

**KONGU ENGINEERING COLLEGE**  
**PERUNDURAI ERODE – 638 052**  
**(Autonomous)**

**VISION**

To be a centre of excellence for development and dissemination of knowledge in Applied Sciences, Technology, Engineering and Management for the Nation and beyond.

**MISSION**

We are committed to value based Education, Research and Consultancy in Engineering and Management and to bring out technically competent, ethically strong and quality professionals to keep our Nation ahead in the competitive knowledge intensive world.

**QUALITY POLICY**

We are committed to

- Providing value based quality education for the development of students as competent and responsible citizens.
- Contributing to the nation and beyond through research and development
- Continuously improving our services

**DEPARTMENT OF MECHATRONICS ENGINEERING**

**VISION**

To be a centre of excellence for development and dissemination of knowledge in Mechatronics Engineering for the Nation and beyond.

**MISSION**

Department of Mechatronics Engineering is committed to:

- MS1: Disseminate knowledge through effective teaching-learning process to develop quality Mechatronics professionals to meet the global challenges
- MS2: Foster continuous learning and research by nurturing innovation and providing state-of-the art facilities
- MS3: Develop expertise in consultancy and training activities focused on industrial needs

**2014 REGULATIONS**

**PROGRAM EDUCATIONAL OBJECTIVES (PEOs)**

Graduates of Mechatronics Engineering will

- PEO1: Utilize the fundamental knowledge of basic sciences and engineering to succeed in their professional career.
- PEO2: Analyse, design and develop Mechatronics Engineering based products and processes for real world applications.
- PEO3: Exhibit professional and managerial capabilities with ethical conduct and an aptitude for continuous learning.

## MAPPING OF MISSION STATEMENTS (MS) WITH PEOs

MS\PEO	PEO1	PEO2	PEO3
MS1	3	3	2
MS2	3	3	3
MS3	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

### PROGRAM OUTCOMES (POs)

#### Engineering Graduates will be able to:

- PO1 Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- PO2 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.
- PO3 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.
- PO4 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.
- PO5 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.
- PO6 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.
- PO7 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.
- PO8 Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
- PO9 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.

### PROGRAM SPECIFIC OUTCOMES (PSOs)

- PSO1** Design and develop Mechatronics systems by synergistic combination of precision mechanical engineering, electronic controls and systems.
- PSO2** Adapt multidisciplinary approach to solve real world industrial problems.

### MAPPING OF PEOs WITH POs AND PSOs

PEO\PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
PEO1	3	2	2	2	2	1	1	1	1	2	1	2	2	2
PEO2	3	3	3	3	2	1	1	1	2	2	2	2	3	3
PEO3	1	1	1	1	1	2	2	3	2	2	3	3	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

### CURRICULUM BREAKDOWN STRUCTURE UNDER REGULATION 2014

Curriculum Breakdown Structure(CBS)	Curriculum Content (% of total number of credits of the program)	Total number of contact hours	Total number of credits
Basic Sciences(BS)	17	510	30
Engineering Sciences(ES)	14.8	465	27
Humanities and Social Sciences(HS)	8.8	315	17
Program Core(PC)	38	1425	69
Program Electives(PE)	9.9	270	18
Open Electives(OE)	4.9	135	9
Project(s)/Internships(PR)	6.6	360	12
<b>Total</b>			<b>182</b>

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**B.E. DEGREE IN MECHATRONICS ENGINEERING**

**CURRICULUM**

(For the candidates admitted from academic year 2014 – 15 onwards)

**SEMESTER – I**

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	<b>THEORY</b>								
14EGT11	Communicative English I	3	0	0	3	40	60	100	HS
14MAT11	Mathematics I	3	1	0	4	40	60	100	BS
14PHT11	Applied Physics	3	0	0	3	40	60	100	BS
14CYT11	Applied Chemistry	3	0	0	3	40	60	100	BS
14MET11	Basics of Civil and Mechanical Engineering	3	0	0	3	40	60	100	ES
14MEC11	Engineering Drawing	2	0	3	3	40	60	100	ES
14VEC11	Value Education	0	2	1	1	100	0	100	HS
	<b>PRACTICAL</b>								
14PHL11	Physical Sciences Laboratory I	0	0	3	1	100	0	100	BS
14MEL11	Basics of Civil and Mechanical Engineering Laboratory	0	0	3	1	100	0	100	ES
		<b>Total</b>			<b>22</b>				

