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

2018-2019

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.

S. Navaneedh
Chairman - BoS
MCT - HiCET

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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.

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PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

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

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

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

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

PO 5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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

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

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

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

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

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

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

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PROGRAMME SPECIFIED OUTCOMES

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

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

PROGRAM EDUCATIONAL OBJECTIVES

To produce professional graduates

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

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

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

S. Ramadh

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CURRICULUM

HINDUSTHAN EDUCATIONAL AND CHARITABLE TRUST
HICET

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)
Valley Campus, Pollachi Highways, Coimbatore, Tamil Nadu.

TÜVRheinland CERTIFIED

DETAILS OF CHANGES CARRIED OUT IN CURRICULUM & SYLLABUS

CBCS PATTERN

UNDERGRADUATE PROGRAMMES

B.E. MECHATRONICS ENGINEERING (UG)

REGULATION-2016

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

SEMESTER I

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16MA1101	Engineering Mathematics I	3	1	0	4	25	75	100
2	16PH1101	Engineering Physics	3	0	0	3	25	75	100
3	16CY1101	Engineering Chemistry	3	0	0	3	25	75	100
4	16HE1101R	Essential English for Engineers – I	3	1	0	4	25	75	100
5	16GE1103	Problem Solving and Python Programming	3	0	0	3	25	75	100
6	16GE1102	Engineering Graphics	3	1	0	4	25	75	100
PRACTICAL									
7	16PS1001	Physical Sciences Lab - I	0	0	2	1	50	50	100
8	16GE1004	Python Solving and Python Programming Lab	0	0	4	2	50	50	100
9	16GE1002	Engineering Practices Laboratory	0	0	4	2	50	50	100
10	16GE1003	Value Added Course I: Language Competency Enhancement Course-I	0	0	2	1	0	100	100
		Total:	**18**	**3**	**12**	**27**	**300**	**700**	**1000**

SEMESTER II

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16MA2102	Engineering Mathematics - II	3	1	0	4	25	75	100
2	16PH2102	Physics of Materials	3	0	0	3	25	75	100
3	16CY2102	Environmental Sciences	3	0	0	3	25	75	100
4	16HE2102R	Essential English for Engineers - II	3	1	0	4	25	75	100
5	16GE2101	Engineering Mechanics	3	1	0	4	25	75	100
6	16EE2202	Basics of Electrical and Electronics Engineering	3	0	0	3	25	75	100
PRACTICAL									
7	16PS2001	Physical Sciences Lab – II	0	0	2	1	50	50	100
8	16ME2001	Computer Aided Drafting Lab	0	0	4	2	50	50	100
9	16GE2001	Value Added Course II: Language Competency Enhancement Course-II	0	0	2	1	0	100	100
		Total:	**18**	**3**	**8**	**25**	**250**	**650**	**900**

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

SEMESTER III

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

SEMESTER IV

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

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

SEMESTER V

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
THEORY									
1	16MT5201	CAD/CAM & CIM	3	0	0	3	25	75	100
2	16MT5202	Industrial Electronics and Control	3	1	0	4	25	75	100
3	16MT5203	Fluid Power	3	0	0	3	25	75	100
4	16MT5204	Embedded systems Design	3	0	0	3	25	75	100
5	16IT5232	Object Oriented Programming	3	1	0	4	25	75	100
6	16MT53XX	**Professional Elective - I**	3	0	0	3	25	75	100
PRACTICAL									
7	16MT5001	CAD/CAM/CAE Laboratory	0	0	4	2	50	50	100
8	16MT5002	Fluid Power Laboratory	0	0	4	2	50	50	100
		Total	**18**	**2**	**8**	**24**	**250**	**550**	**800**

SEMESTER VI

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

LIST OF PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE - I

S.No.	Course Code	Course Title	L	T	P	C	CIA	ESE	TOTAL
1	16MT5301	Non Traditional Machining Techniques	3	0	0	3	25	75	100
2	16MT5302	Discrete Event System Simulation	3	0	0	3	25	75	100
3	16MT5303	Materials Sciences and Applications	3	0	0	3	25	75	100
4	16MT5304	Automobile Systems	3	0	0	3	25	75	100
5	16MT5305	Process Control Instrumentation Technology	3	0	0	3	25	75	100
6	16MA5309	Probability and Statistics	3	0	0	3	25	75	100

PROFESSIONAL ELECTIVE - II

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

OPEN ELECTIVE

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

Credit Distribution

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

Chairman, Board of Studies

Dean – Academics

Principal

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

PRINCIPAL
Hindusthan College of Engineering & Technology
COIMBATORE - 641 032

SYLLABUS

Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MA1101	ENGINEERING MATHEMATICS I (COMMON TO ALL BRANCHES)	3	1	0	4

Course Objective

1. Develop the skill to use matrix algebra techniques that is needed by engineers for practical applications.
2. Find curvature, evolutes and envelopes using the concept of differentiation.
3. Solve ordinary differential equations of certain types using Wronskian technique.
4. Familiarize the functions of several variables which are needed in many branches of engineering.
5. Understand the concept of double and triple integrals.

Unit	Description	Instructional Hours
I	**MATRICES** Eigen values and Eigen vectors of a real matrix – Properties of Eigen values and Eigen vectors (without proof) – Cayley - Hamilton Theorem (excluding proof) – Orthogonal matrices – Diagonalization of matrices by orthogonal transformation– Reduction of a quadratic form to canonical form by orthogonal transformation.	9+3
II	**DIFFERENTIAL CALCULUS** Curvature in cartesian co-ordinates – Radius and Centre of curvature - Circle of curvature – Involutes and Evolutes (parabola, ellipse, cycloid, asteroid) – Envelopes - single parameter and two parameter family of curves..	9+3
III	**ORDINARY DIFFERENTIAL EQUATIONS** Second and higher order linear differential equations with constant coefficients and with RHS of the form e^{ax} , x^n, sinax or cosax , $e^{ax}f(x)$ and $xf(x)$ where $f(x)$ is sinbx or cosbx – Method of variation of parameters – Linear differential equations with variable coefficients (Euler's equation)	9+3
IV	**FUNCTIONS OF SEVERAL VARIABLES** Total differentiation (excluding implicit functions) - Partial derivatives of composite functions - Taylor's series for functions of two variables- Maxima and minima of functions of two variables - Lagrange's method of undetermined multipliers – Jacobians.	9+3
V	**MULTIPLE INTEGRALS** Double integrals in Cartesian coordinates – Change of order of integration – Area enclosed by the plane curves (excluding surface area) – Triple integrals in Cartesian co-ordinates – Volume of solids using Cartesian co-ordinates.	9+3
	Total Instructional Hours	45+15=60

Course Outcome

On completion of the course the students will be able to

- CO1: 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
- CO2: Apply the concept of differentiation to find the radius, centre and circle of curvature of any curve
- CO3: Develop sound knowledge of techniques in solving ordinary differential equations that model engineering problems
- CO4: Identify the maximum and minimum values of surfaces
- CO5: Computation of area of a region in simpler way by changing the order of integration and evaluation of triple integrals to compute volume of three dimensional solid structures

TEXT BOOKS:

T1- Ravish R Singh, Mukul Bhatt, "Engineering Mathematics", McGraw Hill education (India) Private Ltd., Chennai, 2017.

