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

2021-2022

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
Chairman
HINDUSTHAN COLLEGE OF ENGG & TECH

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.

Chairman - BoS
MCT - HiCET

Chairman

Dean (Academics)
HiCET

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. Narmadh
Chairman - BoS
MCT - HiCET

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Dean (Academics)
HiCET

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.

G. Naamadh
Chairman - BoS
MCT - HiCET

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Chairman

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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 2021-2022 and onwards

SEMESTER – I

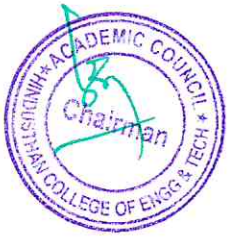
S.NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21HE1101	Technical English	HS	2	1	0	3	40	60	100
2	21MA1102	Calculus and Linear Algebra	BS	3	1	0	4	40	60	100
THEORY WITH LAB COMPONENT										
3	21PH1151	Applied Physics	BS	2	0	2	3	50	50	100
4	21CY1151	Chemistry for Engineers	BS	2	0	2	3	50	50	100
5	21CS1151	Python Programming and Practices	ES	2	0	2	3	50	50	100
6	21ME1152	Engineering Drawing	ES	1	0	4	3	50	50	100
PRACTICAL										
7	21HE1071	Language Competency Enhancement Course - I	HS	0	0	2	1	100	0	100
NON CREDIT MANDATORY COURSES										
8	21HE1072	Career Guidance – Level I Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
			TOTAL	**14**	**2**	**11**	**20**	**480**	**320**	**800**

SEMESTER – II										
S.NO	COURSE CODE	COURSE TITLE	COURSE CATEGORY	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	21HE2101	Business English for Engineers	HS	2	1	0	3	40	60	100
2	21MA2101	Differential Equations and Complex Variables	BS	3	1	0	4	40	60	100
3	21ME2101	Engineering Mechanics	ES	3	0	0	3	40	60	100
THEORY WITH LAB COMPONENT										
4	21PH2151	Material Science	BS	2	0	2	3	50	50	100
5	21CY2151	Environmental Studies	BS	2	0	2	3	50	50	100
6	21MT2153R	Basics of Mechatronics Engineering	ES	2	0	2	3	50	50	100
PRACTICAL										
7	21ME2001	Engineering Practices Lab	ES	0	0	4	2	60	40	100
8	21HE2701	Language Competency Enhancement Course - II	HS	0	0	2	1	100	0	100
NON CREDIT MANDATORY COURSES										
9	21HE2072	Career Guidance Level II Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
10	21HE2073	Entrepreneurship & Innovation	EEC	1	0	0	0	100	0	100
			TOTAL	**17**	**2**	**12**	**22**	**630**	**370**	**1000**

For the students admitted during the academic year 2020-2021 and onwards

SEMESTER III

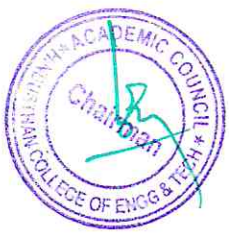
S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19MA3101	Fourier Series and Statistics	BS	3	1	0	4	25	75	100
2	19MT3201	Mechanics of solids	PC	3	1	0	4	25	75	100
3	19MT3202	Industrial Motor Control	PC	3	0	0	3	25	75	100
4	19MT3203R	Digital Electronics in Mechatronics Systems	PC	3	0	0	3	25	75	100
THEORY CUM PRACTICAL										



5	19MT3251R	Production Technology	PC	2	0	2	3	50	50	100
PRACTICAL										
6	19MT3001	Computer Aided Drafting Laboratory	PC	0	0	3	1.5	50	50	100
7	19MT3002R	Industrial Motor Control Laboratory	PC	0	0	3	1.5	50	50	100
MANDATORY										
8	19MC3191	Mandatory II : Indian Constitution	MC	2	0	0	0	100	0	100
9	19HE3072	**Career Guidance Level – III** Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
10	19HE3073	Leadership Management Skills	EEC	1	0	0	0	100	0	100
Total				**19**	**2**	**8**	**20**	**550**	**450**	**1000**

SEMESTER IV

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19MA4101	Numerical Methods	BS	3	1	0	4	25	75	100
2	19MT4201R	Microcomputer Systems and Microcontroller	PC	3	0	0	3	25	75	100
3	19MT4202	Thermodynamics and Fluid Engineering	PC	3	1	0	4	25	75	100
4	19MT4203R	Theory of Machines	PC	3	1	0	4	25	75	100
THEORY CUM PRACTICAL										
5	19MT4251	Sensors and Signal Conditioning	PC	2	0	2	3	50	50	100
PRACTICAL										
6	19MT4001R	Assembly Programming and Interfacing Laboratory	PC	0	0	3	1.5	50	50	100
7	19MT4002	Solid and Fluid Mechanics & Machinery Laboratory	PC	0	0	3	1.5	50	50	100
MANDATORY										



8	19MC4191	Mandatory III : Essence of Indian Traditional Knowledge	MC	2	0	0	0	100	0	100
9	19HE4072	**Career Guidance Level – IV:** Personality, Aptitude and Career Development	EEC	2	0	0	0	100	0	100
10	19HE4073	Ideation Skills	EEC	1	0	0	0	100	0	100
Total				**19**	**3**	**8**	**21**	**550**	**450**	**1000**

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

SEMESTER V

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19MT5201	Machine Design	PC	3	1	0	4	25	75	100
2	19MT5202	Industrial Automation and Control	PC	3	0	0	3	25	75	100
3	19MT5203	Control of Mechatronics Systems	PC	3	0	0	3	25	75	100
4	19MT53XX	**Professional Elective - I**	PE	3	0	0	3	25	75	100
THEORY CUM PRACTICAL										
5	19MT5251	Fluid Power Systems	PC	2	0	2	3	50	50	100
6	19MT5252	Object Oriented Programming	PC	2	0	2	3	50	50	100
PRACTICAL										
7	19MT5001	Computer Aided Machine Drawing Laboratory	PC	0	0	3	1.5	50	50	100
8	19MT5002	Industrial Automation and Control Laboratory - I	PC	0	0	3	1.5	50	50	100
MANDATORY										
9	19HE5071	Soft Skills - I	EEC	1	0	0	1	100	0	100
10	19HE5072	Design Thinking	EEC	1	0	0	1	100	0	100
Total				**18**	**1**	**10**	**24**	**500**	**500**	**1000**

SEMESTER VI

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
THEORY										
1	19MT6181	Total Quality Management	HE	3	0	0	3	25	75	100
2	19MT6201	Design of Mechatronics Systems	PC	3	0	0	3	25	75	100
3	19MT6202	CNC Technology	PC	3	0	0	3	25	75	100
4	19MT63XX	**Professional Elective - II**	PE	3	0	0	3	25	75	100
5	19MT6401	**Open Elective – I**	OE	3	0	0	3	25	75	100
THEORY CUM PRACTICAL										
6	19MT6251	Vetronics	PC	2	0	2	3	50	50	100
PRACTICAL										
7	19MT6001	CNC Laboratory	PC	0	0	3	1.5	50	50	100
8	19MT6002	Industrial Automation and Control Laboratory - II	PC	0	0	3	1.5	50	50	100
9	19MT6701	Inplant Training / Internship *	EEC	0	0	0	1	0	100	100
MANDATORY										
10	19HE6071	Soft Skills - II	EEC	1	0	0	1	100	0	100
11	19HE6072	Intellectual Property Rights (IPR)	EEC	1	0	0	1	100	0	100
Total				**19**	**0**	**8**	**24**	**475**	**625**	**1100**

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE - I

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
1	19MT5301	Engineering Metrology and Measurements	PE	3	0	0	3	25	75	100
2	19MT5302	Non-Traditional Machining Techniques	PE	3	0	0	3	25	75	100
3	19MT5303	Automobile Systems	PE	3	0	0	3	25	75	100
4	19MT5304	Operational Research	PE	3	0	0	3	25	75	100
5	19MT5305	Materials Science and Applications	PE	3	0	0	3	25	75	100

PROFESSIONAL ELECTIVE - II

S.No.	Course Code	Course Title	Course Category	L	T	P	C	CIA	ESE	TOTAL
1	19MT6301	Embedded System	PE	3	0	0	3	25	75	100
2	19MT6302	Discrete Event System Simulation	PE	3	0	0	3	25	75	100
3	19MT6303	Product Design and Development	PE	3	0	0	3	25	75	100
4	19MT6304	Non-Destructive Testing Techniques	PE	3	0	0	3	25	75	100
5	19MT6305	Distinctive Electrical Machines	PE	3	0	0	3	25	75	100

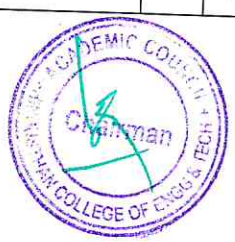
OPEN ELECTIVE

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
1	19MT6401	Industrial Safety and Environment	3	0	0	3	25	75	100

For the students admitted during the academic year 2018-2019 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

ACADEMIC COUNCIL * HINDUSTHAN COLLEGE OF ENGG & TECH * Chairman

SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	21HE1101	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, 2021.

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.	21MA1102	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 ofengineering.
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 toCO1: 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.	21PH1151	APPLIED PHYSICS	2	0	2	3

Course Objective

1. Enhance the fundamental knowledge in properties of matter
2. Analysis the oscillatory motions ofparticles
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 reconstructionof 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
	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.	21CY1151	CHEMISTRY FOR ENGINEERS (COMMON TO ALL BRANCHES)	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

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. **Estimation of total, permanent and temporary hardness of water by EDTA**	6 +3=9
II	**POLYMER & COMPOSITES** 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. **Conductometric titration of strong acid vs strong base (HCl vs NaOH). Conductometric precipitation titration using $BaCl_2$ and Na_2SO_4. Estimation of Ferrous iron by Potentiometry.**	6+9 =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 – principle – instrumentation (block diagram only) – flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry – atomic absorption spectroscopy – principles – instrumentation (block diagram only) – estimation of nickel by atomic absorption spectroscopy. **Determination of iron content of the water sample using spectrophotometer.(1,10 phenanthroline / thiocyanate method).**	6+3
	Total Instructional Hours	**45**

Course Outcome

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 the help of spectroscopy.

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TEXT BOOKS

T1 - P. N. Madudeswaran and B.Jeyagowri, "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd,ChennaiT2 - P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2018).

REFERENCES

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.	21CS1151	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, 2021

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.	21ME1152	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 acquire 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
	PLANE CURVES	
I	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
	PROJECTIONS OF POINTS, LINES AND PLANE SURFACES	
II	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
	PROJECTIONS OF SOLIDS	
III	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
	SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES	
IV	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
	ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS	
V	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.	21HE1071	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. Practical course in Spoken English by J.K. Gangal,PHI Learning , Second edition, 1 January 2018.

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Course code	Course title	L	T	P	C
21HE1072	CAREER GUIDANCE LEVEL - I Personality, Aptitude and Career Development	2	0	0	0
Pre-requisite	None	Syllabus version			
		1			

Course Objectives:

- Introduce students to building blocks of Logical reasoning and Quantitative Aptitude [SLO 1]
- Train students on essential grammar for placements [SLO 2]
- Introduce students on scientific techniques to pick up skills [SLO 3]
- Provide an orientation for recruiter expectation in terms of non-verbal skills, and for how to build one's career with placements in mind [SLO 4]

Expected Course Outcome:

Enable students to approach learning Aptitude with ease, and understand recruiter expectation.

Student Learning Outcomes (SLO): 1, 2, 3 and 4

Module:1 **Lessons on excellence** **1 hour** **SLO:** 3

Skill introspection, Skill acquisition, consistent practice

Module:2 **Logical Reasoning** **7 hours** **SLO:** 1

Thinking Skill

- Problem Solving
- Critical Thinking
- Lateral Thinking

Taught through thought-provoking word and rebus puzzles, and word-link builder questions

Coding & decoding, Series, Analogy, Odd man out and Visual reasoning

- Coding and Decoding
- Series
- Analogy
- Odd Man Out
- Visual Reasoning

Sudoku puzzles

Solving introductory to moderate level sudoku puzzles to boost logical thinking and comfort with numbers

Attention to detail

Picture and word driven Qs to develop attention to detail as a skill

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Module:3 Quantitative Aptitude **8 hours** **SLO:** 1

Speed Maths

- Addition and Subtraction of bigger numbers
- Square and square roots
- Cubes and cube roots
- Vedic maths techniques
- Multiplication Shortcuts
- Multiplication of 3 and higher digit numbers
- Simplifications
- Comparing fractions
- Shortcuts to find HCF and LCM
- Divisibility tests shortcuts

Algebra and functions

Module:4 Recruitment Essentials **1 hour** **SLO:** 4

Looking at an engineering career through the prism of an effective resume

- Importance of a resume - the footprint of a person's career achievements
- How a resume looks like?
- An effective resume vs. a poor resume: what skills you must build starting today and how?