CA – Continuous Assessment, ESE – End Semester Examination

CBS – Curriculum Breakdown Structure

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**SEMESTER – II**

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	<b>THEORY</b>								
14EGT21	Communicative English II	3	0	0	3	40	60	100	HS
14MAT21	Mathematics II	3	1	0	4	40	60	100	BS
14PHT21	Materials Science	3	0	0	3	40	60	100	BS
14CYT21	Environmental Science	3	0	0	3	40	60	100	BS
14CSC11	Problem Solving and Programming	3	0	3	4	40	60	100	ES
14EET11	Basics of Electrical and Electronics Engineering	3	0	0	3	40	60	100	ES
	<b>PRACTICAL</b>								
14PHL21	Physical Sciences Laboratory II	0	0	3	1	100	0	100	BS
14EEL11	Basics of Electrical and Electronics Engineering Laboratory	0	0	3	1	100	0	100	ES
		<b>Total</b>			<b>22</b>				

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**SEMESTER – III**

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	<b>THEORY</b>								
14MAT31	Mathematics III	3	1	0	4	40	60	100	BS
14MET31	Engineering Mechanics	3	1	0	4	40	60	100	ES
14MET33	Fluid Mechanics and Hydraulic Machines	3	0	0	3	40	60	100	PC
14MTT31	Analog Devices and Digital Circuits	3	1	0	4	40	60	100	PC
14MTT32	Sensors and Transducers	3	0	0	3	40	60	100	PC
14MTT33	Manufacturing Processes	3	0	0	3	40	60	100	PC
	<b>PRACTICAL</b>								
14MTL31	Analog Devices and Digital Circuits Laboratory	0	0	3	1	100	0	100	PC
14MTL32	Sensors and Transducers Laboratory	0	0	3	1	100	0	100	PC
14MTL33	Manufacturing Processes Laboratory	0	0	3	1	100	0	100	PC
	<b>Total</b>				<b>24</b>				

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**CURRICULUM**

(For the candidates admitted from academic year 2014 – 15 onwards)

**SEMESTER – IV**

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	<b>THEORY</b>								
14MAT42	Statistics and Numerical Methods	3	1	0	4	40	60	100	BS
14EET44	Electrical Machines	3	0	0	3	40	60	100	PC
14MET41	Strength of Materials	3	1	0	4	40	60	100	ES
14MET43	Kinematics of Machinery	3	1	0	4	40	60	100	ES
14MTT41	Thermodynamics and Heat Transfer	3	1	0	4	40	60	100	PC
14MTT42	Engineering Metrology	3	0	0	3	40	60	100	PC
	<b>PRACTICAL</b>								
14EEL44	Electrical Machines Laboratory	0	0	3	1	100	0	100	PC
14MTL41	a) Fluid Mechanics and Machinery Laboratory	0	0	3	1	100	0	100	PC
	b) Metrology Laboratory								
14MTL42	Computer Aided Drafting Laboratory	0	0	3	1	100	0	100	PC
		<b>Total</b>			<b>25</b>				

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**SEMESTER – V**

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	<b>THEORY</b>								
14EET53	Control Systems	3	1	0	4	40	60	100	PC
14MTT51	Microprocessor and Microcontroller Applications	3	0	0	3	40	60	100	PC
14MTT52	CNC Technology	3	0	0	3	40	60	100	PC
14MTC51	Machine Dynamics	3	0	2	4	40	60	100	PC
14MTC52	Virtual Instrumentation: Theory and Applications	3	0	2	4	40	60	100	PC
	Elective-I (Professional)	3	0	0	3	40	60	100	PE
	<b>PRACTICAL</b>								
14MTL51	Microprocessor and Microcontroller Laboratory	0	0	3	1	100	0	100	PC
14MTL52	CNC Programming Laboratory	0	0	3	1	100	0	100	PC
14EGL41	Communication Skills Laboratory	0	0	3	1	100	0	100	HS
	<b>Total</b>				<b>24</b>				

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**SEMESTER – VI**

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	<b>THEORY</b>								
14GET61	Economics and Management for Engineers	3	0	0	3	40	60	100	HS
14MTT61	Power Electronics and Drives	3	0	0	3	40	60	100	PC
14MTT62	Fluid Power System	3	0	0	3	40	60	100	PC
14MTT63	Programmable Automation Controllers	3	0	0	3	40	60	100	PC
	Elective-II (Professional)	3	0	0	3	40	60	100	PE
	Elective-III (Open)	3	0	0	3	40	60	100	OE
	<b>PRACTICAL</b>								
14MTL61	Power Electronics and Drives Laboratory	0	0	3	1	100	0	100	PC
14MTL62	Fluid Power System Laboratory	0	0	3	1	100	0	100	PC
14MTL63	Programmable Automation Controllers Laboratory	0	0	3	1	100	0	100	PC
	<b>Total</b>				<b>21</b>				

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**CURRICULUM**

(For the candidates admitted from academic year 2014 – 15 onwards)

