiced to create and interpret descriptive communication.
CO3- Introduced to gain information of the professional world.
CO4- acquired various types of communication and etiquette.
CO5- Taught to improve interpersonal and intrapersonal skills.

REFERENCE BOOKS:

1. Verbal Ability and Reading Comprehension by Arun Sharma,9th edition,Tata Mc graw Hill
2. Word Power Made Easy by Norman Lewis,– Print, 1 June 2011.
3. High School English Grammar by Wren and Martin,S.CHAND Publications, 1 January 2017.
4. 4 Practical course in Spoken English by J.K. Gangal,PHI Learning , Second edition, 1 January 2018.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE2101	BUSINESS ENGLISH FOR ENGINEERS	2	1	0	3

Course Objective

1. To introduce to business communication.
2. To train the students to react to different professional situations.
3. To make the learner familiar with the managerial skills
4. To empower the trainee in business writing skills.
5. To learn to interpret and expertise different content

Unit	Description	Instructional Hours
I	**Listening and Speaking** – listening and discussing about programme and conference arrangement **Reading** –reading auto biographies of successful personalities **Writing** Formal & informal email writing, Recommendations **Grammar and Vocabulary-** Business vocabulary, Adjectives & adverbs	9
II	**Listening and Speaking-** listening to TED talks **Reading-** Making and interpretation of posters **Writing-** Business letters: letters giving good and bad news, Thank you letter, Congratulating someone on a success" **Grammar and Vocabulary-** Active & passive voice, Spotting errors (Tenses, Preposition, Articles)	9
III	**Listening and Speaking-**travel arrangements and experience **Reading-** travel reviews **Writing-** Business letters (Placing an order, making clarification & complaint letters). **Grammar and Vocabulary-** Direct and Indirect speech.	9
IV	**Listening and Speaking-** Role play - **Reading-** Sequencing of sentence **Writing-** Business report writing (marketing, investigating) **Grammar and Vocabulary-** Connectors, Gerund & infinitive	9
V	**Listening and Speaking-** Listen to Interviews & mock interview **Reading-** Reading short stories, reading profile of a company - **Writing-** Descriptive writing (describing one's own experience) **Grammar and Vocabulary-** Editing a passage(punctuation, spelling & number rules)	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Introduced to different modes and types of business communication.
CO2: Practiced to face and react to various professional situations efficiently.
CO3: Learnt to practice managerial skills.
CO4: Familiarized with proper guidance to business writing.
CO5: Trained to analyze and respond to different types of communication.

TEXT BOOKS:

T1- Norman Whitby, "Business Benchmark-Pre-intermediate to Intermediate",Cambridge University Press,2014
T2- Ian Wood and Anne Willams. "Pass Cambridge BEC Preliminary", Cengage Learning press 2013

REFERENCE BOOKS:

R1- Michael Mc Carthy, "Grammar for Business", Cambridge University Press, 2009
R2- Bill Mascull, "Business Vocabulary in use: Advanced 2nd Edition", Cambridge University Press, 2009.
R3- Frederick T. Wood, "Remedial English Grammar For Foreign Students", Macmillan publishers, 1986.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MA2101	DIFFERENTIAL EQUATIONS AND COMPLEX VARIABLES (AERO, AUTO, MCT, MECH, CIVIL, FT & AGRI)	3	1	0	4

Course Objective

1. Describe some methods to solve different types of first order differential equations.
2. Solve ordinary differential equations of certain types using Wronskian technique.
3. Use the effective mathematical tools for the solutions of partial differential equations.
4. Describe the construction of analytic functions and conformal mapping.
5. Illustrate Cauchy's integral theorem and calculus of residues

Unit	Description	Instructional Hours
I	**FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS** Equations of the first order and of the first degree – Homogeneous equations – Exact differential equations – Linear equations – Equations reducible to the linear form – Benoulli's equation.	12
II	**ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDER** Second order linear differential equations with constant and variable co-efficients – Cauchy – Euler equations – Cauchy – Legendre equation – Method of variation of paramers.	12
III	**PARTIAL DIFFERENTIAL EQUATIONS** Formation of partial differential equations by the elemination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations of the form f(p,q)=0, Clairaut's type : z = px+qy +f(p,q) – Lagrange's linear equation.	12
IV	**COMPLEX DIFFERENTIATION** Functions of complex variables – Analytic functions – Cauchy's – Riemann's equations and sufficient conditions (excluding proof) – Construction of analytic functions – Milne –Thomson's method – Conformal mapping w = A+z , Az, 1/z and bilinear transformations.	12
V	**COMPLEX INTEGRATION** Cauchy's integral theorem – Cauchy's integral formula –Taylor's and Laurent's series (statement only) –Residues - Cauchy's Residue theorem.	12
	Total Instructional Hours	60

Course Outcome

On completion of the course the students will be able to

CO1: Apply few methods to solve different types of first order differential equations.
CO2: Develop sound knowledge of techniques in solving ordinary differential equations.
CO3: Solve Partial Differential Equations using various methods.
CO4: Infer the knowledge of construction of analytic functions and conformal mapping.
CO5: Evaluate real and complex integrals over suitable closed paths or contours.

TEXT BOOKS:

T1- Ravish R Singh, Mukul Bhatt, "Engineeing Mathematics", McGraw Hill education (India) Private Ltd.,Chennai,2017.
T2- Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley India Private Ltd., New Delhi, 2018.

REFERENCE BOOKS:

R1- Veerarajan T, "Engineering Mathematics", McGraw Hill Education(India) Pvt Ltd, New Delhi, 2016
R2- Grewal B.S, "Higher Engineering Mathematics", 42nd Edition, Khanna Publications, Delhi, 2012.
R3- Peter V. O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage learning,2012.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19ME2101	ENGINEERING MECHANICS	3	0	0	3

Course Objective

1. To understand basic concepts and force systems in a real world environment.
2. To understand the static equilibrium of particles and rigid bodies both in two dimensions.
3. To understand the moment of surfaces and solids.
4. To understand the effect of static friction on equilibrium.
5. To understand the dynamic equilibrium equation.

Unit	Description	Instructional Hours
I	**STATICS OF PARTICLES** Introduction to engineering mechanics - Classifications, force vector, Law of mechanics, System of forces, transmissibility, Force on a particle – resultant of two forces and several concurrent forces – resolution of a force – equilibrium of a particle – – forces in space – equilibrium of a particle in space	9
II	**EQUILIBRIUM OF RIGID BODIES** Free body diagram, moment of a force – varignon's theorem – moment of a couple – resolution of a force and a couple. Support reactions of the beam.	9
III	**CENTROID, CENTRE OF GRAVITY AND MOMENT OF INERTIA** Centroids of simple plane areas, composite areas, determination of moment of inertia of composite plane figures, polar moment of inertia-radius of gyration – mass moment of inertia of simple solids.	9
IV	**FRICTION** Laws of dry friction – angles of friction- angle of repose-coefficient of static and kinetic friction — Friction in inclined plane, Ladder friction, Screw friction– rolling resistance – belt friction.	9
V	**DYNAMICS OF PARTICLES** Rectilinear and Curve linear motion, -Newton's II law – D'Alembert's principle-Energy - potential energy kinetic energy-conservation of energy-work done by a force - work energy method, Impulse momentum method, Impact of bodies, Translation and rotation of the particles.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Define and illustrate the basic concepts of force system.
CO2: Identify the resultant force and couple, support reactions of the beam.
CO3: Calculate the Centre of gravity and moment of inertia of an object.
CO4: Examine the friction force of particles and objects for Impending Motion.
CO5: Determine the Displacement, velocity and acceleration of particles and objects

TEXT BOOKS:

T1- F.P.Beer, and Jr. E.R.Johnston., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).

T2- NH.Dubey, "Engineering Mechanics", Tata Mcraw Hill, New Delhi, 2016.

REFERENCE BOOKS:

R1- R.C.Hibbeller, and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.

R2- S.S.Bhavikatti, and K.G.Rajashekarappa, "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.

R3- P. Jaget Babu, "Engineering Mechanics", Pearson Publisher, India Ltd, 2016.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19PH2151	MATERIALS SCIENCE	2	0	2	3

Course Objective

1. Acquire fundamental knowledge of semiconducting materials which is related to the engineering program
2. Extend the knowledge about the magnetic materials
3. Explore the behavior of super conducting materials
4. Gain knowledge about Crystal systems
5. Understand the importance of ultrasonic waves

Theory

Unit	Description	Instructional Hours
I	**SEMICONDUCTING MATERIALS** Introduction – Intrinsic semiconductor – Compound and elemental semiconductor - direct and indirect band gap of semiconductors. Carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination. Optical properties of semiconductor – Light through optical fiber(Qualitative). **Experimental Components: Determination of band gap of a semiconductor. Determination of acceptance angle and numerical aperature in an optical fiber**	6+3
II	**MAGNETIC MATERIALS** Origin of magnetic moment – Bohr magneton – comparison of Dia, Para and Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – anti ferromagnetic materials – Ferrites and its applications. **Experimental Components: B – H curve by Magnetic hysteresis experiment.**	6+3
III	**PERCONDUCTING MATERIALS** Superconductivity : properties(Messiner effect, effect of magnetic field, effect of current and isotope effects) – Type I and Type II superconductors – High Tc superconductors – Applications of superconductors –Cryotron and magnetic levitation.	9
IV	**CRYSTAL PHYSICS** Crystal systems - Bravais lattice - Lattice planes - Miller indices - Interplanar spacing in cubic lattice - Atomic radius, Coordination number and Packing factor for SC, BCC and FCC crystal structures.	9
V	**ULTRASONICS** Production – Magnetostrictive generator – Piezoelectric generator – Determination of velocity using acoustic grating – Cavitations – Viscous force – co-efficient of viscosity. Industrial applications – Drilling and welding – Non destructive testing – Ultrasonic pulse echo system. **Experimental Components: Determination of velocity of sound and compressibility of liquid – Ultrasonic wave. Determination of Coefficient of viscosity of a liquid – Poiseuille's method.**	6+3
	Instructional Hours	33 +12
	Total Instructional Hours	**45**

Course Outcome

On completion of the course the students will be able to

CO1: Understand the purpose of acceptor or donor levels and the band gap of a semiconductor
CO2: Interpret the basic idea behind the process of magnetism and its applications in everyday
CO3: Discuss the behavior of super conducting materials
CO4: Illustrate the types and importance of crystal systems
CO5: Evaluate the production of ultrasonics and its applications in NDT

TEXT BOOKS:

T1- Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.
T2- Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2015.

REFERENCE BOOKS:

R1- Arthur Beiser "Concepts of Modern Physics" Tata McGraw Hill, New Delhi – 2015
R2- M.N Avadhanulu and PG Kshirsagar "A Text Book of Engineering physics" S. Chand and Company ltd., New Delhi 2016
R3- Dr. G. Senthilkumar "Engineering Physics – I" VRB publishers Pvt Ltd., 2016

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19CY2151	ENVIRONMENTAL STUDIES	2	0	2	3

Course Objective

1. The natural resources, exploitation and its conservation
2. The importance of environmental education, ecosystem and biodiversity.
3. The knowledge about environmental pollution – sources, effects and control measures of environmental pollution.
4. Scientific, technological, economic and political solutions to environmental problems.
5. An awareness of the national and international concern for environment and its protection.

Theory

Unit	Description	Instructional Hours
I	**NATURAL RESOURCES** Renewable and Non renewable resources - Forest resources: Use and over-exploitation, deforestation, timber extraction, mining, dams and their effects on forests and tribal people - Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture – Energy resources: Renewable and non renewable energy sources – Solar energy and wind energy - role of an individual in conservation of natural resources.	6
II	**ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY** Importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem - energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the forest and ponds ecosystem – Introduction to biodiversity definition: types and value of biodiversity – hot-spots of biodiversity – threats to biodiversity– endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.	6
III	**ENVIRONMENTAL POLLUTION** Definition – causes, effects and control measures of: Air pollution- Water pollution – Water quality parameters- Soil pollution - Noise pollution- Nuclear hazards – role of an individual in prevention of pollution. **Experimental Components: Determination of Dissolved Oxygen in sewage water by Winkler's method. Estimation of alkalinity of water sample by indicator method. Determination of chloride content of water sample by argentometric method.**	15
IV	**SOCIAL ISSUES AND THE ENVIRONMENT** From unsustainable to sustainable development – urban problems related to energy-environmental ethics: Issues and possible solutions – 12 Principles of green chemistry-Municipal solid waste management. Global issues – Climatic change, acid rain, greenhouse effect and ozone layer depletion – Disaster Management – Tsunami and cyclones. **Experimental Components: Determination of pH in beverages.**	9
V	**HUMAN POPULATION AND THE ENVIRONMENT** Population growth, variation among nations – population explosion – family welfare programme – environment and human health – effect of heavy metals – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA)- GIS-remote sensing-role of information technology in environment and human health. **Experimental Components: Estimation of heavy metal ion (copper) in effluents by EDTA.**	9
	Instructional Hours	33 +12
	Total Instructional Hours	**45**

Course Outcome

On completion of the course the students will be able to

CO1: Develop an understanding of different natural resources including renewable resources.
CO2: Realise the importance of ecosystem and biodiversity for maintaining ecological balance.
CO3: Understand the causes of environmental pollution and hazards due to manmade activities.
CO4: Demonstrate an appreciation for need for sustainable development and understand the various social issues and solutions to solve the issues.
CO5: Gain knowledge about the importance of women and child education and know about the existing technology to protect environment

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TEXT BOOKS:

T1- Anubha Kaushik and C. P. Kaushik, "Perspectives in Environmental studies", Sixth edition, New Age International Publishers, New Delhi, 2019.

T2- S.Annadurai and P.N. Magudeswaran, "Environmental studies", Cengage Learning India Pvt.Ltd, Delhi, 2018

REFERENCE BOOKS:

R1- Erach Bharucha, "Textbook of environmental studies" University Press (I) Pvt.ltd, Hyderabad, 2015

R2- G.Tyler Miller, Jr and Scott E. Spoolman"Environmental Science" Thirteenth Edition, Cengage Learning, 2010.

R3- Gilbert M. Masters and Wendell P. Ela "Introduction to Environmental Engineering and Science", 3rd edition, Pearson Education, 2013.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT2153	BASICS OF MECHATRONICS ENGINEERING	2	0	2	3

Course Objective

1. To apply the basic laws used in Electrical circuits and the different components
2. To impart knowledge on construction and working of DC
3. To provide knowledge on the fundamentals of semiconductor devices and their applications
4. To impart knowledge on basic measurements and its principles
5. To familiarize the basic engine operations and hydraulic systems

THEORY

Unit	Description	Instructional Hours
I	**ELECTRICAL CIRCUITS AND MEASUREMENTS** Basic circuit components - Ohms Law - Kirchhoff's Law - Steady State Solution of DC Circuits - Nodal analysis - Mesh analysis- Introduction to AC Circuits - Single Phase circuits - Three Phase Balanced Circuits **Experimental Components :Verification of Circuit Laws**	6+3
II	**ELECTRICAL MACHINES** Principles of operation and characteristics of DC machines, Transformers (Single and Three phase), Synchronous machines, Three phase and Single phase Induction motors - Housing wiring, Industrial wiring, Materials of wiring, Types of battery and Earthing system **Experimental Components: Earthing system and Load test on Induction motor**	6+3
III	**INTRODUCTION TO ELECTRONICS** Characteristics of PN Junction Diode - Zener Effect - Zener Diode and its characteristics - Half wave and Full wave Rectifiers - Voltage Regulation. **Experimental Components: DC motor driver circuit using transistor and Zener & PN Junction Diode**	6+3
IV	**SCIENCE OF MEASUREMENT** Units and Standards - Calibration Techniques - Errors in Measurement - Generalized Measurement System - Voltmeter , Ammeter & Multimeter **Experimental Components: Measuring voltage, current and resistance using digital multimeter.**	6+3
V	**ENGINES AND HYDRAULIC SYSTEMS** Petrol and Diesel Engines - Comparison of four stroke and two stroke engines - Basic of Boilers, Turbines, Reciprocating Pumps and Centrifugal Pumps **Experimental Components: Valve Timing & Port Timing and Turbines.**	6+3
	Instructional Hours	30+15
	Total Instructional Hours (Theory + Practical)	45

Course Outcome

On completion of the course, the students will be able to

CO1: Apply the KVL and KCL in electrical circuits

CO2: Explain the constructional features of AC and DC machines.

CO3: Identify electronics components and use of them to design circuits.

CO4: Use appropriate electronic devices for measurement.

CO5: Construct block diagram and explain engine operations and hydraulic systems.

TEXT BOOKS:

T1- VN Mittle, Aravind Mittle , "Basic Electrical Engineering". Tata McGraw Hill Edition, Second edition, New Delhi, 2009.

T2- AK Sawney, Puneet Sawney, "A Course in Electrical and Electronic Measurements and Instrumentation", 2nd Edition, Dhanpat Rai& Company, 2010.

REFERENCE BOOKS:

R1- Shanmugam G and Palanichamy M S, "Basic Civil and Mechanical Engineering", Tata McGraw Hill Publishing Co., NewDelhi, 3rd Edition,2010.

R2- Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill, Second Edition, 2010

R3- Musa Jouaneh and Christopher M Shott, "Fundamentals of Mechatronics", Global Engineering Publications, Second Edition, 2013.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19GE2001	ENGINEERING PRACTICES LABORATORY	0	0	4	2

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

Unit	Description of the Experiments
	Group A (Civil & Mechanical)
1	Preparation of Single pipe line and Double pipe line connection by using valves, taps, couplings, unions, reducers and elbows.
2	Arrangement of bricks using English bond for 1brick thick wall and 11/2 brick thick wall for right angle corner junction.
3	Arrangement of bricks using English bond for 1brick thick wall and 11/2 brick thick wall for T junction.
4	Preparation of arc welding of Butt joints, Lap joints and Tee joints.
5	Practice on sheet metal Models– Trays and funnels
6	Hands-on-exercise in wood work, joints by sawing, planning and cutting.
7	Practice on simple step turning, taper turning and drilling.
8	Demonstration on Smithy operation.
9	Demonstration on Foundry operation.
10	Demonstration on Power tools.
	Practical Hours 22
	Group B (Electrical)
1	Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2	Fluorescent lamp wiring.
3	Stair case wiring.
4	Measurement of Electrical quantities – voltage, current, power & power factor in single phase circuits.
5	Measurement of energy using single phase energy meter.
6	Soldering practice using general purpose PCB.
7	Measurement of Time, Frequency and Peak Value of an Alternating Quantity using CRO and Function Generator.
8	Study of Energy Efficient Equipment's and Measuring Instruments.
	Practical Hours 23
	Total Practical Hours 45

On completion of the course the students will be able to

Course Outcome

CO1: Fabricate wooden components and pipe connections including plumbing works.

CO2: Fabricate simple weld joints.

CO3: Fabricate different electrical wiring circuits and understand the AC Circuits.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE2071	LANGUAGE COMPETENCY ENHANCEMENT COURSE- II	0	0	2	1

(COMMON TO ALL BRANCHES)

Course Objective

- ✓ **To improve communication skills and Professional Grooming.**
- ✓ **To impart deeper knowledge of English Language and its practical application in different facets of life.**
- ✓ **To equip the techniques of GD, Public Speaking, debate etc.**

Unit	Description	Instructional Hours
I	**Listening** Listening for gist and respond – Listen for detail using key words to extract specific meaning – listen for phonological detail – Listen and identify the main points for short explanations and presentation.	3
II	**Reading** Strategies for effective reading – read and recognize different text types – Genre and Organization of Ideas – Quantifying reading – reading to comprehend – Interpreting sentences – contrasting, summarizing or approximating	3
III	**Speaking** Speak to communicate – Make requests and ask questions to obtain personal information – use stress and intonation – articulate the sounds of English to make the meaning understood – speaking to present & Interact – opening and closing of speech.	3
IV	**Writing** Plan before writing – develop a paragraph: topic sentences, supporting sentences – write a descriptive paragraph – elements of good essay – descriptive, narrative, argumentative – writing emails – drafting resumes – project writing – convincing proposals.	3
V	**Language Development** Demonstration at level understanding of application of grammar rules – revision of common errors : preposition, tenses, conditional sentences –reference words – pronouns and conjunctions.	3
	Total Instructional Hours	**15**

Course Outcome

CO1- Introduced to different modes and types of communication.
CO2- Practiced to face and react to various professional situations efficiently.
CO3- learnt to practice managerial skills.
CO4- Familiarized with proper guidance to writing.
CO5- Trained to analyze and respond to different types of communication.

REFERENCE BOOKS:

1. Verbal Ability and Reading Comprehension by Arun Sharma,9th edition,Tata Mc graw Hill
2. Word Power Made Easy by Norman Lewis,– Print, 1 June 2011.
3. High School English Grammar by Wren and Martin,S.CHAND Publications, 1 January 2017.
4. Practical course in Spoken English by J.K. Gangal,PHI Learning , Second edition, 1 January 2017

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SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MA3104	FOURIER ANALYSIS AND NUMERICAL METHODS (COMMON TO CIVIL & MECHATRONICS)	3	0	0	3

Course Objective

1. Introduce fourier series analysis which is central to many applications in engineering
2. Solve boundary value problems by applying fourier series
3. Acquaint with fourier transforms techniques used in wide variety of situations
4. Familiar with the concepts of numerical differentiation and numerical integration
5. Find the numerical solution of ordinary differential equations as most of the engineering problems are expressed in the form of differential equations

Unit	Description	Instructional Hours
I	**FOURIER SERIES** Introduction - Dirichlet's Conditions - General Fourier Series - Odd and Even Functions - Half Range Sine and Cosine Series - Change of Interval - Parseval's Identity - Harmonic Analysis.	9
II	**BOUNDARY VALUE PROBLEMS** Classification - Solution of One Dimensional Wave Equation - One Dimensional Heat Equation - Fourier Series Solution in Cartesian Coordinates.	9
III	**FOURIER TRANSFORMS** Fourier Transform Pairs - Fourier Sine and Cosine Transforms - Properties - Transforms of Simple Functions - Convolution Theorem - Parseval's Identity.	9
IV	**NUMERICAL DIFFEREN TIATION AND INTEGRATION** Differentiation using Interpolation Formulae - Numerical Integration by Trapezoidal and Simpson's 1/3 and 3/8 Rules - Romberg's Method - Double Integrals using Trapezoidal and Simpson's Rules.	9
V	**INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS** Single Step Methods: Taylor Series Method - Euler and Modified Euler Method for First Order Equation - Fourth Order Runge - Kutta Method for Solving First Order Equations - Multi Step Method: Milne's Predictor and Corrector Methods.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Understand the mathematical principles of fourier series which would provide them the ability to formulate and solve some of the physical problems of engineering

CO2: Acquire the knowledge of application of fourier series in solving the heat and wave equations

CO3: Express the information from discrete data set through numerical differentiation

CO4: Evaluate many numerical integration problems and appreciate their applications for engineering problem solving

CO5: Obtain the knowledge of solving ordinary differential equations using single and multi step methods

TEXT BOOKS:

T1- Veerarajan. T., *"Transforms and Partial Differential Equations"*, 2nd Edition Reprint, Tata McGraw Hill Publishing Company Limited, New Delhi, 2012.

T2- Grewal. B.S, *"Higher Engineering Mathematics"*, 40th Edition, Khanna Publishers, New Delhi, 2007.

REFERENCE BOOKS:

R1- Kreyszig. E, *"Advanced Engineering Mathematics"*, 8th Edition, John Wiley and Sons Ltd., Singapore 2001.

R2- Kandasamy P., Thilagavathy K. and Gunavathy K, *"Engineering Mathematics Volume III"*, S. Chand & Company Ltd., New Delhi, 1996.

R3- Kandasamy P., Thilagavathy K. and Gunavathy K, *"Numerical Methods"*, S. Chand & Company Ltd., New Delhi, 1996.

R4- S.K. Gupta, *"Numerical Methods for Engineers"*, New Age International (P) Ltd., New Delhi, 2015.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT3201	THEORY OF MACHINES	3	1	0	4

Course Objective

1. To impart the basic components and layout of linkages in the assembly of a system / machine
2. To manipulate linkages and cam mechanisms for the desired output motions
3. To express the basic concepts of toothed gearing and kinematics of gear trains
4. To classify the vibration occurrence on different machines
5. To familiarize the concepts of balancing of masses for different machine components

Unit	Description	Instructional Hours
I	**MECHANISMS** Introduction - Kinematic Links, Joints, Pairs and Chains - Degree of Freedom - Mobility - Kutzbach Criterion - Grashoff's Law - Kinematic Inversions of Mechanism - Steering Gear Mechanism - Ackermann Steering Gear.	9+3
II	**CAMS** Classification of Cams and Followers - Terminology - Displacement Diagram - Uniform Velocity, Parabolic, Simple Harmonic and Cycloidal Motions on Radial Cams. Velocity and Acceleration Analysis of Slider Crank mechanisms.	9+3
III	**GEARS AND BELT DRIVES** Gears classification - Law of Toothed Gearing - Terminology - Gear Tooth Action - Interference - Simple and Compound Gear Trains - Belt drives - Types - Angle of Contact - Maximum Tension in the Belt - Advantages and Disadvantages.	9+3
IV	**VIBRATION** Introduction - Terms - Types - Free Longitudinal Vibrations - Free Transverse Vibrations - Whirling Speed of the Shaft - Damped Vibration(Free and Forced) - Damping Factor - Logarithmic Decrement - Vibration Isolation and Transmissibility.	9+3
V	**BALANCING** Static and Dynamic Balancing - Balancing of Rotating Masses - Balancing of Reciprocating Masses - Balancing of Radial Engine and V Engines - Hammer Blow - Swaying Couple. Case Studies: Effect of Gyroscopic Couple on Navel Ship and Centrifugal Governors in Automobiles.	9+3
	Total Instructional Hours	45+15=60

Course Outcome

On completion of the course the students will be able to

CO1: Design and analyze all types of mechanism
CO2: Sketch and analyze the profile of various cam mechanisms
CO3: Solve and evaluate the kinematics aspects of gears and gear trains
CO4: Interpret the principles of vibration and mechanism for its control
CO5: Analyze the concept of balancing of masses

TEXT BOOKS:

T1- S.S.Rattan, *"Theory of Machines"*, 4th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2016.
T2- R.S.Khurmi and J.K.Gupta , *"Theory of Machines"*, 5th Edition, S. Chand and Company Ltd., New Delhi, 2010.

REFERENCE BOOKS:

R1- H.David Myszka, *"Machines and Mechanism - Applied Kinematic Analysis"*, 4th Edition, Pearson Education, New Jersey, 2010.
R2- L.Robert Norton, *"Design of Machinery"*, 7th Edition. Tata McGraw Hill Publishing Company Limited, New Delhi, 2013.
R3- J.E.Shigley and J.J.Uicker, *"Theory of Machines and Mechanisms"*, 3rd Edition, Oxford University Press India, 2014.