Impression Management

Getting it right for the interview:

- Grooming, dressing
- Body Language and other non-verbal signs
- Displaying the right behaviour

Module:5 Verbal Ability **3 hours** **SLO:** 2

Essential grammar for placements:

- Nouns and Pronouns
- Verbs
- Subject-Verb Agreement
- Pronoun-Antecedent Agreement
- Punctuations

Verbal Reasoning

Total Lecture hours: 20 hours

Mode of Evaluation: Assignments, 3 Assessments with End Semester (Computer Based Test)

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	21HE2101	**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, 2186.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	21MA2101	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. Solution of ODE related to electric circuits, bending of beams.	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, "Engineering 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.	21ME2101	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, 2198.

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.	21PH2151	MATERIAL SCIENCE	2	0	2	3

Course Objective

1. Acquire fundamental knowledge of semiconducting materials which is related to the
1. 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	**SUPERCONDUCTING 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
	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.	21CY2151	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 inconservation 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
	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, 2021.

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.	21MT2153R	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 introduction of actuators

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	**ACTUATORS** Introduction-Types of actuators – characteristics of actuators- Examples and applications **Experimental Components: Basic connections of actuators and their functions**	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 about the actuators functions.

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.	21ME2001	ENGINEERING PRACTICES LAB	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)

11	Residential house wiring using switches, fuse, indicator, lamp and energy meter.
12	Fluorescent lamp wiring.
13	Stair case wiring.
14	Measurement of Electrical quantities – voltage, current, power & power factor in single phase circuits.
15	Measurement of energy using single phase energymeter.
16	Soldering practice using general purpose PCB.
17	Measurement of Time, Frequency and Peak Value of an Alternating Quantity using CRO and Function Generator.
18	Study of Energy Efficient Equipment's and Measuring Instruments.

Practical Hours 23

Total Practical Hours 45

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Course outcomes	On completion of the course the students will be able toCourse 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 ACCircuits.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	21HE2071	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. 4 Practical course in Spoken English by J.K. Gangal,PHI Learning , Second edition, 1 January 2018.

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Course code	Course title	L	T	P	C
21HE2072	CAREER GUIDANCE LEVEL - II Personality, Aptitude and Career Development	2	0	0	0
Pre-requisite	None	Syllabus version			
		1			

Course Objectives:

- Solve Logical Reasoning questions of easy to intermediate level [SLO 6]
- Solve Quantitative Aptitude questions of easy to intermediate level [SLO 7]
- Solve Verbal Ability questions of easy to intermediate level [SLO 8]

Expected Course Outcome:

Enable students to solve questions on Verbal, Logical and Quantitative Aptitude of placement level

Student Learning Outcomes (SLO): 6, 7, 8

Module:1 Logical Reasoning **5 hours** **SLO:** 6

Word group categorization questions

Puzzle type class involving students grouping words into right group orders of logical sense

Cryptarithmetic

Data arrangements and Blood relations

- Linear Arrangement
- Circular Arrangement
- Multi-dimensional Arrangement
- Blood Relations

Module:2 Quantitative Aptitude **8 hours** **SLO:** 7

Ratio and Proportion

- Ratio
- Proportion
- Variation
- Simple equations
- Problems on Ages
- Mixtures and alligations

Percentages, Simple and Compound Interest

- Percentages as Fractions and Decimals
- Percentage Increase / Decrease
- Simple Interest
- Compound Interest
- Relation Between Simple and Compound Interest

Number System

- Number system
- Power cycle
- Remainder cycle
- Factors, Multiples
- HCF and LCM

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Module:3 Verbal Ability **7 hours** **SLO: 8**

Essential grammar for placements

- Prepositions
- Adjectives and Adverbs
- Tenses
- Forms and Speech and Voice
- Idioms and Phrasal Verbs
- Collocations, Gerund and Infinitives

Reading Comprehension for placements

- Types of questions
- Comprehension strategies
- Practice exercises

Articles, Prepositions and Interrogatives

- Definite and Indefinite Articles
- Omission of Articles
- Prepositions
- Compound Prepositions and Prepositional Phrases
- Interrogatives

Vocabulary for placements

- Exposure to solving questions of
- Synonyms
- Antonyms
- Analogy
- Confusing words
- Spelling correctness

Total Lecture hours: 20 hours

Mode of Evaluation: Assignments, 3 Assessments with End Semester (Computer Based Test)

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	21HE2073	ENTREPRENUERSHIP & INNOVATION	1	0	0	0

Course Objective

1. To acquire the knowledge and skills needed to manage the development of innovation.
2. To recognize and evaluate potential opportunities to monetize these innovations.
3. To plan specific and detailed method to exploit these opportunities.
4. To acquire the resources necessary to implement these plans.
5: To make students understand organizational performance and its importance.

Module	Description	Instructional Hours
1.	Entrepreneurial Thinking	
2.	Innovation Management	
3.	Design Thinking	
4.	Opportunity Spotting / Opportunity Evaluation	
5.	Industry and Market Research	
6.	Innovation Strategy and Business Models	
7.	Financial Forecasting	
8.	Business Plans/ Business Model Canvas	
9.	Entrepreneurial Finance	
10.	Pitching to Resources Providers / Pitch Deck	
11.	Negotiating Deals	
12.	New Venture Creation	
13.	Lean Start-ups	
14.	Entrepreneurial Ecosystem	
15.	Velocity Venture	
	Total Instructional Hours	**15**

Course Outcome

CO1: Understand the nature of business opportunities, resources, and industries in critical and creative aspects.
CO2: Understand the processes by which innovation is fostered, managed, and commercialized.
CO3: Remember effectively and efficiently the potential of new business opportunities.
CO4: Assess the market potential for a new venture, including customer need, competitors, and industry attractiveness..
CO5: Develop a business model for a new venture, including revenue. Margins, operations, working capital, and investment.

TEXT BOOKS

T1: Arya Kumar "Entrepreneurship – Creating and leading an Entrepreneurial Organization", Pearson, Second Edition (2012).
T2: Emrah Yayici "Design Thinking Methodology", Artbiztech, First Edition(2016).

REFERENCE BOOKS

R1: Christopher Golis "Enterprise & Venture Capital", Allen & Unwin Publication, Fourth Edition (2007).
R2: Thomas Lock Wood & Edger Papke "Innovation by Design", Career Press.com, Second Edition (2017).R3: Jonathan Wilson "Essentials of Business Research", Sage Publication, First Edition (2010).

WEB RESOURCES

W1: https://blof.forgeforward.in/tagged/startup-lessons
W2: https://blof.forgeforward.in/tagged/entrepreurship
W3: https://blof.forgeforward.in/tagged/minimum-viable-product
W4: https://blof.forgeforward.in/tagged/minimum-viable-product
W5: https://blof.forgeforward.in/tagged/innovation
W6:https://www.youtube.com/watch?v=8vEyL7uKXs&list=PLmP9QrmTNPqBEvKbMSXvwlwn7fdnXe6Lw

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MA3101	FOURIER SERIES AND STATISTICS (AERO, AUTO, MECH, AND MCT)	3	1	0	4

Course Objective

1. Analyze Fourier series which is central to many applications in engineering.
2. Solve boundary value problems by applying Fourier series.
3. Demonstrate knowledge of large-sample statistical properties.
4. Apply basic concepts of statistical methods for testing the hypothesis.
5. Analyze design of experiment techniques to solve various engineering problem.

Unit	Description	Instructional Hours
I	**FOURIER SERIES** Dirichlet's conditions - General Fourier Series - Odd and Even Functions - Half range sine and cosine series - Change of Interval - Parseval's Identity - Harmonic analysis	12
II	**BOUNDARY VALUE PROBLEMS** Classification - Solution of one dimensional equation - One dimensional heat equation - Fourier series solution in Cartesian coordinates.	12
III	**TESTS BASED ON LARGE SAMPLES** Large sample tests based on Normal distribution - Test of significance for single proportion - Test of significance for difference of proportions - Test of significance for single means -Test of significance for difference of means.	12
IV	**TESTS BASED ON SMALL SAMPLES** Tests based on t (for single mean and difference of means) - F distribution for testing difference of variance, Chi-Square test for Contingency table (Test for Independency) - Goodness of fit.	12
V	**ANOVA** Introduction, assumptions of analysis of variance - Completely randomized design – Randomized block design – Latin square design.	12
	Total Instructional Hours	60

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: Apply the concept of application of Fourier series in solving the heat and wave equations.
- CO3: Understand the mix proportioning techniques for field applications.
- CO4: Understand the concepts of statistical methods for testing the hypothesis.
- CO5: Apply design of experiment techniques to solve various engineering problem.

TEXT BOOKS:

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

T2- Gupta, S.C., & Kapoor, V.K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons,Reprint 2019.

REFERENCE BOOKS:

R1- Veerarajan. T.,"Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., Reprint, New Delhi, 2016.

R2- Kandasamy P., Thilagavathy K. and Gunavathy K.,"Engineering Mathematics Volume III", S.Chand & Company Ltd., New Delhi, 2015.

R3- Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2018.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT3201	MECHANICS OF SOLIDS	3	1	0	4

Course Objective

6. To impart the basic elastic response of the engineering materials
7. To find out the concept of shear force and bending moment in beams
8. To familiarize the concept of torsion in shafts and stresses in different springs
9. To impart knowledge on stresses and load structural members
10. 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
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
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
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
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
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO6: Compute stresses and strain under different load conditions
CO7: Sketch the shear force and bending moment diagrams of different beams
CO8: Analyse the stresses and strains in shafts subjected torsion
CO9: Design standard beams for safe working conditions
CO10: Investigate the mode of failure in pressure vessels

TEXT BOOKS:

T3- Bansal, R.K., "Strength of Materials", 6th Edition, Laxmi Publications (P) Ltd., New Delhi, 2017.
T4- Ferdinand P. Beer "Mechanics of solids", 7th Edition, McGraw Hill Education, New Delhi, 2014.

REFERENCE BOOKS:

R4- Khrumi R S "Strength of Materials", 21ST Edition, s Chand. Ltd., New Delhi, 2008.
R5- Rajput, R. K, "A Textbook of Strength of Materials", 7th Edition, S. Chand and company Ltd., New Delhi, 2016.
R6- Hibbeler, R.C., "Mechanics of Materials", 8th Edition, Pearson Education, New Delhi, 2011.

WEB REFERENCES:

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.	19MT3202	INDUSTRIAL MOTOR CONTROL	3	0	0	3

Course Objective

1. To identify the control circuit components used in electrical circuit
2. To illustrate the basic control circuits for industrial motors
3. To select the suitable starting and braking methods for electrical machines
4. To find the different types of power switching devices
5. To impart knowledge on operation, switching techniques and basics topologies for power electronics

Unit	Description	Instructional Hours
I	**Basic Control Circuit Components** General Principles of Motor Control - Symbols and Schematic Diagrams - Manual Starters, AC starters and DC starters (2 point 3 point) - overload relays - Relays, Contactors- Basic Control Circuits components and switches.	9
II	**Basic Control Circuits** START - STOP Push Button Control - Multiple Push Button Stations – Forward - Reverse Control - Jogging and Inching - Timing Relays - Sequence Control	9
III	**Starting and Braking Methods** DOL Starter - Automatic Auto Transformer Starter, Star/Delta Starter (Semi Automatic and Automatic) Three Step Rotor Resistance Starter - Plugging - Dynamic Braking	9
IV	**Power Semi-Conductor Devices** Study of switching devices: SCR, TRIAC, GTO, BJT, MOSFET, IGBT and IGCT - Static characteristics: SCR, MOSFET and IGBT - Triggering and commutation circuit for SCR - Introduction to Driver and Snubber circuits.	9
V	**Power Electronics Applications** Half bridge and Full bridge: Single phase and Three phase converter - Choppers types - Serial and Parallel Inverter - Single phase and Three phase cycloconverters – Applications - Induction heating, UPS.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

- CO1: Recognize the control circuit components used in electrical wiring
- CO2: Apply the control circuits in industrial motor control
- CO3: Sketch the control circuits for Starting and Braking Methods
- CO4: Analyze the power semi-conductor devices
- CO5: Ability to choose the converters and inverters for real time applications

TEXT BOOKS:

T1- Stephen L. Herman, "Understanding Motor Controls" Third Edition. Cengage Learning, 2017.