**SEMESTER – VII**

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	<b>THEORY</b>								
14GET71	Total Quality Management	3	0	0	3	40	60	100	HS
14MTT71	Micro Electro Mechanical Systems	3	0	0	3	40	60	100	PC
14MTT72	Industrial Robotics	3	0	0	3	40	60	100	PC
	Elective – IV (Professional)	3	0	0	3	40	60	100	PE
	Elective – V (Open)	3	0	0	3	40	60	100	OE
	Elective – VI (Open)	3	0	0	3	40	60	100	OE
	<b>PRACTICAL</b>								
14MTL71	Computer Aided Engineering Laboratory	0	0	3	1	100	0	100	PC
14MTL72	Robotics and Control Laboratory	0	0	3	1	100	0	100	PC
14MTP71	Design and Fabrication Project	0	0	6	3	50	50	100	PR
	<b>Total</b>				<b>23</b>				

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**SEMESTER – VIII**

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	<b>THEORY</b>								
14GET81	Professional Ethics and Human Values	3	0	0	3	40	60	100	HS
	Elective – VII (Professional)	3	0	0	3	40	60	100	PE
	Elective – VIII (Professional)	3	0	0	3	40	60	100	PE
	Elective – IX (Professional)	3	0	0	3	40	60	100	PE
	<b>PRACTICAL</b>								
14MTP81	Project Work	0	0	18	9	100	100	200	PR
	<b>Total</b>				<b>21</b>				

CA – Continuous Assessment, ESE – End Semester Examination  
CBS – Curriculum Breakdown Structure

**Total Credits: 182**

## LIST OF PROFESSIONAL ELECTIVES

Course Code	Course Title	Hours/Week			Credit	CBS
		L	T	P		
<b>SEMESTER V</b>						
14MET54	Operations Research	3	0	0	3	PE
14EIT52	Biomedical Instrumentation	3	0	0	3	PE
14MTE01	Design of Mechanical Elements	3	0	0	3	PE
<b>SEMESTER VI</b>						
14MEO01	Introduction to Aircraft Systems	3	0	0	3	PE
14MTE02	Embedded Programming for Mechatronics Systems	3	0	0	3	PE
14MTE03	Process Control and Instrumentation	3	0	0	3	PE
<b>SEMESTER VII</b>						
14MEO05	Maintenance Engineering	3	0	0	3	PE
14MTE04	Applied Finite Element Analysis	3	0	0	3	PE
14MTE05	Automotive Engineering	3	0	0	3	PE
<b>SEMESTER VIII</b>						
14GEE81	Entrepreneurship Development	3	0	0	3	PE
14MTE06	Advanced Sensors and Networking	3	0	0	3	PE
14MTE07	Automotive Electronics	3	0	0	3	PE
14MTE08	Computer Integrated Manufacturing	3	0	0	3	PE
14MTE09	DSP Processors and Architecture	3	0	0	3	PE
14MTE10	Microfluidics and Bio-MEMS	3	0	0	3	PE
14MTE11	Mobile Robotics	3	0	0	3	PE
14MTE12	Nanotechnology	3	0	0	3	PE
14MTE13	Precision Equipment Design	3	0	0	3	PE
14MTE14	Production Management	3	0	0	3	PE

**LIST OF OPEN ELECTIVES**

<b>Course Code</b>	<b>Course Title</b>	<b>Hours/Week</b>			<b>Credit</b>	<b>CBS</b>
		<b>L</b>	<b>T</b>	<b>P</b>		
<b>SEMESTER VI</b>						
14MTO01	Design of Mechatronics Systems	3	0	0	3	OE
14MTO02	Precision Manufacturing	3	0	0	3	OE
<b>SEMESTER VII</b>						
14MTO03	Machine Vision and Image Processing	3	0	0	3	OE
14MTO04	Industrial Automation Protocols	3	0	0	3	OE
14MTT71	Micro Electro Mechanical Systems	3	0	0	3	OE
14MTT72	Industrial Robotics	3	0	0	3	OE

**14EGT11 COMMUNICATIVE ENGLISH I**  
(Common to all Engineering and Technology branches)

3    0    0    3    9

**UNIT – I**

**Functional Grammar:** Basics of Vocabulary - Parts of speech or Word Classes including Determiners - Prefixes and Suffixes - Homonyms and Homophones - Connectives - Compound Nouns. **Listening:** Introduction to Listening / Types of Listening – Extensive / Intensive Listening - Listening Activities. **Speaking:** Verbal and non verbal communication – An introduction to speech sounds, syllables & word stress – Speaking Activities. **Reading:** Introduction to Skimming and scanning as reading techniques - understanding discourse coherence – sequencing of sentences – Reading activities. **Writing:** Introduction to aspects of technical writing – writing definitions and descriptions- Letter Writing – Informal letters-Punctuation in Letter Writing

**UNIT – II**

**Functional Grammar:** Concord - Tenses - Voice - Use of Articles and prepositions. **Listening:** Listening Comprehension – Cloze Test - Extensive listening – listening for general information. **Speaking:** Role Play – Situational Conversations. **Reading:** Reading newspaper articles – global understanding skills and ability to infer, extract gist and understand main ideas. **Writing:** Letter Writing - Formal letters, Writing a Profile about an organization—Punctuation (General).