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

REFERENCE BOOKS:

R1- Bali N.P & Manish Goyal, "A Text book of Engineering Mathematics", 8th Edition, Laxmi Pub. Pvt. Ltd. 2011.

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.

R4- Sivarama Krishna Das P and Rukmangadachari E., "Engineering Mathematics" Vol I, Second Edition, Pearson publishing, 2011.

R5- Wylie & Barett, "Advanced Engineering Mathematics", McGraw Hill Education, 6th edition, 2003

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16PH1101	ENGINEERING PHYSICS	3	0	0	3

Course Objective

1. Illustrate the fundamental knowledge in mechanical properties of matter and thermal physics
2. Gain knowledge about laser and their applications
3. Conversant with principles of optical fiber, types and applications of optical fiber
4. Discuss the architectural acoustics and applications of Ultrasonics
5. Extend dual nature of matter and the Necessity of quantum mechanics to explore the behavior of sub atomic particles

Unit	Description	Instructional Hours
I	**PROPERTIES OF MATTER AND THERMAL PHYSICS** Elasticity – Hooke's law – Stress-strain diagram - Relation between three modulii of elasticity (qualitative) — Poisson's ratio – Bending moment – Depression of a cantilever – Derivation of Young's modulus of the material of the beam by Uniform bending – I-shaped girder. Modes of heat transfer – Thermal conductivity – Newton's law of cooling - Lee's disc method - Conduction through compound media (series and parallel).	9
II	**LASER AND APPLICATIONS** Spontaneous emission and stimulated emission – Population inversion – Pumping methods – Derivation of Einstein's coefficients (A&B) – Types of lasers – Nd:YAG laser, CO2 laser, Semiconductor lasers:(homojunction and heterojunction) – Laser Applications – Industrial applications: laser welding, laser cutting, laser drilling – Holography – Construction and reconstruction of images.	9
III	**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) – Crucible-crucible technique for fiber fabrication – Sources (LED and LASER) and detectors (p-i-n photodiode and avalanche photodiode) for fiber optics - Fiber optical communication link –Fiber optic sensors – Temperature and displacement sensors.	9
IV	**ACOUSTICS AND ULTRASONICS** Classification of sound – Weber–Fechner law – Sabine's formula (no derivation) - Absorption coefficient and its determination –Factors affecting acoustics of buildings and their remedies. Production – Magnetostrictive generator – Piezoelectric generator – Determination of velocity using acoustic grating – Non destructive testing – Ultrasonic pulse echo system.	9
V	**QUANTUM PHYSICS AND APPLICATIONS** Black body radiation – Planck's theory (derivation) –Compton effect experimental verification only - Matter waves – Physical significance of wave function – Schroedinger's wave equations – Time independent and time dependent wave equations –Particle in a box (One dimensional) – Scanning electron microscope – Transmission electron microscope	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Enhance the fundamental knowledge in Properties of Matter and Thermal Physics
CO2: Understand the advanced technology of LASER in the field of Engineering and medicine
CO3: Exposed the fundamental knowledge of Optical fiber in the field of communication Engineering
CO4: Understand the production of ultrasonic and its applications in NDT
CO5: Impart the fundamental knowledge on Quantum Physics

TEXT BOOKS:

T1- Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2011.
T2- Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, Dhanpat Rai Publications (P) Ltd., New Delhi, 2013.

REFERENCE BOOKS:

R1- Arthur Beiser "Concepts of Modern Physics" Tata McGraw Hill, New Delhi – 2010
R2- M.N Avadhanulu and PG Kshirsagar "A Text Book of Engineering physics" S. Chand and Company ltd., New Delhi, 2014
R3- Dr. G. Senthilkumar "Engineering Physics – I" VRB publishers Pvt Ltd., 2013

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16CY1101	ENGINEERING CHEMISTRY	3	0	0	3

Course Objective

1. The student should be conversant with boiler feed water requirements, related problems and water treatment techniques.
2. The student should be conversant with the principles of polymer chemistry and engineering applications of polymers and composites
3. The student should be conversant with the principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.
4. To acquaint the student with important concepts of spectroscopy and its applications.
5. To acquaint the students with the basics of nano materials, their properties and applications

Unit	Description	Instructional Hours
I	**WATER TECHNOLOGY** Hard water and soft water- Disadvantages of hard water- Hardness: types of hardness, calculations, estimation of hardness of water – EDTA method - scales and sludges – boiler corrosion – priming and foaming – caustic embrittlement; Conditioning methods of hard water – External conditioning - demineralization process- Internal conditioning - domestic water treatment: screening, sedimentation, coagulation, filtration, disinfection – chlorine – UV method; desalination: definition, reverse osmosis.	9
II	**POLYMER & COMPOSITES** Polymerization – types of polymerization – addition and condensation polymerization – mechanism of free radical addition polymerization – copolymers – plastics: classification – thermoplastics and thermosetting plastics, preparation, properties and uses of commercial plastics – PVC, Teflon – moulding of plastics (extrusion and compression); rubber: vulcanization of rubber, synthetic rubber – butyl rubber, SBR; composites: definition, types of composites – polymer matrix composites – FRP.	9
III	**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- solar energy conversion- solar cells- wind energy. Batteries and fuel cells: Types of batteries- alkaline battery lead storage battery- nickel-cadmium battery- lithium battery- fuel cell H_2 -O_2 fuel cell applications.	9
IV	**ANALYTICAL TECHNIQUES** Beer-Lambert's law – UV-visible spectroscopy and IR spectroscopy – principles – instrumentation (block diagram only) – estimation of iron by colorimetry – flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry – atomic absorption spectroscopy – principles – instrumentation (block diagram only) – interferences - estimation of nickel by atomic absorption spectroscopy.	9
V	**NANOMATERIALS** Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Nanoparticles: definition, carbon nanotubes (CNT), types of carbon nano tubes – single walled and multi walled carbon nanotubes – synthesis of carbon nanotubes: chemical vapour deposition – laser ablation – arc-discharge method; properties of CNT: mechanical, electrical, thermal and optical properties; applications of carbon nanotubes in chemical field, medicinal field, mechanical field and current applications.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Illustration of the basic parameters of water, different water softening processes and effect of hard water in industries.

CO2: Knowledge on basic properties and application of various polymers and composites as an engineering material.