T2- M.H. Rashid, "Power Electronics: Circuits, Devices and Applications", Pearson Education, fourth Edition, New Delhi, 2014

REFERENCE BOOKS:

R1- Stephen L. Herman, "Industrial Motor Control" Seventh Edition, Cengage Learning,2013

R2- Bhattacharya.S.K & Brijinder Singh, "Control of Electrical Machines", 2nd Edition, New Age International (P) Ltd., New Delhi, 2010.

R3- M.D. Singh and K.B. Khanchandani, "Power Electronics," 2nd Edition Mc Graw Hill India, 2013.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT3203R	DIGITAL ELECTRONICS IN MECHATRONICS SYSTEMS	3	0	0	3

Course Objective

1. To impart knowledge about the fundamentals of logic gates and boolean algebra
2. To build up various combinational circuits
3. To describe various flip-flops used in sequential circuits
4. To familiarize the basics of memory devices
5. To illustrate the digital concepts in mechatronics applications

Unit	Description	Instructional Hours
I	**LOGIC GATES AND MINIMIZATION TECHNIQUES** Minimization Techniques: Boolean Algebra - Simplification of Boolean Functions - Minterm – Maxterm - Sum of Product - Product of Sum - Karnaugh Map – Quine McClusky Method Binary Number System-Logic Gates: Logic Functions using Gates - NAND - NOR Implementations - Multi Level Gate Implementations - Multi Output Gate Implementations	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 the logic circuits and to evaluate its function realizations using gates
- CO2: Develop combinational circuit systems using flip flops
- CO3: Apply the minimization techniques in sequential circuits
- CO4: Compare the memory 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", 2nd Edition, Thomson Learning, 2006.

REFERENCE BOOKS:

R1- John F.Wakerly, "Digital Design", 4th Edition, PHI Learning Private Limited, New Delhi, 2006.
R2- Thomas L. Floyd, "Digital Fundamentals", 11th Edition, PHI Learning Private Limited, New Delhi, 2014.
R3- Charles H.Roth, "Fundamentals of Logic Design", 7th Edition, Thomson Learning, 2003.

WEB REFERENCES:

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.	19MT3251R	PRODUCTION TECHNOLOGY	2	0	2	3

Course Objective

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

Theory

Unit	Description	Instructional Hours
I	**CASTING** Patterns - Cores - Moulding - Green Sand Moulding - Special Casting Process, Shell Mould Casting - Investment Casting - Centrifugal Casting - Casting Defects.	9
II	**MACHINING** Lathe Machine - Lathe Operations - Drilling Machines - Reaming and Tapping Operations - Shaper - Milling Machine. **Experimental Components: Lathe - Facing, Step Turning and Taper Turning**	6+3
III	**WELDING** Arc Welding - Gas Welding - Thermit Welding - Friction Welding - TIG & MIG Welding - Welding Defects. **Experimental Components: Lathe - Grooving, Thread Cutting and Knurling**	6+3
IV	**FORMING** Rolling Operations - Forging Operations - Extrusion and Types - Piercing - Punching - Trimming. **Experimental Components: Drilling, Tapping and Reaming**	6+3
V	**FINISHING OPERATIONS AND APPLICATIONS OF PRODUCTION TECHNOLOGY** Grinding - Lapping - Honing - Broaching. Applications: Marine Propeller Manufacturing - PCB Board Manufacturing. **Experimental Components: Surface Grinding and Slot Cutting**	6+3
	Instructional Hours	33 +12
	Total Instructional Hours	**45**

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

T1- Kalpak Jain, "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", 6th Edition, Arnold Publisher, New Delhi, 2006.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT3001	COMPUTER AIDED DRAFTING LABORATORY	0	0	3	1.5

Course Objective

1. To develop skills on using software for preparing 2D Drawings.
2. To illustrate basic engineering drawing formats
3. To provide the importance of computer aided drawing in engineering society.
4. To develop surface model of given engineering problems
5. To apply the knowledge of engineering graphics

Concepts and Conventions:

Understand the basic idea of software and its features like draw panel, modify panel, line types, creating dimensions, hatching techniques, layer Creations, text styles, and template drawings, use of Blocks, Design Center, Tool Palettes and Plotting.

Unit	Description of the Experiments	Practical Hours
1	Study of drafting software– Coordinate systems (absolute, relative, polar, etc.) – Creation of simple geometries like polygon and general multi-line figures.	
2	Drawing the conic and special curves.	
3	Draw the orthographic projections of simple solids like Prism, Pyramid, Cylinder, Cone and it's dimensioning.	
4	Draw the symbols of fasteners, weld, rivets, bolts nuts and screws.	
5	Drawing Isometric projection of simple objects.	
6	Draw the orthographic projections of Bush bearing.	
7	Draw the orthographic projections of Oldham's coupling.	
8	Draw the orthographic projections of cotter joint.	
9	Draw the orthographic projections of simple gate valve.	
10	Draw the Plan and Elevation of simple Residential Building.	
11	Drawing of simple steel truss	
12	Drawing sectional views of prism, pyramid, cylinder and cone	
	Total Practical Hours	45

On completion of the course the students will be able to

Course Outcome

CO1: Sketch simple figures with title block using AutoCAD software commands
CO2: Use the software package for drafting
CO3: Create 2D Drawing of Engineering Components
CO4: Apply basic concepts to develop construction drawing techniques
CO5: Design and modeling the given engineering problems

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT3002R	INDUSTRIAL MOTOR CONTROL LABORATORY	0	0	3	1.5

Course Objective

To provide hands-on training for automatic starters of electrical motors

1. To impart knowledge on control circuits for jogging and reversing operations
2. To understand solid state devices by conducting experiments
3. To identify the proper gating sequence and control circuit
4. To construct timer using IC 555

Unit	Description of the Experiments
1	Starting and control of cage motor by jogging method.
2	Starting and control of motor by DOL Starter method.
3	Study the effect of Forward and Reverse Operations control in cage motors.
4	Wire and Test the Control Circuit for Automatic Star-Delta Starter
5	Wire and Test the Control Circuit for Semi-Automatic Star-Delta Starter
6	Control Circuit for Single Phase Preventer.
7	Study of SCR characteristics
8	Study of MOSFET characteristics
9	Study of IGBT characteristics
10	UJT firing circuits for SCR
11	R and RC firing circuits for SCR
12	Electronics timer using IC 555
	Total Practical Hours 45

Course Outcome

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

CO1: To explain the various types of starters using contactors and relays
CO2: To develop the control circuits for jogging and reversing operations
CO3: To analyze solid state switches
CO4: To develop the firing circuit for SCR
CO5: To infer the IC555 timer circuits.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MC3191	INDIAN CONSTITUTION	2	0	0	0

Course Objective

1. To Sensitization of student towards self, family (relationship), society and nature.
2. Understanding (or developing clarity) of nature, society and larger systems, on the basis of human relationships and resolved individuals.
3. Strengthening of self reflection.
4. Development of commitment and courage to act.

Unit	Description	Instructional Hours
	BASIC FEATURES AND FUNDAMENTALE PRINCIPLES	
I	Meaning of the constitution law and constitutionalism – Historical perspective of the constitution of India – salient features and characteristics of the constitution of India.	4
	FUNDAMENTAL RIGHTS	
II	Scheme of the fundamental rights – fundamental duties and its legislative status – The directive principles of state policy – its importance and implementation - Federal structure and distribution of legislative and financial powers between the union and states.	4
	PARLIAMENTARY FORM OF GOVERNMENT	
III	The constitution powers and the status of the president in India. – Amendement of the constitutional powers and procedures – The historical perspective of the constitutional amendment of India – Emergency provisions : National emergency, President rule, Financial emergency.	4
	LOCAL GOVERNANCE	
IV	Local self government -constitutional scheme of India – Scheme of fundamental right to equality – scheme of fundamental right to certain freedom under article19 – scope of the right to life and personal liberty under article 21.	4
	INDIAN SOCIETY	
V	Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.	4
	Total Instructional Hours	20

Course Outcome

On completion of the course the students will be able to

CO1: Understand the functions of the Indian government

CO2: Understand and abide the rules of the Indian constitution

TEXT BOOKS:

T1- Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.

T2- R.C.Agarwal, (1997) "Indian Political System", S.Chand and Company, New Delhi.

T3- Maciver and Page, " Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.

T4- K.L.Sharma, (1997) "Social Stratification in India: Issues and Themes", Jawaharlal Nehru University, New Delhi.

REFERENCE BOOKS:

R1- Sharma, Brij Kishore, " Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.Stenerson

R2- U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar.

R3- R.N.Sharma, "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.

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Course code	Course title	L	T	P	C
19HE3072	CAREER GUIDANCE LEVEL - III Personality, Aptitude and Career Development	2	0	0	0
Pre-requisite	None	Syllabus version 1			

Course Objectives:

- Solve Logical Reasoning questions of easy to intermediate level [SLO 6]
- Solve Quantitative Aptitude questions of easy to intermediate level [SLO 7]
- Solve Verbal Ability questions of easy to intermediate level [SLO 8]
- Display good writing skills while dealing with essays [SLO 12]

Expected Course Outcome:

Enable students to solve Aptitude questions of placement level with ease, as well as write effective essays.

Student Learning Outcomes (SLO): 6, 7, 8, 12

Module:1 Logical Reasoning **6 hours** **SLO:6**

Clocks, calendars, Direction sense and Cubes

- Clocks
- Calendars
- Direction Sense
- Cubes

Data interpretation and Data sufficiency

- Data Interpretation – Tables
- Data Interpretation - Pie Chart
- Data Interpretation - Bar Graph
- Data Sufficiency

Module:2 Quantitative Aptitude **7 hours** **SLO: 7**

Time and work

- Work with different efficiencies
- Pipes and cisterns
- Work equivalence
- Division of wages

Time, Speed and Distance

- Basics of time, speed and distance
- Relative speed
- Problems based on trains
- Problems based on boats and streams
- Problems based on races

Profit and loss, Partnerships and averages

- Basic terminologies in profit and loss
- Partnership

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- Averages
- Weighted average

Module:3 Verbal Ability **5 hours** **SLO:** 8

Sentence Correction

- Subject-Verb Agreement
- Modifiers
- Parallelism
- Pronoun-Antecedent Agreement
- Verb Time Sequences
- Comparisons
- Prepositions
- Determiners

Sentence Completion and Para-jumbles

- Pro-active thinking
- Reactive thinking (signpost words, root words, prefix suffix, sentence structure clues)
- Fixed jumbles
- Anchored jumbles

Module:4 Writing skills for placements **2 hours** **SLO:** 12

Essay writing

- Idea generation for topics
- Best practices
- Practice and feedback

Total Lecture hours: 20 hours

Mode of Evaluation: Assignments, 3 Assessments with End Semester (Computer Based Test)

Recommended by Board of Studies

Approved by Academic Council Date

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE3073	LEADERSHIP MANAGEMENT SKILLS	1	0	0	0

Course Objective`

1. To know about the leadership skills that is to be acquired for success.
2. To become a teamwork expert, real world problem solver, your views will be challenged
3. To gain global perspective and becoming an effective communicator
4. To understand about learning, negotiation and decision making
5: To get first hand information about the skills we possess and to work on improvement.

Module	Description	Instructional Hours
1.	Strategic thinking skills	
2.	Planning and Delivery skills	
3.	People management skills (Delegation)	
4.	Change management and Innovation skills	
5.	Communication skills	
6.	Persuasion and influencing skills	
7.	Learning Agility	
8.	Motivation	
9.	Personality	
10.	Emotions	
11.	Perception	
12.	Negotiation	
13.	Decision making	
14.	Problem solving	
15.	Building trust	
	Total Instructional Hours	**15**

Course Outcome

CO1: To practice essential leadership skills in day to day operations
CO2: To work on leadership skills in the study environment
CO3: To understand and develop the skills consciously.
CO4: To know about the real worth of all the skills for success
CO5: To Analyze the real worth of the person and suggestion for improvement

TEXT BOOKS

T1: A REVIEW OF LEADERSHIP THEORY AND COMPETENCY FRAMEWORKS, Bolden, R., Gosling, J., Marturano, A. and Dennison, P. June 2003
T2: LEADING FROM WITHIN: Building Organizational Leadership Capacity-David R. Kolzow, PhD, 2014

REFERENCE BOOKS

R1: Seven habits of highly effective people – Stephen R.Covey
R2: The Art of Business Leadership: Indian Experiences – G.Balasubramaniam
R3: DEVELOPING the LEADER WITHIN YOU-JOHN C. MAXWELL

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MA4101	NUMERICAL METHODS (AERO, AUTO, MECH, and MCT)	3	1	0	4

Course Objective

1. Solve algebraic, transcendental and system of linear equations by using various techniques.
2. Apply various methods to find the intermediate values for the given data.
3. Explain concepts of numerical differentiation and numerical integration of the unknown functions.
4. Explain single and multi step methods to solve Ordinary differential equations
5. Describe various methods to solve ordinary differential equations and partial differential equations.