**UNIT – III**

**Functional Grammar:** Phrasal verbs - Clauses - Simple, Compound and Complex Sentences - Synonyms and Antonyms. **Listening:** Listening Comprehension – Cloze Text - Intensive listening – listening for specific information. **Speaking:** Describing Places, People, Technical Processes. **Reading:** Reading different types of texts – Understanding general and specific information. **Writing:** Paragraph Writing – Writing reviews on short films and videos - Offering suggestions and recommendations

**UNIT – IV**

**Functional Grammar:** Conditional clauses (If clause) - Adjectives, Compound Adjectives and Degrees of Comparison. **Listening:** Listening to different accents, listening to speeches / presentations. **Speaking:** Describing Technical Processes and Machines and Gadgets - Telephone Skills. **Reading:** Reading Texts with focus on use of verbs and verb phrases. **Writing:** Writing e-mails –Transcoding - Using Charts, pictures and tables for interpretations.

**UNIT – V**

**Functional Grammar:** Modals – Types of Sentences – Idioms and Phrases and proverbs - identifying odd words. **Listening:** Retrieval of factual information – listening to identify topic, context, function, speaker’s opinion, attitude, etc. **Speaking:** Interviews - Personal and Telephonic - Giving impromptu talks, making presentations on given topics. **Reading:** Reading for structure and detail – finding key information in a given text and finding topic sentences. **Writing:** Designing and Making Posters – Writing Advertisements-Free writing on any given topic ( Technical and topics on current affairs )

**TOTAL : 45**

**TEXT BOOKS :**

1. “Learn English – A Fun Book of Functional Language, Grammar and Vocabulary”, McGraw Hill Education [India] Pvt. Ltd., Santanu Sinha Chaudhuri, 2013.

**REFERENCE BOOKS :**

1. Raman, Meenakshi and Sangeetha Sharma, “Technical Communication: Principles and Practice”, Oxford University Press, New Delhi, 2011.
2. Regional Institute of English, “English for Engineers”, Cambridge University Press, New Delhi, 2006.
3. Rizvi, Ashraf M., “Effective Technical Communication”, Tata McGrawHill, New Delhi. 2009.

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: speak clearly, confidently, comprehensibly, and communicate with others using appropriate communicative strategies
- CO2: write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide range of vocabulary, organizing their ideas logically on a topic
- CO3: read different genres of texts adopting various reading strategies
- CO4: listen/view and comprehend different spoken discourses / excerpts in different accents
- CO5: use language effectively and accurately acquiring vocabulary from real-life context

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						1			2	3		2		
CO2						1			1	3		1		
CO3						1			1	3		2		
CO4						1			2	3		2		
CO5						2			2	3		2		

1 – Slight, 2 – Moderate, 3 – Substantial

**14MAT11 MATHEMATICS I**  
(Common to all Engineering and Technology branches)

**3 1 0 4**

**Pre-requisites:** Basics concepts of matrices, Basic idea of differentiation, Knowledge of differential equations

**UNIT – I** **9**

**Matrices:** Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors (without proof) – Cayley-Hamilton Theorem (Statement and Applications) - Similarity transformation (concept only) – Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form – Nature of quadratic forms – Reduction of a quadratic form to canonical form by orthogonal transformation.

**UNIT – II** **9**

**Functions of Several Variables:** Functions of two variables – Partial derivatives – Total differential – Taylor’s Series expansion –Maxima and Minima – Constrained maxima and minima – Lagrange’s multiplier method – Jacobians – Properties.

**UNIT – III** **9**

**Ordinary Differential Equations of First Order:** Solutions of equations in separable form – Exact differential equations – Integrating factors – Linear first order differential equations – Bernoulli’s equation – Clairaut’s equation.

**UNIT – IV** **9**

**Ordinary Differential Equations of Higher Order:** Linear differential equations of second and higher order with constant coefficients – Particular Integrals for the types:  $e^{ax} - \cos(ax) / \sin(ax) - x^n - e^{ax}x^n, e^{ax}\sin(bx)$  and  $e^{ax}\cos(bx) - x^n\sin(ax)$  and  $x^n\cos(ax)$  – Linear differential equations with variable coefficients: Euler-Cauchy’s equation – Legendre’s equation.

**UNIT – V** **9**

**Applications of Ordinary Differential Equations:** Method of variation of parameters – Simultaneous first order linear equations with constant coefficients – Simple harmonic motion – Deflection of beams – Electric circuits (Differential equations and associated conditions need to be given).