CO3: Summarize the various energy sources and energy storage devices

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CO4: Analyze various analytical skills in handling various machines, instruments, apart from understanding the mechanism involved.
CO5: Describe the basic properties and application of nanomaterials.

TEXT BOOKS:

T1- P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2015).
T2- O.G.Palanna, "Engineering chemistry" McGraw Hill Education India (2017).

REFERENCE BOOKS:

R1- B.Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).
R2- B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2005).
R3- S.S.Dara "A Text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2010).

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Programm	Course Code	Name of the Course	L	T	P	C
B.E.	16HE1101R	ESSENTIAL ENGLISH FOR ENGINEERS– I	3	1	0	4

Course Objective

1. It fulfills the necessary skills needed in today's global workplaces
2. Student will be able to interpret and illustrate formal communication
3. It empowers students in choosing right lexical techniques for effective presentation
4. It equips the learner to analyze and list out things in logical order
5. The learner develops the ability to create and integrate ideas in a professional way

Unit	Description	Instructional Hours
I	Getting to know people – Introduction – Talking about jobs (Present Simple) – Talking about working conditions(Adverb of Frequency) - Talking about company history and structure (Past simple, Prepositions of Time) – Talking about company activities (Connectors of addition and contrast, Present Continuous) – Focus on language – Parts of Speech – Gerund and Infinitives – Instruction-**General Vocabulary**	9+3
II	Vocabulary practice – (Telephoning Leaving and taking messages) – requests and obligation – Describing trends (Adjectives and Adverbs) – Talking about company performance (present perfect and past simple, Reasons and consequences) – Reading Test Practice Describing products Dimensions, (Comparatives and Superlatives, Question formation) – Talking about product development (Sequencing words, Present continuous and going to) – Articles – Prepositions-Synonyms – Antonyms- Recommendations-**Interpretation of a chart.**	9+3
III	Talking about business equipment (Giving Instruction) – Letter Phrases- Writing Test Practice- Talking about facilities(Asking for and giving direction)- Presentation on a general topic -Talking about traffic and transport(making predictions)-**Discussion on current affairs**– Tenses- Present – Past-Future-Forms of verbs- Word techniques- Formation-Prefixes-Suffixes.	9+3
IV	Talking about conference arrangement(checking and confirming) – Talking about a conference before, after, when, until etc. – Listening Test Practice- talking about production process – passive- Talking about quality control Conditional 1 (real) (Making suggestions) – Itinery- Jumbled sentences- Paragraph writing- Essay writing – Checklist- Letter to Inviting Dignitaries – Accepting invitation- Declining Invitation.	9+3
V	Talking about call centers, insurance and changes in working practices (future possibility/probability)- Talking about banking- Speaking Test practice – Talking about delivery services (preposition of Time)- Talking about trading (Tense review)- Talking about recruitment conditional 2 (hypothetical) – talking about job applications (indirect questions) – Reading, Writing and Listening Test – Job application Letter and Resume Writing- Permission letters.	9+3
	Total Instructional Hours	45+15=60

Course Outcome

On completion of the course the students will be able to

CO1: Recognize different parts of speech for better usage
CO2: Interpret and illustrate formal communication
CO3: Choosing right lexical techniques for effective presentation
CO4: Analyze and list out things in logical order
CO5: Create and integrate ideas in a professional way describe the basic properties and application of nanomaterials

TEXT BOOKS:

T1- Norman Whitby, Cambridge English: Business BENCHMARK Pre-intermediate to Intermediate – 2nd Edition. 2014.
T2- Ian Wood and Anne Willams. "Pass Cambridge BEC Preliminary", Cengage Learning press 2013.

REFERENCE BOOKS:

R1- Meenakshi Raman and Sangeetha Sharma. "Technical Communication-Principles and Practice", Oxford University Press, 2009.
R2- Rizvi, Ashraf. M. Effective Technical Communication. Tata McGraw-Hill, New Delhi, 2005
R3- Kamalesh Sadanan "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.	16GE1103	PROBLEM SOLVING AND PYTHON PROGRAMMING (COMMON TO ALL BRANCHES)	3	0	0	3

Course Objective

1. Learn the fundamentals of computers.
2. Learn the basics of C programming
3. Learn the basics of Arrays and String
4. Learn the uses of functions and pointers.
5. Learn the basics of structures and unions.

Unit	Description	Instructional Hours
I	**BASICS OF COMPUTER** Generation and Classification of Computers- Basic Organization of a Computer – Input and Output Devices–Hardware and Software definitions- Categories of Software- Number System Conversion and problems. Need for logical analysis and thinking – Algorithm -Pseudo code – Flow Chart.	9
II	**BASICS OF 'C' PROGRAMMING** Fundamentals of ' C' programming – Structure of a 'C' program – compilation and linking processes – Constants, Variables – Data Types –Expressions using operators in 'C' – Managing Input and Output operations-Decision making-Branching and Looping-Case study	9
III	**ARRAYS AND STRINGS** Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String Library functions – String Arrays. Matrix operations-Addition-Subtraction-Multiplication-Transpose-Case study.	9
IV	**FUNCTIONS AND POINTERS** Function – definition – Declaration – Types of Function definition – call by value-call by reference- Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays-Case study.	9
V	**STRUCTURES AND UNIONS** Structure- data type – definition – declaration –Nesting of structure - Union – Storage classes, Pre-processor directives-Case study.	9
	Total Instructional Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Use computers at user level, including operating systems, programming environments and differentiate between basic concepts of computer hardware and software.

CO2: Analyze problems, design and implementing algorithmic solutions.

CO3: Use data representation for the fundamental data types, read, understand and trace the execution of programs written in C language.

CO4: Write the C code using a modular approach and recursive concepts.

CO5: Explain the use of pointers, Structures and union.

TEXT BOOKS:

T1- Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.

T2- Dr.N.Sengottaiyan and K.Ramya, "Fundamentals of Computer Programming",Cengage Learning (India) Pvt.Ltd.,2016.

REFERENCE BOOKS:

R1- Yashavant P. Kanetkar. " Let Us C", BPB Publications, 2011.

R2- Balagurusamy"Programming in ANSI C", Schaum's Outlines, Second Edition, Tata McGraw-Hill, 2006.

R3- M.Rajaram and P.Uma maheswari, "Computer Programming with C" Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2014

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16GE1102	ENGINEERING GRAPHICS (COMMON TO ALL BRANCHES)	3	1	0	4

Course Objective

1. To provide drafting skills for communicating the Engineering concepts and ideas.
2. To expose to BIS and International standards related to engineering drawings.