Unit	Description	Instructional Hours
I	**SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS** Solution of Algebraic and Transcendental equations: Newton Raphson method . Solution of linear system: Gauss Elilmination - Gauss Jordan method -Gauss seidel method. Matrix inversion by Gauss Jordan method.	12
II	**INTERPOLATION** Interpolation - Newton's forward and backward difference formulae – Newton's divided difference formula and Lagrangian interpolation for unequal intervals..	12
III	**NUMERICAL DIFFERENTIATION AND INTEGRATION** Numerical Differentiation: Newton's forward and backward interpolation formulae for equal intervals - Newton's divided difference formula for unequal intervals. Numerical integration: Trapezoidal and Simpson's 1/3 rule - Double integration using Trapezoidal and Simpson's rules	12
IV	**INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS** Single step methods for solving first order equations: Taylor's series method - Euler and Modified Euler methods - Fourth order Runge-kutta method - Multi step method: Milne's predictor and corrector method.	12
V	**BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS** Solution of second order ordinary differential equation by Finite difference method - Solution of partial differential equation: one dimensional heat equation by Bender schmidt method - One dimensional Wave equation by Explicit method– Poisson Equations by Finite difference method.	12
	Total Instructional Hours	60

Course Outcome

On completion of the course the students will be able to

- CO1: Solve the system of linear algebraic equations representing steady state models and non linear equations arising in the field of engineering.
- CO2: Apply various methods to find the intermediate values for the given data.
- CO3: Identify various methods to perfrom numerical differentiation and l integration
- CO4: Classify and solve ordinary differential equations by using single and multi step methods.
- CO5: Illustrate various methods to find the solution of ordinary and partial differential equations.

TEXT BOOKS:

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

T2- Kreyszig.E. "Advanced Engineering Mathematics", Eight Edition, John Wiley and sons (Asia) limited.

REFERENCE BOOKS:

R1- M.K.Jain,S.R.K.Iyengar, R.K.Jain "Numerical methods for Scientific and Engineering Computation", Fifth Edition, New Age International publishers 2010.

R2- Grewal B.S. and Grewal J.S. " Numerical Methods in Engineering and Science ", 6th Edition , Khanna publishers, New Delhi 2015.

R3- S.K.Gupta, Numerical Methods for Engineers ", New Age International Pvt.Ltd Publishers,2015.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT4201R	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
3. To familiarize about the basics of 8051 microcontroller
4. To learn the programming language of 8051 microcontroller
5. To list out the applications of microprocessor and microcontroller in various fields

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) - A/D and D/A Converters.	9
III	**8051 MICROCONTROLLER** Selection of Microcontrollers - 8051 Microcontroller Architecture - Pin Configuration - Memory Organization - Special Function Registers - Instruction Set of 8051 - Addressing Modes.	9
IV	**ASSEMBLY LANGUAGE PROGRAMMING** I/O Port Programming - Timer Programming - Counter Programming - Serial Communication Programming - Interrupt Programming.	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, Microcontrollers, Robotics and 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. NagoorKani, "Microprocessors & Microcontrollers", 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2012.

T2- Mazidi Muhammad Ali, Mazidi Janice Gillispie and McKinlayRolin, "The 8051 Microcontroller and Embedded Systems", 2nd Edition, PHI Learning Private Limited, New Delhi, 2013.

REFERENCE BOOKS:

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

R2- Ramesh Goankar, "Microprocessor Architecture, Programming and Applications with 8085", 5th Edition, Penram International, Mumbai, 2013.

R3- Kennath Ayala, "The 8051 Microcontroller", 3rd Edition, Thomos Delmar Learning, 2014.

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.	19MT4202	THERMODYNAMICS AND FLUID ENGINEERING	3	1	0	4

Course Objective

1. To interpret the basic concepts of thermodynamics
2. To express the basic concepts of heat engines and gas laws
3. To explain the refrigeration systems
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	**REFRIGERATION** Principles of Refrigeration - Refrigerator - 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	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** Darcy Weisbach Equation - Laminar Flow and Turbulent Flow - Minor Losses - Introduction to Flow Through Pipes - 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, 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", 5th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2014.

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

REFERENCE BOOKS:

R1- Kumar.D.S, "Engineering Thermodynamics", 2nd Edition, S.K. Kataria & Sons, 2012.

R2- Bansal.R.K, "Fluid Mechanics and Hydraulic Machines", Laxmi Publications (P) Ltd., New Delhi, 2010.

R3- 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.	19MT4203R	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 the 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
	MECHANISMS	
I	Introduction - Kinematic Links, Joints, Pairs and Chains - Degree of Freedom - Mobility - Kutzbach Criterion - Grashoff's Law - Inversions of Mechanism - Single Slider Mechanism - Double Slider Mechanism – Velocity Diagram of Single Slider Mechanism	9+3
	CAMS	
II	Classification of Cams - Classification of Followers - Terminology used in Radial cams - Displacement Diagram - Uniform Velocity, Parabolic, Simple Harmonic and Cycloidal Motions on Radial Cams - Constructions of Cam Profiles.	9+3
	GEARS AND GEAR TRAINS	
III	Gears classification - Law of Toothed Gearing - Terminology - Gear Tooth Action - Interference - Simple Gear Trains - Compound Gear Trains - Epicyclic Gear Trains - Compound Epicyclic Gear Trains.	9+3
	VIBRATION	
IV	Introduction - Types - Free Longitudinal Vibrations - Free Transverse Vibrations - Whirling Speed of the Shaft - Free Damped Vibration - Damping Factor - Logarithmic decrement - Under damped forced vibration - Vibration isolation and Transmissibility.	9+3
	BALANCING	
V	Balancing of Rotating Masses - Single Mass Rotating in the Same Plane - Single Rotating Mass By Two Masses Rotating in Different Planes - Several Masses Rotating in the Same Plane - Several Masses Rotating in Different Planes - Case Study: Partial Balancing of Unbalanced Primary Force in a Reciprocating Engine	9+3
	Total Instructional Hours	45+15=60

Course Outcome

On completion of the course the students will be able to

- CO1: Design single and double slider mechanism
- CO2: Sketch different classifications of cam mechanisms
- CO3: Solve 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", 14th 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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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT4251	SENSORS AND SIGNAL CONDITIONING	2	0	2	3

Course Objective

1. To explain the fundamentals of measurements and classify the transducers and instruments
2. To impart knowledge in selection of inductive and capacitive transducers
3. To describe the vacuum and flow measuring methods
4. To acquire knowledge on optoelectronic sensors and modern sensors
5. To observe the information about data acquisition and data logging

THEORY

Unit	Description	Instructional Hours
I	**INTRODUCTION** Generalized Measurement System - Classification of Transducers - General transducers characteristics, Criteria for transducer selection - Resistive Transducer: Potentiometer - RTD - Thermistor – Thermocouple. **Experimental Components: Thermistor**	6+3
II	**INDUCTIVE AND CAPACITIVE TRANSDUCERS** Inductive Transducer: LVDT - RVDT - Capacitive Transducer - Piezoelectric Transducer - Hall Effect Sensor. **Experimental Components: LVDT and Capacitive Transducer.**	6+3
III	**PRESSURE AND FLOW TRANSDUCERS** Elastic Transducers: Diaphragm, Bourdon tube - Vacuum Measurement: McLeod Gauge - Thermal Conductivity Gauge - Ionization Gauge - Flow Measurement: Turbine Flow Meter, Hot Wire Anemometer - Speed & Load Measurements: Motor Speed sesor using Magnetic Pickup - Load Cell **Experimental Components: Servomotor Position Control**	6+3
IV	**OPTO ELECTRONICS AND MODERN SENSORS** Photo Conductive - Photo Voltaic Cells - Semiconductor Photodiode - Photo Transistors Smart Sensors - Film Sensors - MEMS and Nano Sensors.	9
V	**DATA ACQUISITION** 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. **Experimental Components: Voltage to Frequency Converter, Inverting & Non-inverting amplifiers and Sample and Hold Circuit**	6+3
	Instructional Hours	33 +12
	Total Instructional Hours (Theory + Practical)	45

Course Outcome

On completion of the course the students will be able to

CO1: Analyze the performance of thermistor and thermocouple
CO2: Classify the capacitive and inductive transducers
CO3: Describe elastic transducer, vacuum and flow measurement
CO4: Apply various electrical and electronic sensors in real time applications
CO5: Analyze the operations of various data acquisition systems

TEXT BOOKS:

T1- Beckwith, Marangoni and Lienhard, "Mechanical Measurements", 2nd Edition, Pearson Education, New Jersey, 2013
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- Murthy D V S, " Transducers & Instrumentation", 2nd Edition, PHI Learning Private Limited, New Delhi, 2010

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT4001R	ASSEMBLY PROGRAMMING AND INTERFACING LABORATORY	0	0	3	1.5

Course Objective

1. To impart the knowledge about microprocessor and microcontroller programs
2. To list the different interfacing I/O devices with microprocessor and microcontroller
3. To familiarize the ADC and DAC interfacing
4. To describe the stepper motor control using microcontroller
5. To study DC motor control interface using microcontroller

Unit	Description of the Experiments
1	Addition of Two 8 - Bit Numbers using 8085 Microprocessor
2	Subtractionof Two 8 - Bit Numbers using 8085 Microprocessor
3	Multiplication of Two 8 - Bit Numbers using 8085 Microprocessor
4	Division of Two 8 - Bit Numbers using 8085 Microprocessor
5	Analog to Digital Conversion (ADC) using 8085 Microprocessor
6	Digital to Analog Conversion (DAC) using 8085 Microprocessor
7	Largest Element in an Array using 8051 Microcontroller
8	Smallest Element in an Array using 8051 Microcontroller
9	Sourcing an Array in Descending order using 8051 Microcontroller
10	Sourcing an Array in Ascending order using 8051 Microcontroller
11	Stepper Motor Control using 8051 Microcontroller
12	DC Motor Control Interface using 8051 Microcontroller
	Total Practical Hours 45

Course Outcome

On completion of the course the students will be able to

CO1: Compile programs for 8085 microprocessor and 8051 microcontroller

CO2: Design the interfacing circuits with 8085 microprocessor & 8051 microcontroller

CO3: Develop a ADC and DAC interfacing

CO4: Infer the stepper motor interfacing with microprocessor

CO5: Demonstrate DC motor control using microcontroller

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT4002	SOLID AND FLUID MECHANICS & MACHINERY LABORATORY	0	0	3	1.5

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 of pelton wheel and Kaplan turbine

Unit	Description of the Experiments
1	Tension and Torsion test on a Mild Steel Rod
2	Deflection test on Beams
3	Compression test on Helical Springs
4	Impact test on Mild Steel Rod (Izod & charpy)
5	Hardness test on Metals by Brinell and by Rockwell Hardness
6	Double Shear test on Mild Steel Rod
7	Determination of Coefficient of Discharge by Venturimeter
8	Determination of Coefficient of Discharge by Orificemeter
9	Experimental and Verification of Bernoulli's Equation.
10	Conducting the experiments and drawing the characteristic curves of Centrifugal Pump and Gear Pump
11	Conducting the experiments and drawing the characteristic curves of Pelton Wheel Turbine
12	Conducting the experiments and drawing the characteristic curves of Kaplan Turbine
	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 in turbines

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Programme	Course code	Name of the course	L	T	P	C
B.E.	19MC4191	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE/VALUE EDUCATION	2	0	0	0

Course Objectives:

1) The course aims at imparting basic principles of thought process, reasoning and inferencing.
2) Sustainability is at the core of Indian Traditional Knowledge Systems connecting society and nature.
3) Holistic life style of Yogic-science and wisdom capsules in Sanskrit literature are also important in modern society with rapid technological advancements and societal disruptions.
4) The course focuses on introduction to Indian Knowledge System, Indian perspective of modern scientific world-view, basic principles of Yoga and holistic health care system, Indian philosophical traditions.Indian linguistic tradition and Indian artistic tradition.