**Lecture: 45, Tutorial: 15, TOTAL: 60**

**TEXT BOOKS:**

- Kandasamy P., Thilagavathy K. and Gunavathy K., “Engineering Mathematics For First Year B.E/B.Tech”, Reprint Edition 2014, S.Chand and Co., New Delhi.
- Veerarajan T., “Engineering Mathematics, (for first year)”, Reprint Edition 2013, Tata McGraw-Hill, New Delhi.

**REFERENCE BOOKS:**

- Grewal B.S., “Higher Engineering Mathematics”, 42<sup>nd</sup> Edition, Khanna Publications, New Delhi, 2011.
- Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, 4<sup>th</sup> Edition, Narosa Publishing House, New Delhi, Reprint 2014.
- Bali N.P. and Manish Goyal, “Text Book of Engineering Mathematics”, 8<sup>th</sup> Edition, Laxmi Publications, New Delhi, 2011.
- Ramana B.V., “Higher Engineering Mathematics”, Tata McGraw Hill Publishing Company, New Delhi, 2011.
- Kreyszig E., “Advanced Engineering Mathematics”, 10<sup>th</sup> Edition, John Wiley Sons, 2010.

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: solve engineering problems which needs matrix computations
- CO2: solve extremal problems which arise in function of several variables
- CO3: identify the appropriate method for solving first order ordinary differential equations
- CO4: classify and find the solution of ordinary differential equations of higher order
- CO5: apply the concept of ordinary differential equations for modeling and finding solutions to engineering problems

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1								1		
CO2	3											1		
CO3	3	3	1	1								1		
CO4	3	3	1	1								1		
CO5	3	3	2	1								1		

1 – Slight, 2 – Moderate, 3 – Substantial

**14PHT11 APPLIED PHYSICS**  
(Common to all Engineering and Technology branches)

**3 0 0 3**

**UNIT – I**

**9**

**Properties of Matter:** Elasticity – Hooke’s law – Modulus of elasticity (qualitative) – Stress-strain diagram – Poisson’s ratio – Bending moment – Depression of a cantilever (theory) – Derivation of Young’s modulus of the material of the beam – Uniform and non-uniform bending – I-shaped girders. **Thermal Physics:** Modes of heat transfer – Thermal conductivity – Derivation of rectilinear flow of heat along a bar – Radial and cylindrical heat flow – Conduction through compound media (series and parallel).

**UNIT – II**

**9**

**Acoustics:** Classification of sound – Weber–Fechner law – Sabine’s formula- derivation using growth and decay method – Absorption coefficient and its determination –Factors affecting acoustics of buildings and their remedies. **Ultrasonics:** Production – Magnetostrictive generator – Piezoelectric generator – Determination of velocity using acoustic grating – Cavitation – Industrial applications – Drilling, welding, soldering and cleaning – Non destructive testing – Ultrasonic pulse echo system.

**UNIT – III**

**9**

**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, CO<sub>2</sub> laser, Semiconductor lasers: homojunction and heterojunction – Laser Applications – Industrial applications: laser welding, laser cutting, laser drilling – Holography – Construction and reconstruction of images.

**UNIT – IV**

**9**

**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 links – Losses in optical fibers – Fiber optic sensors – Temperature and displacement sensors.

**UNIT – V**

**9**

**Quantum Physics and Applications:** Black body radiation – Planck’s theory (derivation) – Compton effect (theory) – Matter waves – Uncertainty principle (qualitative) – Schroedinger’s wave equations – Time independent and time dependent wave equations – Physical significance of wave function – Particle in a box (One dimensional) – Electron microscopes – Scanning electron microscope – Transmission electron microscope.

**TOTAL : 45**

**TEXT BOOKS:**

1. Tamilarasan K and Prabu K, “Engineering Physics-I”, Tata McGraw Hill Education Private Limited, New Delhi, 2014.

**REFERENCE BOOKS:**

1. Gaur R.K. and Gupta S.L., “Engineering Physics”, Dhanpat Rai and Sons, New Delhi, 2009.
2. Uma Mukherji, “Engineering Physics”, Narosa Publishing House, New Delhi, 2011.
3. Laud B.B., “Lasers and non- linear optics”, New Age International (p) Limited Publishers, New Delhi, 1996.
4. Ajoy Ghatak and Thyagarajan K., “Introduction to Fiber Optics”, Cambridge University Press, New York, USA, 2000
5. Mehta and Neeraj, “Applied Physics for Engineers”, Prentice-Hall of India Private Limited, New Delhi, 2011.
6. Douglas Brandt and Douglas C. Giancoli, “Physics for Scientists and Engineers”, Prentice-Hall of India Private Limited, New Delhi, 2000.