Unit	Description	Instructional Hours
I	**PLANE CURVES** Importance of engineering drawing, drafting instruments, drawing sheets – layout and folding, Lettering and dimensioning, BIS standards and scales. Geometrical constructions, 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	15
II	**PROJECTIONS OF POINTS, LINES AND PLANE SURFACES** Introduction to Orthographic projections- Projection of points. Projection of straight lines inclined to both the planes, Determination of true lengths and true inclinations by rotating line method. Projection of planes (polygonal and circular surfaces) inclined to both the planes by rotating object method (First angle projections only).	15
III	**PROJECTIONS OF SOLIDS** Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is perpendicular and inclined to one plane and objects inclined to both the planes by rotating object method.	15
IV	**SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES** Sectioning of simple solids with their axis in vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other – Obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids, cylinder and cone. Development of lateral surfaces of truncated solids. Intersection of solids-cylinder vs cylinder.	15
V	**ISOMETRIC AND ORTHOGRAPHIC PROJECTIONS** Isometric views and projections of 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. Perspective projection of solids in simple position using visual ray method.	15
	Total Instructional Hours	75

Course Outcome

On completion of the course the students will be able to

CO1: Draw the orthographic and isometric views of regular solid objects including sectional views.

CO2: Recognize the International Standards in Engineering Drawing practices.

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", Dhanalaksmi Publishers, Chennai.

REFERENCE BOOKS:

R1- Basant Agrawal and C.M.Agrawal, "Engineering Drawing", Tata McGraw Hill Publishing Company Limited,New Delhi 2008.

R2- K. R. Gopalakrishnan, "Engineering Drawing" (Vol. I & II), Subhas Publications, Bangalore, 1998.

R3- M.B.Shah and B.C.Rana, "Engineering Drawing", Pearson Education, India, 2005.

R4- 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.	16PS1001	PHYSICAL SCIENCES LAB– I PHYSICS LAB I (COMMON TO ALL BRANCHES)	0	0	2	1

Course Objective

1. Evaluate the particle size of micro particles and acceptance angle of fibres.
2. Employ instrumental method to determine Young's modulus of a beam of metals.
3. Apply the concept of diffraction and getting ability to calculate the wavelength of the mercury spectrum

Unit	Description of the Experiments	Practical Hours
1	Determination of Wavelength, and particle size using Laser	
2	Determination of acceptance angle and numerical aperature in an optical fiber.	
3	Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.	
4	Determination of wavelength of mercury spectrum – spectrometer grating	
5	Determination of thermal conductivity of a bad conductor – Lee's Disc method	
6	Determination of Young's modulus by Non uniform bending method	
7	Determination of specific resistance of a given coil of wire – Carey Foster's Bridge.	
8	Post office box Measurement of an unknown resistance	
	Total Practical Hours	30

Course Outcome

On completion of the course the students will be able to

CO1: Point out the particle size of micro particles and acceptance angle of fibres using diode laser.
CO2: Assess the Young's modulus of a beam using non uniform bending methods.
CO3: Illustrate the concept of diffraction and getting ability to calculate the wavelength of the mercury spectrum Using spectrometer.
CO4: Identify the velocity of ultrasonic's in the given liquid.
CO5: Illustrate phenomena of thermal conductivity of a bad conductor.

*** Student will prepare lab record during the course of the semester.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16PS1001	PHYSICAL SCIENCES LAB– I CHEMISTRY LAB – I (COMMON TO ALL BRANCHES)	0	0	2	1

Course Objective

1. Acquire practical skills in the determination of water quality parameters.
2. Acquaint the students with the determination of molecular weight of a polymer by viscometry.
3. Acquaint the students with the estimation of chemical substances using instrumental analysis technique

Unit	Description of the Experiments	Practical Hours
1	Preparation of molar and normal solutions and their standardization.	
2	Estimation of total, permanent and temporary hardness of Water by EDTA	
3	Determination of chloride content of water sample by argentometric method.	
4	Determination of available chlorine in bleaching powder.	
5	Conductometric titration of strong acid vs strong base (HCl vs NaOH).	
6	Conductometric titration (Mixture of weak and strong acids)	
7	Conductometric precipitation titration using $BaCl_2$ and Na_2SO_4	
8	Determination of molecular weight and degree of polymerization using viscometry.	
9	Estimation of iron content of the water sample using spectrophotometer.(1,10 phenanthroline / thiocyanate method).	
	Total Practical Hours	30

Course Outcome

On completion of the course the students will be able to

CO1: Estimate the different types of hardness in a water sample.
CO2: Determine the chloride content of water sample.
CO3: Calculate the strength of acid using conductometric titrations.
CO4: Calculate the strength of strong and weak acid using conductometric titrations.
CO5: Estimate the amount of salt using conductometric precipitation titrations.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16GE1004	PYTHON SOLVING AND PYTHON PROGRAMMING LAB (COMMON TO ALL BRANCHES)	0	0	4	2

Course Objective

1. Be familiar with Microsoft office software.
2. Be exposed to role of constants, variables, identifiers, operators and other building blocks of C Language.
3. Be familiar with the use of conditional expressions and looping statements to solve problems associated with conditions and repetitions.
4. Be familiar with the concept of Array and pointers dealing with memory management.
5. Be exposed to Structures and unions.

Unit	Description of the Experiments	Practical Hours
1	**a. Word Processing:** 1. Document creation, Text manipulation with Scientific notations 2. Table creation, Table formatting and conversion 3. Mail merge and Letter preparation 4. Flow Chart	3
2	**b. Spread Sheet:** 1. Chart - Line, XY, Bar and Pie. 2. Formula - formula editor. 3. Spread sheet - inclusion of object, picture and graphics, protecting the document and sheet. 4. Sorting and Import / Export features	6
3	**c. Basic C programming:** C program using I/O Statements	3
4	C program using arithmetic operations Decision making statement & Looping Concepts	3
5	• Designing a simple arithmetic calculator. (Use switch statement) • Performing the following operations: (Use loop statement) • Generate Pascal's triangle. • Construct a Pyramid of numbers	6
6	**d. Arrays and Strings** C program using one dimensional arrays	3
7	C program using two dimensional arrays	3
8	C program using string functions	3
9	**e. Functions and pointers** 1. Perform the following operations: (Use recursive functions) i. Find the factorial of a given integer. ii. Find the GCD (Greatest Common Divisor) of two given integers. iii. Solve Towers of Hanoi problem.	6
10	Program to swap two numbers using pointers - call by reference.	3
11	**f. Structures and Unions** C Program using Structures	3
12	C Program using Unions	3
	Total Practical Hours	45

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Course Outcome	On completion of the course the students will be able to CO1: Use office packages for documentation and presentation. CO2: Implement program using control structures. CO3: Handle arrays and strings. CO4: Handle functions and pointers. CO5: Form heterogeneous data using structure and union.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16GE1002	Engineering Practices Lab(Common to all Branches)	0	0	4	2

Course Objective

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

GROUP A (CIVIL & MECHANICAL)