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1. http://www.mechanicalbooster.com/2013/11/what-is-governor-in-automobile-how-does-it-works.html

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT3202	DIGITAL APPLICATIONS IN MECHATRONICS SYSTEMS	3	0	0	3

Course Objective

1. To impart knowledge about the fundamentals of logic gates and boolean algebra
2. To learn various combinational and sequential circuits
3. To describe various flip-flops used in sequential circuits
4. To familiarize the basics of synchronous and asynchronous circuits
5. To introduce digital concepts in mechatronics applications

Unit	Description	Instructional Hours
I	**LOGIC GATES AND MINIMIZATION TECHNIQUES** Logic Gates: Logic Functions using Gates - NAND - NOR Implementations - Multi Level Gate Implementations - Multi Output Gate Implementations. Minimization Techniques: Boolean Algebra - Simplification of Boolean Functions - Minterm - Maxterm - Simplification of Logic Functions using Karnaugh Map - Quine McClusky Method.	9
II	**COMBINATIONAL CIRCUITS** Half and Full Adders - Half and Full Subtractors - Code Converters - Encoder - Decoder - Multiplexer - Demultiplexer - Carry Look Ahead Adder - Parity Checker - Parity Generators - Magnitude Comparator.	9
III	**SEQUENTIAL CIRCUITS** Latches - Flip-Flops SR, JK, D, T, and Master - Slave. Asynchronous & Synchronous Up/Down Counters. Design of Synchronous Counters: State Diagram - State Table - State Minimization - State Assignment - Excitation Table and Maps - Modulo-n Counter.	9
IV	**MEMORY DEVICES** Classification of Memories - ROM Organization - RAM Organization. Programmable Logic Devices - Programmable Logic Array (PLA) - Programmable Array Logic (PAL) - Field Programmable Gate Arrays (FPGA).	9
V	**APPLICATIONS** Digital Electronics on Engine Management - FADEC. Industrial Automation - Process Monitoring and Control - Distributed Control Systems in Robotics - 3C - Communications, Command and Control - Automotive Industry - Electronic Control Unit.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

- CO1: Design logic circuits and to evaluate its function realizations using gates
- CO2: Develop combinational and sequential circuit systems using flip flops
- CO3: Apply the minimization techniques in sequential circuits
- CO4: Compare various programmable logic devices and its functions
- CO5: Enumerate the applications of digital electronics in various fields

TEXT BOOKS:

T1- M. Morris Mano, Michel D. Ciletti, *"Digital Design"*, 5th Edition, Pearson Education, New Delhi, 2012.
T2- John.M Yarbrough, *"Digital Logic Applications and Design"*, 1st Edition, Thomson Learning, 2002.

REFERENCE BOOKS:

R1- John F.Wakerly, *"Digital Design"*, 4th Edition, PHI Learning Private Limited, New Delhi, 2006.
R2- Thomas L. Floyd, *"Digital Fundamentals"*, 8th Edition, PHI Learning Private Limited, New Delhi, 2003.
R3- Charles H.Roth, *"Fundamentals of Logic Design"*, 7th Edition, Thomson Learning, 2003.

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1. http://www.experimentalaircraft.info/articles/aircraft-engines-fadec.php
2. http://www.mouser.com/applications/distributed-control-systems-robotics/
3. http://embedded-computing.com/articles/automotive-industry-innovation-driven-electronics

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT3203	MECHANICS OF MATERIALS	3	0	0	3

Course Objective

1. To impart the basic elastic response of the engineering materials
2. To familiarize the concept of shear force and bending moment in beams
3. To familiarize the concept of torsion in shafts and stresses in different springs
4. To impart knowledge on stresses and load structural members
5. To impart the concepts of structural elements and pressure vessels

Unit	Description	Instructional Hours
I	**STRESS STRAIN AND DEFORMATION OF SOLIDS** Introduction to Materials - Classification - Properties of Engineering Materials - Hooke's Law - Types of Stresses - Deformation of Simple and Composite Bars - Thermal Stresses - Elastic Constants and their Relations - Factor of Safety.	9+3
II	**SHEAR FORCE AND BENDING MOMENT** Beams and its Types -Types of Loading on Beams - Shear Force and Bending Moment in Beams - Cantilevers, Simply Supported Beams and Over Hanging Beams - Theory of Simple Bending - Bending Formula - Bending Stress Distribution - Shear Stress Distribution.	9+3
III	**TORSION OF SHAFT AND SPRINGS** Introduction to Torsion Stresses and Deformation in Circular and Hollows Shafts - Composite Shafts - Stresses in Helical Springs - Deflection of Helical Springs and Leaf Springs.	9+3
IV	**DEFLECTION OF BEAMS AND COLUMNS** Slope and Deflection of Cantilever and Simply Supported Beams by Double Integration and Macaulay's Methods - Column - Buckling of column - Euler's and Rankine's Formula for Different End Condition.	9+3
V	**THIN ANDTHICK CYLINDERS** Stresses in Thin Cylindrical Shell due to Internal Pressure Circumferential and Longitudinal Stresses and Deformation in Thin and Thick cylinders - Applications - Design of Mechatronics System Components - Spring - Shaft - Rope - Case Study of Stress Distribution in Automobile Tyres - Case Study of Automation Systems used in Investigating Strength of the Engineering Materials.	9+3
	Total Instructional Hours	45+15=60

Course Outcome

On completion of the course the students will be able to

CO1: Compute stresses and strain under different load conditions
CO2: Sketch the shear force and bending moment diagrams of different beams
CO3: Analyse the stresses and strains in shafts subjected torsion
CO4: Design standard beams for safe working conditions
CO5: Investigate the mode of failure in pressure vessels

TEXT BOOKS:

T1- Bansal, R.K., *"Strength of Materials"*, 6th Edition, Laxmi Publications (P) Ltd., New Delhi, 2017.
T2- Ferdinand P. Beer *"Mechanics of solids"*, 7th Edition, McGraw Hill Education, New Delhi, 2014.

REFERENCE BOOKS:

R1- Khurumi R S *"Strength of Materials"*, 3rd Edition, Asian Books Pvt. Ltd., New Delhi, 2007.
R2- Subramanian R.,*"Strength of Materials"*, 2nd Edition, Oxford University Press, Oxford Higher Education Series, 2007.
R3- Rajput, R. K, *"A Textbook of Strength of Materials"*, 5th Edition, S. Chand and company Ltd., New Delhi, 2007.
R4- Hibbeler, R.C., *"Mechanics of Materials"*, 8th Edition, Pearson Education, New Delhi, 2011.

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1. http://www.timeattack.co.uk/chassis-stiffening-basics/#sthash.kzqhpA2W.dpbs
2. http://www.totalconstructionhelp.com/columns.html

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT3204	CONTROL OF ELECTRICAL MACHINES	3	0	0	3

Course Objective

1. To discuss Constructional details, principle of operation, starters and speed control of Electrical Machines
2. To identify the control circuit components used in electrical circuit
3. To illustrate DC electric machines control circuits
4. To select the suitable parts to construct the AC electrical machines
5. To learn to use Different control circuits for industrial applications

Unit	Description	Instructional Hours
I	**ELECTRICAL MACHINES** Review of Constructional Details - Working Principle of DC Machines & AC Motor - Characteristics of Shunt, Series & Compound Motors - Necessity of Starters - Speed Control - Construction and Principle of Operation of Single Phase Induction Motors.	9
II	**INTRODUCTION TO CONTROL CIRCUIT COMPONENTS** Control Circuit Components Switches - Push Button, Selector, Limit, Pressure, Temperature (Thermostat). Relays - Voltage Relay, DC Series Current Relay - Over Current Relay - Bimetallic Thermal Over Load Relay and Magnetic Dash Pot Oil Filled Relay - Timer - Thermal, Pneumatic and Electronic Timer - Solenoid Valve, Solid State Relay, Simple ON - OFF Motor Control Circuit.	9
III	**DC MOTOR CONTROL CIRCUITS** Need of Starter - Manual Starters for DC Motors - Speed Controlling Methods - Current Limit Acceleration Starters - Series Relay and Counter EMF Starters - Definite Time Acceleration Starters - Jogging Control, Dynamic Braking Control, Reversing Control and Plugging Control Circuits.	9
IV	**AC MOTOR CONTROL CIRCUITS** Types of AC Motors - Construction and Working of Three Phase AC Motors - DOL Starter - Automatic Auto Transformer Starter, Star/Delta Starter (Semi Automatic and Automatic) Starter for Two Speed, Two Winding Motor - Reversing the Direction of Rotation of Induction Motor - Plug Stopping of the Motor - Dynamic Braking - Three Step Rotor Resistance Starter for Wound Induction Motor.	9
V	**INDUSTRIAL CONTROL CIRCUITS** Planner Machine - Battery Trolley - Battery Operated Truck - Skip Hoist Control - Automatic Control of a Water Pump - Control of Electric Oven - Control of Air Compressor - Control of Over Head Crane - Control of Conveyor System - Control of Elevator.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Analyze the principle, construction and operation of electrical machine
CO2: Recognize the control circuit components used in electrical wiring
CO3: Illustrate the control circuits for DC Machines
CO4: Sketch and describe the control circuits for AC Machines
CO5: Apply the control circuit concepts into various industrial applications

TEXT BOOKS:

T1- Bhattacharya.S.K & Brijinder Singh, *"Control of Electrical Machines"*, 2nd Edition, New Age International (P) Ltd., New Delhi, 2010.

T2- D. P. Kothari & I. J. Nagrath, "*Electric Machines*", 4th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2016.

REFERENCE BOOKS:

R1- Clarence A. Phipps, *"Fundamentals of Electrical Control"*, 2nd Edition, Fairmont Press, 2011.

R2- Steve Senty, *"Motor Control Fundamentals"*, 2nd Edition, Delmar Cengage Publication, 2013.

R3- Metha.V.K. & Rohit Metha, *"Principle of Electrical Engineering"*, 2nd Edition, S.Chand & Company Ltd., New Delhi, 2010.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT3205	PRODUCTION TECHNOLOGY	3	0	0	3

Course Objective

1. To list the fundamentals and various methods of manufacturing process
2. To choose the suitable welding process for manufacturability
3. To identify the different forming operations
4. To develop the knowledge about the casting and molding process
5. To identify the finishing operations

Unit	Description	Instructional Hours
I	**MACHINING** Lathe and Lathe Operations - Drilling Machines - Reaming and Tapping Operations - Shaper - Planer - Slotter - Milling Machine.	9
II	**WELDING** Welding Equipments - Electrode Types - Specification - Arc Welding - Gas Welding - Thermit Welding - Laser Beam Welding - Electron Beam Welding - Plasma Arc - Ultrasonic Welding - Friction Welding - Welding Defects.	9
III	**FORMING** Hot and Cold Working, Rolling - Rolling Mills and Rolling Operations - Forging Operations and Drop Forging - Extrusion and Types - Sheet Metal Operations: Blanking - Piercing - Punching - Trimming.	9
IV	**CASTING** Introduction to Casting and Patterns - Moulding and Moulding Sand - Cores & Core Making - Special Casting Process, Shell Mould Casting - Die Casting, Investment Casting and Centrifugal Casting - Casting Defects.	9
V	**FINISHING OPERATIONS AND APPLICATIONS OF PRODUCTION TECHNOLOGY** Finishing Operations - Grinding - Lapping - Honing and Broaching. Applications: Manufacturing of Air Bag System in Automobiles - Marine Propeller Manufacturing - PCB Board Manufacturing - Aircraft Fuselage Manufacturing.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Justify the most appropriate manufacturing process and material for a given product
CO2: Interpret the different welding processes used in manufacturing
CO3: Design the process parameters for rolling and sheet metal operations
CO4: Choose the suitable casting process based on the product requirements
CO5: Perform a variety of finishing operations on manufacturing products

TEXT BOOKS:

T1- Kalpakjian, *"Manufacturing Engineering and Technology"*, 4th Edition, Addison Wesley Congmen Pvt. Ltd., Singapore, 2013.

T2- Hajra Choudhury, *"Elements of Workshop Technology"*, Vol - I and II, 3rd Edition, Media Promoters and Publishers Pvt. Ltd., Mumbai, 2012.

REFERENCE BOOKS:

R1- Jain.R.K, *"Production Technology: Manufacturing Processes, Technology and Automation"*, 17th Edition, Khanna Publishers, New Delhi, 2011.

R2- Sharma.P.C, *"Production Technology: Manufacturing Processes"*, 7th Edition, S. Chand and Company Ltd., New Delhi, 2008.

R3- Chapman.W.A.J, *"Workshop Technology Vol. I and II"*, 5th Edition, Arnold Publisher, New Delhi, 2001.

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1. http://www.madehow.com/Volume-1/Air-Bag.html

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT3001	PRODUCTION TECHNOLOGY LABORATORY	0	0	4	2

Course Objective

1. To familiarize the basic concepts of manufacturing processes
2. To provide hands on training to the students on various machining operations
3. To interpret specifications and characteristics of all unconventional machines
4. To familiarize the basic concepts of finishing operations
5. To create a various gear profile from gear blanks

Unit	Description of the Experiments	Practical Hours
1	Lathe - Facing and Plain Turning.	3
2	Lathe - Step and Taper Turning.	6
3	Lathe - Grooving and External Threading.	6
4	Lathe - Drilling and Knurling.	3
5	Lathe - Boring and Internal Threading.	6
6	Drilling, Tapping and Reaming.	3
7	Milling - Face Mill.	3
8	Milling - Pocket Mill.	3
9	Milling - Gear.	3
10	Shaping - Slot Cutting.	3
11	Shaping - Dovetail Cutting.	3
12	Grinding - Surface Grinding.	3
	Total Practical Hours	45

Course Outcome

On completion of the course the students will be able to

CO6: Perform various operations on a given component using lathe
CO7: Operate milling, shaper and slotting machines on the given component to produce flat surface
CO8: Produce surface finishing for a given component.
CO9: Perform drilling, tapping and reaming operations
CO10: Produce required gear profile on the given component

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT3002	CONTROL OF ELECTRICAL MACHINCES AND ELECTRONICS LABORATORY	0	0	4	2

Course Objective

1. To designing the electronic circuits using basic logic gates
2. To provide hands-on training for automatic starters of electrical motors
3. To impart knowledge on control circuits for braking, jogging and reversing operations
4. To test the characteristics of diode and transistor
5. To construct rectifier circuits using diode

Unit	Description of the Experiments	Practical Hours
1	Wire and Test the Control Circuit for Jogging in Cage Motor and Single Phase Preventer.	6
2	Wire and Test the DOL Starter and Control Circuit for Forward and Reverse Operations.	6
3	Performance Characteristics of Single Phase Transformer.	3
4	Load Test on Three Phase Induction Motor.	3
5	Wire and Test the Control Circuit for Automatic Star-Delta Starter and Semi-Automatic Star-Delta Starter.	6
6	Swinburne's Test.	3
7	Design and Implementation of Adders and Subtractors using Logic Gates.	3
8	Design and Implementation of Code Converters using Logic Gates.	3
9	Design and Implementation of 2-Bit Magnitude Comparator using Logic Gates.	3
10	Design and Implementation of Full Wave and Half Wave Rectifier using Diode.	3
11	Characteristics of Semiconductor Diode and Zener Diode.	3
12	Input and Output Characteristics of Transistor under CE Configuration.	3
	Total Practical Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: To design the electronic circuits using logic gates
CO2: To create various types of starters using contactors and relays
CO3: To develop the control circuits for braking, jogging, reversing operations
CO4: To perform the load test on 3 phase Induction Motor
CO5: To analyze the performance of machines without load

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT4201	THERMODYNAMICS AND FLUID ENGINEERING	3	1	0	4

Course Objective

1. To interpret the basic concepts of thermodynamics
2. To derive how to apply the steady flow energy equation to a system of thermodynamic components to estimate required balances of heat, work and energy flow
3. To explain the refrigeration systems and air conditioning
4. To identify the properties of fluids and dynamics of fluids
5. To solve the problems in fluid dimensions and incompressible fluid dynamics

Unit	Description	Instructional Hours
I	**BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS** Working Substance - System - Ideal Gas Laws - Perfect Gas - Property - State, Process, Path and Cycle - Equilibrium - Zero law of Thermodynamics - Point and Path Functions - Quasi Static Process, Reversible and Irreversible Processes - First law of Thermodynamics - Energy - Specific Heat - Internal Energy and Enthalpy - Energy Changes in Non-flow Processes - Flow Equation.	9+3
II	**SECOND LAW OF THERMODYNAMICS** Kelvin - Plank and Clausius Statements - Basic Concepts of Heat Engines and Heat pumps (Efficiency and COP) - Corollaries of II Law - Absolute Temperature Scale, Entropy, Entropy Change for a Perfect Gas, Principle of Entropy Increase, Clausius Inequality.	9+3
III	**AIR STANDARD CYCLES, REFRIGERATION AND AIR-CONDITIONING** Otto - Diesel - Dual combustion and Brayton cycles - Principles of Refrigeration - Refrigerator & Heat Pump Cycle Refrigerants - Refrigerant Properties - Refrigerant Selection and Vapor Compression Refrigeration Cycle. Vapor Absorption Cycle - Dry Bulb Temperature, Wet Bulb Temperature, Comfort Air Conditioning, Psychometric Chart, Humidification, De Humidification, Air Coolers and Cooling Towers.	9+3
IV	**FLUID PROPERTIES AND DYNAMICS OF FLUIDS** Definition of Fluid - Properties of Fluids - Mass Density, Specific Weight, Specific Volume, Specific Gravity, Viscosity, Compressibility, Vapour Pressure, Surface Tension and Capillarity, Continuity Equation - Application of Control Volume to Continuity - Energy Equation - Euler's Equation - Bernoulli Equation - Applications of Bernoulli's Equation and Momentum Equation	9+3
V	**INCOMPRESSIBLE FLUID FLOW AND DIMENSIONAL ANALYSIS** Boundary Layer Concepts - Darcy Weisbach Equation - Laminar Flow and Turbulent Flow - Minor Losses - Flow through Pipes in Series and in Parallel. Need for Dimensional Analysis - Buckingham's π Theorem.	9+3
	Total Instructional Hours	45+15=60

Course Outcome

On completion of the course the students will be able to

CO1: Identify the different concepts in thermodynamics
CO2: Analyze the processes on TV diagrams to solve engineering problems
CO3: Describe the principles of air conditioning, refrigeration and psychometric relations
CO4: Analyze the properties of fluids
CO5: Interpret the flow of fluid through pipes in series and parallel

TEXT BOOKS:

T1- Nag.P.K, *"Engineering Thermodynamics"*, 4th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

T2- Yunus A. Cengel , John M. Cimbala , *" Fluid Mechanics"* , 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2011.

REFERENCE BOOKS:

R1- Rajput.R.K, *"Engineering Thermodynamics,"* 4th Edition, Laxmi Publications (P) Ltd., New Delhi, 2010.

R2- Kumar.D.S, *"Engineering Thermodynamics"*, 2nd Edition, S.K. Kataria & Sons, 2012.

R3- Bansal.R.K, *"Fluid Mechanics and Hydraulic Machines"*, Laxmi Publications (P) Ltd., New Delhi, 1995.

R4- Streeter, V. L. and Wylie E. B., *"Fluid Mechanics"*, Tata McGraw Hill Publishing Company Limited, New Delhi, 2010.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT4202	CONTROL OF MECHATRONICS SYSTEMS	3	1	0	4

Course Objective

1. To solve the fundamental concepts of control systems and mathematical modeling of the system
2. To discuss the concept of time response of the system
3. To Sketch the frequency response of system
4. To develop and analysis State variable model
5. To select the controller for mechatronics applications

Unit	Description	Instructional Hours
	SYSTEM REPRESENTATION AND MODELLING	
I	Introduction and Need for Control Systems with Examples - Open Loop and Closed Loop Systems - Transfer Function Model - Mathematical Modeling of Mechanical, Electrical Systems - Block Diagram Reduction - Signal Flow Graph.	9+3
	TRANSIENT RESPONSE ANALYSIS	
II	Standard Test Signals - Time Response of Second Order System - Time Domain Response Performance Criteria - Routh Hurwitz Criterion - Root Locus.	9+3
	FREQUENCY DOMAIN ANALYSIS	
III	Bode Plot - Polar Plot - Nyquist Stability Criterion - Stability Analysis - Lead Lag and Lag Lead Compensation - M &N Circle-Nichols Charts.	9+3
	STATE SPACE ANALYSIS	
IV	Concepts of State - State Variables and State Models - State Space Equations - Transfer Function - Transfer Model, State Space Representation of Dynamic Systems, State Transition Matrix - Decomposition of Transfer Function - Controllability and Observability.	9+3
	BASIC CONTROLLERS	
V	P, PI, PD and PID Controller - Tuning of Controller - Process Reaction Curve Method - Ziegler Nicol Tuning Method - Mathematical Modeling of Pneumatic, Hydraulics and Thermal System - Distributed Control System.	9+3
	Total Instructional Hours	45+15=60

Course Outcome

On completion of the course the students will be able to

- CO1: Derive the mathematical model of a system
- CO2: Describe the response of different order systems for various step inputs
- CO3: Analyze the stability of the system
- CO4: Solve system equations in state-variable form
- CO5: Identify controller concepts in industry

TEXT BOOKS:

T1- B.C. Kuo and F.Golnaraghi, *"Automatic Control Systems"*, 9th Edition. Wiley India Pvt. Limited., New Delhi, 2014.

T2- Curtis D. Johnson, *"Process Control Instrumentation Technology"*, 2nd Edition, PHI Learning Private Limited, New Delhi, 2006.

REFERENCE BOOKS:

R1- Katsuhiko Ogata, *"Modern Control Engineering"*, 5th Edition, PHI Learning Private Limited, New Delhi, 2010.

R2- M Gopal, *"Control Systems - Principles and Design"*, 4th Edition, McGraw Hill Education, New Delhi, 2012.

R3- Norman S. Nise, *"Control Systems Engineering"*, 6th Edition, John Wiley & Sons Inc., New York, 2010.

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1. http://instrumentationtools.com/difference-between-dcs-plc-systems

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT4203	SENSORS AND SIGNAL CONDITIONING	3	0	0	3

Course Objective

1. To learn the fundamentals of measurements and classify the transducers and instruments
2. To impart knowledge in selection of suitable sensor for temperature, pressure, vacuum and flow measurement
3. To describe the resistance, inductance and capacitance measuring methods
4. To acquire knowledge on modern sensors and optoelectronic sensors
5. To observe information about data acquisition, data logging and application of sensors in industries

Unit	Description	Instructional Hours
I	**SCIENCE OF MEASUREMENT** Units and Standards - Calibration Techniques - Errors in Measurement - Generalized Measurement System - Static and Dynamic Characteristics of Transducers - Generalized Performance of Zero Order and First Order Systems - Response of Transducers to Different Time Varying Inputs - Classification of Transducers.	9
II	**MECHANICAL MEASUREMENTS** Temperature Measurement: Filled Thermometer - Bimetallic Thermometer - Pressure Measurement - Manometers - Elastic Transducers. Vacuum Measurement - McLeod Gauge - Thermal Conductivity Gauge - Ionization Gauge - Flow Measurement - Orifice, Venturi, Turbine Flow Meter, Hot Wire Anemometer.	9
III	**ELECTRICAL MEASUREMENTS** Resistive Transducer: Potentiometer - RTD - Thermistor - Thermocouple - Strain Gauge. Inductive Transducer: LVDT - RVDT - Capacitive Transducer - Piezoelectric Transducer - Hall Effect Sensor.	9
IV	**OPTO ELECTRONIC AND MODERN SENSORS** Photo Conductive - Photo Voltaic Cells - Semiconductor Photodiode - Photo Transistors - Digital Encoding Transducers - Optical Displacement Transducers. Smart Sensors - Film Sensors - MEMS and Nano Sensors.	9
V	**DATA ACQUISITION AND SENSOR APPLICATIONS** Introduction - Signals - Amplification - Inverting and Non Inverting Amplifier - Filtering - Low Pass and High Pass Filter - Sample and Hold Circuits - Data Acquisition - Single Channel and Multi Channel Data Acquisition - Data Logging - Tactile Sensors for Pneumatic Switch - Robotic Arc Welding Sensors for Simple Active Optical Seam Tracker - Slip Sensing Fingers.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

- CO1: Generalize the performance of zero and first order system
- CO2: Classify the various mechanical measurements in different applications
- CO3: Apply various electrical and electronic sensors in real time applications
- CO4: Compare modern sensors from conventional sensors by their operation and construction
- CO5: Analyze the operations of various data acquisition systems

TEXT BOOKS:

T1- Beckwith, Marangoni and Lienhard, *"Mechanical Measurements"*, 1st Edition, Pearson Education, New Jersey, 2007.

T2- AK Sawney, Puneet Sawney, *"A Course in Electrical and Electronic Measurements and Instrumentation"*, 2nd Edition, Dhanpat Rai & Company, 2010.

REFERENCE BOOKS:

R1- Patranabis.D, *"Sensors and Transducers"*, 2nd Edition, PHI Learning Private Limited, New Delhi, 2003.

R2- Doeblin E.O, *"Measurements Systems - Applications and Design"*, 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi,, 2011.

R3- D.V.S.Murthy, *"Transducer & Instrumentation"*, PHI Learning Private Limited, New Delhi, 2011.

R4- Richard D Klafter, Thomas A Chmielewski, Michael Negin, *"Robotics Engineering: An Integrated Approach"*, PHI Learning Private Limited, New Delhi, 2009.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT4204	MACHINE DESIGN (APPROVED DESIGN DATA BOOK IS PERMITTED)	3	1	0	4

Course Objective

1. To familiarize the fundamentals involved in design process
2. To learn fundamental approaches to failure prevention for static and repeated loading
3. To interpret the types of gears and principles of gear tooth action
4. To learn the fundamentals of brakes and chain drives
5. To impart the knowledge in selection of bearings and springs for different applications

Unit	Description	Instructional Hours
	DESIGN FUNDAMENTALS	
I	Design Process - Computer Aided Design - Optimum Design - Mechanical Properties of Materials - Types of Loads - Stresses - Static, Varying, Thermal, Impact and Residual - Factors of Safety - Theories of Failure - Stress Concentration Factors.	9+3
	DESIGN OF SHAFTS, KEYS AND COUPLINGS	
II	Design of Solid and Hollow Shafts - Based on Strength, Rigidity and Deflection- Torsional Rigidity - Lateral Rigidity - Material Constants - Design of Keys - Types - Keyways - Design of Rigid and Flexible Couplings.	9+3
	GEARS	
III	Principles of Gear Tooth Action - Gear Correction - Gear Tooth Failure Modes - Stresses and Loads - Component Design of Spur, Helical and Bevel gears.	9+3
	BRAKES AND CHAIN DRIVES	
IV	Dynamic and Thermal Aspects of Braking - Design of Brakes - Chain Drives - Selection of Transmission Chains and Sprockets - Design of Sprockets - Failure of Chain Drives.	9+3
	BEARINGS AND SPRINGS	
V	Design of Bearings - Sliding Contact - Rolling Contact - Design of Journal Bearings - Calculation of Bearing Dimensions - Design of Helical and Leaf Springs.	9+3
	Total Instructional Hours	45+15=60

Course Outcome

On completion of the course the students will be able to

- CO1: Analyse the stress, strain and deflection simple machine elements
- CO2: Calculate safety factors of simple structures exposed to static and repeated loads
- CO3: Determine the performance requirements in the selection of commercially available machine elements such as shaft, coupling, gears, bearings and springs etc.
- CO4: Design and optimize the selection of brakes and clutches for automotive components and machine elements
- CO5: Decide an appropriate failure model

TEXT BOOKS:

T1- Joseph Edward Shigley and Charles R.Mischke, *"Mechanical Engineering Design"*, Special Indian Edition, McGraw Hill Education, New Delhi, 2011.