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: infer the extensive properties of matter and heat conduction in metal
- CO2: demonstrate acoustically good buildings and non-destructive testing using ultrasonic waves
- CO3: employ the laser in engineering and technology
- CO4: sketch the principle of fiber optics and fiber optic communication link
- CO5: interpret the concepts of quantum physics to optical phenomena and electrons in a metal

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			2	2		2		1					
CO2	3			2	2		2		1					
CO3	3			2	2		2		1					
CO4	3			2	2		2		1					
CO5	3			2	2		2		1					

1 – Slight, 2 – Moderate, 3 – Substantial



**UNIT – I**

**Water:** Introduction - Sources of water - Impurities in water - Types of water - Water quality standards - Water quality parameters (Brief discussion only) - Hardness of water- Expression of hardness - Units of hardness –Estimation of Hardness of water by EDTA method – Determination of alkalinity - Disadvantages of using hard water - Boiler troubles due to hard water - scale and sludge formation – boiler corrosion – caustic embrittlement- priming and foaming- Softening of water- External treatment methods - zeolite and demineralization process (principle, process, advantages and disadvantages only) - Internal treatment process - colloidal, carbonate, calgon and phosphate conditioning (brief discussion only) - desalination by reverse osmosis method

**UNIT – II**

**Electrochemistry:** Introduction – Electrolytic and Electrochemical Cells – Representation of a galvanic cell - Reversible and Irreversible cells - EMF and its determinations – Electrode potential - Nernst Equation – Reference electrodes (hydrogen and calomel electrodes) – Electrochemical series and its applications – Conductometric titrations (strong acid vs strong base only) - Batteries (Lead Acid battery, NICAD, Lithium battery, Lithium Sulphur battery) – Proton exchange membrane cells.

**UNIT – III**

**Corrosion and Its Control:** Introduction – Mechanism of chemical and electrochemical corrosion – galvanic corrosion - concentration cell corrosion – Galvanic series - Factors influencing rate of corrosion – corrosion control methods - Sacrificial anode and impressed current cathodic protection methods – Corrosion inhibitors - Protective coatings - classifications - Pretreatment of metal surface - Metallic coating -electroplating and electrolessplating (General discussion) - Hot dipping (Tinning and galvanising) - Non-metallic coating - surface conversion coating (phosphate coating and anodized coating) - Organic coating - paints – constituents and their function – Special paints (Fire retardant, temperature indicating, water repellent and luminescent paints)

**UNIT – IV**

**Fuels:** Coal and its varieties – proximate and ultimate analysis – their significance – metallurgical coke - Otto-Hoffman byproduct method - Liquid fuel - refining of petroleum – Manufacture of synthetic petrol – Cracking - Polymerization - Hydrogenation of coal (Fisher Tropsch and Bergius methods) - knocking - octane number – improving octane number by additives – Diesel – cetane number – Gaseous fuels (Water gas and LPG).

**Combustion:** Introduction – Calorific Values – Gross and Net Calorific Values – Dulong’s formula (simple problems)- Flue gas analysis by Orsat’s method - Explosive range and Spontaneous Ignition Temperature

**UNIT – V**

**Polymers:** Introduction – Nomenclature of polymers – functionality – polymerization - types – addition, condensation and co-polymerization with examples – Effect of polymer structure on properties (strength, plastic deformation, glass transition temperature and melting point of polymers (T<sub>g</sub> and T<sub>m</sub>), crystallinity and chemical resistance) - plastics – types (thermo and thermosetting plastics) - individual polymers - Polyethylene, Polypropylene, PVC, Teflon and Bakelite (preparation, properties and uses only) - Compounding of plastics- Fabrication of plastics (compression, injection and extrusion moulding methods) – conducting polymers

**TOTAL : 45**

**TEXT BOOKS:**

- Palanisamy P.N, Geetha A, Manjula Rani K, “Applied Chemistry”, 2<sup>nd</sup> Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2013.
- Jain P C and Monica Jain, “Engineering Chemistry”, 15<sup>th</sup> Edition, Dhanpat Rai Publication Co., New Delhi, 2008.

**REFERENCE BOOKS:**

- Sharma B.K., “Engineering Chemistry”, Krishna Prakasan Media (P) Ltd., Meerut, 2001.
- Sivasankar B., “Engineering Chemistry”, Tata McGraw-Hill, New Delhi, 2008.
- Krishnamurthy N., “Engineering Chemistry”, 2<sup>nd</sup> Edition, PHI Learning Private Limited, New Delhi, 2008.