Unit	Description of the Experiments	Practical Hours
	I CIVIL ENGINEERING PRACTICE	
	Study of plumbing and carpentry components of Residential and Industrial buildings.	
	(A) PLUMBING WORKS:	
1	Study on pipe joints, its location and functions: Valves, taps, couplings, unions, reducers, elbows in household fittings.	
2	Study of pipe connection requirements for pumps.	
3	Preparation of plumbing line sketches for water supply and sewage works.	
4	Hands-on-exercise: ➢ Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.	9
5	Demonstration of plumbing requirements of high-rise buildings.	
	(B) CARPENTRY USING POWER TOOLS ONLY:	
1	Study of the joints in roofs, doors, windows and furniture.	
2	Hands-on-exercise in wood works by sawing, planning and cutting.	
	II MECHANICAL ENGINEERING	
	(A) Welding:	
1	Preparation of arc welding of Butt joints, Lap joints and Tee joints	
	(B) Machining:	
1	Practice on Simple step turning and taper turning	
2	Practice on Drilling Practice	
	(C) Sheet Metal Work:	10
1	Practice on Models– Trays, cone and cylinder.	
	DEMONSTRATION	
	(D) Smithy	
	➢ Smithy operations: Upsetting, swaging, setting down and bending. ➢ Demonstration of – Production of hexagonal headed bolt.	
	(E) Gas welding	
	(F) Foundry Tools and operations.	

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GROUP B (ELECTRICAL & ELECTRONICS)

Unit	Description of the Experiments	Practical Hours
	ELECTRICAL ENGINEERING PRACTICES	
1	Residential house wiring using switches, fuse, indicator, lamp and energy meter.	10
2	Fluorescent lamp wiring	
3	Stair case wiring.	
4	Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.	
5	Measurement of energy using single phase energy meter.	
	ELECTRONICS ENGINEERING PRACTICES	
1	Study of Electronic components and equipments – Resistors - colour coding	13
2	Measurement of DC signal - AC signal parameters (peak-peak, RMS period, frequency) using CRO.	
3	Study of logic gates AND, OR, NOT and NAND .	
4	Soldering practice – Components Devices and Circuits – Using general purpose PCB.	
5	Measurement of average and RMS value of Half wave and Full Wave rectifiers.	
	Total Practical Hours	45

Course Outcome

On completion of the course the students will be able to

CO1: Fabricate wooden components and pipe connections including plumbing works.
CO2: Fabricate simple weld joints.
CO3: Fabricate electrical and electronics circuits.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16GE1003	VALUE ADDED COURSE I: LANGUAGE COMPETENCY ENHANCEMENT COURSE- I (COMMON TO ALL BRANCHES)	0	0	2	1

Course Objective

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

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

Course Outcome

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

REFERENCE BOOKS :

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

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MA2102	ENGINEERING MATHEMATICS–II (COMMON TO ALL BRANCHES)	3	1	0	4

Course Objective

1. Learn the basics of vector calculus comprising gradient, divergence, Curl and line, surface, volume integrals.
2. Understand analytic functions of complex variables and conformal mappings.
3. Know the basics of residues, complex integration and contour integration.
4. Apply Laplace transform techniques to solve linear differential equations.
5. Know the effective mathematical tools for the solutions of partial differential equations that model several physical problems in mathematical physics

Unit	Description	Instructional Hours
I	**VECTOR CALCULUS** Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.	9+3
II	**ANALYTIC FUNCTIONS** Analytic function - Cauchy-Riemann equations - sufficient conditions (excluding proof) – Harmonic - conjugate harmonic functions– Construction of analytic functions (Milne-Thompson method) – Conformal mapping: w = z+c, cz, 1/z and bilinear transformation without problems related to the concept of conformal mapping.	9+3
III	**COMPLEX INTEGRATION** Complex integration – Statements of Cauchy's integral theorem – Taylor's and Laurent's series expansions - Singular points – Residues – Cauchy's residue theorem – Evaluation of real definite integrals as contour integrals around unit circle.	9+3
IV	**LAPLACE TRANSFORM** Laplace transform –Basic properties – Transforms of derivatives and integrals of functions - Transforms of unit step function and impulse function – Transform of periodic functions. Inverse Laplace transform - Convolution theorem (with out proof) – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.	9+3
V	**PARTIAL DIFFERENTIAL EQUATIONS** Formation of partial differential equations by elimination 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-Linear homogeneous partial differential equations of second and higher order with constant coefficient.	9+3
	Total Instructional Hours	45+15=60

Course Outcome

On completion of the course the students will be able to

CO1: Know the gradient, divergence and curl of vectors useful for engineering application like fluid flow, electricity and magnetism.

CO2: Test the analyticity to construct the analytic function and transform complex functions from one plane to another plane graphically.

CO3: Evaluate real and complex integrals over suitable closed paths or contours.

CO4: Know the applications of Laplace transform and its properties and to solve certain linear differential equations using Laplace transform technique.

CO5: Solve the engineering problems using Partial Differential Equations.

TEXT BOOKS:

T1- Ravish R Singh, Mukul Bhatt, "Engineeing Mathematics", McGraw Hill education (India) Private Ltd., Chennai, 2017.

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

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REFERENCE BOOKS:

R1- Bali N.P & Manish Goyal, "A Text book of Engineering Mathematics", 8th Edition, Laxmi Pub. Pvt. Ltd. 2011.

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.

R4- Sivarama Krishna Das P and Rukmangadachari E., "Engineering Mathematics" Vol I, Second Edition, Pearson publishing, 2011.

R5- Wylie & Barett, "Advanced Engineering Mathematics", McGraw Hill Education, 6th edition, 2003

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16PH2102	PHYSICS OF MATERIALS	3	0	0	3

Course Objective

1. Gain knowledge about conducting materials.
2. Provide fundamental knowledge of semiconducting materials which is related to the engineering program.
3. Extend the properties of magnetic materials, applications and super conducting materials.
4. Defend the various types of dielectric materials and their uses.
5. Expose the students to smart materials and the basis of nano technology.

Unit	Description	Instructional Hours
I	**CONDUCTING MATERIALS** Introduction – Conductors – Classical free electron theory of metals – Electrical and thermal conductivities – Wiedemann–Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi function – Density of energy states – Carrier concentration in metals.	9
II	**SEMICONDUCTING MATERIALS** Introduction – Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – compound semiconductors –direct and indirect band gap of semiconductors- derivation of carrier concentration in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration — Hall effect – Determination of Hall coefficient – Applications	9
III	**MAGNETIC & SUPERCONDUCTING MATERIALS** **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. **Superconducting Materials :** Superconductivity : properties(Messiner effect, effect of magnetic field, effect of current and isotope effects) – Type I and Type II superconductors – BCS theory of superconductivity(Qualitative) - High Tc superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation	9
IV	**DIELECTRIC & COMPOSITES MATERIALS** Introduction – Electrical susceptibility – dielectric constant – polarization - electronic, ionic, orientation and space charge polarization –internal field – Claussius – Mosotti relation (derivation) – dielectric loss and dielectric breakdown (qualitative) Introduction to composites materials – types of composites materials – polymer, metallic and ceramic matrix composites (qualitative). Application in surgery, sports equipment.	9
V	**SMART MATERIALS AND NANOTECHNOLOGY** **New Engineering Materials**: Metallic glasses – preparation, properties and applications – shape memory alloys (SMA) – characteristics, properties of NiTi alloy applications. **Nano Materials**: Synthesis - plasma arcing – Chemical vapour deposition – properties of nanoparicles and applications. – Carbon nano tubes – fabrication – pulsed laser deposition - Chemical vapour deposition - properties & applications.	9
	Total Instructional Hours	45

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Course Outcome

On completion of the course the students will be able to

CO1: Illustrate the electrical / thermal conductivity of conducting materials.