T2- V.B.Bhandari, *"Design of machine elements"*, 3rd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2010.

REFERENCE BOOKS:

R1- William Orthwein, *"Machine Component Design (Vol. I & II)"*, M/s. Jaico Publishing House, Mumbai, 2003.

R2- Maitra.G.M., and Prasad.LN., *"Hand Book of Mechanical Design"*, 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2005.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT4205	MICROCOMPUTER SYSTEMS AND MICROCONTROLLER	3	0	0	3

Course Objective

1. To impart knowledge on the basics of microcomputer systems
2. To introduce commonly used peripheral / interfacing ICs and simple applications to the students
3. To familiarize about the basic of 8051 microcontroller
4. To learn the programming language of 8051 microcontroller
5. To list out the applications of microprocessor and microcontroller in various field

Unit	Description	Instructional Hours
I	**MICROCOMPUTER SYSTEMS** Microcomputer - Components - Microprocessor 8085: Architecture, Internal Register Organization and Pin Configuration - Instruction Set of 8085 - Addressing Modes - Methods of 8085 Programs - Interrupts.	9
II	**INTERFACING DEVICES** Need for Interfacing - Programmable Peripheral Device (8255) - Programmable Communication Interface (8251) (USART) - Programmable Interrupt Controller - Programmable DMA Controller (8257).	9
III	**8051 MICROCONTROLLER** Selection of Microcontrollers - 8051 Microcontroller Architecture - Pin Configuration - Memory Organization - Special Function Registers - Program Counter - PSW Register - Stack and Stack Pointer - Timers - Counters.	9
IV	**ASSEMBLY LANGUAGE PROGRAMMING** I/O Port Programming - Timer Programming - Counter Programming - Serial Communication Programming - Interrupt Programming - A/D and D/A Converters.	9
V	**MICROPROCESSOR AND MICROCONTROLLER APPLICATIONS** Interfacing of Sensors - Temperature - Pressure - Level - Proximity Switches - Stepper Motor Control - DC Motor Speed Control - Case Studies: Automotive Applications, Robotic Applications & Aerospace Applications.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Interpret the configuration and constructional details of 8085 microprocessor
CO2: Implement different microprocessor interfacing techniques
CO3: Apply basic skills for interfacing common devices to microcontroller
CO4: Develop skill in programming for 8051 Microcontroller
CO5: Enumerate various applications interfacing with microcontroller

TEXT BOOKS:

T1- A. Nagoor Kani, "*Microprocessors & Microcontrollers*", 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2002.

T2- David G. Alciatore and Michael B.Histand, "*Introduction to Mechatronics and Measurement Systems*", 4th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2011.

REFERENCE BOOKS:

R1- V. Douglas Hall, "*Microprocessors and Interfacing Programming and Hardware*", 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2002.

R2- Ramesh Goankar, "*Microprocessor Architecture, Programming and Applications with 8085*", 2nd Edition, Penram International, Mumbai, 2009.

R3- Mazidi Muhammad Ali, Mazidi Janice Gillispie and McKinlay Rolin, "*The 8051 Microcontroller and Embedded Systems*", 2nd Edition, PHI Learning Private Limited, New Delhi, 2013.

WEB REFERENCES:

1. https://www.ecnmag.com/article/2013/03/lockstep-microcontrollers-advance-aerospace-electronics-safety.
2. http://home.roboticlab.eu/en/microcontrollers.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT4206	ENGINEERING METROLOGY AND MEASUREMENTS	3	0	0	3

Course Objective

1. To describe the principle of dimensional metrology
2. To discuss various linear and angular measurements
3. To identify the various types of errors using different instruments
4. To familiarize the principles, techniques and devices used for quality control in modern Industrial environment
5. To acquire the knowledge on various metrological equipments

Unit	Description	Instructional Hours
I	**BASIC OF MEASUREMENTS** Basic Concept of Measurement: Sensitivity, Stability, Range, Accuracy and Precision - Errors - Types of Errors - Standards of Measurement - Geometric Dimensioning, Tolerance - Types, Fits - Types.	9
II	**LINEAR AND ANGULAR METROLOGY** Linear Metrology: Vernier, Micrometer Measurement, Dial Indicator, Slip Gauges and Classification, Optical Flats - Limit Gauges, Comparators - Mechanical, Pneumatic and Electric Types, Applications. Angular Metrology: Sine Bar, Optical Bevel Protractor, Auto Collimator, Angle Decker - Taper Measurements.	9
III	**SURFACE MEASUREMENTS** Surface Finish Measurement - Terminology - Roughness - Waviness - Analysis of Surface Finish - Stylus Probe Instrument - Talysurf Screw Thread Metrology: Errors in Thread - Pitch Error - Drunkenness - Measurement of Various Elements of Thread - Two and Three Wire Method, Measurement of Gears - Measurement of Various Elements of Gear - Tooth Thickness - Constant Chord and Base Tangent Method - Parkinson Gear Tester.	9
IV	**ADVANCED TECHNIQUES IN METROLOGY** Coordinate Measuring Machine - Constructional Features - Types and Application, Machine Vision Systems, Profile Projector, Universal Measuring Machine, Laser principles - Laser Interferometer - Types - DC and AC Lasers Interferometer.	9
V	**APPLICATIONS OF MEASUREMENTS** Applications - Flow Measurements in Chemical Pipelines - Vehicle Tire Pressure Measurement, Temperature Measurement in Furnace - Force Measurements in Brake Pedal and Torque Measurements in Motors.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Analyze the uncertainties in dimensional metrology and use the measurement standards
CO2: Apply geometric tolerance in design of engineering components
CO3: Choose the proper method to find the errors in surface and screw threads
CO4: Measure the complex profile using advanced techniques
CO5: Select the right measuring tool with decided accuracy for a given application

TEXT BOOKS:

T1- Ernest O Doebelin, *"Measurement Systems - Applications and Design"*, 4th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

T2- R. K. Jain, *"Engineering Metrology"*, 20th Edition, Khanna Publishers, New Delhi, 2013.

REFERENCE BOOKS:

R1- Thomas G Beckwith, Lienhard, Roy D. Marangoni, John H. Lienhard V *"Mechanical Measurements"*, 6th Edition Addison Wesley, 2009.

R2- Anand K Bewoor, Vinay A Kulkarni, *"Metrology and Measurement"*, 1st Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2009.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT4001	SENSORS AND SIGNAL CONDITIONING LABORATORY	0	0	4	2

Course Objective

1. To acquire knowledge on sensors and transducers
2. To provide hands on experience in measurement of different signals using sensor and processing them in required form
3. To experiment the measurement of displacement using LVDT and capacitive transducers
4. To design a circuit to convert voltage to frequency and frequency to voltage signal
5. To design and test the amplifier, differentiator and intergrator

Unit	Description of the Experiments	Practical Hours
1	Measurement of Temperature using Thermistor and Thermocouple.	6
2	Measurement of Displacement using LVDT and Capacitive Transducer.	6
3	Strain Measurement using Strain Gauge.	3
4	Servomotor Position Control using Photo Electric Pickup.	3
5	Position and Velocity Measurement using Encoders.	3
6	Wave Shaping Circuit.	3
7	Voltage to Frequency Converter.	3
8	Frequency to Voltage Converter.	3
9	Measurement of Resistance using Wheatstone's Bridge and Kelvin's Double Bridge.	3
10	Design and Testing of Inverting, Non-inverting and Differential Amplifiers.	6
11	Design and Testing of Differentiator and Integrator.	3
12	Design and Testing of Sample and Hold Circuit.	3
	Total Practical Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Apply the sensors for the measurement of different signals and use of signal processing techniques to convert them to useful signal
CO2: Choose and apply suitable transducers for various measurement purposes
CO3: Select sensors for practical problems
CO4: Design different amplifier circuits
CO5: Interpret the operation of sample and hold circuit

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT4002	ASSEMBLY LANGUAGE PROGRAMMING LABORATORY	0	0	4	2

Course Objective

1. To impart knowledge about microprocessor and microcontroller programs
2. To learn about different interfacing I/O devices with microprocessor and microcontroller
3. To describe stepper motor control using microprocessor
4. To study DC motor control interface using microcontroller
5. To familiarize the ARM processor and PIC controller

Unit	Description of the Experiments	Practical Hours
1	Addition and Subtraction of Two 8 - Bit Numbers using 8085 Microprocessor.	6
2	Addition of Two 16 - Bit Numbers using 8085 Microprocessor.	3
3	Subtraction of Two 16 - Bit Numbers using 8085 Microprocessor.	3
4	ADC and DAC Conversion using 8085 Microprocessor.	6
5	To Arrange a Series of Numbers in Ascending Order using 8085 Microprocessor.	3
6	Stepper Motor Control using 8085 Microprocessor.	3
7	Addition of Two 8 - Bit Numbers using 8051 Microcontroller.	3
8	Subtraction of Two 8 - Bit Numbers using 8051 Microcontroller.	3
9	Multiplication of 8 - Bit Numbers using 8051 Microcontroller.	3
10	Division of 8 - Bit Numbers using 8051 Microcontroller.	3
11	Largest and Smallest Element in an Array using 8051 Microcontroller.	6
12	DC Motor Control Interface using 8051 Microcontroller.	3
	Total Practical Hours	45

Course Outcome

On completion of the course the students will be able to

- CO1: Compile program for 8085 microprocessor and 8051 microcontroller
- CO2: Design interfacing circuits with 8085 microprocessor & 8051 microcontroller
- CO3: Implement stepper motor interfacing with microprocessor
- CO4: Demonstrate DC motor control using microcontroller
- CO5: Develop a microprocessor and microcontroller based system for mechatronics applications

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT4003	SOLID AND FLUID MECHANICS LABORATORY	0	0	4	2

Course Objective

1. To demonstrate various performance tests on engineering materials
2. To provide knowledge on deflection test and compression test on materials
3. To impart knowledge of various flow meters and the concept of fluid mechanics
4. To obtain knowledge on the performance characteristics of various pumps
5. To impart knowledge on strengthening of engineering materials

Unit	Description of the Experiments	Practical Hours
1	Tension and Torsion Test on a Mild Steel Rod.	6
2	Deflection Test on Beams.	3
3	Compression Test on Helical Springs.	3
4	Impact Test on Mild Steel Rod (Izod & chropy).	3
5	Hardness Test on Metals by Brinell and by Rockwell Hardness.	3
6	Double Shear Test on Mild Steel Rod.	3
7	Determination of Coefficient of Discharge by Venturimeter and Pitot Tube.	6
8	Experimental and Verification of Bernoulli's Equation.	3
9	Conducting Experiments and Drawing the Characteristic Curves of Centrifugal Pump and Gear Pump.	6
10	Conducting Experiments and Drawing the Characteristic Curves of Pelton Wheel Turbine.	3
11	Conducting Experiments and Drawing the Characteristic Curves of Kaplan Turbine.	3
12	Study of Strengthening Mechanism of Engineering Materials.	3
	Total Practical Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Evaluate the different types of mechanical properties of engineering materials
CO2: Calculate the different stresses and strain of engineering materials
CO3: Apply the concepts of fluid energy in fluid flow applications
CO4: Calculate the performance characteristics of various pumps
CO5: Apply the measurement equipments for flow measurement

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SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT5201	CAD/CAM & CIM	3	0	0	3

Course Objective

1. To memorize the role of computers in CAD/CAM and its integration
2. To identify the various geometric modeling techniques
3. To point out an insight of automation process used in manufacturing
4. To express the application of computers in planning and scheduling for manufacturing
5. To setup the concept of finite element analysis

Unit	Description	Instructional Hours
I	**CAD/CAM** Introduction - Types of Manufacturing - Product Development Cycle - Sequential Engineering - Concurrent Engineering - Product Life Cycle Management - Role of Computer in CAD/CAM - Benefits of CAD/CAM.	9
II	**GEOMENTRIC MODELING TECHNIQUES** Types of Geometric Modeling - Wireframe, Surface and Solid Modeling. CSG and B - Rep Solid Modeling Techniques - Drawing Utilities - Entities - Design of Curved Shapes: Cubic Spline, Bezier and B - Spline (Basic Treatment Only).	9
III	**COMPUTER INTEGRATED MANUFACTURING** Computer Aided Process Planning (CAPP) - Variant and Generative Approaches - Group Technology (GT) - Part Families, Coding and Classification - Flexible Manufacturing Systems (FMS) - FMS Concept - Benefits - Material Handling Systems - Automatic Guided Vehicles (AGV) - Automated Storage and Retrieval Systems.	9
IV	**PRODUCTION PLANNING AND SHOP FLOOR CONTROL** Manufacturing Resources Planning - Master Production Schedule (MPS) - Material Requirement Planning (MRP) - Capacity Requirements Planning (CRP) - Inventory Management - Supply Chain Management (SCM) - Shop Floor Control - Order Release - Order Scheduling - Shop Floor Data Collection.	9
V	**FINITE ELEMENT ANALYSIS** Basic Concepts – FEA Vs Analytical Method - Basic Ideas in a Finite Element Solution - General Finite Element Solution Procedure - Finite Element Equations using Modified Galerkin Method, Application: Axial Deformation of Bars, Axial Spring Element - Analysis of Trusses - Two Dimensional Truss Element.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Express the role of computers in CAD/CAM and its integration
CO2: Identify proper computer graphics techniques for geometric modeling
CO3: Compare the different types of FMS layouts, material handling and insight of automation in manufacturing
CO4: Develop competency in planning and scheduling in manufacturing operations
CO5: Analyze the product before the commencement of manufacturing

TEXT BOOKS:

T1- Mikell P. Groover, *"Automation, Production Systems and Computer - Integrated Manufacturing"*, 2nd Edition, PHI Learning Private Limited, New Delhi, 2011.
T2- Seshu.P, *"Textbook of Finete Element Analysis"*, 1st Edition, PHI Learning Private Limited, New Delhi, 2012.

REFERENCE BOOKS:

R1- Sadhu Singh. *"Computer Aided Design and Manufacturing"*, 4th Edition, Khanna Publishers, New Delhi, 1998.
R2- Ibrahim Zeid, *"CAD/CAM Theory and Practice"*, 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2009.
R3- Radha Krishnan and S.Subramanian, *"CAD/CAM/CIM"*, 3rd Edition, New Age International (P) Ltd., New Delhi, 2015.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT5202	INDUSTRIAL ELECTRONICS AND CONTROL	3	1	0	4

Course Objective

1. To outline the different types of power semi-conductor devices
2. To discuss the operation, characteristics and performance parameters of controlled rectifiers
3. To describe the inverters and choppers construction and performance
4. To list the power electronics heating and welding devices
5. To familiarize the practical application for power electronics

Unit	Description	Instructional Hours
I	**POWER DEVICES** Power Diode - Power Transistor - Power MOSFET - IGBT - SCR - Protection of Power Devices - DIAC - TRIAC - GTO - SCS - MCT.	9+3
II	**PHASE CONTROLLED CONVERTERS** Single Phase Full Converters, 3 Phase Half Converter and 3 Phase Full Converter - Inverter Operation - Input Power Factor - Effect of Source Inductance - Use of Flywheel Diode in Controlled Rectifier Configurations - Thyristor Triggering Circuits.	9+3
III	**INVERTERS AND CHOPPERS** Classification of Inverters, Thyristor Inverters, Voltage and Current Commutated Inverters, PWM Inverters, Principle of Chopper, Chopper Classification - Step Up and Step Down Chopper - Cycloconverter.	9+3
IV	**ELECTRONIC CONTROL OF HEATING AND WELDING** Resistance Heating - Induction Heating - Electronic Heaters Employed for Induction Heating - Thyristorised Supplies used in Induction Furnaces - Dielectric Heating - Electric Welding.	9+3
V	**APPLICATION OF POWER SWITCHING DEVICES** Principle of Operation and Working of Switching Circuits - Automatic Battery Charger - Emergency Light - Time Delay Relay Circuit - Fan Speed Control - Temperature Control - Speed Control of DC and Small DC Motors - SMPS - UPS.	9+3
	Total Instructional Hours	60

Course Outcome

On completion of the course the students will be able to

CO1: Select different types of power semi-conductor devices based on application
CO2: Recognize the operation, characteristics & performance of converters.
CO3: Familiarize basic concepts of chopper and inventers
CO4: Apply power electronics devices to heating and welding applications
CO5: To learn to develop applications based on power electronics devices

TEXT BOOKS:

T1- Biswanath Paul, *"Industrial Electronics and Control"*, 1st Edition, PHI Learning Private Limited, New Delhi, 2004.

T2- S. Bhattacharys , S. Chatterjee, *"Industrial Electronics and Control "* , 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2004

REFERENCE BOOKS:

R1- M. H. Rashid, *"Power Electronics Circuits, Devices and Application"*, 3rd Edition, PHI Learning Private Limited, New Delhi, 2004.

R2- F. D. Petruzulla, *"Industrial Electronics"*, 1st Edition, Tata McGraw Hill Publishing Company Limited, Singapore, 1996.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT5203	FLUID POWER	3	0	0	3

Course Objective

1. To familiarize the fundamentals of fluid power Principles, characteristics of the fluid power system components
2. To learn the hydraulic system components for various applications
3. To develop fluid power circuits for various Mechatronics systems
4. To impart knowledge about pneumatic system components for various application circuits
5. To learn to develop applications based on fluid power system

Unit	Description	Instructional Hours
I	**FLUID POWERSYSTEMS AND FUNDAMENTALS** Introduction to Fluid Power - Advantages of Fluid Power, Application of Fluid Power System. Types of Fluid Power Systems, Properties of Hydraulic Fluids - General Types of Fluids - Fluid Power Symbols - Basics of Hydraulics - Applications of Pascal's Law - Laminar and Turbulent Flow - Reynolds Number - Darcy's Equation - Losses in Pipe, Valves and Fittings.	9
II	**HYDRAULIC SYSTEM & COMPONENTS** Sources of Hydraulic Power - Pumping Theory - Pump Classification - Gear Pump, Vane Pump, Piston Pump, Construction and Working of Pumps - Pump Performance - Variable Displacement Pumps - Fluid Power Actuators: Linear Hydraulic Actuators - Types of Hydraulic Cylinders - Single Acting, Double Acting, Special Cylinders like Tanden, Rodless, Telescopic, Cushioning Mechanism, Construction of Double Acting Cylinder - Rotary Actuators - Fluid Motors, Gear, Vane and Piston Motors.	9
III	**DESIGN OF HYDRAULIC CIRCUITS** Construction of Control Components: Direction Control Valve - 3/2 Way Valve - 4/2 Way Valve - Shuttle Valve - Check Valve - Pressure Control Valve - Pressure Reducing Valve, Sequence Valve, Flow Control Valve - Fixed and Adjustable, Electrical Control Solenoid Valves, Relays, Ladder Diagram - Accumulators and Intensifiers: Types of Accumulators - Accumulators Circuits, Sizing of Accumulators, Intensifier - Applications of Intensifier - Intensifier Circuit.	9
IV	**PNEUMATIC SYSTEMS AND COMPONENTS** Pneumatic Components: Properties of Air - Compressors - Filter, Regulator and Lubricator Unit - Air Control Valves, Quick Exhaust Valves and Pneumatic Actuators - Fluid Power Circuit Design - Speed Control Circuits, Synchronizing Circuit, Pneumatic and Hydraulic Circuit - Sequential Circuit Design for Simple Applications using Cascade Method.	9
V	**APPLICATION, MAINTENANCE AND TROUBLE SHOOTING** Development of Hydraulic / Pneumatic Circuits Applied to Machine Tools - Presses - Material Handling Systems - Automotive Systems - Packaging Industries - Manufacturing Automation - Maintenance and Trouble Shooting of Fluid Power Circuits - Safety Aspects.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Explain the fundamental concepts of fluid power system
CO2: Apply the hydraulic concepts into pumps and valves
CO3: Design hydraulic circuits for different applications
CO4: Apply the knowledge of pneumatic systems and its components
CO5: Manipulate the knowledge in fluid power system maintenance and troubleshooting techniques

TEXT BOOKS:

T1- Anthony "*Esposito, Fluid Power with Applications*", 6th Edition, PHI Learning Private Limited, New Delhi, 2009.
T2- Andrew *Parr, "Hydraulics and Pneumatics*", 7th Edition, Jaico Publishing House, 2008.

REFERENCE BOOKS:

R1- John Pippenger, Tyler Hicks, *"Industrial Hydraulics"*, 3rd Edition, Tata McGraw Hill Publishing Company Limited, International, 1985.
R2- FESTO, "*Fundamentals of Pneumatics*", Vol I, II, III.
R3- Werner Deppert , "*Kurt Stoll, Pneumatic Application*", Vogel Verlag, 1986.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT5204	EMBEDDED SYSTEMS DESIGN	3	0	0	3

Course Objective

1. To impart a detailed knowledge of embedded system
2. To visualize the arm processor of architecture
3. To familiarize with the communication networks and devices
4. To illustrate knowledge in real time operating systems
5. To familiarize with the applications of embedded systems

Unit	Description	Instructional Hours
I	**FUNCTIONAL BLOCK OF EMBEDDED SYSTEMS** Introduction to Functional Building Blocks of Embedded Systems (ES) - Processor Embedded into a System - Single Processor - Embedded Hardware Units and Devices in a System - Software Tools for Designing Embedded System - Embedded System on Chip - Challenges in Designing Embedded Systems.	9
II	**ARM PROCESSOR AND MEMORY ORGANIZATION** Arm Processor Architecture - Instruction Set - SHARC - Processor - Memory Organization - Instruction Level Parallelism: Pipelined and Superscalar Units - Performance Metrics - Processor Selection - DMA - Memory Management - Cache Mapping Techniques, Dynamic Allocation - Fragmentation.	9
III	**DEVICES AND COMMUNICATION BUSES FOR DEVICES NETWORK** IO Types - Synchronous and Asynchronous - Timer and Counting Devices - Wireless Devices - Watch Dog Timer - Serial Communication Network Using I^2C, CAN, USB and Advanced High Speed Buses - Parallel Communication Network using ISA, PCI, PCI-X, ARM and Advanced High Speed Buses.	9
IV	**REAL TIME OPERATING SYSTEMS** Architecture of Kernel - Tasks and Task Scheduler: Task States, Context Switching, Scheduling Algorithm, Rate Monotonic Analysis, Task Management Function Calls - Interrupt Service Routine - Semaphores - Mutex - Mail boxes - Message Queues -Event Registers - Pipes - Signals - Timers and Memory Management.	9
V	**CASE STUDIES** *Case Studies*: Embedded System in Washing Machine, Automatic Chocolate Vending machine, Adaptive Cruise Control in Car, Smart Card.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Design the embedded system using software tools
CO2: Apply Arm processor in various industries
CO3: Discriminate between various protocols like serial and parallel networks
CO4: Design an embedded system using real time operating system
CO5: Implement to provide an interface between hardware peripherals, sensors and systems

TEXT BOOKS:

T1- P.Rajkamal, *"Embedded System - Architecture, Programming and Design"*, 3rd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2015.

T2- Daniel W.Lewis, *"Fundamentals of Embedded Software: with Arm Cortex-M3"*, 2nd Edition, PHI Learning Private Limited, New Delhi, 2012.

REFERENCE BOOKS:

R1- Frank Vayid, Tony Givargis, *"Embedded System Design- A Unified Hardware & Software Introduction"*, 3rd Edition, Wiley India Pvt Ltd., 2009.

R2- Heath Steve *"Embedded Systems Designs"*, 2nd Edition, Newnes, 2003.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16IT5232	OBJECT ORIENTED PROGRAMMING (ONLY FOR MECHATRONICS)	3	1	0	4

Course Objective

1. To learn the concepts of object oriented programming
2. To impart the fundamental concepts of core JAVA
3. To classify various types of inheritance
4. To develop the application programming based on exception handling
5. To develop the program using multithread

Unit	Description	Instructional Hours
I	**BASIC CONCEPTS OF OBJECT ORIENTED PROGRAMMING** Object Oriented Programming Concepts - Objects - Classes - Methods and Messages - Abstraction and Encapsulation - Inheritance - Abstract Classes - Polymorphism - Overview of Object Oriented Development - Object Basics - Class Hierarchy - UML Applications: Design a Model for the ViaNet Bank ATM Systems.	9+3
II	**OVERVIEW OF JAVA** Basics of Java Programming, Data Types, Variables and Arrays, Operators, Control Structures - Classes, Objects and Methods - Access Specifiers - Static Members - Constructors - This keyword - Finalize Method. Applications: Implement a Stack and Queue using Classes and Object.	9+3
III	**PACKAGES AND INTERFACES** Inheritance - Method Overriding - Abstract Class - Final keyword - Java API Packages - Naming Conventions - Creating, Accessing, Using Packages - Hiding Classes - Interfaces: Multiple Inheritance - Defining, Extending, Implementing Interfaces. Applications: Apply Inheritance to Calculate Shipping Cost of a Box Implement an Automated Decision Maker using Interfaces.	9+3
IV	**EXCEPTION HANDLING** Fundamentals - Exception Types - Uncaught Exceptions - Using Try and Catch - Multiple Catch - Nested Try - Throws - Finally - Built in Exceptions - Throwing own exceptions - Chained Exceptions - Using Exceptions. Applications: Create an Exception Handling Application for Array Out of Bounds.	9+3
V	**MULTITHREAD PROGRAMMING** Creating Threads - Extending Thread Class - Stopping and Blocking Thread - Life Cycle - Using Thread - Thread Exceptions - Thread priority - Synchronization - Runnable Interface - Inter Thread Communications. Applications: Implement Producer Consumer problem using Multi-Thread Programming.	9+3
	Total Instructional Hours	45+15=60

Course Outcome

On completion of the course the students will be able to

CO1: Describe the concepts of objects, classes and inheritance
CO2: Apply the concepts of data, array and structures
CO3: Develop the program using function overloading, operator overloading, virtual functions and polymorphism.
CO4: Create an exception handling application using programs
CO5: Develop the program using the concepts of multithread

TEXT BOOKS:

T1- Herbert Schild, *"Java the Complete Reference"*, 8th Edition, McGraw Hill Education, New Delhi, 2011.
T2- Ali Bahrami, *"Object Oriented Systems Development"*, 1st Edition, Pearson Education, New Delhi, 2008.