UNIT	DESCRIPTIVE	INSTRUCTIONAL HOURS
UNIT I :	Basic Structure of Indian Knowledge System	4
UNIT II :	Modern Science and Indian Knowledge System	4
UNIT III :	Yoga and Holistic Health care	4
UNIT IV :	Philosophical tradition	4
UNIT V:	Indian linguistic tradition (Phonology, Morphology, Syntax and semantics), Indian artistic tradition and Case Studies.	4

TOTAL INSTRUCTIONAL HOURS: 20

Course Outcomes:

1) Ability to understand the structure of Indian system of life.
2) Connect up and explain basics of Indian Traditional knowledge in modern scientific perspective.
3) Understanding the holistic life style of yoga.
4) Understanding the tradition of philosophy.
5) Understanding the Indian linguistic and artistic tradition.

REFERENCE BOOKS:

R1. V. Sivaramakrishna (Ed.), Cultural Heritage of India-Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edition, 2014
R2. Swami Jitatmanand, Modern Physics and Vedant, Bharatiya Vidya Bhavan
R3. Fritzof Capra, Tao of Physics
R4. Fritzof Capra, The wave of Life.
R5. V N Jha (Eng. Trans,), Tarkasangraha of Annam Bhatta, Inernational Chinmay Foundation, Velliarnad, Amaku,am
R6. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkatta.
R7. GN Jha (Eng. Trans.) Ed. R N Jha, Yoga-darshanam with Vyasa Bhashya, Vidyanidhi Prakasham, Delhi, 2016.
R8. RN Jha, Science of Consciousness Psychotherapy and Yoga Practices, Vidyanidhi Prakasham, Delhi, 2016.
R9. P R Sharma (English translation), Shodashang Hridayam.

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Course code	Course title	L	T	P	C
19HE4072	CARRER GUIDANCE LEVEL- IV Personality, Aptitude and Career Development	2	0	0	0
Pre-requisite	None	Syllabus version 1			

Course Objectives:

- Solve Logical Reasoning questions of easy to intermediate level [SLO 6]
- Solve Quantitative Aptitude questions of easy to intermediate level [SLO 7]
- Solve Verbal Ability questions of easy to intermediate level [SLO 8]
- Crack mock interviews with ease [SLO 13]
- Be introduced to problem-solving techniques and algorithms [SLO 14]

Expected Course Outcome:

Enable students to solve Aptitude questions of placement level with ease, as well as write effective essays.

Student Learning Outcomes (SLO): 6, 7, 8, 13, 14

Module:1 Logical Reasoning **3 hours** **SLO:6**

Logical connectives, Syllogism and Venn diagrams

- Logical Connectives
- Syllogisms
- Venn Diagrams – Interpretation
- Venn Diagrams - Solving

Module:2 Quantitative Aptitude **6 hours** **SLO: 7**

Logarithms, Progressions, Geometry and Quadratic equations

- Logarithm
- Arithmetic Progression
- Geometric Progression
- Geometry
- Mensuration
- Coded inequalities
- Quadratic Equations

Permutation, Combination and Probability

- Fundamental Counting Principle
- Permutation and Combination
- Computation of Permutation
- Circular Permutations
- Computation of Combination
- Probability

Module:3 Verbal Ability **2 hours** **SLO: 8**

Critical Reasoning

- Argument – Identifying the Different Parts (Premise, assumption, conclusion)
- Strengthening statement

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- Weakening statement
- Mimic the pattern

Module:4 Recruitment Essentials **1 hour** **SLO:** 12

Cracking interviews - demonstration through a few mocks

Sample mock interviews to demonstrate how to crack the:

- HR interview
- MR interview
- Technical interview

Cracking other kinds of interviews

- Skype/ Telephonic interviews
- Panel interviews
- Stress interviews

Resume building – workshop

A workshop to make students write an accurate resume

Module:5 Problem solving and Algorithmic skills **8 hours** **SLO:** 12

- Logical methods to solve problem statements in Programming
- Basic algorithms introduced

Total Lecture hours: 20 hours

Mode of Evaluation: Assignments, Mock interviews, 3 Assessments with End Semester (Computer Based Test)

Recommended by Board of Studies

Approved by Academic Council Date

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE4073	IDEATION SKILLS	1	0	0	0

Course Objective

- To study the importance of ideation.
- To learn about the various tools for Ideation.
- To provide an insight in Prototyping and its significance.

Unit	Description	Instructional Hours
	IDEATION: INTRODUCTION TO DESIGN THINKING METHODOLOGY	
I	Design Thinking Methodology and how it can be used as a powerful tool for developing new and innovative solutions - Inspiration – Implementation - Disruptive technology.	4
	IDEATION: TOOLS FOR IDEATION	
II	Various resources to kindle new ideas for innovation. Explore the types of ideas in the past – Effect of the ideas and innovation of past on the world – Innovation Thinking – Case studies.	4
	IDEATION: INTRODUCTION TO CUSTOMER DISCOVERY	
III	Intro to Customer Discovery - development of customer discovery plan that can lead to powerful business innovation - Customer Discovery Plan	4
	PROTOTYPING AND PRODUCT IDEATION	
IV	Introduction to Prototyping - minimum viable product - High fidelity prototype vs low fidelity prototype – Prototyping tools	3
	Total Instructional Hours	**15**

Course Outcome

Upon completion of the course, students will be able to
CO1: Develop a strong understanding and importance of ideation
CO2: Learn about the different kinds of tools for Ideation.
CO3: Learn the need and significance of prototyping and its significance.

TEXT BOOKS:

T1 - Mark Baskinger and William Bardel, "Drawing Ideas: A Hand-Drawn Approach for Better Design",2013
T2 - Nigel Cross, "Design Thinking", Kindle Edition

REFERENCE BOOKS:

R1 - Kurt Hanks and Larry Belliston, "Rapid Viz : A New Method for the Rapid Visualitzation of Ideas", 2008.
R2 - Kathryn McElroy , "Prototyping for Designers: Developing the Best Digital and Physical Products", 2017.

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SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT5201	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
I	**INTRODUCTION TO BEHAVIOR OF MATERIALS** Behavior of Materials - 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
II	**DESIGN OF SHAFTS AND WELDED JOINTS** Design of Solid and Hollow Shafts - Based on Strength, Rigidity and Deflection- Torsional Rigidity - Design of welding joints.	9+3
III	**GEARS** Principles of Gear Tooth Action - Gear Correction - Gear Tooth Failure Modes - Stresses and Loads - Component Design of Spur, Helical and Bevel gears.	9+3
IV	**BRAKES AND CHAIN DRIVES** Design of Brakes -Types - Band - Block - Chain Drives - Selection of Transmission Chains and Sprockets - Failure of Chain Drives-Design of Bolt - Design of Nuts.	9+3
V	**BEARINGS AND SPRINGS** Design of Bearings - Sliding Contact - Rolling Contact - Design of Journal Bearings - Design of Springs - Types - Helical and Leaf.	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 in 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- R.B.Patil, *"Design of Machine Elements"*, 1st Edition, McMillan Publications, India, 2017.

T2- S. Md. Jalaludeen, *"Machine Design (Vol. I & II)"*, 4th Edition, Anuradha Publications, Chennai, 2014.

REFERENCE BOOKS:

R1- V.B.Bhandari, *"Design of Machine Elements"*, 3rd Edition, Tata McGraw Hill Publishing CompanyLimited, New Delhi, 2010.

R2- PSG College of Technology, *"Design Data Book of Engineers"*, KalaikathirAchchagam, Coimbatore, 2018.

R3- Maitra.G.M., and Prasad.LN., *"Hand Book of Mechanical Design"*, 2nd Edition, Tata McGraw Hill Publishing CompanyLimited,New Delhi, 2005.

R4- Sundararajamoorthy T. V. Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2015.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT5202	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 -Principles of Operations - PLC size and Application - PLC Discrete Modules - PLC Analog Modules– I/O Specifications-Memory Types - Scan Cycle - PLC Programming Language - Fundamentals of Logics.	9
II	**PROGRAMMING INSTRUCTIONS** Programming EXAMINE ON and EXAMINE OFF Instructions -Logical Instructions - Control Instructions - Data Manipulating Instructions - Math Instructions –Immediate I/O Instructions - PLC Ladder Diagram.	9
III	**TIMERS AND COUNTERS** ON DELAY Timer - OFF DELAY Timer - Retentive Timer - Timer Applications - UP Counter - DOWN Counter- UP/DOWN Counter - Counter Applications - Combining Timer and Counter Functions.	9
IV	**APPLICATIONS OF PLC** Water Level Control - Material Handling Application - StampingSystem - Spray Painting System - Bottle Filling System - Lift Elevator Control - Traffic Light Control - - Automatic car washing machine - Automatic lubrication of supplier Conveyor belt .	9
V	**SCADA SYSTEMS** Introduction and Definition of SCADA - Basic Architecture of SCADA - Human Machine 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: 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 CompanyLimited,NewDelhi, 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, NewJersey, 2003.

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

R3- William T. Shaw, *"Cybersecurity for SCADA systems"*, Penn Well Books, 2006

R4- Gary Dunning, *"Introduction to Programmable Logic Controllers"*,3rd India edition, Cengage Learning, 2007

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT5203	CONTROL OF MECHATRONICS SYSTEMS	3	0	0	3

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 and error
3. To sketch the plot for frequency response of system and stability analysis
4. To develop and analysis state variable model
5. To select the controller for mechatronics applications

Unit	Description	Instructional Hours
I	**SYSTEM REPRESENTATION AND MODELLING** 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
II	**TIME RESPONSE ANALYSIS** Standard Test Signals - Time Response – First order and Second order systems- Time Domain Specifications- Error Coefficients – Generalized Error series – Steady State Error.	9+3
III	**STABILITY ANALYSIS** Frequency Domain: Bode Plot - Polar Plot –Effects of Lag, Lead and Lag Lead compensation. Time Domain: Routh Hurwitz Criterion - Root Locus construction- Nyquist Stability Criterion	9+3
IV	**STATE SPACE ANALYSIS** 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
V	**BASIC CONTROLLERS** P, PI, PD and PID Controller –Feed Forward Control - Tuning of Controller - Ziegler Nicol Tuning - Distributed Control System - Case study:Controller design for flow control process.	9+3
	Total Instructional Hours	45+15=60

Course Outcome

On completion of the course the students will be able to

CO1: Interpret different physical, mechanical, electrical system to Construct equivalent models and its Transfer functions.
CO2: Describe the response of different order systems for and error series
CO3: Analyze the stability of the system using different plots
CO4: Solve system equations in state-variable form
CO5: Identify controller concepts used in industry

TEXT BOOKS:

T1- A. Nagoorkani, *"Control systems Engineering"*, 3rd Edition, RBA Publications, Chennai, 2017.
T2- Curtis D. Johnson, *"Process Control Instrumentation Technology"*, 8th Edition, PHI Learning Private Limited, New Delhi, 2005.

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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.
R4- S.K.Bhattacharya, "*Control System Engineering*", 3rd Edition, Pearson, 2013.