CO2: Understand the purpose of the acceptor or donor levels and the band gap of a semiconductor.

CO3: Interpret the basic idea behind the process of magnetism and applications of magnetic materials in everyday life

CO4: Identify and compare the various types of dielectric polarization and dielectric breakdown.

CO5: Evaluate the properties and applications of various advanced engineering materials and develop the new ideas to synthesis Nano materials.

TEXT BOOKS:

T1- S.O.Pillai "Solid State Physics" New Age International Publishers, New Delhi – 2011

T2- Rajendran V "Materials Science" McGraw-Hill Education" New Delhi -2016.

REFERENCE BOOKS:

R1- William D Callister, Jr "Material Science and Engineering" John wiley and Sons, New York, 2014.

R2- Raghavan, V. "Materials Science and Engineering – A First Course" Prentice Hall of India, New Delhi 2016.

R3- Dr. G. Senthilkumar "Engineering Physics – II" VRB publishers Pvt Ltd., 2013

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16CY2102	ENVIRONMENTAL SCIENCES	3	0	0	3

Course Objective

1. To gain knowledge on the importance of environmental education, ecosystem and biodiversity.
2. To acquire knowledge about environmental pollution – sources, effects and control measures of environmental pollution.
3. To find and implement scientific, technological, economic and political solutions to environmental problems.
4. To study about the natural resources, exploitation and its conservation
5. To be aware of the national and international concern for environment and its protection.

Unit	Description	Instructional Hours
I	**ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY** Importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers- energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.	9
II	**ENVIRONMENTAL POLLUTION** Definition – causes, effects and control measures of: Air pollution – Air pollution standards – control methods- Water pollution – Water quality parameters- Soil pollution - Marine pollution - Noise pollution- Thermal pollution - Nuclear hazards–role of an individual in prevention of pollution – pollution case studies.	9
III	**NATURAL RESOURCES** Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and Desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.	9
IV	**SOCIAL ISSUES AND THE ENVIRONMENT** From unsustainable to sustainable development – urban problems related to energy- energy conversion – electrical energy calculations- environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- Current Environmental issues at Country level – management of municipal sewage, municipal solid waste, Hazardous waste and Bio-medical waste – Global issues – Climatic change, Acid rain, greenhouse effect and Ozone layer depletion. Disaster management: floods, earthquake, cyclone and landslides.	9
V	**HUMAN POPULATION AND THE ENVIRONMENT** Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child	9

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welfare –Environmental impact analysis (EIA)- GIS-remote sensing-role of information technology in environment and human health – Case studies

Total Instructional Hours 45

Course Outcome

On completion of the course the students will be able to

CO1: Understand the natural environment and its relationships with human activities.
CO2: Characterize and analyze human impacts on the environment
CO3: Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes
CO4: Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world.
CO5: Understand and implement scientific research strategies, including collection, management, evaluation, and interpretation of environmental data.

TEXT BOOKS:

T1- Anubha Kaushik and C. P. Kaushik, "Environmental Science and Engineering", Fourth edition, New Age International Publishers, New Delhi, 2014.
T2- Deeksha Dave and S.S.Katewa, "Textbook of Environmental Studies", Second Edition, Cengage Learning, 2012.

REFERENCE BOOKS:

R1- Trivedi R.K. "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media.
R2- G.Tyler Miller, Jr and Scott E. Spoolman"Environmental Science" Thirteenth Edition, Cengage Learning, 2010.
R3- Gilbert M. Masters, "Introduction to Environmental Engineering and Science", 2nd edition, Pearson Education, 2004

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Programm	Course Code	Name of the Course	L	T	P	C
B.E.	16HE2102R	ESSENTIAL ENGLISH FOR ENGINEERS - II	3	1	0	4

Course Objective

1. The learner will be introduced to global corporate culture and professional communication.
2. It helps the students to focus on organizing professional event and documentation.
3. The student will be able to describe the events and process in an effective way.
4. It trains the student to analyze the problems and to find solution to it.
5. The learner will be familiar with business communication.

Unit	Description	Instructional Hours
I	Introduction- talking about teamwork- Making arrangements- Improving Communication in spoken language – Taking and leaving Voice mail messages (present Tense, Past Tense and Present Perfect) Talking about Business Hotel- (Speaking Activity) Talking about Corporate Hospitality- Formal and Informal Language – Making accepting and declining invitations (Auxiliary Verb, Countable or Uncountable Nouns) – Focus on Language – Definitions and Extended Definitions- **Reading comprehension.**	9+3
II	Talking about orders – Clarity Written Language – Phone and Letter Phrases – Talking about Company Finances – Conditional 1 and 2 – Managing Cash Flow (Intention and Arrangements Conditional 1 and 2) – Talking about Brands and Marketing – Ethical Banking- Talking about Public Relations – Organizing a PR Event – Describing Duties and Responsibilities – (Future Tense and Articles) – Reported Speech – Modal Verbs and Passive, Impersonal Passive Voice-**interpretation of posters or advertisements.**	9+3
III	Talking about relocation – Report Phrases – Talking about Similarity and difference- Giving Directions- Asking for Information and Making Suggestions – Talking about Location (Comparatives and Superlatives, Participles) – Talking about Company Performances- Describing Trends – Describing Cause and Effect – Talking about Environmental Impact – Discussing Green Issues – Language of Presentations (Adjectives and Adverbs, Determiners)- Homophones – Homonyms- Acronyms-Abbreviations- British and American words.	9+3
IV	Talking about Health and Safety – Expressing Obligation- Discussing Regulations- Talking about personnel Problems – Passives – Talking about Problem at Work (modal Verbs, Passives)- Talking about Expenses Claims- Talking about Air Travel (Relative Pronoun, Indirect Questions) – **E-mail Writing - Note completion-** Transcoding.	9+3
V	Talking about staff Benefits- Talking about Appraisal Systems (gerunds and Infinitives, Reported Speech) – Talking about Marketing Disasters – Expressing hypothetical Situations- Talking about entering Foreign Market (Conditional 3, Grammar review) – Letter for calling quotations, Replying for quotations – Placing an order and Complaint and **reply to a complaint.**	9+3
	Total Instructional Hours	45+15=60

Course Outcome

On completion of the course the students will be able to

CO1: Introduced corporate culture and professional communication.
CO2: It focused on organizing a professional event and its documentation.
CO3: Improved the ability to describe the events and process in an effective way
CO4: Trained to analyze the problems and to find solution to it.
CO5: Practiced to make business communication.