REFERENCE BOOKS:

R1- E Balagurusamy, *"Programming with JAVA"*, 5th Edition, McGraw Hill Education, New Delhi, 2015.
R2- Michael Blaha, James Rumbaugh, *"Object Oriented Modeling and Design With UML"*, 2nd Edition, Pearson Education, New jersey, 2008.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT5001	CAD/CAM/CAE LABORATORY	0	0	4	2

Course Objective

1. To gain practical experience in handling 2D drafting and 3D modelling software systems
2. To study the features and applications of CNC machine tool
3. To impart knowledge in developing program for CNC operations
4. To familiarize the basics of finite element analysis
5. To expose students to analyse engineering problems using simulation and analysis tools

Unit	Description of the Experiments	Practical Hours
1	Modelling of a Component using Modeling Softwares.	3
2	Modelling and Assemble of Flange Coupling using Modeling Softwares.	6
3	Modelling and Assemble of Universal Coupling using Modeling Softwares.	6
4	Modelling and Assemble of Screw Jack Coupling using Modeling Softwares.	6
5	Modelling and Tool Path Simulation using Master CAM (MILL) or any CAM Package.	3
6	Modelling and Tool Path Simulation using Master CAM (Lathe) or any CAM Package.	3
7	Study of G codes and M codes.	3
8	NC Code Generation for Milling using Master CAM (MILL) or any CAM Package.	3
9	NC Code Generation for Turning using Master CAM (Lathe) or any CAM Package.	3
10	Structural Analysis using FEA Softwares.	3
11	Beam Deflection Analysis using FEA softwares.	3
12	Thermal Analysis using FEA Softwares.	3
	Total Practical Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Develop 2D, 3D models and assembly using modelling software
CO2: Design and optimize the given engineering problems
CO3: Generate CNC codes for the given model and simulate it
CO4: Demonstrate CNC part programming and perform machining operations
CO5: Analyse and simulate real world engineering problems

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT5002	FLUID POWER LABORATORY	0	0	4	2

Course Objective

1. To impart knowledge in selection of actuators and valves for the design of fluid power circuit
2. To familiarize and simulate the fluid power circuits using software tool
3. To learn fluid power circuits construction using suitable actuators and valves
4. To demonstrate electro pneumatics circuits
5. To impart knowledge difference between various power system

Unit	Description of the Experiments	Practical Hours
	HYDRAULICS	
1	Design and Testing of the Following Hydraulic Circuits: a. Pressure Control b. Flow Control	3
2	Design and Testing of Hydraulic Bi-Directional and Semi-Rotary Motor System Fluid Power Simulation Software.	3
3	Design and Testing of Hydraulic Cylinder Sequencing System using Fluid Power Simulation Software.	3
4	Design and Testing of Electro-Hydraulic Cylinder Reciprocating System.	3
5	Design and Testing of Electro-Hydraulic Bi-Directional Motor System.	3
6	Design and Testing of a Double Acting Cylinder using Relay Based Electro Hydraulic Control.	6
	PNEUMATICS	
7	Design and Testing of Single Acting Cylinder using of 3/2 Way Direction Control Valves.	3
8	Design and Testing of Single Acting Cylinder and also Speed Control using Flow Control Valves.	3
9	Design and Testing Circuit using 5/2 Way Valves, Double Acting Cylinder, AND, OR logic Elements.	6
10	Design and Testing of Two Pneumatic Double Acting Cylinder Sequencing Circuit (A+ B+ B- A-).	6
11	Design and Testing of Single Acting Cylinder with Electro Pneumatic System.	3
12	Design and Testing of Double Acting Cylinder using Electro Pneumatic Kit.	3
	Total Practical Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Identify basic components in a fluid power system

CO2: Develop the concept of designing hydraulic and pneumatic circuits

CO3: Model and simulate the basic hydraulic and pneumatic systems

CO4: Test the various hydraulic and pneumatic circuit

CO5: Develop and test the process integration for a complete automatic process

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT5301	NON-TRADITIONAL MACHINING TECHNIQUES	3	0	0	3

Course Objective

1. To select the process parameters of different advanced manufacturing processes
2. To express their knowledge of electrical based manufacturing processes over conventional techniques
3. To list the chemicals used in the manufacturing process
4. To choose the suitable thermal techniques to achieve the high precision on the machining component
5. To examine the surface coating process

Unit	Description	Instructional Hours
I	**MECHANICAL ENERGY BASED PROCESSES** Introduction - Modern Machining Process - Need - Advantages & Applications - Abrasive Jet Machining (AJM) - Working Principles - Process Parameters - Applications - Water Jet Machining (WJT) - Working Principles - Process Parameters -Applications - Ultrasonic Machining (USM) - Working Principles - Process Parameters - Applications.	9
II	**ELECTRICAL ENERGY BASED PROCESSES** Electric Discharge Machining (EDM) - Working Principles - Equipments - Process Parameters - Power Circuits - Tool Wear - Material Removal Rate - Tool - Dielectric - Flushing - Wire Cut EDM and its Applications - Electrical Discharge Grinding - Working Principle - Equipment - Process Parameters - Applications.	9
III	**CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED PROCESSES** Chemical Machining and Electro - Chemical Machining (CHM and ECM) - Etchants - Maskant - Techniques of Applying Maskant - Process Parameters - Material Removal Rate - Applications - Principles of ECM - Equipments - Material Removal Rate - Process Parameters - Electro Chemical Grinding (ECG) and Electro Chemical Honing (ECH) - Applications.	9
IV	**THERMAL ENERGY BASED PROCESSES** Laser Beam Machining (LBM) - Principles - Equipment - Types Z-Beam Control Techniques - Applications - Plasma Arc Machining (PAM) - Principles - Equipment - Types - Beam Control Techniques - Applications and Electron Beam Machining (EBM) - Principles - Equipment - Types - Beam Control Techniques - Applications.	9
V	**SURFACE COATING AND HARDENING PROCESS** Classification - Removal Processes - Conversion Coatings - Thermal Treatments - Metal Coatings - Physical Vapor Deposition (PVD) - Chemical Vapor Deposition (CVD) - Ion Planting - Galvanizing - Electroplating - Organic Coatings - Surface hardening - Laser hardening.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: List the process parameters of different methods
CO2: Operate the advanced electrical machining operation on the given component
CO3: Select the appropriate chemical process based on the product material
CO4: Interpret how a thermal techniques to be carried out
CO5: Analyse and improve manufacturing processes through surface coating

TEXT BOOKS:

T1- Benedict. G.F, *"Non Traditional Manufacturing Processes"*, 1st Edition, Taylor, CRC Press, NewYork, 1987.
T2- Pandey P.C. and Shan H.S. *"Modern Machining Processes"*, 1st Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

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REFERENCE BOOKS:

R1- V. K. Jain, *"Advanced Machining Processes"*, 4th Edition, Allied Publishers, 2009.
R2- J. A. McGeough, *"Advanced Methods of Machining"*, 1st Edition, Springer, 1988.

WEB REFERENCES:

1. http://www.sciencedirect.com/science/article/pii/S1877705815004798
2. http://www.slac.stanford.edu/cgi-wrap/getdoc/slac-r-621.pdf

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT5302	DISCRETE EVENT SYSTEM SIMULATION	3	0	0	3

Course Objective

1. To familiarize the comports of the system and different types of models
2. To provide an exposure on how to simulate a system or a process
3. To generate the random number using various techniques
4. To solve the models through mathematical distributions and generate random variables
5. To model the different field of applications

Unit	Description	Instructional Hours
I	**OVERVIEW OF SYSTEM** Systems and System Environment - Components of a System: Discrete and Continuous Systems - Model of a System - Types of Models - Discrete - Event System Simulation - Steps in a Simulation Study - When Simulation is the Appropriate Tool and When it is Not Appropriate - Advantages and Disadvantages of Simulation.	9
II	**SYSTEM SIMULATION** Simulation of Single Server Queuing Systems - Simulation of Two Server Queuing Systems - Simulation of Inventory Systems - Simulation of Reliability Systems - Simulation of Lead Time Demand.	9
III	**RANDOM NUMBER GENERATION** Properties of Random Numbers - Generation of Pseudo Random Numbers - Techniques for Generating Random Numbers - Tests for Random Numbers.	9
IV	**RANDOM VARIATE GENERATION** Review of Terminology and Concepts - Useful Statistical Models - Inverse Transform Technique for Exponential, Uniform, Triangular, Weibull, Empirical, Uniform and Discrete Distribution, Acceptance Rejection Method for Poisson and Gamma Distribution	12
V	**SIMULATION OF MANUFACTURING AND MATERIAL HANDLING SYSTEM** Models of Manufacturing System - Models of Material Handling Systems - Goals and Performance Measures - Issues in Manufacturing and Material Handling Simulation - Manufacturing Examples - Verification and Validation of Simulation Model.	6
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Define the simulation and its importance in creation of models for real time systems
CO2: Develop a simulate for queuing system
CO3: Produce the random numbers through various techniques
CO4: Analyze the random variates using mathematical and statistical simulation
CO5: Develop the applications of manufacturing and material handling system

TEXT BOOKS:

T1- Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, *"Discrete-Event System Simulation"*, 5th Edition, Pearson Education, New Jersey, 2013.

T2- Lawrence M. Leemis, Stephen K.Park, *"Discrete-Event Simulation: A First Course"*, 4th Edition, PHI Learning Private Limited, New Delhi, 2006.

REFERENCE BOOKS:

R1- Averill M. Law, *"Simulation Modeling and Analysis"*, 4th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2007.

R2- Sheldon M. Ross, *"Simulation"*, 4th Edition, Elsevier, 2006.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT5303	MATERIAL SCIENCES AND APPLICATIONS	3	0	0	3

Course Objective

1. To impart knowledge in mechanical properties of metals and non metals
2. To provide knowledge on effect of alloys in engineering materials
3. To identify the different types of heat treatment processes
4. To impart knowledge in production of composites materials
5. To learn the different field of applications of materials and composites

Unit	Description	Instructional Hours
I	**MATERIALS AND ITS PROPERTIES** Introduction - Types of Materials - Metallic - Composite - Polymeric - Ceramic - Materials - Recent Advances in Materials. Mechanical Properties - Thermal Properties, Chemical Properties - Factors Affecting Mechanical Properties. Factors in Selection of Materials - Applications in Field of Automotive - Medical and Aero Space.	9
II	**METALS AND NON METALS** Metallic Materials - Effect of Alloying Additions on Steel - Stainless and Tool Steels HSLA - Maraging Steels - Cast Iron - Grey and white - Copper and Copper Alloys - Aluminium and Aluminium Alloys - Brass - Bronze - Ni-based Super Alloys and Titanium Alloys. Non Metallic Materials - Polymers - Types of Polymer - Commodity and Engineering Polymers -Properties and Applications - Engineering Ceramics - Types of Ceramics - Properties and Applications.	9
III	**PROCESSING AND HEAT TREATMENT OF MATERIALS** Processing of Ferrous and Non Ferrous Metals-Processing of Ceramics - Metals - Processing of Polymers - Introduction-Annealing, Stress Relief - Recrystallization and Spheroidising-Normalizing - Hardening, Case Hardening and Tempering of Steel - Chemical Vapor Deposition(*CVD)* - Physical Vapor Deposition(PVD).	9
IV	**COMPOSITE MATERIALS** Introduction - Classification of Composite Materials - Particle Reinforced Composites - Fibre Reinforced Composites - Fibre Glass Reinforced Composites - Hydrid Composites - Structural Composites - Protective Coatings - Adhesives - Concrete Polymer Composities.	9
V	**PROCESSING AND APPLICATIONS OF COMPOSITES** Manufacturing of Polymer Matrix Composites (PMCs) - Pultrusion, Resin Transfer Moulding (RTM) - Manufacturing of Metal Matrix Composites (MMCs) - Solid State - Liquid State - Vapour State Processing - Manufacturing of Ceramic Matrix Composites (CMCs) - Hot Pressing - Applications and Case Studies - Automotive - Aerospace - Commercial Applications.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Identify the properties of different ferrous and nonferrous metals
CO2: Select appropriate materials based on the application
CO3: Choose the suitable heat treatment process for changing the properties of materials
CO4: Explain the properties composite materials
CO5: Identify the production process in different fields of application

TEXT BOOKS:

T1- George P. Carney and *Dieter* Tillman, *"Mechanical Metallurgy"*, 3rd Edition, McGraw Hill Education, New York, 2016.

T2- Sidney H. Avner, *"Physical Metallurgy "*, 2nd Edition, Tata McGraw Hill Education, New York, 2012.

REFERENCE BOOKS:

R1- Robert M. Jones, *"Mechanics of Composite Materials"*, 1st Edition, 2nd Edition Taylor and Francis Group, 2006.

R2- Lawrence H.VanVlack, *"Elements of Material Science and Engineering"* 6th Edition, Pearson Publication, Australia, 2013.

R3- Williams D Callister, *"Material Science and Engineering"* Revised Indian Edition, Wiley India Pvt. Ltd., New Delhi, 2007.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT5304	AUTOMOBILE SYSTEMS	3	0	0	3

Course Objective

1. To impart knowledge about the various automobile components and subsystems
2. To define various transmission systems of automobiles and to have the practice for assembling and dismantling of engine parts
3. To describe the mechanisms involved in the steering systems and braking systems
4. To classify different suspension systems used in automobile
5. To learn about Electrical system and accessories used in automobiles

Unit	Description	Instructional Hours
I	**ENGINE COMPONENTS** Principles of IC Engines - Engine Terminology - Types of Engines: Petrol & Diesel - Two Stroke and Four Stroke - Engine Components: Cylinder Block - Cylinder Head - Sump - Manifolds - Gaskets - Cylinder - Piston - Rings - Connecting Rod - Piston Pins - Crank Shaft - Bearings - Valves - Mufflers. Engine Cooling and Lubrication systems.	9
II	**TRANSMISSION SYSTEMS** Clutch - Construction of Electromagnetic - Mechanical - Hydraulic - Vacuum. Gear Boxes: Manual and Automatic - Over Drives - Transfer Box - Fluid Flywheel - Torque Converter - Propeller Shaft - Slip Joint - Universal Joints - Differential and Rear Axle - Case Study on Lightweight Chassis.	9
III	**STEERING AND BRAKES** Steering: Wheels and Tyres - Wheel Alignment Parameters - Steering Geometry - Power Steering - Electronic Steering. Braking Systems: Hydraulic Brakes - Diagonal Braking System.	9
IV	**SUSPENSION SYSTEMS** Basic Requirements - Functions - Types of Suspension Springs - Plastic, Air and Independent Suspension System - Shock Absorbers - Air suspension - Hydrolastic suspension - Trouble Shooting.	9
V	**ELECTRICAL SYSTEM AND ACCESSORIES** Types of Batteries - Construction, Operation and Maintenance - Lighting - Wiring Circuit - Head Lights - Switches - Indicating Lights - Trouble Shooting - Direction Indicators - Windscreen Wiper - Horn - Speedometer - Heaters - Air conditioner.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Explain various components in automobiles and also compare petrol and diesel engine
CO2: Describe the working of manual and automatic transmission
CO3: Apply the steering mechanism in developing a new vehicle
CO4: Design and develop prototype of a suspension vehicle system
CO5: Integrate various electrical systems and accessories with vehicle battery

TEXT BOOKS:

T1- Kirpal Singh, "*Automobile Engineering Vol. 1 and 2*", 7th Edition, Standard Publishers, New Delhi, 2011.
T2- H. M. Sethi, "*Automobile Technology*", 1st Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2007.

REFERENCE BOOKS:

R1- Jain K.K. and Asthana .R.B, "*Automobile Engineering*", 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2002.
R2- Newton, Steeds and Garet, "*Motor Vehicles*", 11th Edition, Butterworth Publishers, 1989.
R3- Joseph Heitner, "*Automotive Mechanics*," 2nd Edition, East-West Press, 1999.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT5305	PROCESS CONTROL INSTRUMENTATION TECHNOLOGY	3	0	0	3

Course Objective

1. To define the various complex control schemes
2. To explain various control elements and scheme
3. To impart knowledge about the characteristics of various controller modes and methods of tuning of controller
4. To discuss the elements of computer aided measurement and control
5. To know about the applications of process control

Unit	Description	Instructional Hours
I	**BASIC CONTROLLER SCHEME** Introduction - On Off Control - Time Proportional Control - Typical PID Controller Characteristics and Related Terminology - Comparison of Control Actions - Parameter Adjustment - Pneumatic Controller - Electronic Controller - Hydraulic Controller and Program Controller.	9
II	**FINAL CONTROL ELEMENT AND CONTROL SCHEME** Introduction - Pneumatic Actuator - Electrical Actuators - Ratio Control Systems - Split Range Control - Cascade Control - Feed Forward Control - Selector Control - Inverse Derivative Control - Antireset Control - Multi Variable Control Systems.	9
III	**INDUSTRIAL PROCESS TECHNIQUES AND INSTRUMENTATION** Analytical Instrumentation - Batch Process - Continuous Process - Measuring Devices - Feedback loop Interfacing Instruments - Monitoring Instruments - Manipulation Devices.	9
IV	**COMPUTER AIDED MESUREMENT AND CONTROL SYSTEM** Role of Computer in Measurement and Control - Elements of Computer Aided Measurement and Control - Computer Aided Process Control Architecture - Man Machine Interface - Computer Aided Process Control Hardware - Process Related Interfaces - Communication and Networking - Industrial Communication System - Data Transfer Techniques - RTOS.	9
V	**APPLICATIONS OF PROCESS CONTROL** Boiler Control - Steel Plant Control System - Control and Paper Industry - Distillery Column - Built Conveyor Control - Electric Oven Temperature Control - Thickness and Flatness Control System for Metal Rolling - Automatic Control for Metal Width and Thickness - Photo Electronic Control.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Choose the controller based on the source of application for the control actions
CO2: Classify the various control schemes
CO3: Design a physical process for the specific application
CO4: Interpret the computer aided measurement and process control
CO5: Apply the control system in various processes

TEXT BOOKS:

T1- D.Patranabis, *"Principles of Process Control"*, 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2011.

T2- S.K.Singh *"Industrial Instrumentation and Control"*, 3rd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2012.

REFERENCE BOOKS:

R1- Chennakesava R. Alavala, *"Principles of Industrial Instrumentation and Control Systems"*, CENGAGE Learning Asia, 2009.

R2- Curtis D Johnson, *"Process Control Instrumentation"*, PHI Learning Private Limited, New Delhi, 2003.

R3- Eckman D P, *"Automatic Process Control"*, Wiley Eastern Ltd., New Delhi, 1993.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MA5309	PROBABILITY AND STATISTICS	3	0	0	3

Course Objective

1. Provide fundamental knowledge of the concepts of probability
2. Express knowledge of standard distributions which can describe real life phenomenon
3. Interpret mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering
4. Provide the necessary basic concepts of a few statistical methods
5. Manipulate different kinds of problems occurring in engineering and technology by applying the design of experiments

Unit	Description	Instructional Hours
I	**PROBABILITY** Introduction - Conditional Probability - Multiplication Theorem on Probability - Independent Events - Total Probability - Baye's Theorem(Without Proof).	9
II	**ONE DIMENSIONAL RANDOM VARIABLES** Random Variable - Discrete and Continuous Random Variables - Mean and Variance of random variable - Moment Generating Functions - Binomial, Poisson and Normal Distributions.	9
III	**TWO DIMENSIONAL RANDOM VARIABLES** Joint Distributions - Marginal and Conditional Distributions - Definitions and Problems - Covariance - Correlation.	9
IV	**TESTING OF HYPOTHESIS** Large Sample Test based on Normal Distribution for Single Mean and Difference of Means - Tests based on T (Single Mean and Difference of Means) - F Distribution - for Testing Difference of Variances.	9
V	**DESIGN OF EXPERIMENTS (ANOVA)** One Way and Two Way Classifications - Completely Randomized Design - Randomized Block Design - Latin Square Design.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Have a fundamental knowledge of the probability concepts
CO2: Acquire knowledge of standard distributions
CO3: Understand the concepts of two dimensional random variables, correlation and regression
CO4: Acquire skills in analyzing statistical methods
CO5: Have a clear perception of the statistical ideas and demonstrate the applications of these techniques to problems drawn from industry, management and other engineering fields

TEXT BOOKS:

T1- Gupta, S.C., & Kapoor, V.K., "*Fundamentals of Mathematical Statistics*", Sultan Chand & Sons,Reprint 2011.

T2- Veerarajan.T. "*Probability, Statistics and Random Process*", 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2010.

REFERENCE BOOKS:

R1- Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Publishing Company Limited, New Delhi, 2004.

R2- Walpole R.E., Myers.R.H., Myers.S.L and Ye.K., "*Probability and Statistics for Engineer and Scientist*", 8th Edition, Pearson Education, Asia, 2007.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT6201	INDUSTRIAL AUTOMATION AND CONTROL	3	0	0	3

Course Objective

1. To study the architecture, Hardware and Software wiring of programmable logic controller
2. To read the fundamentals of PLC programming instructions
3. To explain the PLC programs to perform specified discrete sequential control operations
4. To develop the knowledge in real time application using PLC
5. To learn basic knowledge on architecture of SCADA and HMI

Unit	Description	Instructional Hours
I	**PROGRAMMABLE LOGIC CONTROLLERS** Architecture of PLC - Types of PLC - PLC Modules, PLC Configuration - Scan Cycle - Capabilities of PLC - Selection Criteria for PLC - PLC Communication with PC and Software - PLC Wiring - Installation of PLC and its Modules.	9
II	**BASICS OF PLC PROGRAMMING** PLC Programming Simple Instruction - Control Instructions - Data Manipulating Instructions - Math Instructions - Programming EXAMINE ON and EXAMINE OFF Instructions - PLC Ladder Diagram - Converting Simple Relay Diagram into PLC Relay Ladder Diagram.	9
III	**TIMERS AND COUNTERS** Mechanical Timing Relay - ON DELAY Timer and OFF DELAY - Timer Instructions - Retentive Timer - Cascading Timers - Counter Instructions - UP/DOWN Counters - Cascading Counters - Incremental Encoder - Counter Applications.	9
IV	**APPLICATIONS OF PLC** Material Handling Application - Gray Painting System - Bottle Filling System - Lift Elevator Control - Traffic Light Control - Water Level Control - Speed Control of DC Motor - PLC Based Pick and Place Robot.	9
V	**SCADA SYSTEMS** Introduction and Definition of SCADA - Basic Architecture of SCADA - HumanMachine Interface - Master Terminal Unit - Remote Terminal Unit - SCADA Data Transfer through PLC - Communication Technologies - Communication System Components.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Demonstrate knowledge and understanding of PLC interfacing and programming techniques
CO2: Design and describe the operation of a PLC program
CO3: To choose various Timers and Counters based on real time applications
CO4: Create PLC program to control typical industrial related processes
CO5: Infer and control the Industrial Process using SCADA systems

TEXT BOOKS:

T1- Frank D. Petruzella, *"Programmable Logic Controllers"*, 3rd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2010.

T2- Ronald L.Kurtz, *"Securing SCADA System"*, 1st Edition, John Wiley & Sons, 2015.

REFERENCE BOOKS:

R1- John W.Webb and Ronald A.Reis, *"Programmable Logic Controllers - Principles and Applications"*, 4th Edition, PHI Learning Private Limited, New Jersey, 2003.

R2- Stenerson, *"Fundamentals of Programmable Logic Controllers, Sensors and Communication"*, 3rd Edition, Pearson Education, Asia, 2005.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT6202	VIRTUAL INSTRUMENTATION AND HUMAN MACHINE INTERFACE	3	1	0	4

Course Objective

1. Understand the basic components of virtual instrumentation system
2. To develop a VI program using various techniques
3. Identify elements of data acquisition for software and hardware installation
4. To gain the knowledge about different types of common instrument interfaces
5. To learn to develop applications based on virtual instrumentation system

Unit	Description	Instructional Hours
I	**VIRTUAL INSTRUMENTATION** Historical Perspective - Conventional and Distributional Virtual Instrumentation(VI) - VI Vs Traditional Instruments - Advantages - Block Diagram and Architecture of a Virtual Instrument – Data Flow Techniques - Graphical Programming in Data Flow - Development of Virtual Instrument using LabVIEW - HMI / SCADA Software.	9+3
II	**VI PROGRAMMING TECHNIQUES** Controlling Programs through Structures - Case and Sequence Structures - Formula Nodes - Arrays - Clusters - Error Handling - Waveform Charts and Waveform Graphs - XY Graphs – Strings - File I/O.	9+3
III	**DATA ACQUISITION BASICS** Concepts of Data Acquisition - Data Acquisition in LabVIEW - Hardware Installation and Configuration - Components of DAQ - DAQ Signal Accessory - DAQ Assistant - DAQ Hardware - DAQ Software.	9+3
IV	**INTERFACING** Common Instrument Interfaces:RS 232 / RS 485 – GPIB – VISA standard - Bus Interfaces: USB - PCI - PCI - X - PXI - PCMCIA - SCXI - VXI – LXI.	9+3
V	**APPLICATIONS** Application of Virtual Instrumentation: Digital Stop Watch using Lab VIEW - BCD to Seven Segment Decoder - Cruise Control - PID Controller – Client Server Application in LABVIEW – Notifiers, Simple Read Only Server, Two Way Communication, Read Write Server.	9+3
	Total Instructional Hours	45+15=60

Course Outcome

On completion of the course the students will be able to

CO1: Demonstrate the basic concepts about virtual instrumentation
CO2: Develop programming through LabVIEW graphical programming environment
CO3: Experiment with data acquisition hardware and LabVIEW software
CO4: Apply the knowledge of common instrument interfaces and bus interfaces
CO5: Design and develop the industrial applications using LabVIEW

TEXT BOOKS:

T1- Sanjay Gupta & Joseph John, *"Virtual Instrumentation using LabVIEW"*, McGraw Hill Education, New York, 2005.
T2- Sumathi & Surekha, *"Virtual Instrumentation with LabVIEW"*, ACME Learning Private Limited, 2011.