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: get the basic knowledge of water quality parameters and treatment methods
- CO2: obtain the principles of electrochemical cells, EMF series and energy storing devices
- CO3: acquire the knowledge of the types and prevention methods of corrosion
- CO4: know the concepts and developments in combustion and various types of fuels
- CO5: understand the knowledge about the types of polymers, plastics and moulding methods

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2		2	2		2	3	3	1	1			
CO2	3	2		2	2		2	3	3	1	1			
CO3	3	2		2	2		2	3	3	1	1			
CO4	3	2		2	2		2	3	3	1	1			
CO5	3	2		2	2		2	3	3	1	1			

1 – Slight, 2 – Moderate, 3 – Substantial

**14MET11 BASICS OF CIVIL AND MECHANICAL ENGINEERING**  
(Common to all Engineering and Technology branches)

**3    0    0    3**

**PART-A: CIVIL ENGINEERING**

<b>UNIT – I</b>	<b>5</b>
<b>Introduction:</b> History of civil engineering - Role and Functions of civil engineer - Fields of civil engineering	
<b>UNIT- II</b>	<b>5</b>
<b>Building Materials:</b> Introduction – Properties and applications of Construction Materials – bricks – stones – sand – cement – mortar- concrete – steel – glass-wood –plastics- ceramics -rubber- FRP – Non ferrous materials - Geosynthetics – Smart materials.	
<b>UNIT – III</b>	<b>4</b>
<b>Sub Structure:</b> Soil – classification- bearing capacity- foundation -function- requirements- types-failures -remedial measures- machine foundation	
<b>UNIT – IV</b>	<b>4</b>
<b>Super Structures:</b> Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring – plastering- damp proofing- weathering course	
<b>UNIT – V</b>	<b>4</b>
<b>Interior design and Landscaping:</b> History of Interior design-Importance of Interior design- Basic elements of Interior design. Landscape Architecture-Elements of Landscaping- Green Engineering	

**PART-B: MECHANICAL ENGINEERING**

<b>UNIT – I</b>	<b>5</b>
<b>Thermal Science:</b> Laws of thermodynamics and their applications – Principle of operation of Steam, Diesel, Hydro-electric and Nuclear power plants - Classification of internal combustion engines and their working principles – Components of basic Vapour Compression Refrigeration system.	
<b>UNIT – II</b>	<b>4</b>
<b>Fluid Science:</b> Properties of fluids – Classification of hydraulic turbines, working principle of Pelton turbine – Applications of steam and gas turbines. Classification of pumps, working principle of centrifugal and reciprocating pump	
<b>UNIT – III</b>	<b>4</b>
<b>Mechanics and Materials:</b> Classification of engineering materials - Mechanical properties of engineering materials- Definition and importance of stress and strain - Definition and importance of centre of gravity and moment of inertia.	
<b>UNIT – IV</b>	<b>5</b>
<b>Mechanical Components And Their Applications:</b> Basic principles and applications of power transmission systems such as belt, rope, chain and gear drives – Function and principles of coupling, clutch, brake, flywheel and governor	
<b>UNIT – V</b>	<b>5</b>
<b>Manufacturing Technology:</b> Principle and applications of Metal forming process – Foundry, Forging. Principle and applications of Metal Joining process – Welding, Soldering and Brazing, Basics of CAD/CAM/CIM.	

**TOTAL : 45**

**TEXT BOOKS:**

1. Palanichamy M.S., “Basic Civil Engineering”, Tata McGraw-Hill, New Delhi, 2006.
2. Pravin Kumar, “Basic Mechanical Engineering”, Pearson Publishers, New Delhi, 2013.

**REFERENCE BOOKS:**

1. Rangawala S.C., “Engineering Materials” Charotar Publishing House(P) Ltd., Anand, 2013.
2. Punmia B.C., Ashok Kumar Jain, Arun Kumar Jain, “Building Construction,” Laximi Publications (P) Ltd., NewDelhi, 2005.
3. Shanmugam G., “Basic Mechanical Engineering”, Tata McGraw-Hill, New Delhi, 2005.
4. Venugopal K. and Prabhu Raja V., “Basic Mechanical Engineering”, 6<sup>th</sup> Edition, Anuradha Publishers, Kumbakonam, 2005.

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: select the suitable materials and components required for building construction
- CO2: demonstrate an understanding of basic concepts in thermal engineering
- CO3: demonstrate an understanding of basic concepts in fluid mechanics and fluid machines
- CO4: demonstrate an understanding of basic concepts in engineering mechanics and materials
- CO5: demonstrate an understanding of principles and applications of different mechanical components
- CO6: demonstrate an understanding of principles and applications of various manufacturing process

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2		2	1	2			2		2		
CO2	3	2	2		2	1	2			2		2		
CO3	3	2	2		2	1	2			2		2		
CO4	3	2	2		2	1	2			2		2		
CO5	3	2	2		2	1	2			2		2		
CO6	3	2	2		2	1	2			2		2		

1 – Slight, 2 – Moderate, 3 – Substantial

**14MEC11 ENGINEERING DRAWING**  
(Common to all Engineering and Technology branches)

2   0   3   3

**Pre-requisites:** Basic knowledge in practical geometry construction and mathematics

**UNIT – I** **9**

**General Principles of Orthographic Projection:** Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. Projections of Points, Lines and Planes. General principles of orthographic projection – First angle projection – Layout of views – Projection of points, located in all quadrant and straight lines located in the first quadrant – Determination of true lengths and true inclinations and location of traces – Projection of polygonal surface and circular lamina inclined to both reference planes.