TEXT BOOKS:

T1- Norman Whitby, Cambridge English: Business BENCHMARK Pre-intermediate to Intermediate – 2nd Edition. 2014.
T2- Ian Wood and Anne Willams. "Pass Cambridge BEC Preliminary", Cengage Learning press 2013.

REFERENCE BOOKS:

R1- Meenakshi Raman and Sangeetha Sharma. "Technical Communication-Principles and Practice", Oxford University Press, 2009.
R2- Technical Communication, Daniel G. Riordan, Cengage learning publishers.
R3- Kamalesh Sadanan "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.	16GE2101	ENGINEERING MECHANICS (COMMON TO ALL BRANCHES)	3	1	0	4

Course Objective

1. Understand the vector and scalar representation of forces and moments
2. Understand the static equilibrium of particles and rigid bodies both in two dimensions.
3. Understand the principle of work and energy.
4. Comprehend the effect of friction on equilibrium.
5. Write the dynamic equilibrium equation.

Unit	Description	Instructional Hours
I	**BASICS & STATICS OF PARTICLES** Introduction – Units and Dimensions – Laws of Mechanics – Lame's theorem, Parallelogram and triangular Law of forces – Vectors – Vector representation of forces and moments – Coplanar Forces – Resolution and Composition of forces – Equilibrium of a particle –Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility.	9+3
II	**EQUILIBRIUM OF RIGID BODIES** Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis– Scalar components of a moment – Varignon's theorem – Single equivalent force – Equilibrium of Rigid bodies in two dimensions.	9+3
III	**PROPERTIES OF SURFACES AND SOLIDS** Determination of Areas and Volumes – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, - Angle section, Hollow section by using standard formula – Second and product moments of plane area – Rectangle, triangle, circle from integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principal moments of inertia of plane areas.	9+3
IV	**DYNAMICS OF PARTICLES** Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion – Newton's law – Work Energy Equation of particles – Impulse and Momentum – Impact of elastic bodies. Co-efficient of restitution.	9+3
V	**FRICTION** Frictional force – Laws of Coloumb friction – Simple contact friction – Rolling resistance – Wedge friction - Belt friction, Applications of friction.	9+3
	Total Instructional Hours	45+15=60

Course Outcome

On completion of the course the students will be able to

CO1: To solve engineering problems dealing with force, displacement, velocity and acceleration.
CO2: To analyze the forces in any structure.
CO3: To solve rigid body subjected to dynamic forces.

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).

REFERENCE BOOKS:

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

R2- S.Rajasekaran and G.Sankarasubramanian, "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.

R3- S.S.Bhavikatti, and K.G.Rajashekarappa, "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16GE2202	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	3	0	0	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 and AC machines
3. To provide knowledge on the fundamentals of semiconductor devices and their applications.
4. To impart knowledge on digital electronics and its principles.
5. To develop block diagrams for satellite and optical fiber communications.

Unit	Description	Instructional Hours
	ELECTRICAL CIRCUITS AND MEASUREMENTS	
I	Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Waveforms and RMS Value – Power and Power factor – Single Phase circuits - Three Phase Balanced Circuits. Operating Principles of Moving Coil and Moving Iron Instruments - Ammeters and Voltmeters, Dynamometer type Watt meters and Energy meters.	9
	ELECTRICAL MACHINES	
II	Construction, Principle of Operation of DC Generators - EMF Equation - Construction, Principle of Operation of DC shunt and series Motors, Single Phase Transformer - EMF Equation, Single phase capacitor start - capacitor run – Construction, Principle of Operation of Three Phase Induction Motor – Applications - (Qualitative Approach only).	9
	SEMICONDUCTOR DEVICES AND APPLICATIONS	
III	Characteristics of PN Junction Diode – Zener Diode and its Characteristics – Zener Effect – Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor (BJT) – CB, CE, CC Configurations and Characteristics – FET – Characteristics.	9
	DIGITAL ELECTRONICS	
IV	Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops (RS, JK, T & D), A/D and D/A Conversion (Dual Slope, SAR, Binary-weighted and R-2R).	9
	FUNDAMENTALS OF COMMUNICATION ENGINEERING	
V	Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations - Satellite and Optical Fibre communications (Block Diagram Approach only).	9
	Total Instructional Hours	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 logic gates in circuit design.

CO5: Construct block diagram and explain satellite and optical Fibre communication systems.

TEXT BOOKS:

T1- Mittle N., "Basic Electrical Engineering", Tata McGraw Hill Edition, New Delhi, 1990.

T2- Sedha R.S., "Applied Electronics", S. Chand & Co., 2006.

T3- Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics and Computer Engineering", Tata McGraw Hill, Second Edition, 2006.

REFERENCE BOOKS:

R1- Nagsarkar T K and Sukhija M S, "Basics of Electrical Engineering", Oxford press 2005.

R2- Mehta V K, "Principles of Electronics", S.Chand & Company Ltd, 1994.

R3- Premkumar N, "Basics of Electrical Engineering", Anuradha Publishers, 2003.

R4- T.Thyagarajan. "Fundamentals of Electrical and Electronics Engineering" Scitech Publications Pvt Ltd, 2011.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16PS2001	PHYSICAL SCIENCES LAB – II PHYSICS LAB II (COMMON TO ALL BRANCHES)	0	0	2	1

Course Objective

1. Evaluate the band gap of a semiconductor.
2. Apply the concept of interference and calculate the thickness of thin wire.
3. Acquire the practical skills in Young's modulus by uniform bending method.

Unit	Description of the Experiments	Practical Hours
1	Determination of Young's modulus by uniform bending method	
2	Determination of band gap of a semiconductor	
3	Determination of Coefficient of viscosity of a liquid –Poiseuille's method	
4	Determination of Dispersive power of a prism - Spectrometer	
5	Determination of thickness of a thin wire – Air wedge method	
6	Determination of Rigidity modulus – Torsion pendulum	
7	Magnetic hysteresis experiment.	
8	Calibration of ammeter using potentiometer	
	Total Practical Hours	30

Course Outcome

On completion of the course the students will be able to

CO1: Experiment involving the physical phenomena of the Rigidity modulus of wire.
CO2: Determine the band gap of a semiconductor and variation of Energy Gap (E_g)with temperature.
CO3: Assess the Young's modulus of a beam using non uniform bending method.
CO4: Explain the concept of interference and calculate the thickness of thin wire and other fine objects.
CO5: Experiment provides a unique opportunity to validate Dispersive power of a prism using Spectrometer.