REFERENCE BOOKS:

R1- Gary Johnson, *"LabVIEW Graphical Programming"*, 2nd Edition, McGraw Hill Education, New York, 1997.
R2- Lisa K. Wells & Jeffrey Travis, *"LabVIEW for Everyone"*, PHI Learning Private Limited, New Jersey, 1997.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT6203	VETRONICS	3	0	0	3

Course Objective

1. To impart knowledge about the evolution of electronics in automobile and its emission standard
2. To classify various ignition and injection system
3. To identify various sensors and actuators used in automobiles
4. To familiarize with different engine control management
5. To expose the safety systems used in automobiles

Unit	Description	Instructional Hours
I	**ELECTRONICS IN AUTOMOBILES** Evolution of Electronics in Automobiles - Emission Laws - Introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards - Emission Control Management. Charging Systems: Working and Design of Charging Circuit Diagram - Requirements of Starting System - Starter Motors and Starter Circuits.	9
II	**IGNITION AND INJECTION SYSTEMS** Ignition Fundamentals - Electronic Ignition Systems - Programmed Ignition - Distribution Less Ignition - Direct Ignition - Spark Plugs - Carburetion - Study of Fuel Injector - Petrol Fuel Injection - Diesel Fuel Injection.	9
III	**SENSOR AND ACTUATORS** Working Principle and Characteristics of Airflow Rate, Engine Crankshaft Angular Position, Hall Effect, Throttle Angle, Temperature, Exhaust Gas Oxygen Sensors - Exhaust Gas Recirculation Actuators, Stepper Motor Actuator, and Vacuum Operated Actuator.	9
IV	**ENGINE CONTROL SYSTEMS** Control Modes for Fuel Control - Engine Control Subsystems - Ignition Control Methodologies - Different ECU's used in the Engine Management - Block Diagram of the Engine Management System - Vehicle Networks: CAN Standard, Format of CAN Standard - Diagnostics Systems in Modern Automobiles.	9
V	**INFOTAINMENT AND SAFETY SYSTEMS** Traction Control System - Cruise Control System - Electronic Control of Automatic Transmission - Antilock Braking System - Electronic Suspension System - Working of Airbag and Role of MEMS in Airbag Systems - Centralized Door Locking System - Climate Control of Cars.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Apply the basics of electronics and emission controls techniques in automobiles
CO2: Select proper ignition and injection system for an automobile
CO3: Compile different sensors and actuators used in automobile industries
CO4: Conclude a electronic control unit to be used in an automobile
CO5: Design and develop the safety system in automobiles

TEXT BOOKS:

T1- Ribbens, "*Understanding Automotive Electronics*", 7th Edition (Indian Reprint), Elsevier, 2013.
T2- Tom Denton," *Automobile Electrical and Electronics Systems*", 4th Edition, Edward Arnold Publishers, 2012.

REFERENCE BOOKS:

R1- Tim, Gilles, "*Automotive Engines: Diagnosis, Repair, Rebuilding*", 7th Edition, Delmar Publishers, New York, 2015.
R2- Barry Hollembeak, "*Automotive Electricity, Electronics & Computer Controls*", 1st Edition, Delmar Publishers, 2001.
R3- Ronald. K. Jurgon, "*Automotive Electronics Handbook*", 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 1999.
R4- Robert Bosch GmbH, "*Automotive Hand Book*", 9th Edition, Wiley & Sons Inc., New York, 2014.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MA6111	OPERATIONS RESEARCH	3	1	0	4

Course Objective

1. To experience in modeling, solving and analyzing problems using linear programming
2. To expose variety of problems such as transportation and trans-shipment
3. To familiarize the students with assignment models
4. To introduce about maintenance and replacement schedule against failure
5. To learn the basics of production scheduling in manufacturing

Unit	Description	Instructional Hours
I	**LINEAR PROGRAMMING** Introduction - Origin of Operations Research(OR) - Characteristics of Operations Research - Models in Operations Research - Role of Operations Research in Decision - Making, Methods of Solving OR Problems - Scope of OR. Steps of Formulating Linear Programming Problem (LPP) - Graphical Method - Special Cases in LP - Simplex Method - Minimization Case - Degeneracy in LP.	9+3
II	**TRANSPORTATION PROBLEM** Formulation of General Transportation Problems - Types of Transportation Problems - Solving Transportation Problem - Loops in Transportation Method - Transportation Algorithm - Modified Distribution Method - Stepping Stone Method - Variations of Transportation Problem.	9+3
III	**ASSIGNMENT PROBLEM** Mathematical Formulation of Assignment Problem (AP) - Solution Methods of AP - Enumeration Method - The Hungarian Method - Variations of the Assignment Problem - Multiple Optimal Solutions - Unbalanced Assignment Problems - Maximization case in Assignment Problems.	9+3
IV	**REPLACEMENT AND MAINTENANCE ANALYSIS** Types of Maintenance - Types of Replacement Problem - Determination of Economic Life of an Asset - Basics of Interest Formulae - Examples - Simple Probabilistic Model for Items which Completely Fail.	9+3
V	**PRODUCTION SCHEDULING** Single Machine Scheduling - Measures of Performance - Shortest Processing Time Rule to Minimize Mean Flow Time - Weighted Shortest Processing Time Rule - Earliest Due Date Rule - Introduction to Branch and Bound Technique. Flow Shop Scheduling - Johnsons Algorithm - Branch and Bound Methods for n Jobs and m Machines - Job Shop Scheduling.	9+3
	Total Instructional Hours	45+15=60

Course Outcome

On completion of the course the students will be able to

CO1: Formulate and solve linear programming problem for a physical situations like production, distribution of goods and economics
CO2: Build and solve Transportation Models
CO3: Perform model formulation for assignment problems
CO4: Analyze the various replacement models and apply them for arriving at optimal decisions
CO5: Optimize the production schedule to achieve minimal processing time

TEXT BOOKS:

T1- Nita H Shah, Ravi M.Gor and Hardik Soni, *"Operations Research"*, 1st Edition, PHI Learning Private Limited, New Delhi, 2007.

T2- R.Panneerselvam, *"Operations Research"*, 2nd Edition, PHI Learning Private Limited, New Delhi, 2006.

REFERENCE BOOKS:

R1- Hamdy A Taha, *"Operations Research"*, 8th Edition, Pearson Education, New Delhi, 2008.

R2- S.Jaishankar, *"Operations Research: Decision Models Approach"*, 1st Edition, Excel Books, New Delhi, 2010.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT6001	INDUSTRIAL AUTOMATION AND CONTROL LABORATORY	0	0	4	2

Course Objective

1. To impart the knowledge about PLC programming
2. To list out the various programming methods used in PLC
3. To create ladder logic diagrams and interface with PLC for industrial applications
4. To interpret the working knowledge of SCADA
5. To read the basics of distributed control system

Unit	Description of the Experiments	Practical Hours
1	Implementation of Basic Mathematical Instruction using PLC Basic Operations.	3
2	Design a Ladder Logic for the Lamp Circuit.	3
3	Programming with PLC - Gray Painting System.	3
4	Programming with PLC -Bottle Filling System and Stamping and Material Handling System.	6
5	Programming with PLC -Lift Elevator Control and Traffic Light Control.	6
	Program and Interface the PLC using Ladder Logic for	
6	Water Level Control of Two Different Water Tanks.	3
7	Speed Control of DC Motors.	3
8	Flow Control in Pump for Water Circulation.	3
9	Pressure Control in Closed Air pressure Tank.	3
10	Temperature Control of Water Heater.	3
11	Development of SCADA systems for Automating Bottle Filling Systems and Traffic Light Controller.	6
12	Study of Distributed Control System.	3
	Total Practical Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Demonstrate the working knowledge of PLC for a real time process
CO2: Develop the program in PLC Software and interface with different controlled applications
CO3: Develop hard wiring with PLC and field I/Os
CO4: Construct a SCADA monitoring system for industrial automation process
CO5: Explain the concept of distributed control system and their applications

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT6301	FLEXIBLE MANUFACTURING SYSTEMS	3	0	0	3

Course Objective

1. To study the different types of production systems
2. To expose the knowledge on planning and scheduling of FMS
3. To impart knowledge on group technology and various components of FMS
4. To learn the simulation and computer control in FMS
5. To familiarize about application FMS and concept of factory of the future

Unit	Description	Instructional Hours
I	**FUNDAMENTALS OF FMS** Introduction - Evolution - Definition - Need for FMS - Need for Flexibility - Types of Flexibility - Economic Justification of FMS - Machine Tool Selection and Layout - Computer Control System - Data Files - Reports - Planning the FMS - Analysis Methods for FMS - Benefits and Limitations - Transfer Machines.	9
II	**PLANNING AND SCHEDULING FMS** Development of Manufacturing Systems - FMC and FMS - Comparison - FMS Application and Flexibility - Single Product, Single Batch, n Batch Scheduling Problem - Knowledge Based Scheduling System.	9
III	**ELEMENTS OF FMS** Components of FMS - FMS Work Station - Job Coding and Classification - Group Technology - Benefits of FMS - Tools and Tooling - Machining Centers - Head Indexers - Pallets - Fixtures - Work Handling Equipments - System Storage - Automated Guided Vehicles - Industrial Robots - Programming of Robots - Assembly & Inspection.	9
IV	**SIMULATION OF FMS** Flexible Manufacturing System Management - FMS Control Software - Manning of FMS - Tool Management - Controlling Precision - Simulation and Analysis of FMS - Approaches to Modelling for FMS - Network Simulation - Simulation Procedure - FMS Design - Economics of FMS.	9
V	**APPLICATIONS OF FMS AND FACTORY OF THE FUTURE** FMS Application in Machining - Sheet Metal Fabrication - Prismatic Component Production - Aerospace Application - FMS Development towards Factories of the Future - Artificial Intelligence and Expert Systems in FMS - Virtual Manufacturing.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

- CO1: Develop a Modern manufacturing system
- CO2: Discuss the planning and scheduling methods used in manufacturing systems
- CO3: Select suitable components of FMS for given machine cell
- CO4: Simulate and Implement FMS in a manufacturing environment
- CO5: Develop a Flexible Manufacturing Cell for various fields of application

TEXT BOOKS:

T1- Raouf, A. and Ben-Daya, M., Editors, "Flexible Manufacturing Systems: Recent Development", 1st Edition, Elsevier Science, 1995.

T2- Yoram Koren,"Computer Control of Manufacturing Systems", McGraw Hill Education, New Delhi, 2011.

REFERENCE BOOKS:

R1- Radhakrishnan P. and Subramanyan S., "CAD/CAM/CIM", 1st Edition, New Age International (P) Ltd., New Delhi, 1994.

R2- Groover M.P., "Automation, Production Systems and Computer Integrated Manufacturing", 1st Edition, PHI Learning Private Limited, New Delhi, 2008.

R3- Kant Vajpayee, "Principles of Computer Integrated Manufacturing", 1st Edition, PHI Learning Private Limited, New Delhi, 2014.

R4- Jha, N.K. "Handbook of Flexible Manufacturing Systems", Academic Press Inc., 1991.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT6302	PRINCIPLES OF MANAGEMENT (ONLY FOR MECHATRONICS)	3	0	0	3

Course Objective

1. To impart knowledge about functions of management and manager in an organization
2. To familiarize about planning and management objectives
3. To classify organization structure and its process
4. To recognize various motivational techniques and theories
6. To learn different approaches to management through case studies

Unit	Description	Instructional Hours
I	**MANAGEMENT** Definition - Importance - Functions - Skills Required for Managers - Roles and Functions of Managers - Science and Art of Management - Management and Administration. Types of Business Organization - Sole Proprietorship, Partnership, Company - Public and Private Sector Enterprises.	9
II	**PLANNING** Nature and Purpose - Steps Involved in Planning - Types of Plans - Plans at Individual, Department and Organization Level - Managing by Objectives. Forecasting - Purpose - Steps and Techniques. Decision Making - Steps in Decision Making.	9
III	**ORGANIZING** Nature and Purpose of Organizing - Formal and Informal Organization - Organization Chart - Structure and Process - Strategies of Departmentation - Line and Staff Authority - Benefits and Limitations - Centralization Vs De-Centralization and Delegation of Authority.	9
IV	**DIRECTING AND CONTROLLING** Staffing - Manpower Planning - Recruitment - Selection - Placement. Motivation - Theories and Techniques of Motivation. Leadership - Types and Theories of Leadership. System and Process of Controlling - Budgetary and Non-Budgetary Control Techniques - Direct and Preventive control.	9
V	**APPROACH TO MANAGEMENT AND CASE STUDIES** American Approach to Management - Japanese Approach to Management - Indian Approach to Management. Case Studies: Curtain Dream - Compsoft - Headland - Dragon Data - Wardle Storeys.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Apply the function of management in an organization
CO2: Develop various planning techniques to apply it in public and private sector enterprises
CO3: Solve the problem faced by the workers due to decentralization
CO4: Illustrate the leadership qualities and to apply motivational techniques
CO5: Enumerate different approaches to management through case studies

TEXT BOOKS:

T1- Harold Koontz & Heinz Weihrich, "*Essentials of management*", 9th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2012.

T2- P.C. Tripathy and P. N. Reddy, "*Principles of Management*", 5th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2012.

REFERENCE BOOKS:

R1- Stephen A.Robbins & David A.Decenzo & Mary Coulter, "*Fundamentals of Management*", 7th Edition, Pearson Education, New Jersey, 2011.

R2- JAF Stoner, Freeman R.E and Daniel R Gilbert "*Management*", 6th Edition, Pearson Education, New York, 2004.

R3- Stephen P. Robbins & Mary Coulter, "*Management*", 10th Edition, PHI Learning Private Limited, New Delhi, 2007.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT6303	DIAGNOSTIC TECHNIQUES	3	0	0	3

Course Objective

1. To identify the different defects and failure analysis methods
2. To learn the different types of maintenance flowing in industries
3. To prepare catalogue for the system maintenance
4. To apply the computer in maintenance applications
5. To expose the concept of condition monitoring techniques

Unit	Description	Instructional Hours
I	**DEFECTS AND FAILURE ANALYSIS** Defect Generation - Types of Failures - Defects Reporting and Recording - Defect Analysis -Failure Analysis - Equipment Down Time Analysis - Breakdown Analysis - FTA, FMEA.	9
II	**MAINTENANCE SYSTEMS** Planned and Unplanned Maintenance - Breakdown Maintenance - Corrective Maintenance - Opportunistic Maintenance - Routine Maintenance - Preventive Maintenance, Predictive Maintenance - Condition Based Maintenance System - Selection of Maintenance System.	9
III	**SYSTEMATIC MAINTENANCE** Codification and Cataloguing - Instruction Manual and Operating Manual - Maintenance Manual and Departmental Manual - Maintenance Time Standard - Maintenance Work Order and Work Permit - Feedback and Control - Maintenance Records and Documentation.	9
IV	**COMPUTER MANAGED MAINTENANCE SYSTEM** Selection and Scope of Computerization - Equipment Classification - Codification of Breakdown, Material and Facilities - Material Management Module - Captive Engineering Module.	9
V	**CONDITION MONITORING** Condition Monitoring Techniques - Visual Monitoring - Temperature Monitoring - Vibration Monitoring - Lubricant Monitoring - Cracks Monitoring - Thickness Monitoring - Noise and Sound Monitoring - Condition Monitoring of Hydraulic System. Machine Diagnostics - Objectives - Monitoring Strategies - Examples of Monitoring and Diagnosis.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Recognize the defects and failure analysis
CO2: Discover the types of maintenance used in industries
CO3: Plan and create the maintenance manual, work order, related documentations
CO4: Utilize the computer for maintenance
CO5: Familiarize the condition monitoring types and methods

TEXT BOOKS:

T1- Sushil Kumar Srivastava, "*Industrial Maintenance Management*", S. Chand and Company Ltd., New Delhi, 2006.
T2- Don Nyman and Joel Levitt, "*Maintenance Planning, Scheduling and Coordination*", Industrial Press Inc., NewYork, 2010.

REFERENCE BOOKS:

R1- Michael E. Brumbach and Jeffrey A. Clade, "*Industrial Maintenance*", Cengage Learning India Pvt Ltd., New Delhi, 2006.
R2- R. Keith Mobley, "*Maintenance Fundamentals*", Butterworth Heinmann Publications, USA, 2004.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT6304	PRODUCT DESIGN AND DEVELOPMENT	3	0	0	3

Course Objective

1. To learn several aspects of the product design process
2. To select suitable methodology for product development
3. To familiarize about the concept of product architecture
4. To provide knowledge about the concept of manufacturing in product design
5. To impart knowledge about design of manufacturing

Unit	Description	Instructional Hours
I	**PRODUCT DESIGN** Introduction - Product Life Cycles - Characteristics of Successful Product Development - Design and Development of Products -Types of Design and Redesigns -Engineering Designs - Duration and Cost of Product Development - Challenges of Product development.	9
II	**CONCEPT GENERATION AND SELECTION** Task - Structured Approaches - Clarification - Search - Externally and Internally - Explore Systematically - Reflect on the Solutions and Processes - Concept Selection - Methodology - Benefits.	9
III	**PRODUCT ARCHITECTURE** Implications - Product Change - Variety - Component Standardization - Product Performance -Manufacturability - Product Development Management - Establishing the Architecture - Creation - Clustering - Geometric Layout Development - Fundamental and Incidental Interactions - Related System Level Design Issues - Secondary Systems - Architecture of the Chunks - Creating Detailed Interface Specifications.	9
IV	**INDUSTRIAL DESIGN** Integrate Process Design - Managing Costs - Robust Design - Integrating CAE - CAD - CAM Tools - Simulating Product Performance and Manufacturing Processes Electronically - Need for Industrial Design - Impact - Design Process - Investigation of Industrial Design - Impact - Design Process - Investigation of Customer Needs - Conceptualization - Refinement - Management of the Industrial Design Process - Technology Driven Products - User - Driven Products - Assessing the Quality of Industrial Design.	9
V	**DESIGN FOR MANUFACTURING** Definition - Overview of DFM Process Estimation of Manufacturing Cost - Reducing the Component Costs and Assembly Costs - Estimating the Manufacturing Cost - Reduce the Costs of Component and Assembly- Impact of DFM Decision on Other Factors.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Design the products for the given set of applications
CO2: Generate and select suitable design methods to design the product
CO3: Design a product, component or process to meet desired needs
CO4: Use CAE, CAD and CAM in industrial product design
CO5: Design the products for manufacturing and Assembly

TEXT BOOKS:

T1- Karl T. Ulrich and Stephen D. Eppinger, *"Product Design and Development"*, 4th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2009.

T2- Kevin Otto, Kristin wood, *"Product Design"*, 4th Edition, Pearson Education, Australia, 2012.

REFERENCE BOOKS:

R1- S. Dalela and Mansoor Ali, *Industrial Engineering and Management Systems*, Standard Publishers Distributors Pvt. Ltd., New Delhi, 2006.

R2- Harry Nystrom, *Creativity and Innovation*, John Wiley and Sons Pvt. Ltd., 1st Edition Singapore, 1988.

R3- Benjamin W. Niebel and Alanb.Draper, *"Product Design and Process Engineering"*, 1st Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 1976.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT6305	DISTINCTIVE ELECTRICAL MACHINES	3	0	0	3

Course Objective

1. To learn different types of stepper motors
2. To explain the control techniques in switched reluctance motor
3. To discuss the performance characteristics of PMBLDC
4. To describe the various characteristics of PMSM
5. To infer the construction and working of LIM and servo motor

Unit	Description	Instructional Hours
I	**STEPPER MOTORS** Constructional Features - Principle of Operation - Variable Reluctance Motor - Single and Multi-stack Configurations - Permanent Magnet Stepper Motor - Hybrid Stepper Motor. Different Modes of Excitation - Theory of Torque Predictions - Drive Systems and Circuit for Open Loop and Closed Loop Control of Stepper Motor.	9
II	**SWITCHED RELUCTANCE MOTORS** Constructional Features - Principle of Operation -Torque Equation - Power Converters for SR Motor - Rotor Sensing Mechanism & Logic Controller - Sensorless Control of SR motor - Applications.	9
III	**PERMANENT MAGNET BRUSHLESS DC MOTORS** Principle of Operation - Types - Magnetic Circuit Analysis - EMF and Torque Equations - Power Controllers - Motor Characteristics and Control - Applications.	9
IV	**PERMANENT MAGNET SYNCHRONOUS MOTORS** Principle of Operation - EMF - Power Input and Torque Expressions - Power Controllers - Torque speed characteristics - Self control - Vector control - Applications.	9
V	**LINEAR INDUCTION MOTORS AND SERVO MOTORS** Linear Induction Motor (LIM) - Construction - Principle of Operation - Control of LIM - Applications Servomotor - Types - Constructional Features, Principle of Operation - Control Applications.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Choose the suitable stepper motor for specific industrial applications
CO2: Apply the different control techniques for switched reluctance motor
CO3: Analyze the speed and torque characteristics of PMBLDC
CO4: Derive the power and torque equations of PMSM
CO5: Use LIM and servo motor for industrial applications

TEXT BOOKS:

T1- K.Venkataratnam, "*Special Electrical Machines*", 2nd Edition, Universities Press, India, 2009.
T2- E.G. Janardhanam, "*Special Electrical Machines*", 4th Edition, PHI Learning Private Limited, New Delhi, 2014.

REFERENCE BOOKS:

R1- Naser A and BoldeaL,"Linear Electric Motors: Theory Design and Practical Applications PHI Learning Private Limited, New Delhi, 2008.
R2- Kenjo, T and Naganori, S "Permanent Magnet and brushless DC motors", Clarendon Press, Oxford, New Delhi, 2014.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT6306	MEDICAL MECHATRONICS	3	0	0	3

Course Objective

1. To familiarize the role of instrumentation in medical applications
2. To introduce the various sensing and measurement devices
3. To learn different types of amplifiers and filters
4. To discuss the need and technique of electrical safety in hospitals
5. To learn the advanced equipments in medicine

Unit	Description	Instructional Hours
I	**MEDICAL EQUIPMENTS** Cell Structure - Electrode - Electrolyte Interface, Electrode Potential, Resting and Action Potential - Electrodes for their Measurement, ECG, EEG, EMG, PCG - Machine Description - Methods of Measurement, Stem Cells - Three Equipment Failures and Trouble Shooting.	9
II	**SENSORS AND TRANDUCERS IN BIO-MEDICAL APPLICATIONS** Basic Transducer Principles - Types - Resistive, Inductive, Capacitive, Fiber - Optic, Photoelectric, Chemical, Active and Passive Transducers and their Description and Feature Applicable for Biomedical Instrumentation - Bio, Nano Sensors and Application.	9
III	**CONDITIONING, RECORDING AND DISPLAY OF BIOSIGNALS** Input Isolation, DC Amplifier, Charge Amplifier, Power Amplifier and Differential Amplifier - Feedback, Operational Amplifier - Electrometer Amplifier, Carrier Amplifier - Instrument Power Supply, Basis of Signal Conversion and Digital Filtering, Data Reduction Technique - Time and Frequency Domain Technique.	9
IV	**MEDICAL SUPPORT** Blood Pressure Measurement: by Ultrasonic Method - Plethysonography - Blood Flow Measurement by Electromagnetic Flow Meter Cardiac Output Measurement by Dilution Method - Vector Cardiography. Heart Lung Machine - Artificial Ventilator - Anesthetic Machine - Cardiac Pacemaker - DC - Defibrillator Patient Safety - Electrical Shock Hazards.	9
V	**MEDICAL CASE STUDIES IN MECHATRONICS** Smart Probe for Detecting Kidney Stones, Smart Probe for Breast Cancer, Ankle Sprain, Active Prosthetic Knee, Smart System for Cardiovascular Plaque Detection.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Select modern engineering and information technology tools for engineering practice
CO2: Select different sensors and transducers for biomedical instrumentation
CO3: Describe the signal conditioning circuits used in biomedical engineering
CO4: Identify different measurement techniques used in physiological parameters measurement
CO5: Analyze the problems in various fields of medical practice

TEXT BOOKS:

T1- Khandpur, R.S., "*Handbook of Biomedical Instrumentation*", 3rd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2014.

T2- Siamak Najarian, Javad Darghai, Goldis Darbemamieh, Siamak H. Farkoush, " *Mechatronics in Medicine - A Biomedical Engineering Approach*" , 1st Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2012.

REFERENCE BOOKS:

R1- Tompkins W.J., "*Biomedical Digital Signal Processing*", 1st Edition, PHI Learning Private Limited, New Delhi, 2000.

R2- Cromwell, Weibell and Pfeiffer, "*Biomedical Instrumentation and Measurements*", 2nd Edition, PHI Learning Private Limited, New Delhi, 2010.

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OPEN ELECTIVE I

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT6401	INDUSTRIAL SAFETY AND ENVIRONMENT	3	0	0	3

Course Objective

1. To impart knowledge about the fundamentals of safety, health and environment
2. To provide knowledge in different safety organizations
3. To impart awareness about the work safety in industry
4. To learn the industrial safety and ergonomics in work area
5. To impart awareness about the environment management

Unit	Description	Instructional Hours
I	**FUNDAMENTALS OF SAFETY** Need for Integration of Safety, Health and Environment - Fundamentals of Safety - Factory Act 1948 - Process Safety Management - Civilizations and Safety Requirements - Economic Aspects - Elements of Safety Programming - Safety Versus Health.	9
II	**SAFETY ORGANIZATION** Introduction - Purpose of a Safety Organization - Classification of Accidents - Safety and Government Role - National Safety Council - Safety Act - Provisions for Worker Welfare - Workmen Compensation Act 1943 - Safety and Security Measures - Management Safety Policy - Safety Auditing - Maintenance and Safety - Security Management of Industrial Plants.	9
III	**SAFE WORKING AND HAZARDS** Introduction - Work Place Safety - Safe Working Environment - Fire Safety Instructions - Safety Devices and Tools - Safety Instruction - Maintenance - Electricity - Welding - Hand Tools - Safety Measures for Compressed System and Cylinders - Personal Safety - Permit to Work System - Personal Protection Equipment (PPE) - Concepts of Hazard Avoidance - Hazard Classification Scale.	9
IV	**INDUSTRIAL SAFETY AND ERGONOMICS** Introduction - Safety Training - Hazard Check List - General Safety Rules - Human Factors in Machine Equipment Safety - Fire Prevention - Accident Prevention - Principles of Safe Machine Design - Safety in Materials Handling and Storage - GeneralSafety Rules - Roles of Occupational Safety and Health Administration - Facets of Ergonomics - Ergonomics Standards - Ergonomic Risk Analysis - Sources of Ergonomic Hazards.	9
V	**ENVIRONMENTAL MANAGEMENT AND CASE STUDIES** Environment Protection Act - National Environment Policy - Environmental Standards - Degradation of Environment - Environment Management System - ISO 14000 - International Environmental Principles - Environmental Protection Agency - Environmental Impact Assessment - Case study on Machines and Equipment - Handling of Equipment.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Identify the evaluation of industrial safety, health and environmental standards
CO2: Describe the types of accidents and safety measures
CO3: Describe the safety working procedure of different work area
CO4: Apply ergonomics for safety working procedure for humans in industrial area
CO5: Identify the needs of environmental management for sustainable development

TEXT BOOKS:

T1- R.K Jain, *"Industrial Safety, Health and Environment Management System"*, 4th Edition, Khanna Publishers, New Delhi, 2015.

T2- R.K. Mishra, *"Safety Management"*, 2nd Edition, AITBS Publishers, 2012.