WEB REFERENCES:

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.	19MT5251	FLUID POWER SYSTEMS	2	0	2	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
	FLUID POWERSYSTEMS AND FUNDAMENTALS	
I	Introduction to Fluid Power - Advantages of Fluid Power, Application of Fluid Power System. Types of Fluid Power Systems, Properties of Hydraulic Fluids - Types of Fluids - Fluid Power Symbols - Basics of Hydraulics-ANSII symbols	6
	HYDRAULIC COMPONENTS AND ACTUATORS	
II	Introduction to Pumps, Fluid Power Actuators: Linear Hydraulic Actuators - Types of Hydraulic Cylinders - Single Acting - Double Acting - Special Cylinders like Tandem – Rodless – Telescopic - Cushioning Mechanism.	6
	DESIGN OF HYDRAULIC CIRCUITS	
III	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 - Accumulators and Intensifiers: Types of Accumulators - Accumulators Circuits, Intensifier Circuit.	6
	PNEUMATIC SYSTEMS AND COMPONENTS	
IV	Pneumatic Components: Properties of Air - Compressors - Filter, Regulator and Lubricator Unit - Fluid Power Circuit Design - Speed Control Circuits, Synchronizing Circuit, Sequential Circuit Design for Simple Applications using Cascade Method.	6
	APPLICATION, MAINTENANCE AND TROUBLE SHOOTING	
V	Development of Hydraulic / Pneumatic Circuits Applied to Machine Tools - Presses - Material Handling Systems - Automotive Systems - Maintenance and Trouble Shooting of Fluid Power Circuits - Safety Aspects.	6
	Total Instructional Hours	30

LABORATORY COURSES

HYDRAULICS

1.	Design and Testing of the Following Hydraulic Circuits: a. Pressure Control b. Flow Control	2
2.	Design and Testing of Hydraulic Bi-Directional and Semi-Rotary Motor System.	2
3.	Design and Testing of Hydraulic Cylinder Sequencing System using fluid power simulation software and PLC.	2
4.	Design and Testing of a Double Acting Cylinder using Sensor Based Electro Hydraulic Control and PLC.	3
	PNEUMATICS	
5.	Design and Testing of Single Acting Cylinder using of 3/2 Way Direction Control Valves.	2
6.	Design and Testing of Single Acting Cylinder and also Speed Control using Flow Control Valves.	2
7.	Design and Testing Circuit of a Double Acting Cylinder using 3/2 and 5/2 Way Valves, AND, OR logic Elements.	2
	Total Instructional Hours	15+30=45

On completion of the course the students will be able to

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Course Outcome

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- R.Srinivasaan, *"Hydraulics and Pneumatics Control"*, 2nd Edition, Mcgraw Hill India Pvt. Ltd, 2008

REFERENCE BOOKS:

R1- Andrew *Parr, "Hydraulics and Pneumatics"*, 7th Edition, Jaico Publishing House, 2008

R2- FESTO, *"Fundamentals of Pneumatics"*, Vol. I, II, III

R3- S.R.Majundar , *"Oil Hydraulic Systems- Principles and Maintenance"*, 2nd Edition, Mcgraw Hill India Pvt. Ltd, 2008.

R4- S.R.Majundar , *"Pneumatic Systems- Principles and Maintenance"*, 2nd Edition, Mcgraw Hill India Pvt. Ltd, 2007.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT5252	OBJECT ORIENTED PROGRAMMING	2	0	2	3

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

THEORY

Unit	Description	Instructional Hours
I	**BASIC CONCEPTS OF OBJECT ORIENTED PROGRAMMING** Object Oriented Programming Concepts - Objects - Classes - Methods and Messages - Abstraction and Encapsulation - Inheritance - Polymorphism	6
II	**OVERVIEW OF JAVA** Basics of Java Programming, Data Types, Variables and Arrays, Operators, Control Structures - Classes, Objects and Methods - Constructors - This keyword - Finalize Method.	6
III	**PACKAGES AND INTERFACES** Inheritance - Method Overriding - Abstract Class - Final keyword - Java API Packages - Naming Conventions - Creating, Accessing, Using Packages - Interfaces: Defining, Extending, Implementing Interfaces.	6
IV	**EXCEPTION HANDLING** Exception Types - Uncaught Exceptions - Using Try and Catch -Multiple Catch - Nested Try - Throws - Finally - Built in Exceptions - Throwing own exceptions - Chained Exceptions.	6
V	**MULTITHREAD PROGRAMMING** Creating and Extending Thread - Stopping and Blocking Thread - Life Cycle - Using Thread - Thread priority - Synchronization - Runnable Interface - Inter Thread Communications.	6
	Instructional Hours	30

PRACTICAL

1	Create class and object using Java programto display first 100 prime numbers
2	Java program to implement Method overloading and random number generation.
3	Java program using to implement Inheritance i) single inheritance ii) multilevel inheritance iii) hierarchal inheritance using super keyword
4	Java program using to implement method overriding and dynamic dispatch
5	Java program to print Odd and Even Numbers from an Array
6	Java program to create a thread, multi thread program
7	Java program for implement a Stack concept using Classes and Object
8	Java program for producer consumer application
	Instructional Hours 15
	Total Hours 45

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

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT5001	COMPUTER AIDED MACHINE DRAWING LABORATORY	0	0	3	1.5

Course Objective

1. To develop skills on 2D drafting and 3D modeling using CAD software systems
2. To apply constructional drawing techniques in Engineering field
3. To provide the importance of computer aided machine drawing in various applications
4. To assemble various components to achieve the desire mechanisms.
5. To expose students to gain knowledge in machine design elements.

Unit	Description of the Experiments	Practical Hours
1	Study of Welding Symbols and Riveted Joints	
2	Study of Limits, Fits and Tolerances	
3	Study of Screw Threads and Threaded Fasteners	
4	Assembly Drawing of sleeve coupling	
5	Assembly Drawing of Protected Flange Coupling	
6	Assembly Drawing of Universal Coupling	
7	Assembly Drawing of Knuckle Joint	
8	Assembly Drawing of Screw Jack	
9	Assembly Drawing of Stuffing Box	
10	Assembly Drawing of Plummer Block	
11	Assembly Drawing of Connecting Rod	
12	Assembly Drawing Of Machine Vice	
	Total Practical Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Develop 2D, 3D models using modeling software
CO2: Design and model the constructional features in Engineering field
CO3: Apply the design skills in computer aided machine drawing
CO4: Demonstrate the machine drawings in assembly operations
CO5: Design and model the given machine elements

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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.

R3: Paul Deitel, Harvey Deitel, "*Java, How to Program*", 8th Edition, PHI Publications , 2010.

R4: Ken Arnold, James Gosling, David Holms, "*The java Programming Language*", Pearson Education, 2003.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT5002	INDUSTRIAL AUTOMATION AND CONTROL LABORATORY-I	0	0	3	1.5

Course Objective

1. To acquire knowledge onPLC hardware and software
2. To impart the knowledge about the basic instruction set of PLC
3. To explain the PLC wiring with field devices
4. To create ladder logic diagrams for digital I/O's and interface with PLC for industrial applications
5. To read the basics of SCADA

Unit	Description of the Experiments
1	Implementation of Logic Instruction using PLC Basic Operations.
2	Implementation of Math Instruction using PLC Basic Operations
3	Programming with PLCfor the Lamp Circuit.
4	Programming with PLC for Actuating Single Acting Cylinder.
5	Programming with PLC for Water Level Control of Two Different Water Tanks.
6	Programming with PLC for Material Handling System.
7	Programming with PLC for StampingSystem.
8	Programming with PLC for Spray Painting System.
9	Programming with PLC for Bottle Filling System.
10	Programming with PLC for Lift Elevator Control.
11	Programming with PLC for Traffic Light Control.
12	Study of SCADA System.

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 digital I/Os
CO4: Create the ladder logic for industrial applications
CO5: Explain the uses ofSCADA

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Programme	Course Code	Course Title	L	T	P	C
B.E.	19HE5071	SOFT SKILLS- I	1	0	0	1

Course Objectives:

1.To employ soft skills to enhance employability and ensure workplace and career success.
2.To enrich students' numerical ability of an individual and is available in technical flavor.
3.To interpret things objectively, to be able to perceive and interpret trends to make generalizations and be able to analyze assumptions behind an argument/statement.

Unit	Description	Instructional Hours
I	**Introduction to Soft Skills:** Introduction- Objective -Hard vs Soft Skills - Measuring Soft Skills- Structure of the Soft Skills -Self Management-Critical Thinking-Reflective thinking and writing- p2p Interaction	3
II	**Art of Communication:** Verbal Communication - Effective Communication - Active listening –Paraphrasing - Feedback - Non-Verbal Communication – Roles-Types- How nonverbal communication can go wrong- How to Improve nonverbal Communication - Importance of feelings in communication - dealing with feelings in communication.	4
III	**World of Teams:** Self Enhancement - importance of developing assertive skills- developing self-confidence – developing emotional intelligence - Importance of Team work – Team vs. Group - Attributes of a successful team – Barriers involved - Working with Groups – Dealing with People- Group Decision Making.	3
IV	**Quantitative Aptitude:** Averages - Profit and loss - Partnerships - Time and work - Time, Speed and Distance - Problems based on trains - Problems based on boats and streams	3
V	**Logical Reasoning:** Clocks - Calendars - Direction Sense - Data Interpretation: Tables, Pie Chart, Bar Graph - Data Sufficiency	2

Course Outcome:

CO1:	Students will have clarity on their career exploration process and to match their skills and interests with a chosen career path.
CO2:	Students will develop knowledge, skills, and judgment around human communication that facilitate their ability to work collaboratively with others
CO3:	Students will understand how teamwork can support leadership skills
CO4:	Students will be able to make sense of problems, develop strategies to find solutions, and persevere in solving them.
CO5:	Students will demonstrate an enhanced ability to draw logical conclusions and implications to solve logical problems.

REFERENCE BOOKS:

R1: Soft Skills Training: A Workbook to Develop Skills for Employment - Frederick H. Wentz
R2: How to prepare for data interpretation for CAT by Arun Sharma.
R3: How to Crack TEST OF REASONING in all competitive examinations by Jaikishan and Premkishan.
R4: A New Approach To Reasoning Verbal & Non-Verbal By B.S. Sijwali
R5: Quantitative Aptitude for Competitive Examinations - Dr. R.S. Aggarwal, S. Chand

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19HE5072	DESIGN THINKING	1	0	0	1

Course Objective

OBJECTIVES:

- To expose students to the design process
- To develop and test innovative ideas through a rapid iteration cycle.
- To provide an authentic opportunity for students to develop teamwork and leadership skills

Unit	Description	Instructional Hours
I	**DESIGN ABILITY** Asking Designers about what they Do – Deconstructing what Designers Do – Watching what Designers Do – Thinking about what Designers Do – The Natural Intelligence of Design Sources	4
II	**DESIGNING TO WIN** Formula One Designing – Radical Innovations – City Car Design – Learning From Failures – Design Process and Working Methods	4
III	**DESIGN TO PLEASE AND DESIGNING TOGETHER** Background – Product Innovations – Teamwork versus Individual work – Roles and Responsibilities – Avoiding and Resolving Conflicts.	4
IV	**DESIGN EXPERTISE** Design Process – Creative Design - Design Intelligence – Development of Expertise – Novice to Expert	3
	Total Instructional Hours	15

Course Outcome

Upon completion of the course, students will be able to
CO1: Develop a strong understanding of the Design Process
CO2: Learn to develop and test innovative ideas through a rapid iteration cycle.
CO3: Develop teamwork and leadership skills

TEXT BOOKS:

T1 - 1. Nigel Cross, "Design Thinking", Kindle Edition.

REFERENCE BOOKS:

R1 - Tom Kelley, "Creative Confidence", 2013.
R2 - 3. Tim Brown, "Change by Design", 2009.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT6181	TOTAL QUALITY MANAGEMENT	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, Juran 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- Dr.V.Jayakumar, et. al., *"Total Quality Management"*, 4thEdition, Lakshmi Publications, Chennai, 2016.
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.
R3- Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.
R4- ISO 9001-2015 standards

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT6201	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.	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 - 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 - Fuzzy Logics in Automaticwashing machine- 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: Understand the 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.

R3- Bradley, D.Dawson, N.C. Burd and A.J. Loader, "*Mechatronics: Electronics in Products and Processes*", CRC Press 1991 , First Indian print 2010.

R4- De Silva, "*Mechatronics: A Foundation Course*", Taylor & Francis, Indian Reprint, 2013.