*** Student will prepare lab record during the course of the semester.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16PS2001	PHYSCIAL SCIENCES LAB– II CHEMISTRY LAB – II (COMMON TO ALL BRANCHES)	0	0	2	1

Course Objective

1. Acquire practical skills in the quantitative analysis of water quality parameters.
2. Acquire practical skills in the instrumental methods for quantitative estimation of metal ion content.
3. Gain knowledge in determination of rate of corrosion.

Unit	Description of the Experiments	Practical Hours
1	Determination of Dissolved Oxygen in water by Winkler's method.	
2	Estimation of alkalinity of water sample by indicator method.	
3	Estimation of hydrochloric acid by pH metry.	
4	Estimation of ferrous iron by Potentiometry.	
5	Estimation of Copper by EDTA	
6	Determination of sodium by flame photometry	
7	Determination of corrosion rate of mild steel by weight loss method.	
	Total Practical Hours	30

Course Outcome

On completion of the course the students will be able to

CO1: Determine the level of DO in a water sample.

CO2: Identify and estimate the different types of alkalinity in water sample.

CO3: Estimate the acidity of water sample using pH metry.

CO4: Estimate the amount of copper in a brass sample.

CO5: Determine the metal ion content using instrumental methods.

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16ME2001	COMPUTER AIDED DRAFTING LAB (COMMON TO ALL BRANCHES)	0	0	4	2

Course Objective
1. To develop skills on using software for preparing 2D Drawings.
2. To provide the importance of computer aided drawing in engineering society.

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 its 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.	
	Total Practical Hours	45

Course Outcome
On completion of the course the students will be able to
CO1: The students shall be able to use the software package for drafting
CO2: The students shall be able to create 2D Drawing of Engineering Components
CO3: :The students shall be able to apply basic concepts to develop construction drawing techniques

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16GE2001	VALUE ADDED COURSE – II: LANGUAGE COMPETENCY ENHANCEMENT COURSE- II	0	0	2	1

(COMMON TO ALL BRANCHES)

Course Objective

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

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

Course Outcome

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

REFERENCE BOOKS:

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

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SYLLABUS

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

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

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

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

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

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

WEB REFERENCES:

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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.	16MT3203	MECHANICS OF MATERIALS	3	0	0	3

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

CO1: To design the electronic circuits using logic gates

CO2: To create various types of starters using contactors and relays

CO3: To develop the control circuits for braking, jogging, reversing operations

CO4: To perform the load test on 3 phase Induction Motor

CO5: To analyze the performance of machines without load

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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

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2. http://home.roboticlab.eu/en/microcontrollers.

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

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SYLLABUS

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

CO1: Express the role of computers in CAD/CAM and its integration
CO2: Identify proper computer graphics techniques for geometric modeling
CO3: Compare the different types of FMS layouts, material handling and insight of automation inmanufacturing
CO4: Develop competency in planning and scheduling in manufacturing operationsCO5:
Analyze the product before the commencement of manufacturing

TEXT BOOKS:

T1- Mikell P. Groover, *"Automation, Production Systems and Computer - Integrated Manufacturing"*, 2nd Edition, PHILearning Private Limited, New Delhi, 2011.

T2- Seshu.P, *"Textbook of Finete Element Analysis"*, 1st Edition, PHI Learning Private Limited, New Delhi, 2012.

REFERENCE BOOKS:

R1- Sadhu Singh. *"Computer Aided Design and Manufacturing"*, 4th Edition, Khanna Publishers, New Delhi, 1998.

R2- Ibrahim Zeid, *"CAD/CAM Theory and Practice"*, 2nd Edition, Tata McGraw Hill Publishing Company Limited, NewDelhi, 2009.

R3- Radha Krishnan and S.Subramanian, *"CAD/CAM/CIM"*, 3rd Edition, New Age International (P) Ltd., New Delhi, 2015.

WEB REFERENCES:

1. http://ciilogistics.com/coursware/sem2/Warehousing.pdf
2. http://www.warehouse-logistics.com/download/Flyer/GB_Flyer_Produkt_Solvo_001.pdf

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

CO1: Identify basic components in a fluid power system
CO2: Develop the concept of designing hydraulic and pneumatic circuits
CO3: Model and simulate the basic hydraulic and pneumatic systems
CO4: Test the various hydraulic and pneumatic circuit
CO5: Develop and test the process integration for a complete automatic process

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PROFESSIONAL ELECTIVE - I

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

T1- Benedict. G.F, *"Non Traditional Manufacturing Processes"*, 1st Edition, Taylor, CRC Press, NewYork, 1987.

T2- Pandey P.C. and Shan H.S. *"Modern Machining Processes"*, 1st Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

REFERENCE BOOKS:

R1- V. K. Jain, *"Advanced Machining Processes"*, 4th Edition, Allied Publishers, 2009.

R2- J. A. McGeough, *"Advanced Methods of Machining"*, 1st Edition, Springer, 1988.

WEB REFERENCES:

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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Programme	Course Code	Name of the Course	L	T	P	C
B.E.	16MT5303	MATERIAL SCIENCES AND 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
CO4: Explain the properties composite materials
CO5: Identify the production process in different fields of application

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

T1- Gupta, S.C., & Kapoor, V.K., "*Fundamentals of Mathematical Statistics*", Sultan Chand & Sons,Reprint 2011.
T2- Veerarajan.T. "*Probability, Statistics and Random Process*", 2nd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2010.

REFERENCE BOOKS:

R1- Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Publishing Company Limited, New Delhi, 2004.
R2- Walpole R.E., Myers.R.H., Myers.S.L and Ye.K., "*Probability and Statistics for Engineer and Scientist*", 8th Edition, Pearson Education, Asia, 2007.

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

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PROFESSIONAL ELECTIVE II

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

REFERENCE BOOKS:

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

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

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

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

REFERENCE BOOKS:

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

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

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OPEN ELECTIVE I

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

Course Objective

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

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

Course Outcome

On completion of the course the students will be able to

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

TEXT BOOKS:

T1- R.K Jain, *"Industrial Safety, Health and Environment Management System"*, 4th Edition, Khanna Publishers, New Delhi, 2015.
T2- R.K. Mishra, *"Safety Management"*, 2nd Edition, AITBS Publishers, 2012.

REFERENCE BOOKS:

R1- C. Ray Asfahl, David W. Rieske, *"Industrial Safety and Health Management"*, 6th Edition, Pearson Education, Asia,2010.
R2- Krishnan N.V., *"Safety in Industry"*, 2nd Edition, Jaico Publisher House, 2005.
R3- L.M Deshmukh, *"Industrial Safety Management and Risk Control"*, 1st Edition, McGraw Hill Education, New Delhi,2008.

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