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REFERENCE BOOKS:

R1- C. Ray Asfahl, David W. Rieske, *"Industrial Safety and Health Management"*, 6th Edition, Pearson Education, Asia, 2010.

R2- Krishnan N.V., *"Safety in Industry"*, 2nd Edition, Jaico Publisher House, 2005.

R3- L.M Deshmukh, *"Industrial Safety Management and Risk Control"*, 1st Edition, McGraw Hill Education, New Delhi, 2008.

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SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT7201	DESIGN OF MECHATRONICS SYSTEMS	3	0	0	3

Course Objective

1. To impart knowledge about mechatronics design process
2. To impart knowledge about System modeling
3. To familiarize the design of mechatronics system with real time interfacing
4. To provide knowledge in data acquisition and control
5. To know about the case studies and the application of mechatronics systems

Unit	Description	Instructional Hours
I	**MECHATRONICS SYSTEM DESIGN** Introduction - Integrated design Issues - Key Elements - Mechatronics Design Process - Traditional and Mechatronics Designs, Advanced Approaches in Mechatronics, Industrial Design and Ergonomics, Safety.	9
II	**SYSTEM MODELLING** Introduction - Model Categories - Fields of Application - Model Development - Model Verification - Model Validation - Model Simulation - Design of Mixed Systems - Electro Mechanics Design - Model Transformation Domain - Independent Description Forms - Simulator Coupling.	9
III	**REAL TIME INTERFACING** Introduction - Elements of Data Acquisition & Control Systems - Overview of I/O Process - Installation of the I/O Card and Software, Data Conversion Process, Application Software -Vim - Sim Environment and its Applications.	9
IV	**CASE STUDIES** Introduction - Thermal Cycle Fatigue Test of an Aluminum Plate - PH Control System - Windscreen Wiper Motion - Pick and Place Robot - Car Park Barrier - Digital Camera - Car Engine Management - Bar Code Reader - Skip Control of a CD Player - Strain Gauge Weighing System - Rotary Optical Encoder - De Icing Temperature Control System.	9
V	**APPLICATIONS IN MECHATRONICS** Sensors for Condition Monitoring - Mechatronics Control in Automated Manufacturing -Artificial Intelligence - Fuzzy Logics in Mechatronics Applications - Micro Sensor - Principle - Fabrication Techniques - Applications of Micro Mechatronics Components.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Design a system, formulate, analyze and solve mechatronics engineering problems
CO2: Classify various models of system modeling
CO3: Describe various elements used in real time interfacing
CO4: Explain the data acquisition and control system through case studies
CO5: Apply fuzzy logic techniques in the applications of mechatronics system design

TEXT BOOKS:

T1- DevdasShetty and Richard A. Kolk, *"Mechatronics System Design"*, 9th Edition, Thomson Asia Pvt. Ltd., Singapore, 2011.

T2- Georg Pelz, *"Mechatronics Systems: Modeling and simulation with HDLs"*, 1st Edition, John Wiley and Sons Ltd., NewDelhi, 2003.

REFERENCE BOOKS:

R1- W. Bolton, Mechatronics, *"Electronic Control systems in Mechanical and Electrical Engineering"*, 4th Edition, Pearson Education, New Delhi, 2011.

R2- Brian Morriss Automated Manufacturing Systems - Actuators, Controls, Sensors and Robotics, 13th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 1995.

WEB REFERENCES:

1. http://een.iust.ac.ir/profs/Shamaghdari/Mechatronics/Resources/3Shetly_Mechatronics%20System%20Design.
2. http://mte401.weebly.com/uploads/1/4/0/7/14075053/2hr15sep14.pdf

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT7202	ROBOTICS AND MACHINE VISION	3	0	0	3

Course Objective

1. To outline the evolution of robots and its anatomy
2. To describe the various kinematics and inverse kinematics of robot motions
3. To illustrate the principle of robot end effectors
4. To acquire knowledge about different types of sensors and its applications
5. To discuss the applications of robots in industries

Unit	Description	Instructional Hours
I	**FUNDAMENTALS OF ROBOTICS** Definition and History of Robotics - Classification of Robots - Robot Anatomy - Robot Coordinates - Workspace - Degrees of Freedom - Asimov's Laws of Robotics. Robot Actuators - Hydraulic - Pneumatic - Electric - Servomotor - Stepper Motor - Control Systems for Robot - Robotics and Programmable Automation.	9
II	**ROBOT KINEMATICS AND PROGRAMMING** Introduction to Robot kinematics - Homogeneous Transformations - Forward Kinematics - Denavit - Hartenberg (D-H) Representation - Inverse kinematics. Basics ofTrajectory Planning. Robot Programming: Robot Languages - Classification of Robot Language - Computer Control and Robot Software.	9
III	**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 - Design Considerations.	9
IV	**SENSORS AND MACHINE VISION** Robotic Sensors - Position Sensors, Velocity Sensors, Acceleration Sensors, Force and Torque Sensors, Touch and Tactile sensors, Proximity and Range, Sniff Sensors, RCC System and Voice Recognition System. Machine vision: Image Acquisition - Sampling and Quantization - Data Reduction Techniques - Segmentation - Feature Extraction - Object Recognition - Binary morphology.	9
V	**APPLICATIONS OF ROBOT** Machine Interface - Robots in Manufacturing and Non - Manufacturing Applications - Medical Applications - Automation and Mechatronics Applications - Robot Cell Design - Selection of Robot for Specific Applications.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Explain the basic concepts and working of robot.
CO2: Analyze the kinematics of robot motions for a given problem
CO3: Evaluate and construct a robot end effector for specific applications
CO4: Interpret the function of sensors and machine vision system
CO5: Design a robot for real world problems and applications

TEXT BOOKS:

T1- Deb. S.R., *"Robotics Technology and Flexible Automation"*, 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2010.

T2- Saeed B.Niku *"Introduction to Robotics: Analysis, Systems, Applications"*, 2nd Edition, John Wiley & Sons Ltd., New Delhi, 2012.

REFERENCE BOOKS:

R1- Mikell P. Groover, Mitchell Weiss, Roger N.Nagel Nicholas G.Odrey, *"Industrial Robotics Technology, Programming*

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and Applications ", 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2012.

R2- Klafter R.D., Chimielewski T.A., Negin M., *"Robotic Engineering - An integrated approach"*, PHI Learning Private Limited, New Delhi, 2003.

R3- Fu K.S. Gonzaleaz R.C. and Lee C.S.G., *"Robotics Control Sensing, Vision and Intelligence"*, Tata McGraw Hill Publishing Company Limited, New Delhi, 1998.

R4- Ghosh, *"Control in Robotics and Automation: Sensor Based Integration"*, Allied Publishers, Chennai, 1998.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT7001	ROBOTICS LABORATORY	0	0	4	2

Course Objective

1. To learn about different types of robots and their links and joints
2. To learn the basics of robot programming
3. To simulate a robot using simulation software
4. To learn the applications of vision system in robot used in inspection system
5. To develop the robot for a particular applications

Unit	Description of the Experiments	Practical Hours
1	Study the Different Types of Robots Based on Configuration and Function.	3
2	Programming for Point-to-Point Operation and Continuous Path Operation.	6
3	Programming for Pick and Place Operation with and without delay.	6
4	Programming for Estimation of Accuracy of a Robot.	3
5	Programming for Estimation of Repeatability of a Robot.	3
6	Programming for Estimation of Resolution of a Robot.	3
7	Create a Model to Find the Force in Spring Damper at Static Equilibrium and Simulate using ADAMS Software.	6
8	Create a Model to Find the Minimum Inclination that Crate Slides off an Inclined Plane and Simulate using ADAMS Software.	3
9	Create Geometry of the Lift Mechanism and then Set the Constraints of the Model and Simulate using ADAMS Software.	3
10	Create a Model to Find the Force and Frequency for a Single Degree of Freedom Pendulum and Simulate using ADAMS Software.	3
11	Create a Model to Find the Force and Frequency for a Projectile Motion and Simulate using ADAMS Software.	3
12	Study of Machine Vision System used in Assembly and Inspection of Parts.	3
	Total Practical Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Choose different types of robots, links and joints for specific tasks
CO2: Demonstrate the robot movements through programming
CO3: Create basic programming in robots
CO4: Design a robot for the given applications
CO5: Develop an inspection system using machine vision system

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PROFESSIONAL ELECTIVE III

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT7301	MEMS AND MICROSYSTEMS	3	0	0	3

Course Objective

1. To examine the scaling laws in micro systems
2. To learn about micro sensors and actuators
3. To interpret the fundamental standard of micro fabrication techniques and micro systems in MEMS
4. To discuss the various etching techniques in micromachining
5. To observe a knowledge about applications in micro system techniques

Unit	Description	Instructional Hours
I	**SCALING IN MICRO SYSTEMS** Overview - Microsystems and Microelectronics-Definition - MEMS Materials - Scaling Laws - Scaling in Geometry - Scaling in Rigid Body Dynamics - Scaling in Electrostatic Forces - Scaling in Electricity Scaling in Fluid Mechanics - Scaling in Heat Transfer.	9
II	**MICRO SENSORS & ACTUATORS** Working principle of Microsystems - Micro Actuation Techniques - Micro Sensors - Types - Microactuators - Types - Micropump - Micromotors - Microvalves - Microgrippers - Micro Accelerometers.	9
III	**MICRO SYSTEM FABRICATION** Substrates - Single Crystal Silicon Wafer Formation - MEMS Materials - Photolithography - Ion Implantation - Diffusion - Oxidation - CVD - Physical Vapor Deposition - Deposition by Epitaxy - Etching Process.	9
IV	**MICRO SYSTEM MANUFACTURING AND PACKAGING** Bulk Micro manufacturing - Surface Micro Machining - LIGA - SLIGA - Micro system Packaging - Materials - Die Level - Device Level System Level Packaging Techniques - Die preparation - Surface Bonding - Wire Bonding - Sealing.	9
V	**MICRO SYSTEM APPLICATIONS** Applications of Micro System: Automotive - Bio Medical - Aero Space - Telecommunications field - Basic exposure to software for MEMS Design - Intellisuite.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Analyze scaling laws that are used extensively in the conceptual design of micro devices and systems
CO2: Select suitable micro sensors and actuators
CO3: Summarize various micro system fabrication techniques
CO4: Choose a micromachining technique, such as bulk micromachining and surface micromachining for a specific MEMS process
CO5: Infer recent advancements in the field of MEMS

TEXT BOOKS:

T1- Tai - Ran Hsu, *"MEMS & Microsystems Design and Manufacture"*, 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

T2- Mohamed Gad - el - Hak, *"The MEMS Hand book"*, 2nd Edition, CRC Press, New York, 2002.

REFERENCE BOOKS:

R1- Sergej Fatikow, Ulrich Rembold, *"Microsystem Technology and Microrobotics"*, 1st Edition, Springer Science & Business Media, 2013.

R2- Marc Madou, *"Fundamentals of Micro Fabrication"*, 2nd Edition, CRC press, New York, 2011.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT7302	FACTORY AUTOMATION	3	0	0	3

Course Objective

1. To impart knowledge of automation in manufacturing industries
2. To classify material handling system and AGVs
3. To study various storage methods and its equipments
4. To learn about manufacturing cells and automated assembly lines
5. To list out different assembly methods in industries

Unit	Description	Instructional Hours
I	**OVERVIEW OF AUTOMATION** Automation in Production Systems - Automation Principles and Strategies - Elements of an Automated System - Advanced Automation Function - Levels of Automation - Hardware Components for Automation and Process Control.	9
II	**MATERIAL TRANSPORT SYSTEM** Introduction - Material Handling equipment - Design considerations in Material Handling - Industrial trucks - Automated guided vehicles - Monorails and other Rail Guided Vehicles - Conveyors - Cranes and Hoists - Analysis of Vehicle Based System - Conveyor Analysis.	9
III	**STORAGE SYSTEM** Introduction - Performance - Strategies - Conventional Storage Methods and Equipment - Automated Storage System - Carousel Storage System - Engineering Analysis of Storage System.	9
IV	**MANUFACTURING SYSTEMS** Components of Manufacturing System - Single Station Manufacturing Cells, Manual Assembly Lines - Automated Production Lines - Automated Assembly Systems.	9
V	**ASSEMBLY SYSTEMS** Robotic Assembly Automation - Parts Presentation Methods - Assembly Operations - Compliance and Remote Centre Compliance (RCC) Device - Adaptable Programmable Assembly System.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Apply the automation principles in manufacturing systems
CO2: Develop different material handing mechanisms for industries
CO3: Propose the benefits of automated storage systems
CO4: Compare manual assembly lines and automated assembly lines
CO5: Enumerate different assembly operations in industries

TEXT BOOKS:

T1- Groover, M.P. "*Automation, Production Systems, and Computer - Integrated Manufacturing*", 3rd Edition, Pearson Education, 2008.
T2- C.Ray Asfahl, "Robtos and Manufacturing automation", 2nd Edition, John Wiley and Sons Ltd., New Delhi, 2011.

REFERENCE BOOKS:

R1- Groover, M.P. and Simmers, E.W. "*Computer Aided Design and Manufacturing*", Pearson Education, New Delhi, 2009.
R2- Nand K. Jha. "*Handbook of Flexible Manufacturing Systems*", Academic Press, Orlando, 2006.

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2. http://mte401.weebly.com/uploads/1/4/0/7/14075053/2hr15sep14.pdf

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT7303	SIX SIGMA AND LEARN MACUFACTURING	3	0	0	3

Course Objective

1. To familiarize the basic concepts of six sigma in manufacturing
2. To learn different six sigma techniques used in implementation
3. To impart knowledge on various lean manufacturing tools
4. To provide knowledge on different concepts on cellular manufacturing
5. To illustrate importance of 5S principles and setup time reduction in industries

Unit	Description	Instructional Hours
I	**SIX SIGMA** Definition - Traditional Vs Manufacturing Lean Six Sigma - Common Terms, Foundations of Lean Six Sigma - Five Laws of Lean Six Sigma - Lean Six Sigma Tools - Total Quality Cost - Types of Lean Six Sigma: Define, Measure, Analyze, Improve and Control (DMAIC) Vs Design for Six Sigma (DFSS) - Lean Six Sigma Project Selection.	9
II	**DESIGN FOR SIX SIGMA** Methodologies: Define, Measure, Analyze, Design, Verify (DMADV) Vs Define, Measure, Analyze, Design, Optimize, Verify (DMADOV) - Overview of Quality Function Deployment (QFD) - Theory of Inventive Problem Solving (TRIZ) - Overview of Failure Modes and Effects Analysis (FMEA) - Robust Design and Process - Lean Six sigma Implementation - Common Implementation Issues and Management Strategies.	9
III	**INTRODUCTION TO LEAN MANUFACTURING** Conventional Manufacturing Versus Lean Manufacturing - Principles of Lean Manufacturing - Basic Elements of Lean Manufacturing - Introduction to Lean Manufacturing Tools.	9
IV	**CELLULAR MANUFACTURING** Cellular Manufacturing - Types of Layout, Principles of Cell layout, Implementation - Just in Time (JIT) - Principles of JIT - Implementation of Kanban - Total Productive Maintenance (TPM) - Pillars of TPM, Principles and Implementation of TPM.	9
V	**SET UP TIME REDUCTION AND 5S PRINCIPLES** Set up Time Reduction - Definition, Philosophies and Reduction Approaches. TQM - Principles and Implementation - 5S Principles and Implementation - Value Stream Mapping - Procedure and Principles - Case Studies of Implementation of Lean Manufacturing in Industries.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Apply the different six sigma tools in an organization
CO2: Employ six sigma techniques for solving implementation issues
CO3: Evaluate the concepts of lean manufacturing over conventional manufacturing
CO4: Identify and implement the cellular manufacturing concept for an industry
CO5: Evaluate the 5S principles and setup time reduction for effective implementation of lean manufacturing in an industries

TEXT BOOKS:

T1- Craig Gyai, Bruce Williams, Stephen R Covey, John Wiley & Sons, *"Six Sigma for Dummies"*, 2nd Edition, Wiley Publishes, U.S.A, 2012.

T2- Mikell P. Groover, *"Automation Production Systems and CIM"*, 6th Edition, Pearson Education, New Delhi, 2016.

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REFERENCE BOOKS:

R1- Rother M. and Shook J, "*Learning to See*", 1st Edition, Stream Mapping to Add Value a Eliminate Muda, Lean Enterprise Institute, Brookline, 1999.

R2- Michael L George, David T Rowlands and Bill Kastle, *"What is Lean Six Sigma"*, 1st Edition, McGraw Hill Education, New York, 2004.

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2. http://www.sixsigmaonline.org/wp - cotent/uploads/Six - Sigma - DMAIC – DMADV.pdf
3. http://www.technicaljournalsonline.com/jers/VOL%20I/JERS/Article%JulySept.2010.pdf

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT7304	NON DESTRUCTIVE TESTING	3	0	0	3

Course Objective

1. To list all types of NDT techniques in engineering
2. To select the appropriate ultrasonic scanning techniques
3. To examine the defects through radiography method
4. To state the principles of advanced techniques of NDT
5. To compare and select the suitable NDT techniques

Unit	Description	Instructional Hours
I	**VISUAL INSPECTION & LIQUID PENETRANT TESTING** Introduction to Various Non - Destructive Methods, Comparison of Destructive and Non Destructive Tests, Visual Inspection, Optical Aids used for Visual Inspection, Applications. Physical Principles, Procedure for Penetrate Testing, Penetrant Testing Materials, Penetrant Testing Methods - Water Washable, Post - Emulsification Methods, Applications.	9
II	**ULTRASONIC TESTING** Principle, Ultrasonic Transducers, Ultrasonic Flaw Detection Equipment, Modes of Display A-Scan, B-Scan, C-Scan, Applications, Inspection Methods - Normal Incident Pulse - Echo Inspection, Normal Incident Through Transmission Testing - Applications of Normal Beam Inspection in Detecting Fatigue Cracks.	9
III	**RADIOGRAPHY** Principle of Radiography, X-Ray and Gamma Ray Sources - Safety Procedures and Standards, Effect of Radiation on Film, Radiographic Imaging, Inspection Techniques - Single Wall Single Image, Double Wall Penetration, Multiwall Penetration Technique.	9
IV	**MAGNETIC PARTICLE TESTING & THERMOGRAPHY** Principle of Magnetic Particle Testing (MPT) - Procedure used for Testing a Component, Equipment used for MPT, Magnetizing Techniques, Applications. Principle of Thermography, Infrared Radiometry, Applications - Imaging Entrapped Water Under an Epoxy Coating.	9
V	**ACOUSTIC EMISSION & EDDY CURRENT TESTING** Principle of AET, Instrumentation, Applications - Testing of Metal Pressure Vessels, Fatigue Crack Detection in Aerospace Structures - Principles, Instrumentation for ECT, Technique - High Sensitivity Techniques, Multi Frequency, Phased Array ECT, Applications - Case Studies on Defects in Cast, Rolled, Extruded, Welded and Heat Treated Components.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Describe about the various NDT techniques
CO2: Interpret the various internal defects of the manufacturing product through ultrasonic method
CO3: Analysis the different defects propagation through radiography method
CO4: Examine the defects through thermography and magnetic particle method
CO5: Analyze the crack propagation through acoustic emission and eddy current testing

TEXT BOOKS:

T1- Baldev Raj, Jeyakumar.T, Thavasimuthu.M., *"Practical Non Destructive Testing"*, 2nd Edition, Narosa Publishing House, New Delhi, 2002.

T2- Peter J. Shull, *"Non Destructive Evaluation: Theory, Techniques and Application"*, 6th Edition, Marcel Dekker, Inc., New York, 2016.

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REFERENCE BOOKS:

R1- Krautkramer. J., *"Ultra Sonic Testing of Materials"*, 1st Edition, Springer, Verlag Publication, New York, 1996.

R2- Karl Jorg Langenberg, René Marklein, Klaus Mayer, *"Ultrasonic Nondestructive Testing of Materials: Theoretical Foundations"*, 1st Edition, CRC Press, New York, 2012.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT7305	INTELLIGENT MANUFACTURING SYSTEM	3	0	0	3

Course Objective

1. To learn basics of sensors in manufacturing
2. To expose the concept of condition monitoring techniques
3. To identify the manufacturing part to avoid the collision through various techniques
4. To impart knowledge of methods and techniques used in group technology
5. To select and demonstrate the structure for knowledge based system for group technology

Unit	Description	Instructional Hours
I	**INTELLIGENT MANUFACTURING SYSTEM** Introduction - Sensors in Manufacturing - Temperature Sensors in Process Control - Fiber Optic Sensors and their Principles and Applications - Displacement Sensor for Robotic Application - Sensors for CNC Machine Tools - Sensors for Process Monitoring - Online and Offline Quality Control.	9
II	**CONDITION MONITORING** Condition Monitoring of Manufacturing Systems - Principles - Sensors for Monitoring Force, Vibration and Noise - Selection of Sensors and Monitoring Techniques - Acoustics Emission Sensors - Principles and Applications - Online Tool Wear Monitoring.	9
III	**AUTOMATIC IDENTIFICATION TECHNIQUES** MRP - MRPII - Shop Floor Control - Factory Data Collection Systems - Automatic Identification Methods - Bar code technology - Automated Data Collection System - Agile Manufacturing - Flexible Manufacturing - Enterprise Integration and Factory Information System.	9
IV	**GROUP TECHNOLOGY** Formation of Part Families - Part Classification - Coding System Optiz -Multi Class - Production Flow Analysis - Machine Cells Design - Clustering Methods - Modern Algorithms - Benefits of GT - System Planning - Objective, System Definition and Sizing - Human Resources - Objective, Staffing, Supervisor Role.	9
V	**IMPLEMENTATION OF INTELLIGENT MANUFACTURING SYSTEM** Knowledge based Group Technology - Group Technology in Automated Manufacturing System - Structure of Knowledge Based System for Group Technology (KBSGT) - Data Base, Knowledge Base and Clustering Algorithm.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Describe types of sensor operations in manufacturing system
CO2: Monitoring the parameters of condition in machinery
CO3: Provide an information about the automatic manufacturing system
CO4: Apply various method to solve group technology problems
CO5: Utilize online collaboration tools to work in complex teams

TEXT BOOKS:

T1- Mikell P. Groover, "*Automation, Production Systems and Computer Integrated Manufacturing*", 8th Edition, PHI Learning Private Limited, New Delhi, 2008.

T2- Andre Kusaic, "*Intelligent Manufacturing Systems*", 1st Edition, PHI Learning Private Limited, New Delhi, 1989.

REFERENCE BOOKS:

R1- Yagna Narayana, "*Artificial Neural Networks*", PHI Learning Private Limited, New Delhi, 2009.

R2- Hamid R. Parsaei and Mohammad Jamshidi, "*Design and Implementation of Intelligent Manufacturing Systems*", PHI Learning Private Limited, New Delhi, 2009.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT7306	ESSENTIALS OF SOFTWARE PROJECT MANAGEMENT	3	0	0	3

Course Objective

1. To observe how to plan and manage the projects at each stage of the software development life cycles
2. To learn the successful projects that support organization's strategic goals
3. To acquire the knowledge about the activities necessary to successfully complete and close the software projects
4. To discuss the various categories of risk involved in project development
5. To develop the knowledge about organizational behavior and team works

Unit	Description	Instructional Hours
I	**SOFTWARE PROJECT MANAGEMENT** Introduction - Need for Software Project Management - Activities by Software Project Management - Software Project versus Other Projects - Categories of Software Projects - Overview of Project Planning.	9
II	**PROJECT EVALUATION AND PROGRAMME MANAGEMENT** Project Evaluation: Introduction - Management Control - Project Portfolio Management -Evaluation of Individual Projects - Cost Benefit Analysis and Evaluation Techniques. Programme Management: Managing the Allocation of Resources - Strategic Programme Management - Creating a Programme - Aids to Programme Management - Benefits Management.	9
III	**ACTIVITY PLANNING** Objectives of Activity Planning - Project Schedules, Projects and Activities, Sequencing and Scheduling Activities, Network Planning Modules - Formulating Network Models, Activity on Arrow Network using Dummy Activities, Identifying Critical Path, Identifying Critical Activities.	9
IV	**RISK MANAGEMENT** Introduction - Nature of Risk - Framework for Dealing with Risk - Risk Identification - Risk Assessment - Risk Planning - Evaluating Risks to the Schedule - Applying the PERT Technique - Monte Carlo Simulation - Critical Chain Concepts.	9
V	**PEOPLE MANAGEMENT AND TEAM ORGANIZATION** Managing People: Understanding Behavior, Organizational Behavior - Selecting the Right Person for the Job - Instruction in the Best Method - Motivation - Stress - Health and Safety. Team Organization: Becoming a Team - Decision Making - Organization and Team Structures - Dispersed and Virtual Teams - Communication Genres and Plans.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Integrate organizational needs to the most effective software development model
CO2: Plan and manage projects at each stage of the software development life cycle
CO3: Analyze between planning modules that address real world management challenges
CO4: Describe various types of risk, risk identifications and planning involved in project management
CO5: Applying skill of working as a team and as a decision maker in an organization

TEXT BOOKS:

T1- Bob Hughes, Mike Cotterel, *"Software Project Management"*, 5th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2010.
T2- Gopalaswamy Ramesh, *"Managing Global Software Projects"*, 1st Edition, Tata McGraw Hill Publishing Company Limited, New Delhi,2005.

REFERENCE BOOKS:

R1- Dick Billows, *"Essentials of Software Project Mangement"*, 1st Edition, Hampton Group Inc., 2004.R2- Donald J.Reifer, *"Software Mangement"*, 7th Edition, John Wiley & Sons Ltd., New Delhi, 2006.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT7307	RAPID PROTOTYING AND REVERSE ENGINEERING	3	0	0	3

Course Objective

1. To impart the Basics and Concepts of rapid product development
2. To impart knowledge about Liquid and Solid based models
3. To provide knowledge of methods for the manufacturing of prototypes from computer based models
4. To impart knowledge about Reverse Engineering and the applications
5. To familiarize about rapid tooling and applications of RP in various fields

Unit	Description	Instructional Hours
I	**RAPID PROTOTYPING** Introduction to Prototypes - Historical Development of Rapid Prototyping (RP) Systems - Need for Time Compression in Product Development - Product Development - Conceptual Design - Development - Detail Design - Prototype.	9
II	**LIQUID BASED AND SOLID BASED RAPID PROTOTYPING SYSTEMS** Classification - Liquid Based System - Stereo Lithography Apparatus (SLA) - Details of SL Process - Products - Advantages - Limitations - Applications and Uses - Solid Based System - Fused Deposition Modeling, Principle - Process - Products - Advantages - Applications and Uses - Laminated Object Manufacturing (LOM).	9
III	**POWDER BASED RAPID PROTOTYPING SYSTEMS** Selective Laser Sintering - Principles of SLS Process, Principle of Sinter Bonding Process - Laser Sintering Materials - Products - Advantages - Limitations - Applications and Uses. Three Dimensional Printing (3DP)- Process - Major Applications - Research and Development - Laser Engineered Net Shaping (LENS).	9
IV	**REVERSE ENGINEERING** Introduction - History of Reverse Engineering - Measuring Device - Contact Type and Non - Contact Type - CAD Model Creation from Point Clouds Preprocessing - Point Clouds to Surface Model Creation, Medical Data Processing - Types of Medical Imaging - Software for Making Medical Models - Medical Materials - Other Applications.	9
V	**RAPID TOOLING AND RP APPLICATIONS** Indirect Method - Metal Deposition Tools - Metal Deposition Tools - Room Temperature Vulcanization (RTV) Tools Direct Method - EOS Direct Tool Process - Direct Metal Tooling using 3DP - Applications - Planning - Design - Analysis - Manufacturing - Automotive.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Differentiate types of rapid prototyping systems and its applications in various fields.
CO2: Identify the process of liquid and solid based models.
CO3: Select the process of powder based RP system in model making.
CO4: Develop a replica of given model by using principles of reverse engineering
CO5: Choose the various RPT tooling and various applications RP

TEXT BOOKS:

T1- Chua C.K, Leong K.F and Lim C.S, *"Rapid Prototyping: Principles and Applications"*, 2nd Edition, World Scientific, 2003.