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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
3. https://www.researchgate.net/publication/326348482_Design_and_Simulation_of_Washing_Machine_using_Fuzzy_Logic_Controller_FLC/link/5b474aaaa6fdccadaec1e057/download

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT6202	CNC TECHNOLOGY	3	0	0	3

Course Objective

1. To understand evolution and principle of CNC machine tools
2. To understand the structure and parts of CNC machine tools
3. To describe constructional features of CNC machine tools, drives and positional transducers
4. To generate CNC programs for popular CNC controllers
5. To describe tooling and work holding devices for CNC machine tools

Unit	Description	Instructional Hours
I	**INTRODUCTION TO CNC MACHINE TOOLS** Evolution of CNC Technology, Principles, Features, Advantages, Applications - CNC and DNC Concept -Types of Control Systems - CNC Controllers, Characteristics, Interpolators - Types of CNC Machines - Turning Centre, Machining Centre, Grinding Machine - EDM - Computer Aided Inspection	9
II	**STRUCTURE OF CNC MACHINE TOOL** CNC Machine Building, Structural Details, Configuration and Design - Guide ways, Friction, Anti friction and other types of Guide ways - Elements used to convert the Rotary motion to a Linear motion - Screw and Nut, Recirculating Ball Screw, Planetary Roller Screw, Recirculating Roller Screw - Rack and Pinion - Spindle Assembly - Torque Transmission Elements - Gears, Timing Belts, Flexible Couplings, Bearings.	9
III	**DRIVES AND CONTROLS** Spindle Drives - DC Motors - Feed Drives -Stepper Motor - Servo Principle, DC and AC Servomotors - Linear Motors Open Loop and Closed Loop Control - Axis Measuring System - Synchro, Synchro-resolver - Gratings, Moiré Fringe Gratings - Encoders - Inductosyn - Laser Interferometer.	9
IV	**CNC PROGRAMMING** Coordinate System - Structure of a Part Program - G & M Codes - Tool Length Compensation, Cutter Radius and Tool Nose Radius Compensation - Do Loops, Subroutines, Canned Cycles - Mirror Image - Parametric Programming - Machining Cycles - Programming for Machining Centre and Turning Centre for well known Controllers such as Fanuc, Heidenhain, Sinumerik etc - Generation of CNC Codes from CAM Packages	9
V	**TOOLING AND WORK HOLDING DEVICES** Introduction to Cutting Tool Materials - Carbides, Ceramics, CBN, PCD- Inserts Classification - Qualified, Semi Qualified and Preset Tooling - Tooling System for Machining Centre and Turning Centre - Tool for Complete Machining System - Work Holding Devices for Rotating and Fixed Work Parts - Economics of CNC - Maintenance of CNC Machines	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to
CO1:Gain knowledge on CNC components and their working
CO2:Interpret the CNC machine structures and tools
CO3:Describe the drives and controls of CNC machines
CO4:Program for various CNC operations using part programming techniques
CO5:Illustrate the control systems of CNC drives and devices

TEXT BOOKS:

T1- Graham T Smith, "*CNC Machining Technology*" Springler Verlag, 2016.
T2- Rao P.N., "*CAD/CAM Principles and Applications*", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2010.

REFERENCE BOOKS:

R1-Evans K., "*Programming of CNC Machines*", 4th Edition – Industrial Press Inc, New York, 2016
R2-Mike Mattson, "*CNC Programming Principles and Applications*", Delmar Cengage learning, 2010.
R3- Michael Fitzpatric, "Machining & CNC technology", 3rd Edition, 2013.
R4- Suk.Hwan Suh, "Theory and Design of CNC Systems", Springer, 2008.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT6251	VETRONICS	2	0	2	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 and Euro VI standards - Emission Control Management. Charging Systems: Working and Design of Charging Circuit Diagram - Requirements of Starting System.	6
II	**IGNITION AND INJECTION SYSTEMS** Ignition Fundamentals - Electronic Ignition Systems - Distribution Less Ignition - Direct Ignition - Spark Plugs - Carburetion - Study of Fuel Injector - Petrol Fuel Injection - Diesel Fuel Injection.	6
III	**SENSOR AND ACTUATORS** Working Principle and Characteristics of Airflow Rate, Engine Crankshaft Angular Position, Hall Effect, Exhaust Gas Oxygen Sensors - Exhaust Gas Recirculation Actuators, Stepper Motor Actuator, and Vacuum Operated Actuator.	6
IV	**ENGINE CONTROL SYSTEMS** Control Modes for Fuel Control - Engine Control Subsystems - Ignition Control Methodologies - Different ECU's used in the Engine Management - Vehicle Networks: CAN Standard, Format of CAN Standard - Diagnostics Systems in Modern Automobiles..	6
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 -Climate Control of Cars.	6
	Instructional Hours	30
1	Testing of Batteries and Battery Maintenance	2
2	Testing of Staring motors and Generators	2
3	Diagnosis of Ignition System	2
4	Study of Automobile Electrical Wiring	2
5	Interfacing of Actuators like Stepper motor in Automobile	2
6	Study and onboard Diagnosis of Engine Management System	2
7	Study of Three Wheeler Chassis frame and Power Transmission System	3
	Instructional Hours	15
	Total Instructional Hours (Theory + Practical)	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 CompanyLimited,NewDelhi, 1999.
R4- Robert Bosch GmbH, "*Automotive Hand Book*", 9th Edition, Wiley& Sons Inc., New York, 2014.
R5- Powertrain,"Worldwide emission standards and related regulations", siemens, 2020

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT6001	CNC LABORATORY	0	0	3	1.5

Course Objective

1. To study the features and applications of CNC machine tools
2. To impart knowledge in developing program for CNC operations
3. To train the students in manual and computer assisted part programming
4. To impart knowledge in tool path generation and control operation
5. To describe operationof CNC controlled machines tools

Unit	Description of the Experiments	Practical Hours
1	Manual part programming using G and M codes for Turning Operation	3
2	Manual part programming using G and M codes for Step Turning Operation	3
3	Manual part programming using G and M codes for Taper Turning Operation	3
4	Manual part programming using G and M codes for Thread Cutting Operation	3
5	Manual part programming using G and M codes for Radius Turning on Cylindrical Components	3
6	Programming and Simulation of machining using Linear Interpolation	6
7	Programming and Simulation of machining using Circular Interpolation	6
8	Programming and Simulation of machining using Pocket Milling	3
9	Programming and Simulation of machining using Slotting	3
10	Programming and Simulation of machining using Peck Drilling	3
11	Programming and Simulation of machining using Canned Cycles	3
12	Given a component drawing to write the manual part programming and execute on CNC Lathe and Milling Machine	6
	Total Practical Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Ability to write manual part programming using G and M code for simple component
CO2: Develop knowledge on machining operation using CNC machines
CO3:Enrich the knowledge and manual and computer assisted part programming
CO4: Generate CNC codes for the given model and simulate it
CO5: Demonstrate CNC part programming and perform machining operations

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT6002	INDUSTRIAL AUTOMATION AND CONTROL LABORATORY-II	0	0	3	1.5

Course Objective

1. To impart the knowledge about the data manipulation instruction set of PLC
2. To create ladder logic diagrams for analog I/O's and interface with PLC for industrial applications
3. To describe the PID controller in closed loop system
4. To interpret the working knowledge of SCADA
5. To read the basics of Discrete Control System

Unit	Description of the Experiments	Practical Hours
1	Implementation of Data Manipulation Instruction using PLC Basic Operations	6
2	Programming with PLC for Speed Control of DC Motors.	6
3	Programming with PLC for Temperature Control of Water Heater.	3
4	Programming with PLC for Flow Control in Pump for Water Circulation.	3
5	Programming with PLC for Pressure Control in Closed Air pressure Tank.	3
6	Development of SCADA systems for the Lamp Circuit.	3
7	Development of SCADA systems for Water Level Control of Two Different Water Tanks.	6
8	Development of SCADA systems for Material Handling System.	3
9	Development of SCADA systems for StampingSystem.	3
10	Development of SCADA systems for Automatic Bottle Filling Systems.	3
11	Development of SCADA systems for Spray Painting System	3
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: Develop hard wiring with PLC and field analog I/Os CO2: Explain the concept of SCADA and their applications CO3: Apply various controllers in Real Time Applications

CO4: Construct a SCADA monitoring system for industrial automation process

CO5: Explain the concepts of SCADA

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Programme	Course Code	Course Title	L	T	P	C
B.E.	19HE6071	SOFT SKILL-II	1	0	0	1

Course Objectives:

1. To make the students aware of the importance, the role and the content of softskills through instruction, knowledge acquisition, demonstration and practice.
2. To learn everything from equations to probability with a completely different approach.
3. To make the students learn on an increased ability to explain the problem comprehensively.

Unit	Description	Instructional Hours
I	**Group Discussion & Presentation Skills:** GD skills – Understanding the objective and skills tested in a GD – General types of GDs – Roles in a GD – Do's & Don'ts – Mock GD & Feedback. - Presentation Skills – Stages involved in an effective presentation – selection of topic, content, aids – Engaging the audience – Time management – Mock Presentations & Feedback	4
II	**Interview Skills and Personality Skills:** Interview handling Skills – Self preparation checklist – Grooming tips: do's & don'ts – mock interview & feedback - Interpersonal skills-creative thinking-problem solving-analytical skills	3
III	**Business Etiquette & Ethics:** Etiquette – Telephone & E-mail etiquette – Dining etiquette – do's & Don'ts in a formal setting – how to impress. Ethics – Importance of Ethics and Values – Choices and Dilemmas faced – Discussions from news headlines.	3
IV	**Quantitative Aptitude:** Permutation, Combination - Probability - Logarithm - Quadratic Equations - Algebra - Progression - Geometry - Mensuration.	3
V	**Logical Reasoning:** Logical Connectives - Syllogisms - Venn Diagrams – Cubes - Coded inequalities - Conditions and Grouping	2

Course Outcome:

CO1: Students will have learnt to keep going according to plan, coping with the unfamiliar, managing disappointment and dealing with conflict.
CO2: Students will Actively participate meetings, Group Discussions / interviews and prepare & deliver presentations
CO3: Students will define professional behavior and suggest standards for appearance, actions and attitude in a Business environment
CO4: Students will be able to apply quantitative reasoning and mathematical analysis methodologies to understand and solve problems.
CO5: Students will excel in complex reasoning.

REFERENCE BOOKS:

R1: Bridging the Soft Skills Gap: How to Teach the Missing Basics to Todays Young Talent- Bruce Tulgan
R2: Quantitative Aptitude for Competitive Examinations (5th Edition) - Abhjit Guha
R3: How to crack test of Reasoning - Jaikishan and Premkishan
R4: The hand on guide to Analytical Reasoning and Logical Reasoning - Peeyush Bhardwaj

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Programme	Course Code	Course Title	L	T	P	C
B.E.	19HE6072	INTELLECTUAL PROPERTY RIGHTS(IPR)	1	0	0	1

Course Objectives:

1. To introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.
2. To disseminate knowledge on patents, patent regime in India and abroad and registration aspects.
3. To disseminate knowledge on copyrights and its related rights and registration aspects.
4. To disseminate knowledge on trademarks and registration aspects.
5. To disseminate knowledge on Design, Geographical Indication (GI) and their registration aspects.

Unit	Description	Instructional Hours
I	**INTRODUCTION TO INTELLECTUAL PROPERTY** Introduction, Types of Intellectual Property, International Organizations, Agencies and Treaties, Importance of Intellectual Property Rights.	3
II	**PATENTS** Patents -Elements of Patentability: Novelty, Non-Obviousness (Inventive Steps), Industrial Application -Non -Patentable Subject Matter -Registration Procedure, Rights and Duties of Patentee, Assignment and license.	3
III	**COPYRIGHTS** Purpose And Function Of Trade Marks, Acquisition Of Trade Mark Rights, Protectable Matter, Selecting And Evaluating Trade Mark, Trade Mark Registration Processes.	3
IV	**TRADEMARKS** Concept of Trademarks -Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) -Non-Registrable Trademarks - Registration of Trademarks.	3
V	**DESIGN AND GEOGRAPHICAL INDICATION** Design: meaning and concept of novel and original -Procedure for registration. Geographical indication: meaning, and difference between GI and trademarks -Procedure for registration.	3

Course Outcome:

CO1: Identify different types of Intellectual Properties (IPs), the right of ownership, scope of protection as well as the ways to create and to extract value from IP.

CO2: Recognize the crucial role of IP in organizations of different industrial sectors for the purposes of product and technology development.

CO3: Identify, apply and assess ownership rights and marketing protection under intellectual property law as applicable to information, ideas, new products and product marketing.

CO4: Identify different types of trademarks and procedure for registration

CO5: Recognize the concept of design, geographical indication and procedure for registration

TEXT BOOKS:

T1- Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.
T2- V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt. Ltd, 2012.

REFERENCE BOOKS:

R1- Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
R2- Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013.