T2- D. T. Pham and S.S. Dimov, *"Rapid Manufacturing the Technologies and Applications of Rapid Prototyping and Rapid Tooling"*, Springer, 1st Edition, Verlag London Limited, 2001.

REFERENCE BOOKS:

R1- Alexandru C. Telea, *"Reverse Engineering of Physical Objects - Teaching Manual"*, Creaform, 2014.

R2- Hopkinson N., R.J.M, Hauge, P M, Dickens, *"Rapid Manufacturing - An Industrial Revolution for the Digital Age"*, 1st

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Edition, John Wiley and Sons Ltd., New Delhi, 2006.

R3- Ian Gibson, *"Advanced Manufacturing Technology for Medical Applications: Reverse Engineering, Software Conversion and Rapid Prototyping"*, 1st Edition, John Wiley and Sons Ltd., New Delhi, 2006.

R4- Paul F.Jacobs, *"Rapid Prototyping and Manufacturing, Fundamentals of Stereo lithography"*, 1st Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 1993.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT7308	COMPUTER CONTROL OF MANUFACTURING SYSTEM	3	0	0	3

Course Objective

1. To impart knowledge of CNC tools and classify the CNC machines
2. To describe the constructional features of CNC machine
3. To familiarize the CNC part programming
4. To express Interpolators and control loop for CNC manufacturing system
5. To explain computerized numerical control drives

Unit	Description	Instructional Hours
I	**OVERVIEW OF CNC** Introduction to Numerical Control (NC), Computer Numerical Control (CNC) and Direct Numerical Control (DNC) Machine Tools - Classification of NC /CNC Machine Tools - Advantage & Disadvantages of NC/CNC Machine Tools - Application of NC/CNC/ DNC Systems - Micro Computers in CNC - Application of CNC in Industrial Robot.	9
II	**CONSTRUCTIONAL DETAILS OF CNC MACHINE** Machine Structure - Slide Ways, Motion Transmission Element, Swarf Removal and Safety Considerations, Automatic Tool Changers and Multiple Pallet System, Sensors and Feedback Devices in CNC Machines, Constructional Detail of CNC Turning Center and CNC Machining Center, Classification of CNC Control System.	9
III	**CNC PART PROGRAMMING** Introduction to NC Part Program - Manual Programming, Basic Concepts, Preparatory and Miscellaneous (G & M) Coding for Turning and Milling - Computer Aided Programming, General Information, Post Processors - Automatically Programmed Tool (APT), General Description, Geometric Expression, Motion Statement, Additional APT Statement, Example of APT Program.	9
IV	**INTERPOLATORS & CONTROL LOOPS** DDA Hardware Interpolator, linear Interpolator, Circular Interpolator, Complete Interpolator - CNC Software Interpolators - Software DDA Interpolator - Control of Point to Point System, Incremental Open Loop Control, Incremental Closed Loop Control, Absolute Closed Loop Circuit.	9
V	**SYSTEM DEVICES** Drives, Hydraulic System, DC Motors, Stepping Motors - Feedback Devices - Counting Devices - Computer Integrated Manufacturing (CIM) - Case Studies about CNC Technology in Today's Industries, Trends of CNC Cutting Tool and Application of Developed CNC in AERO Shop.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Express the NC, DNC and CNC classification
CO2: Manipulate the structural details of CNC machine
CO3: Write manual part programming to manufacture the component
CO4: Apply the programming knowledge in automated manufacturing process
CO5: Illustrate the control systems of CNC drives and devices

TEXT BOOKS:

T1- Warren S.Seamers, *"Computer Numeric Control"*, 9th Edition, Thomson Delmar, 2012
T2- Yoram Koren,"Computer Control of Manufacturing Systems", McGraw Hill Education, New Delhi, 2011.

REFERENCE BOOKS:

R1- HMT, *"Mechatronics"*, 4th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2012.
R2- Radhakrishnan P. and Subramanyan S., "CAD/CAM/CIM", New Age International (P) Ltd., New Delhi, 1994.

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2. http://www.archivist.info/apt/aptos/apt360/doc/manual/samp_part_prog.html
3. https://www.industry.usa.siemens.com/drives/us/en/cnc/industries/Documents/Aero.pdf

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT7309	TOTAL QUALITY MANAGEMENT (COMMON TO MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING)	3	0	0	3

Course Objective

1. Acquire knowledge on TQM concepts
2. To Acquire knowledge on customer satisfaction, motivation etc
3. Develop skills to use TQM tools for domain specific applications
4. To explore industrial applications of Quality function deployment and taguchi quality concepts
5. To impart detail exposure to students on various quality systems like ISO and its standards

Unit	Description	Instructional Hours
I	**INTRODUCTION** Introduction - Definition of quality - Dimensions of quality - Basic concepts of TQM - TQM Framework – Gurus of TQM - Contributions of Deming, Juan and Crosby - Barriers to TQM Implementation– Principles of TQM- Quality statements - Quality Council - Quality circle- Costs of Quality- Leadership.	9
II	**TQM PRINCIPLES** Customer satisfaction - Strategic quality planning - Customer complaints, Customer retention - Employee involvement - Motivation, Empowerment – Teams - Recognition and Reward, Performance appraisal - PDSA Cycle, 5S, Kaizen - Supplier Partnership - Partnering, Supplier selection, Supplier Rating – Supplier Certification.	9
III	**STATISTICAL PROCESS CONTROL** The seven traditional tools of Quality - New Seven Management tools – Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample - Control Charts - Concept of Six sigma- Process capability - Bench marking - Reason to bench mark, Bench marking process.	9
IV	**TQM TOOLS** Quality Function Deployment (QFD) -Taguchi quality loss function – Total Productive Maintenance (TPM) - Concepts, improvement needs - Performance measures - FMEA - Stages, Types.	9
V	**QUALITY SYSTEMS** Need for ISO 9000 and other Quality System - ISO 9001-2008 Quality System – Elements - Implementation of Quality System - Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Understand quality concepts and philosophies of TQM
CO2: Apply TQM principles and concepts of continuous improvement
CO3: Apply and analyze the quality tools, management tools and statistical fundamentals to improve quality
CO4: Understand the TQM tools as a means to improve quality
CO5: Remember and understand the ISO quality systems and procedures adopted

TEXT BOOKS:

T1- Dale H. Besterfiled, et. al., *"Total Quality Management"*, 4th Edition, Pearson Education, Asia, 2014.
T2- Suganthi.L and Anand Samuel, "*Total Quality Management*", PHI Learning Private Limited, New Delhi, 2006.

REFERENCE BOOKS:

R1- James R. Evans and William M. Lindsay, *"The Management and Control of Quality"*, 8th Edition, 1st Indian Edition, Cengage Learning, 2012.
R2- Janakiraman. B and Gopal .R.K., "*Total Quality Management - Text and Cases*", PHI Learning Private Limited, New Delhi, 2006.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT7310	ENGINEERING ECONOMICS AND COST ANALYSIS	3	0	0	3

Course Objective

1. To learn the basic law of economics
2. To discuss the time consideration and improvement in quality
3. To acquire the knowledge of major types of costing methods and budgeting operations that support engineering cost analysis and project/operations planning and control
4. To impart knowledge in replacement and maintenance analysis
5. To explain how to replace the old one, the new asset has to be purchased with the help of depreciation charge

Unit	Description	Instructional Hours
I	**ECONOMICS** Introduction to Economics - Flow in an Economy, Law of Supply and Demand, Concept of Engineering Economics - Engineering Efficiency, Economic Efficiency, Scope of Engineering Economics - Element of Costs, Marginal Cost, Marginal Revenue, Sunk Cost, Opportunity Cost, Break - Even Analysis - V Ratio, Elementary Economic Analysis - Material Selection for Product Design Selection for a Product.	9
II	**VALUE ENGINEERING** Make or Buy Decision, Value Engineering - Function, Aims and Value Engineering Procedure. Interest Formulae and their Applications - Time Value of Money, Single Payment Compound Amount Factor, Single Payment Present Worth Factor, Equal Payment Series Sinking Fund Factor, Equal Payment Series Payment Present Worth Factor - Equal Payment Series Capital Recovery Factor - Uniform Gradient Series Annual Equivalent Factor, Effective Interest Rate, Examples in all the Methods.	9
III	**CASH FLOW** Methods of Comparison of Alternatives - Present Worth Method (Revenue Dominated Cash Flow Diagram) Future Worth Method (Revenue Dominated Cash Flow Diagram, Cost Dominated Cash Flow Diagram) Annual Equivalent Method (Revenue Dominated Cash Flow Diagram, Cost Dominated Cash Flow Diagram) Rate of Return Method.	9
IV	**REPLACEMENT AND MAINTENANCE ANALYSIS** Replacement and Maintenance analysis - Types of Maintenance, Types of Replacement Problem, Determination of Economic Life of an Asset, Replacement of an Asset with a New Asset - Capital Recovery with Return and Concept of Challenger and Defender, Simple Probabilistic Model for Items which Fail Completely.	9
V	**DEPRECIATION** Depreciation - Introduction, Straight Line Method of Depreciation, Declining Balance Method of Depreciation - Sum of the Years Digits Method of Depreciation, Sinking Fund Method of Depreciation - Annuity Method of Depreciation, Service Output Method of Depreciation - Evaluation of Public Alternatives - Introduction, Examples, Inflation Adjusted Decisions - Procedure to Adjust Inflation, Examples on Comparison of Alternatives and Determination of Economic Life of Asset.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Solve engineering economic problems
CO2: Create a team with positive attitude for making a decision to build a new acceptable profit
CO3: Apply strategies in cash flows for the investments in projects
CO4: Implement the knowledge of maintenance analysis of assets
CO5: Choose the method of depreciating fund to recover money from earnings

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TEXT BOOKS:

T1- R.Panneerselvam, *"Engineering Economics"*, 1st Edition, PHI Learning Private Limited, New Delhi, 2012.

T2- Chan S.Park, *"Contemporary Engineering Economics"*, 6th Edition, PHI Learning Private Limited, New Delhi, 2015.

REFERENCE BOOKS:

R1- Donald.G. Newman, Jerome.P.Lavelle, *"Engineering Economics and Analysis"*, 1st Edition, Engg. Press, Texas, 2004.

R2- Kesavan.R, *"Engineering Economics and Financial Accounting"*, 1st Edition, Laxmi Publications (P) Ltd., New Delhi, 2005.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT7311	NANO TECHNOLOGY	3	0	0	3

Course Objective

1. To familiarize the basic concepts of nano technology
2. To impart the knowledge in nano system
3. To outline the interfaces of nano technology
4. To learn the characteristics and physical properties of nano sensors
5. To expose the students MEMS / NEMS devices and their applications

Unit	Description	Instructional Hours
I	**BASICS OF NANO TECHNOLOGY** Introduction to Physics of the Solid State - Atomic Structure - Microscopy - Spectroscopy - Properties of Nano Particles - Metal Nano Clusters - Semiconducting Nano Particles - Rare Gas and Molecular Clusters - Method of Synthesis.	9
II	**DIVERSITY IN NANO SYSTEM** Fullerenes - Carbon Nano Tubes - Filling of Nano Tubes - Mechanism of Growth - Properties of Nano Tubes - Self Assembled Mono Layers - Gas phase Clusters - Semiconductor Quantum Dots - Mona Layer Protected Metal Nano Particles - Core Shell Nano Particles.	9
III	**EVALUATING INTERFACES OF NANO** Nano Biology - Different types of Inorganic Materials - Nano Probes for Analytical Applications - Current Status of Nano Biotechnology - Molecular Nano Machines - Nano Tribology.	9
IV	**NANO SENSORS** Nano Sensors - Nano Scale Organization of Sensors - Characterization - Nano Sensors Based on Optical Properties - Nano Sensors Based on Quantum Size Effects - Electrochemical Sensor - Sensors Based on Physical Properties - Nano Bio Sensors - Senosrs for Future Applications.	9
V	**NANODEVICES AND APPLICATIONS** Micro Electro Mechanical Systems (MEMS) - Nano Electro Mechanical Systems (NEMS) - Fabrication - Nano Devices - Molecular and Supra molecular Switches -Nano Technology in Diagnostic Applications - Nano Technology in Memory and Storage - Nano Technology for Flexible Electronics.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1:Interpret the basic concepts of nano technology
CO2:Express the knowledge in nano system
CO3:Evaluate the interfaces of nano technology
CO4:Select the suitable nano sensor for different applications
CO5:Design MEMS / NEMS devices for various applications

TEXT BOOKS:

T1- Charles P. Poole, Frank J. Owens, *"Introduction to Nanotechnology"*, John Wiley & Sons Ltd., New Delhi, 2000.
T2- T. Pradeep, Nano, *"The Essentials Understanding Nanoscience and Nanotechnology"*, McGraw Hill Education, New Delhi, 2008.

REFERENCE BOOKS:

R1- Guozhong Cao, *"Nanosructures and Nanomarterials"*, Imperial college press, 2003.
R2- C.N.R.Rao, P.J.ThomasU.Kulkarni, *"Nanomaterials: Synthesis, Properties and Applications"*, Springer - Verlag 2007.

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1. https://www.slideshare.net/supercha2/nanotechnology-and-its-applications-33323858

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT7312	SIGNALS AND SYSTEMS FOR MECHATRONICS	3	0	0	3

Course Objective

1. To classify different signal and its properties.
2. To learn about the response and stability characterization of linear time invariant system
3. To familiarize continuous fourier series & fourier transformation techniques
4. To recognize the relation between Z - transform and DTFT
5. To describe sampling techniques in reconstruction of a signal using interpolation

Unit	Description	Instructional Hours
I	**SIGNALS** Classification of Signals - Operations of Signals - Basic Continuous Time Signals and Discrete Time Signals - Systems Viewed as Interconnection of Operations - Properties of Systems.	9
II	**LINEAR TIME INVARIANT SYSTEM** Convolution Sum - Properties of Convolution Sum - Convolution Integral - Properties of Convolution Integral - Representation of Linear Time Invariant (LTI) System - Properties of System - Step Response of a LTI System - Stability of LTI Systems and Characteristic Equation - Block Diagram Representation.	9
III	**FOURIER SERIES AND FOURIER TRANSFORM** Network Analysis - Modulation - Sampling. Introduction to Continuous Fourier Series and Fourier Transform (CTFT) - Properties. Introduction to Discrete Time Fourier Series and Fourier Transform (DTFT) - Properties.	9
IV	**Z TRANSFORM ANALYSIS** Z Transform - Z Transform and Region of Convergence (ROC) of Finite and Infinite Duration Sequences - ROC & Stability - Properties of Z Transform - Transforms of Sequences - Inverse Z - Transforms - Relation Between Z - Transform and DTFT.	9
V	**SAMPLING** Sampling Theorem - Sampling Techniques - Reconstruction of a Signal from its Samples using Interpolation - Sampling of Discrete Time Signals. Relationship between DTFT and CTFT.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Compare continuous time signals and discrete time signals
CO2: Implement convolution techniques in linear time invariant system.
CO3: Examine the properties of fourier series and fourier transform
CO4: Solve Fourier Transform and Z transform in continuous time signal & discrete Time signals
CO5: Develop continuous time signal from its samples using interpolation

TEXT BOOKS:

T1- D.Ganesh Rao, Sathish Tunga , "*Signals and Systems*", 4th Edition, Pearson Education, New Delhi, 2011.
T2- Tarun Kumar Rawat, "*Signals and Systems*", 1st Edition, Oxford University Press, 2010.

REFERENCE BOOKS:

R1- Edward W.Kamen, Bonnie S Heck, "*Fundamentals of Signals and Systems Using Web and Matlab*", 3rd Edition, Pearson Education, Asia, 2011.
R2- I J Nagrath, S N Sharan, Rakesh Ranjan, "*Signals and Systems*", 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2011.

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OPEN ELECTIVE II

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT7402	ELECTRIC AND HYBRID VECHILES	3	0	0	3

Course Objective

1. To summarize the developments of electrical vehicles
2. To discuss the hybrid vehicles design considerations
3. To extend design consideration to ancillary systems
4. To familiarize battery and novel energy sources
5. To learn about electric vehicle modeling

Unit	Description	Instructional Hours
I	**OVERVIEW OF ELECTRICAL VECHICLE SYSTEM** Electrical Vehicle Systems - History of Electric Vehicles - Components - Social and Environmental Importance of Electric Vehicles - Types of Electric Vehicle in use Today - Electric Vehicles for the Future.	9
II	**HYBRID VECHICLE DESIGN CONSIDERATIONS** Introduction - Aerodynamic Considerations - Consideration of Rolling Resistance - Transmission Efficiency - Consideration of Vehicle Mass - Electric Vehicle Chassis and Body Design - General Issues in Design.	9
III	**DESIGN OF ANCILLARY SYSTEMS** Introduction - Heating and Cooling Systems - Design of the Controls - Power Steering - Choice of Tyres - Wing Mirrors, Aerials and Luggage Racks - Electric Vehicle Recharging and Refuelling Systems.	9
IV	**BATTERY AND NOVEL ENERGY SOURCES** Introduction - Battery Parameters - Lead Acid Battery - Nickel Based Batteries - Sodium Based Batteries - Lithium Batteries - Battery Charging - Use of Battery in Hybrid Vehicle Fuel Cell Based Energy Storage, Solar Photovoltaic - Wind Power - Flywheels - Super Capacitors - Supply Rails.	9
V	**ELECTRIC VEHICLE MODELLING AND CASE STUDIES** Introduction - Tractive Effort - Modelling Vehicle Acceleration - Modelling Electric Vehicle Range. Case Studies: Rechargeable Battery Vehicles - Hybrid Vehicles - Fuel Cell Powered Bus.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Classify electric vehicle and its components
CO2: Calculate the vehicles design considerations
CO3: Develop the ancillary systems and its design
CO4: Compare various energy storage devices and energy sources
CO5: Conclude the performance of the electrical vehicle using modeling

TEXT BOOKS:

T1- James Larminie, "*John Lowry, Electric Vehicle Technology Explained*", 2nd Edition, John Wiley & Sons Ltd., New Delhi, 2012.

T2- Iqbal Hussein, "*Electric and Hybrid Vehicles: Design Fundamentals*", 2nd Edition, CRC Press, New York, 2011.

REFERENCE BOOKS:

R1- Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, "*Modern Electric,Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design*", 2nd Edition, CRC Press, New York, 2009.

R2- Thomas J., Frank, Benjamin, "*Hybrid Systems, Optimal Control and Hybrid Vehicles*", 1st Edition, Springer International Publishing, 2017.

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PROFESSIONAL ELECTIVE V

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT8301	INFORMATION SYSTEM FOR ENGINEERS	3	0	0	3

Course Objective

1. To interpret the basic concepts of information systems applicable to engineers
2. To learn the system design of information systems
3. To identify the role of database management system in an information systems
4. To outline the data security of information systems
5. To estimate various modules in ethical and social issues in using information systems

Unit	Description	Instructional Hours
I	**INFORMATION TECHNOLOGY** Introduction to Information Technology - Need for Information Technology - Information Technology Firms - What They Are and How They Do Things - Opportunities in the IT Industries.	9
II	**SYSTEM DESIGN** Information Systems: Concepts and Overview of Information Systems - A Systematic Framework for Information Systems - Components of Information Systems - Information Systems Design - Analysis and Management - Types of Information Systems.	9
III	**DATABASE MANAGEMENT SYSTEM** Database Management Systems for Information Systems: Data Resources - Structure and Functional Aspects - Graphic Database - Data Storage and Hypermedia - Data Design Issues and Output Designs.	9
IV	**DATA SECURITY** Information Systems Security - System Vulnerability and Abuse - Improve Business Value of Security & Control using Various Technologies - Framework for Security and Control - Recent Technologies and Tools for Protecting Information Resources.	9
V	**ETHICS IN INFORMATION SYSTEM** Ethical and Social Issues in Information Systems - Ethics in an Information Society - Moral Dimensions of Information Systems - Role of Government in Information Technology.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO6: Describe the basic concepts of information systems
CO7: Create an information system with suitable components
CO8: Familiarize with the database management system of an information systems
CO9: Point out framework for security and control
CO10: Evaluate various modules in ethical and social issues in using information systems

TEXT BOOKS:

T1- Kenneth C. Laudon & Jane P.Laudon, "*Management Information Systems*" 12th Edition, Pearson Education, New Delhi, 2014.

T2- Gerald V.Post David L. Anderson, "*Management Information System - Solving Business Problems with Information Technology*", Tata McGraw Hill Publishing Company Limited, New Delhi, 2012.

REFERENCE BOOKS:

R1- Alexis Leon, "*Enterprise Resource Planning*". 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2005.

R2- Raymond Meleod, JR "*Information Systems*", 14th Edition, Mac Millan Publishing Co. Ltd, 2013.

R3- Gordan B.Davis Margrette H.Olsan, "*Management Information System*", Conceptual Foundations, Structure & Development, Tata McGraw Hill Publishing Company Limited, New Delhi, 2012.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT8302	INDUSTRIAL IOT	3	0	0	3

Course Objective

1. To point out the vision, strategic research and innovation Directions about IoT
2. To learn the concepts of networks and communications in the internet of things
3. To familiarize security and privacy for IoT
4. To enumerate various applications of IoT in industries
5. To distinguish between the various interaoperability used in IoT

Unit	Description	Instructional Hours
I	**INTERNET OF THINGS** Introduction: Internet of Things (IoT) Today - Time for Convergence - Towards the IoT Universe - Internet of Things Vision - IoT Strategic Research and Innovation Directions - IoT Applications.	9
II	**INTERNET OF THINGS STRATEGIC RESEARCH AND INNOVATION** Internet of Things and Related Future Internet Technologies - Infrastructure - Networks and Communication - Processes - Data Management - Security, Privacy & Trust - Device Level Energy Issues - IoT Related Standardization.	9
III	**SECURITY, PRIVACY FOR IOT AND IOT STANDARDISATION** Security, Privacy and Trust in IoT - Data - Platforms for Smart, Cities - First Steps towards a Secure Platform - Smartie Approach - M2M Service Layer Standardization - OGC Sensor Web for IoT - IEEE and IETF.	9
IV	**IOT APPLICATIONS FOR INDUSTRY** Future Factory Concepts - Brownfield IoT - Technologies for Retrofitting - Smart Objects, Smart Applications - Four Aspects in your Business to Master IoT - Auto ID - Value Creation from Big Data and Serialization in the Pharmaceutical Industry - IoT for Retailing - Industry - IoT for Oil and Gas Industry.	9
V	**IOT IN FUTURE** Physical Vs Virtual - Solve the Basic First - Physical Word - Data Interoperability - Semantic Interoperability - Organizational Interoperability - Eternal Interoperability - Importance of Standardization - Beginning of Everything - Need of Methods and Tools and Corresponding Research - Important Economic Dimension - Research Roadmap for IoT Testing Methodologies.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Describe about IoT and its applications
CO2: Use of networks, communication and data management in IoT
CO3: Explain security and privacy in IoT
CO4: Develop applications in IoT for industry
CO5: Compare and contrast different interoperability

TEXT BOOKS:

T1- Ovidiu Vermesan and Peter Friess, *"Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems"*, 1st Edition, Apress Publications, 2013.

T2- Vijay Madisetti and Arshdeep Bahga, *"Internet of Things: A Hands - on - Approach"*, 1st Edition, VPT, 2014.

REFERENCE BOOKS:

R1- Francis daCosta, *"Rethinking the Internet of Things: A Scalable Approach to Connecting Everything"*, 1st Edition, Apress Publications, 2013.

R2- J. Biron and J. Follett, *"Foundational Elements of an IoT Solution"*, O'Reilly Media, 2016.

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2. http://www.iot - i.eu/public.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT8303	ENTREPRENEURSHIP DEVELOPMENT (ONLY FOR MECHATRONICS)	3	0	0	3

Course Objective

1. To impart knowledge on the scope of an entrepreneur
2. To learn about various entrepreneur development programs
3. To prepare the needs of information to run the business
4. To familiarize the methods of taxation and tax benefits
5. To learn the factors of sickness in enterprises

Unit	Description	Instructional Hours
I	**ENTREPRENEURSHIP** Entrepreneur - Types of Entrepreneurs - Difference between Entrepreneur and Intrapreneur - Entrepreneurship in Economic Growth - Factors Affecting Entrepreneurial Growth.	9
II	**MOTIVATION** Major Motives Influencing an Entrepreneur - Achievement Motivation Training, Self Rating - Business Game - Thematic Apperception Test - Stress Management, Entrepreneurship Development Programs - Need and Objectives.	9
III	**BUSINESS** Small Enterprises - Definition, Classification - Characteristics, Ownership Structures - Project Formulation - Steps Involved in setting up a Business - Identifying, Selecting a Good Business Opportunity, Market Survey and Research, Techno Economic Feasibility Assessment - Preparation of Preliminary Project Reports - Project Appraisal - Sources of Information - Classification of Needs and Agencies.	9
IV	**FINANCING AND ACCOUNTING** Need - Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of Working Capital, Costing, Break Even Analysis, Network Analysis Techniques of PERT/CPM - Taxation - Income Tax, Excise Duty - Sales Tax Production.	9
V	**SUPPORT TO ENTREPRENEURS** Sickness in small Business - Concept, Magnitude, Causes and Consequences, Corrective Measures - Government Policy for Small Scale Enterprises - Growth Strategies in Small Industry - Expansion, Diversification - Joint Venture, Merger and Sub Contracting.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Apply the knowledge in regard to the process of new technology to the market
CO2: Describe their needs of motivational programs
CO3: Assess the need for innovation, initiate the process and run innovations in organizations
CO4: Manipulate the knowledge in finance and accounting for the development of entrepreneurship
CO5: Evaluate the growth of the enterprises

TEXT BOOKS:

T1- Hisrich R D and Peters M P, *"Entrepreneurship"* 5th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2002.
T2- Rabindra N. Kanungo "*Entrepreneurship and innovation*", Sage Publications, New Delhi, 1998.