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PROFESSIONAL ELECTIVE I

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT5301	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 knowledge on various metrological equipments

Unit	Description	Instructional Hours
I	**BASICS OF MEASUREMENTS** General Concept of Measurement - Need for Measurement - Methods of Measurement - Units and Standards – Sensitivity - Stability - Range - Accuracy - Precision - Tolerance - Fits - Errors - Types of Errors - Interchangeability.	9
II	**LINEAR AND ANGULAR METROLOGY** Linear Metrology: Vernier Caliper - Micrometer - Dial Indicator - Slip Gauges and Classification - Optical Flats - Limit Gauges - Comparators - Mechanical, Pneumatic and Electric Types. Angular Metrology: Sine Bar - Optical Bevel Protractor - Auto Collimator - Angle Decker - Taper Measurements.	9
III	**FORM AND SURFACE MEASUREMENTS** Screw Thread Terminologies - Errors in Thread - Drunkenness - Measurement of Various Elements of Thread - Two and Three Wire Method, Gears Measurement: Gear Errors - Constant Chord and Base Tangent Method - Parkinson Gear Tester – Gleason Gear Testing Machine.Surface Finish Measurement: Elements of Surface Texture - Analysis of Surface Finish - Stylus Probe Instrument – Talysurf Method.	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 Laser Interferometer.	9
V	**APPLICATIONS OF MEASUREMENTS** Applications - Flow Measurements in Chemical Pipelines -Vehicle Tyre 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 tolerances 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 measurement 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 CompanyLimited,New Delhi, 2008.

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

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REFERENCE BOOKS:

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

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

R3- Connie Dotson et.al, " *Fundamentals of Dimensional Metrology*", Thomas Asia, Singapore, 2003.

R4- Groover.M.P, "*Automation, Production system and computer integrated manufacturing*", Prentice Hall Publishing, New Delhi, 2003.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT5302	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 processes

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 - Material Removal Rate - Tool - Dielectric - Flushing - Wire Cut EDM and its Applications - Electric Discharge Grinding - Working Principle - Equipment - Process Parameters - Applications.	9
III	**CHEMICAL AND ELECTRO CHEMICAL ENERGY BASED PROCESSES** Chemical Machining (CHM) - Etchants - Maskant - Techniques of Applying Maskant - Process Parameters - Material Removal Rate - Applications - Electro Chemical Machining (ECM) - 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 - Applications - Plasma Arc Machining (PAM) - Principles - Equipment - Types - Beam Control Techniques - Applications - 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 Vapour Deposition (PVD) - Chemical Vapour Deposition (CVD) - Ion Plating - 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 manufacturing process
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"*, 2nd Edition, Taylor, CRC Press, NewYork, 2019.

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T2- Kaushik kumar, J,Paulo Darim Divya Zindani, *"Advanced Machining and Manufacturing Processes"*, 1st Edition, Springler Nature, 2018.

REFERENCE BOOKS:

R1- V. K. Jain, *"Advanced Machining Processes"*,4th Edition, Allied Publishers, 2009.
R2- E Weller, "*Non Traditional Machining Process*", 2nd Edition,2006.
R3- P.C.Pandey, "*Modern Machining Process*", Mcgraw Hill Education, 2017.
R4- *"Advance Analysis of Non Traditional Machining*", Springer, DRC 2012.

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.	19MT5303	AUTOMOBILE SYSTEMS	3	0	0	3

Course Objective

1. To impart knowledge about 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 clutches. 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** Constructional details of steering linkages. Different types of steering gear boxes. Steering linkages and layouts. Power and Power assisted steering, Wheels and Tyres - Wheel Alignment Parameters - Steering Geometry. Braking System: Classification of brakes, drum brake & disc brakes. Constructional details-Theory of braking. Mechanical hydraulic and Pneumatic brakes .	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 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,NewDelhi, 2007.

REFERENCE BOOKS:

R1- Jain K.K. and Asthana .R.B, "*Automobile Engineering*", 2nd Edition, Tata McGraw Hill Publishing Company Limited,NewDelhi, 2002.
R2- William H crouse, Donald T Anglin, "*Automotive Mechanics*", 10th Edition, Butterworth Publishers, 2017.
R3- Joseph Heitner, "*Automotive Mechanics*," 2nd Edition, East-West Press, 1999.
R4- Ganesan V, "*Internal Combustion Engine*", 3rd Edition, Tata McGraw Hill Publishing, NewDelhi, 2012.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT5304	OPERATIONAL RESEARCH	3	0	0	3

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 learn basic inventory control techniques.
5. To introduce about maintenance and replacement schedule against failure

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.	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.	9+3
IV	**INVENTORY CONTROL** Models of inventory-Operation of inventory-Quality discount-Implementation of purchase inventory model-Multiple item model with storage limitation-Determination of stock level- Empirical queuing model.	9+3
V	**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
	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: Understand the inventory control plan and workout stock level.
CO5: Analyze the various replacement models and apply them for arriving at optimal decisions

TEXT BOOKS:

T1- Nita H Shah, Ravi M.Gor and HardikSoni, *"Operations Research"*, 1st Edition, PHI Learning Private Limited, New Delhi, 2007.
T2- R.Panneerselvam, *"Operations Research"*, 2nd Edition, PHI Learning Private Limited, New Delhi, 2010.

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.
R3- Taha.H A, *"Operations Research"*,6th Edition, PHI Learning Private Limited, New Delhi, 2003.
R4- Bazara M J and Sherail H, "Linear programming and Network Flows", John Wiley, 2009.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT5305	MATERIALS SCIENCE AND APPLICATION	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

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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. Van Vlack, *"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.
R4- O P kanna, *"A Text Book of Material Science and Metallurgy"*, 5th Edition, Dhanpat Rai Publications, 2001.

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PROFESSIONAL ELECTIVE - II

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT6301	EMBEDDED SYSTEM	3	0	0	3

Course Objective

1. To impart a detailed knowledge of Embedded system
2. To visualize the Architecture of ARM processor
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, Task state and Task Scheduler - Context Switching - Scheduling Algorithms - Types - Semaphores - Mutex - Mail boxes - Message Queues - Event Registers - Pipes - Signals.	9
V	**CASE STUDIES** *Case Studies*: Embedded System in Washing Machine, Automatic Chocolate Vending machine, Adaptive Cruise Control in Car, Smart Card. Design and Implement Wireless Network to Drive a Motor Car Toy.	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 an interface between Hardware Peripherals, Sensors and Systems

TEXT BOOKS:

T1- P.Rajkamal, *"Embedded System-Architecture, Programming and Design"*, 2nd Edition, Tata McGraw Hill Publishing CompanyLimited,New Delhi, 2011.

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"*,2nd Edition, Wiley India PvtLtd., 2011.

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

R3- David E. Simon, "*An embedded software primer*", Addison – Wesley, Indian Edition Reprint, 2009.

R4- Santanu Chattopadhyay, " Embedded System Design", 2nd Edition, PHI Learning Private Limited, New Delhi, 2013.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT6302	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 - Kolmogorov Smirnov Test - Chi Square Test -Runs Test - Autocorrelation Test	9
IV	**RANDOM VARIATE GENERATION** Review of Terminology and Concepts - Inverse Transform Technique for Exponential, Uniform, Triangular, Weibull, Empirical, Uniform and Discrete Distribution, Acceptance Rejection Method for Poisson and Gamma Distribution	9
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 Example- An Assembly Line Simulation.	9
	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 Simulation 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 CompanyLimited,New Delhi, 2007.

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

R3- Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, *"Discrete-Event System Simulation"*, 2nd Edition, Pearson Education, New Jersey, 2008 (For Unit 2&3).

R4- Geoffrey Gordon, *"System Simulation"*,PHI Learning Private Limited, New Delhi, 2003.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT6303	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 Product s -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 Product s - User - Driven Product s - 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 Product s 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 Product s for manufacturing and Assembly

TEXT BOOKS:

T1- Karl T. Ulrich and Stephen D. Eppinger, *"Product Design and Development"*, 7th Edition, Tata McGraw Hill Publishing CompanyLimited,NewDelhi, 2020.

T2- S. Dalela and Mansoor Ali, *Industrial Engineering and Management Systems*, Standard Publishers Distributors Pvt. Ltd., New Delhi, 2006.

REFERENCE BOOKS:

R1- Kevin Otto, Kristin wood, *"Product Design"*, 4th Edition, Pearson Education, Australia, 2012.

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 CompanyLimited,New Delhi, 1976.

R4- Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, 1992, ISBN 1-55623-603-4.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT6304	NON DESTRUCTIVE TESTING TECHNIQUES	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 ThroughTransmission 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. Measurements, 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 UltrasonicMethod
- 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"*, 4th Edition, Springer, Verlag Publication, New York, 2002.

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

R3- V.Jayakumar, K.Elagovan, *"Non Destructive Testing and Materilas"*, Lakshmi Publications, Chennai, 2008.

R4- Ravi prakash, *"Non Destructive Testing Techniques"*, 1st Revised Edition, New Age Publications, New Delhi, 2010.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT6305	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 AND SWITCHED RELUCTANCE MOTORS** Constructional Features - Principle of Operation - Variable Reluctance Motor - Permanent Magnet Stepper Motor - Hybrid Stepper Motor. Different Modes of Excitation – SRM Motors-Constructional Features - Principle of Operation -Torque Equation	9
II	**SPECIAL TRANSFORMERS** Different types of connections of power and distribution transformers - Welding transformers- Isolation transformer- Pulse transformer- Audio transformers and microphone transformers- Instrument transformers : current transformers and potential transformers- Constant Voltage Transformer (CVT) and Constant Current Transformer (CCT)	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 ofLIM - 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.
T3- Ghosh, Smarajit, "Electrical Machines" 2nd Edition,PHI Learning Private Limited, New Delhi, 2012

REFERENCE BOOKS:

R1- Naser A and BoldeaL,"Linear Electric Motors: Theory Design and Practical Applications PHI Learning PrivateLimited, New Delhi, 2008
R2- Kenjo, T and Naganori, S "Permanent Magnet and brushless DC motors", Clarendon Press, Oxford, New Delhi, 2014.
R3- R. Krishnan, "Switched Reluctance Motors Drives", CRC Press, New York, 2012.
R4- T.Kenjo, "Stepping Motors & their Microprocessor Controls", Clarendon Press, London, 2002.

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OPEN ELECTIVE

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	19MT6401	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 - General Safety 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, NewDelhi,2008.
R4- Er.Gupta, " Industrial Safety and Environment", 1st Edition,Laxmi Publications, 2008.

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SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT7201	DESIGN OF MECHATRONICS SYSTMES	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 CompanyLimited, New Delhi, 2010.

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

REFERENCE BOOKS:

R1- Mikell P. Groover, Mitchell Weiss, Roger N.Nagel Nicholas G.Odrey, *"Industrial Robotics Technology, Programming 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 PrivateLimited, New Delhi, 2003.

R3- Fu K.S. Gonzalcaz R.C. and Lee C.S.G., *"Robotics Control Sensing, Vision and Intelligence"*, Tata McGraw HillPublishing 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.

WEB REFERENCES:

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4. 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 LEAN MANUFACTURING	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.

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.

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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MCT - MCET

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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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MCT - HiCET

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT7306	ESSENTIAL OF SOFTWARE PROJECCT 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 Mananagement - 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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PROFESSIONAL ELECTIVE - IV

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT7307	RAPID PROTOTYPING 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 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 MachineTools - 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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1. http://nptel.ac.in/courses/112102103//Module%20E/Module%20E(1)/p1.html
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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Dean (Academics)

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

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, *"Nanostructures 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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1. https://www.slideshare.net/supercha2/nanotechnology-and-its-applications-33323858

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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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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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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

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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.

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.

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 geothermalCO4: 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 SKILSS 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"*, 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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HiCET

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 - Mechanism of 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

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 Micro turning
- 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:

T1- Jain V. K., *"Micro Manufacturing Processes"*, 2nd Edition , CRC Press, Taylor & Francis Group, 2012.
T2- Norio Taniguchi, *"Nano Technology"*, 3rd Edition, Oxford University Press, New York, 2003.

REFERENCE BOOKS:

R1- Mcgeough.J.A., *"Micromachining of Engineering Materials"*, 1st Edition, CRC press, New York, 2001.
R2- Jain V.K., "Advanced Machining Processes", 3rd Edition, Allied Publishers, Delhi, 2012.
R3- Tai Ran Hsu, *"MEMS and Microsystems Design and Manufacture"*, 6th Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2002.

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Chairman - FoS
MCT - BICEL

Chairman

Dean
BICEL

OPEN ELECTIVE

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT7402	ELECTRIC AND HYBRID VEHICLES	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 andEnvironmental 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 - FuelCell 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

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Dean (Academics)
HICET

TEXT BOOKS:

T1- James Larminie, "*John Lowry, Electric Vehicle Technology Explained*", 2nd Edition, John Wiley & Sons Ltd., NewDelhi, 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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Chairman - BoS
MCT - HICET

ACADEMIC COUNCIL * HICET * Chairman

Dean (Academics)
HICET