REFERENCE BOOKS:

R1- *EDII "Faulty and External Experts"* - A Hand Book for New Entrepreneurs Publishers, 1998.
R2- *"Entrepreneurship Development"* Institute of India, Ahmadabad, 1986.
R3- S.S.Khanka "*Entrepreneurial Development"* S.Chand & Company Ltd., New Delhi, 1999.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT8304	MOBILE ROBOTICS	3	0	0	3

Course Objective

1. Design and kinematic modeling of mobile robots
2. Develop the path and trajectory for the robot
3. Identify the robot performance characteristics through sensors
4. Locate the robot and mapping
5. Write algorithms in path planning and navigation

Unit	Description	Instructional Hours
I	**MOBILE ROBOT** Introduction - Locomotion, Classification - Legged, Wheeled, Aerial. Key Issues in Locomotion. Mobile Robot Kinematics - Kinematic Model - Forward Kinematic Model, Representing Position, Wheel Kinematic Constraints and Robot Kinematic Constraints.	9
II	**ROBOT MANEUVERABILITY AND WORKSPACE** Degree of Mobility - Degree of Steerability - Robot Maneuverability - Degrees of Freedom - Holonomic Robots - Path and Trajectory Considerations - Motion Control - Open Loop Control and Feedback Control.	9
III	**PERCEPTION** Sensors for Mobile Robots - Classification, Performance, Uncertainty in Sensors, Wheel Sensor - Heading Sensor- Accelerometers - Inertial Measurement - Motion Sensor - Range Sensors - Vision Sensor - Basics of Computer Vision, Image Processing Techniques, Feature Extraction - Image, Range Data Location Recognition.	9
IV	**LOCALIZATION** Major Challenges, Localization Based Navigation. Belief Representation, Map Representation, Probabilistic Map - Examples of Localization Systems - Autonomous Map Building.	9
V	**PLANNING AND NAVIGATION** Planning and Reaction - Path Planning - Graph search, Potential field - Obstacle Avoidance - Bug Algorithm, Histogram, Curvature Velocity Techniques - Navigation Architecture - Case Studies on Rock Climbing.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Design and modeling of mobile robots
CO2: Model the trajectory path of the robot
CO3: Interpret various sensors used for perception
CO4: Prepare localizing and mapping the robot
CO5: Develop the navigation path of the robot

TEXT BOOKS:

T1- Siegwart, Nourbakhsh, *"Introduction to Autonomous Mobile Robots"*, 2nd Edition, MIT Press, 2011.
T2- Siciliano. et.al, *"Robotics: Modelling, Planning and Control"*, 4th Edition, Springer, 2013.

REFERENCE BOOKS:

R1- Choset Et. al, *"Principles of Robot Motion: Theory, Algorithm & Implementations"*, 3rd Edition, MIT Press, 2011.
R2- Siciliano, Khatib, Eds., *"Handbook of Robotics"*, 4th Edition, Springer, 2008.
R3- Thrun, Burgard, Fox, *"Probabilistic Robotics"*, 1st Edition, MIT Press, 2010.

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1. http://www.intechopen.com/books/mobile - robots - current - trends
2. http://www.telegraph.co.uk/lifestyle/pets/10200202/Official - studies - strengthen - case - for electric - collar - ban - says - dog - group.html
3. http://cw.routledge.com/textbooks/eresources/9780750651868/casestudies - 12.doc

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT8305	ARTIFICIAL INTELLIGENCE FOR MECHATRONICS ENGINEERING	3	0	0	3

Course Objective

1. To familiarize with the concepts of artificial techniques
2. To learn AI technology that supports in decision making
3. To learn the concepts of genetic algorithms
4. To familiarize fuzzy techniques for building well engineered and efficient artificial Intelligence Systems
5. To create AI techniques in the fields of chaos and fractals

Unit	Description	Instructional Hours
I	**OVERVIEW OF THE FIELD OF ARTIFICIAL INTELLIGENCE** Introduction to Artificial Intelligence - Neural Network - Neuron - Basic Idea of the Back Propagation Model - Details of the Back Propagation Mode - A Cookbook Recipe to Implement the Back Propagation Model - Additional Technical Remarks on the Back Propagation Model - Simple Perceptrons - Applications of the Back Propagation Model - General Remarks on Neural Networks.	9
II	**NEURAL NETWORKS** Prelude - Associative Memory - Hopfield Networks - The Hopfield - Tank Model for Optimization Problems - Applications of Hopfield - Tank Model - The Kohonen model - Simulated Annealing - Boltzmann Machines.	9
III	**GENETIC ALGORITHMS AND EVOLUTIONARY COMPUTING** Fundamentals of Genetic Algorithms - A Simple Illustration of Genetic Algorithm - Input to Output Mapping - Travelling Salesman Problem - Changes of Schemata Over Generations - Example of Schema Processing - Genetic Programming.	9
IV	**FUZZY SYSTEMS** Fundamentals of Fuzzy sets - Fuzzy Relations - Fuzzy Logic - Fuzzy Control - Hybrid Systems - Fundamental Issues - Rough Sets: Definability and Rough Sets - Knowledge Representation Systems.	9
V	**CHAOS** Typical features of Chaos - Representing Dynamical Systems - Trajectory, Orbit and Flow - Cobwebs - Equilibrium Solutions and Stability - Attracters - Bifurcations - Fractals - Applications of Chaos.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Solve the given problem using back propagation algorithm which is used as a decision support tool
CO2: Identify problems that are amenable to solution by neural networks
CO3: Apply Genetic Algorithm to various optimization problems
CO4: Summarize the concepts of fuzzy system
CO5: Develop the practical skills for understanding complexity and solving dynamic systems that exhibits chaotic behavior

TEXT BOOKS:

T1- Toshinori Munakata, *"Fundamentals of the New Artificial Intelligence,"* 2nd Edition, Springer, 2008.
T2- Uma Rao, "*Artificial Intelligence and Neural Networks"*, Pearson Education, Asia, 2011.

REFERENCE BOOKS:

R1- Sivanandam and Deepa, *"Introduction to Genetic Algorithms"*, Springer, 2008.
R2- Timothy J. Ross, *"Fuzzy Logic with Engineering Applications"*, 2nd Edition, John Wiley & Sons Ltd., New Delhi, 2004.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT8306	MODERN WIRELESS COMMUNICATION SYSTEMS	3	0	0	3

Course Objective

1. To discuss the fundamentals of transmission media
2. To provide an overview of various approaches to communication networks
3. To study the numerous different-generation technologies with their individual pros and cons
4. To discuss about the principles of operation of the different access technologies like WCDMA, CDMA and their pros and cons
5. To learn about wireless networks and smartphone applications

Unit	Description	Instructional Hours
I	**TRANSMISSION FUNDAMENTALS** Transmission Fundamentals: Time Domain & Frequency Domain Concepts - Radio - Analog Vs Digital - Channel Capacity - Transmission Media - Carrier Based Signaling - Spread - Spectrum Signaling.	9
II	**NETWORK CONCEPTS** Communication Networks: LANs - MANs - WANs - Circuit Switching - Packet Switching. ATM Cellular Networks: Cells - Duplexing - Multiplexing - Voice Coding. Multiple Access Techniques: FDMA - TDMA - SDMA - CDMA - Spectral Efficiency.	9
III	**PERSONAL COMMUNICATION SERVICES** GSM - HSCSD - GPRS - D-AMPS - CDMA One - CDMA Two - Packet Data Systems.	9
IV	**3G & BEYOND** IMT-2000 - WCDMA - CDMA 2000 - EDGE - Wi-Fi - WiMAX - OFDM.	9
V	**MOBILE DATA SERVICES & SHORT-RANGE NETWORKS** Mobile Data Services: Messaging - Wireless Web, WAP - Site Design Short - Range Wireless Networks: Unlicensed Spectrum - WLANs - Cordless Telephony - IrDA. Bluetooth Smart Phones: Future Phones - Mobile Oss - Smart Phone Applications.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

- CO1: Identify proper transmission channel
- CO2: Categorize different communication networks and its accessing techniques
- CO3: Combine terminal mobility, personal mobility, and service profile management
- CO4: Illustrate the performance of various access technologies
- CO5: Plan the features for future phones

TEXT BOOKS:

T1- Andy Dornan, "*The Essential Guide to Wireless Communications Applications: From Cellular Systems to Wi-Fi*", 2nd Edition, PHI Learning Private Limited, New Delhi, 2002.

T2- Misra, "Wireless *Communications and Networks: 3G & Beyond*", 1st Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2009.

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REFERENCE BOOKS:

R1- Theodore S. Rappaport, "*Wireless Communications: Principles and Practice*", 2nd Edition, Pearson Education, Asia, 2009.

R2- William Stallings, "*Wireless communications and networking*", 2nd Edition, PHI Learning Private Limited, New Delhi, 2002.

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PROFESSIONAL ELECTIVE VI

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT8307	PROFESSIONAL ETHICS IN ENGINEERING (ONLY FOR MECHATRONICS)	3	0	0	3

Course Objective

1. To express moral values, social values and loyalty
2. To learn the relationship between engineering and society
3. To identify the social responsibilities through case studies
4. To learn the different types of responsibilities and rights
5. To provide an insight of professional ethics in the global issues

Unit	Description	Instructional Hours
I	**HUMAN VALUES** Morals, Values and Ethics - Integrity - Work Ethic - Service Learning - Civic Virtue - Respect for Others - Living Peacefully - Caring - Sharing - Honesty - Courage - Valuing Time - Co-Operation - Commitment - Empathy - Self - Confidence - Character - Spirituality in Business.	9
II	**ENGINEERING ETHICS** Senses of Engineering Ethics - Variety of Moral Issues - Types of Inquiry - Moral Autonomy - Kohlberg's Theory - Gilligan's Theory - Consensus and Controversy - Models of Professional Roles - Theories about Right Action - Self Interest Uses of Ethical Theories	9
III	**ENGINEERING AS SOCIAL EXPERIMENTATION** Engineering as Experimentation - Engineers as Responsible Experimenters - Codes of Ethics - A balanced Outlook on Law - The Challenger Case Study - Bhopal Gas Tragedy - The Three Mile Island and Chernobyl Case Studies - Safety Aspects in Nuclear Power Plants.	9
IV	**RESPONSIBILITIES AND RIGHTS** Responsibilities and Duties of Indian Citizens - Collegiality and loyalty - Respect for authority - Collective bargaining - Confidentiality - Conflicts of interest - Occupational crime - Fundamental Rights - Professional rights - Employee rights - Discrimination - Right to Information Act.	9
V	**GLOBAL ISSUES** Multinational corporations - Environmental Ethics and Environmental Protection Act - Computer Ethics - Engineers as Managers - Consulting Engineers - Engineers as Expert Witnesses and Advisors - Moral Leadership - Sample Code of Ethics like IETE, ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management - Weapons Development.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

- CO1: Analyze the components of ethics and values
- CO2: Recognize, list and describe ethical issues and professional importance to the engineer.
- CO3: Apply function effectively as an individual, as a part of team and in a multi disciplinary environment.
- CO4: Discuss what it means to be human and to live in a community with rights and responsibilities
- CO5: Analyze international interconnections and interdependence through global issues

TEXT BOOKS:

T1- Mike W. Martin and Roland Schinzinger, *"Ethics in Engineering"*, 4th Edition, McGraw Hill Education, New York, 2005.

T2- M. Govindarajan, S. Natarajan and V. S. Senthil Kumar, *"Engineering Ethics"*, PHI Learning Private Limited, New Delhi, 2013.

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REFERENCE BOOKS:

R1- Charles D. Fleddermann, *"Engineering Ethics"*, 4thEdition, Pearson Education, New Jersey, 2014.

R2- Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, *"Engineering Ethics - Concepts and Cases"*, 5th Edition, Wadsworth Cengage Learning, 2014.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT8308	NON CONVENTIONAL ENERGY SOURCES	3	0	0	3

Course Objective

1. Learn different primary energy sources and renewable energy sources
2. Design various solar energy utilized systems
3. Illustrate the principles of wind, tidal and geothermal energy and its applications
4. Impart the applications of energy from waste and designing of bio gas plant
5. Exposure in various direct energy conversion systems

Unit	Description	Instructional Hours
I	**ENERGY AND ENERGY CONSERVATION** Primary Energy Resources - World Energy Resources - Principles of Energy Conservation and Energy Audit - Energy Conservation Approach - Co-generation - Heat Pumps - Energy Storage - Renewable Energy Sources/Devices - Instrumentation and Control.	9
II	**SOLAR ENERGY** Principles of Solar Energy Collection - Solar Radiation - Measurements - Instruments - Data and Estimation - Types of Collectors - Characteristics and Design Principles of Different Type of Collectors, Performance and Testing of Collectors - Solar Water and Air Heaters - Performance and Applications - Solar Cooling - Solar Pumping - Solar Photo - Voltaics - Solar Distillation - Solar Furnace.	9
III	**WIND,TIDAL AND GEOTHERMAL ENERGY** Basic Principles of Wind Energy Conversion - Site Selection Consideration - Design Aspects of Horizontal Axis Wind Mills - Applications - Energy from Tides and Waves - Working Principles of Tidal Plants and Ocean Thermal Energy Conversion Plants - Geothermal Power Plants.	9
IV	**BIO ENERGY** Biomass Conversion Technologies - Biogas Generation - Classification of Biogas Plants - Biogas from Plant Wastes - Biomass as a Source of Energy - Methods for Obtaining Energy from Biomass - Thermal Classification of Biomass - Advantage and Disadvantage of Bio - Logical Conversion of Solar Energy.	9
V	**DIRECT ENERGY CONVERSION SYSTEM** Magneto Hydro Dynamic Systems (MHD) - Thermo Electric Generators - Thermionic Generators - Fuel Cells, Emf Generated Power Output, Losses and Efficiency Applications - Energy Storage and Distribution.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

- CO1: Relate the effect of renewable and non renewable energy sources on climate change and other global contemporary issues
- CO2: Describe the technologies that are used to harness the power of solar energy
- CO3: Summarize the renewable energy sources such as wind, tidal and geothermal
- CO4: Discuss the biogas conversion of biomass for energy application
- CO5: Compute performance characteristics of direct energy conversion systems and explain their storage and transport phenomena

TEXT BOOKS:

T1- Rai G.D, *"Non Conventional Energy Sources"*, 4th Edition (24th Reprint), Khanna Publishers, New Delhi, 2009.

T2- Kothari D.P, Singal K.C and Ranjan R, *"Renewable Energy Sources and Emerging Technologies"*, Eastern Economy Edition, 2009.

REFERENCE BOOKS:

R1- B.H.Khan, *"Non Convention Energy Resources"*, 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2009.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT8309	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	3	0	0	3

Course Objective

1. To impart knowledge on fundamentals of product development
2. To learn the requirements and system design for new product development
3. To understand the design and testing techniques in new product development
4. To illustrate knowledge in configuration management and intellectual product development
5. To explain the importance of specific product development processes, Intellectual property rights, security and configuration management in industries

Unit	Description	Instructional Hours
I	**FUNDAMENTALS OF PRODUCT DEVELOPMENT** Global Trends Analysis and Product Decision: Types of Various Trends Affecting Product Decision - Social Trends - Technical Trends - Economical Trend - Environmental Trends - Political/Policy Trends PESTLE Analysis- Introduction to Product Development Methodologies and Management: Overview of Products and Service - Types of Product Development - Re-Engineering - Reverse Engineering - Design Porting & Homologation - Overview of Product Development methodologies - Product Life Cycle - Product Development Planning and Management .	9
II	**DESIGN AND TESTING** Requirement Engineering - Types of Requirements - Requirement Engineering - Analysis - Design Specification - Traceability Matrix and Analysis - Requirement Management, System Design & Modelling - Introduction to System Modelling - System Optimization - System Specification - SubSystem Design - Interface Design.	9
III	**WIND,TIDAL AND GEOTHERMAL ENERGY** Conceptualization: Industrial Design and User Interface Design - Introduction to Concept generation Techniques - Concept Screening & Evaluation. Detailed Design - Component Design and Verification - High Level Design/Low Level Design of S/W Programs - S/W Testing - Hardware Schematic - Component design - Layout and Hardware Testing. Certification and Documentation.	9
IV	**SUSTENANCE ENGINEERING AND END OF LIFE SUPPORT** Sustenance - Maintenance and Repair - Enhancements, Product EoL - Obsolescence Management - Configuration Management- EoL Disposal.	9
V	**BUSINESS DYNAMICS ENGINEERING SERVICES INDUSTRY** Engineering Services Industry - Overview; Product development in Industry Versus Academia - IPD Essentials: Introduction to vertical specific product development processes - Product development Trade-Offs - Intellectual Property Rights and Confidentiality - Security and Configuration management.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Analyze various global trends and decide on the scope of a new product

CO2: Develop product management plan for a new product based on the type of the new product and development methodology

CO3: Summarize requirement engineering and know how to collect, analyze and to arrive the requirements for new product development and convert them in to design specification

CO4: Conceptualize new product integrating the hardware, software, controls, electronics and mechanical systems

CO5: Explain the growth of engineering services and product development in industries

TEXT BOOKS:

T1- *"Foundation Skills in Integrated Product Development (FSIPD)"*, 1st Edition, Published by NASSCOM, 2013.

T2- Ulrich, Karl T. and Eppinger, Steven D, *"Product Design and Development"*, 5th Edition, McGraw Hill Education, New Delhi, 2012.

REFERENCE BOOKS:

R1- Kevin N. Otto, *"Product Design - Techniques in Reverse Engineering and New Product Development"*, Pearson Education, New Delhi, 2011.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT8310	DIGITAL IMAGE PROCESSING TECHNIQUES	3	0	0	3

Course Objective

1. To learn the fundamental concepts of digital image processing
2. To impart knowledge and methods of image transforms
3. To explain algorithms for image enhancement
4. To describe the techniques in restoration and image analysis
5. To expose students to current applications in the field of digital image processing

Unit	Description	Instructional Hours
I	**DIGITAL IMAGE PROCESSING** Introduction - Elements of Digital Image Processing Systems - Elements of Visual Perception - Brightness Adaption and Discrimination - Colour Representation - Statistical Background - Image Representation - The BMP Format.	9
II	**DIFFERENT IMAGE TRANSFORMS** The Discrete Fourier Transform (DFT) - Properties of 2D DFT - Hadamard Transform, Walsh and Discrete Cosine Transform (DCT) - Discrete Sine Transform - Karhunen Loeve (KL) Transform - Wavelet Transform (WT) - Wavelet Functions and Compression.	9
III	**IMAGE ENHANCEMENT** Introduction - Point Operations - Histogram Modelling - Image Smoothing - Magnification and Interpolation (Zooming) - Transform Operations - Multispectral Image Enhancement - False Colour, True Colour and Pseudocolour - Colour Image Enhancement.	9
IV	**RESTORATION AND IMAGE ANALYSIS** Restoration : Introduction - Convolution Techniques - Formulation of Discrete Linear Operators - Inverse and Wiener Filtering - Maximum Entropy Restoration - Coordinate Transformation and Geometric Correction - Splines and their role in Image Restoration - Fourier Descriptors.Image Analysis: Segmentation - Texture - Texture Segmentation - Image Features and its Extraction - Motion Detection - Elementary Approaches to Image Motion Features Extraction Different Images.	9
V	**APPLICATIONS OF IMAGE PROCESSING** Finger prints - An Identity Authentication System and classification - Face Recognition - Iris Recognition - Speaker Recognition - Digital Water marking for Images - Medical Image Processing - Industrial Machine Vision Applications - Applications of Image Processing in Remote Sensing - Artificial Neural Networks (ANNs) in Image Processing.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Discuss the elements of digital image processing system
CO2: Classify the different image transforms
CO3: Simulate multispectral image enhancement to examine the given problem
CO4: Combine acquired knowledge of image enhancement, restoration techniques and image analysis to propose a solution to the given problem
CO5: Apply image processing algorithms in practical applications

TEXT BOOKS:

T1- Madhuri A.Joshi "Digital Image Processing: An Algorithmic Approach", 1st Edition, PHI Learning Private Limited, New Delhi, 2011.

T2- Rafael C Gonzalez and Richard E Woods, "Digital Image Processing", 3rd Edition, Addition - Wesley, New Delhi, 2009.

REFERENCE BOOKS:

R1- Tinku Acharya, Ajoy K. Ray "Image Processing: Principles and Applications", 1st Edition, John Wiley & Sons Ltd..New Delhi, 2005.

R2- Jayaraman S, Esakkirajan S and Veerakumar T, "Digital Image Processing", 1st Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2009.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT8311	TEXTILE AUTOMATION	3	0	0	3

Course Objective

1. To summarize the basic concepts and list the basic processing of the textile technology
2. To familiarize with the basics of spinning
3. To interpret the basics of weaving process and its variables
4. To operate the automated spinning machines
5. To impart the knowledge about the basics of waving machines

Unit	Description	Instructional Hours
I	**BASICS OF PROCESSING** History of Textile Technology and its Advancements - Introduction to Textile Fibers - Overview of Textile Manufacturing - Introduction to Automation in Textile Industries - Objectives and Process Variables in Processing Machines - Singeing - Desizing - Scouring - Bleaching - Mercerizing - Dyeing - Printing - Finishing - Robotics in Textile Industries.	9
II	**BASICS OF SPINNING** Spinning Process Flow Chart - Objectives and Process Variables of Textile Spinning Machineries - Mixing - Blow Room - Carding - Draw Frame - Combing - Speed Frame - Ring Frame - Rotor Spinning.	9
III	**BASICS OF WEAVING** Weaving Process Flowchart - Objectives and Process Variables in Weaving - Preparatory Winding, Warping, Sizing and beaming - Objectives and Process Variables in Weaving - Drawing In, Knotting, Denting and Weaving.	9
IV	**AUTOMATION IN SPINNING MACHINERY** Machinery Material Flow and its Variation Controls - Feeders & Stop Motions - Auto Levelers - Safety Switches - Production and Quality Monitors - Full Doff and Preset Length Monitors - Data Acquisition System for Spinning Preparatory - Ring Spinning - Rotor Spinning - CAD / CAM / CIM in Spinning.	9
V	**AUTOMATION IN WEAVING MACHINERY** Yarn Cleaner Controls - Knotter / Splicer Carriage Controls - Warping Machine Monitors and Controls - Sizing Machine Monitors and Controls - Auto Reaching / Drawing In and Knotting Machine Monitors and Controls - Data Acquisition System in Weaving Preparatory and Weaving - Humidification Systems - Weaving, Dyeing, Printing, Apparel Production.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Evaluate textile technology and manufacturing with textile fibers
CO2: Describe various process involved in spinning
CO3: List out the various process involved in weaving
CO4: Explain various stages of automation scopes in spinning machinery
CO5: Outline the role of computers in automated weaving machinery

TEXT BOOKS:

T1- J Chattopadhyay R, "*Advances in Technology of Yarn Production*", 1st Edition, NCUTE, IIT Delhi, 2002.
T2- Venkatachalam. A and Ashok Kumar L, "*Monograph on Instrumentation & Textile Control Engineering*", New Age International (P) Ltd., New Delhi, 2005.

REFERENCE BOOKS:

R1- Krishna Kant, "*Computer Based Industrial Control*", 2nd Edition, PHI Learning Private Limited, New Delhi, 2011.
R2- Oxtoby E, "*Spun Yarn Technology*", New Edition, Butter Worth"s, London, 2012.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT8312	MICRO MANUFACTURING	3	0	0	3

Course Objective

1. To state the principles of various basic micro manufacturing process
2. To calculate the force involving in micro turning operations
3. To select the necessary parameters for micro grinding process
4. To explain how laser sources has been utilized in micro joining and forming process
5. To apply the micro manufacturing techniques in complex profile manufacturing

Unit	Description	Instructional Hours
I	**MICRO MACHINING** Introduction to Micro Machining - Miniaturzation and Applications - Classification - Subtractive Process - Traditional Micro Machining - Nano Finishing Process - Additive Process - Mass Containing Process - Micro Forming - Micro Molding - Micro Joining.	9
II	**MICRO TURING** Machining for Micro Turing - Design Requirements - Source of Errors - Mechanismof Material Removal - Force in Micro Turing - Deflection and Bending Stress - Cutting Force Ratio - Effective of Speed, Feed, Grain Size - Surface Finishing -Materials Micro Turing Vs Micro Cutting.	9
III	**MICRO GRINDING** Types of Grinding Wheels - Comparison of Machining And Grinding - Grindability - Grinding Mechanisms - Chip Formation Energy - Primary Rubbing - econdary Rubbing - Specific Plowing Energy - Quick Stop Apparatus - Machine Tools - Abrasive Types - Bending of Abrasive Tools - Geometry of Grinding Wheels - Grinding Fluids - Micro Grinding of Ceramic Materials - Surface Quality.	9
IV	**MICRO JOINING & FORMING** Laser Welding Process - Conduction Welding - Deep Penetration Welding - Laser Welding Practice - Thermal Model - Laser Micro Welding - Defects - Applications - Recent Advances in Micro Welding - Micro Welding of Polymers - Brittle Rigid Welding Materials - High Speed Laser Scanning - Nano Plastic Forming - Micro Surface Development.	9
V	**RECENT TRENDS AND APPLICATIONS** Metrology for Micro Machined Components - Ductile Regime Machining - AE Based Tool Wear Compensation - Machining of Micro Gear, Micro Nozzle, Micro Pins -Applications.	9
	Total Instructional Hours	45

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Course Outcome	On completion of the course the students will be able to CO1: Design and development Micro machining set up CO2: Select a micro manufacturing method and identify key variables to improve quality of Microturning CO3: Interpret different techniques for the synthesis and characterization of micro materials CO4: Identify the defects through laser penetration techniques CO5: Apply their visualization skills in developing new research in micro level products

TEXT BOOKS:

1. Jain V. K., *"Micro Manufacturing Processes"*, 2nd Edition , CRC Press, Taylor & Francis Group, 2012.
2. Norio Taniguchi, *"Nano Technology"*, 3rd Edition, Oxford University Press, New York, 2003.

REFERENCE BOOKS:

1. Mcgeough J.A., *"Micromachining of Engineering Materials"*, 1st Edition, CRC press, New York, 2001.
2. Jain V.K., "Advanced Machining Processes", 3rd Edition, Allied Publishers, Delhi, 2012.
3. Tai Ran Hsu, *"MEMS and Microsystems Design and Manufacture"*, 6th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2002.

WEB REFERENCES:

1. www.sciencemag.org.handbook
2. www.cmxr.com/industrial/

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