**UNIT – II** **9**

**Projections of Solid:** Projections of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.

**UNIT – III** **9**

**Sectioning of Solids:** Sectioning of solids- prisms, pyramids, cylinder and cone in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other – Obtaining true shape of section.

**UNIT – IV** **9**

**Development of Surfaces:** Development of lateral surfaces of simple and truncated solids – prisms, pyramids, cylinders and cone with cutout, perpendicular and inclined to the horizontal axis.

**UNIT – V** **9**

**Isometric and Perspective Projection:** Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones Conversion of isometric projection into orthographic projection. Perspective projection of prisms, pyramids and cylinders by visual ray method.

**TOTAL : 45**

**TEXT BOOKS:**

1. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw-Hill, New Delhi, 2008.
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, New Delhi, 2008.

**REFERENCE BOOKS:**

1. Bhatt N.D., “Engineering Drawing”, 46<sup>th</sup> Edition, Charotar Publishing House, Anand, 2003.
2. Gopalakrishnana K.R., “Engineering Drawing”, Volume. I & II, Subhas Publications, Bangaluru, 2006.
3. Dhananjay A. Jolhe, “Engineering Drawing with an introduction to AutoCAD”, Tata McGraw Hill, New Delhi, 2008.

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: gain knowledge on international standards of drawings and to draw the different types of projections for points, lines and planes
- CO2: draw the different positions of 3D primitive objects like cube, cone, cylinder, etc.
- CO3: draw sections of solids including prisms, pyramids, cylinders and cones
- CO4: understand the concepts of development of surfaces of simple and truncated solids
- CO5: draw the isometric and perspective projections for the given object

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3		2	1				2		2		
CO2	3	2	3		2	1				2		2		
CO3	3	2	3		2	1				2		2		
CO4	3	2	3		2	1				2		2		
CO5	3	2	3		2	1				2		2		

1 – Slight, 2 – Moderate, 3 – Substantial

**14VEC11 VALUE EDUCATION**  
(Common to all Engineering and Technology branches)

**0    2    1    1**  
**6**

**UNIT – I**

**Philosophy of Life Science:** Life – Purpose of life (four stages of life) – Philosophy of life (who am ‘I’) – Law of nature (cause of the life and body) – Content of the Life (five sheaths) – Goal of life. Five duties in life.

**Methodology:** Life and messages of spiritual and national leaders– The forgotten hero, etc.

**Project report:** Complementing with happiness - Every soul is potentially divine

**UNIT – II**

**6**

**Human Values-Moral foundation:** Truth, forgiveness, compassion, endurance, humility, non violence, moderate diet, non stealing, self purification, self discipline, self study, content, cleanliness, honesty, and totality in faith– Good habits – Attitude forming for Individual peace.

**Practical Methods:** Personal experience with above characters, Puranic Stories - Self resolve diary maintenance

**UNIT – III**

**6**

**Social Values:** Family – Family System - Greatness of women – World brotherhood (vasudeiva kudumbagam) – Glorious Bharath - Bharathian systems - Past –Present – Future - Team spirit - Goal setting – Economics – Education – Politics – Responsibilities of people – Preserving natural resources.

**Methodology:** Preparing an album on glorious Bharath Past, Present and Future Plans. Goal setting - Management Games. Team Spirit - Yogic Games.

**UNIT – IV**

**6**

**Development of Mental Prosperity:** Prosperity of mind – Functions of mind - Obstacles of mind - Practical method to perfect mind is yoga – Types – Uses – Precaution – Contradiction – Kriyas - Asanas – Pranayamas – Meditative techniques.

**Methodology:** Asana - Pranayama – Cyclic meditation – Nada anu sandhana – Meditation – Yogic games for memory. Album on asanas , pranayama and mantra.

**UNIT – V**

**6**

**Maintenance of Physical Health:** Human body – Structure - Ten Systems of the body as per modern science. Five elements - Harmonious relationship – Life force – Conserving vitality & health through natural life – Pranic food and its importance – Uses of herbs - Right way of cooking to preserve nutrients - Cause of the disease – Acute and chronic - Disease - Life and death.

**Methodology:** Natural food making, traditional millet dishes. Asanas, pranayamas, cleansing procedures, Quiz on healthy living, Uses of herbs or kitchen garden.

**TOTAL : 30**

**TEXT BOOK:**

- “Value Education”, compiled by Vethathiri Maharishi Institute for Spiritual and Intuitional Education, Aliyar, Pollachi, for Kongu Engineering College.

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: understand the purpose and value of life
- CO2: exhibit positive human values
- CO3: understand social values
- CO4: take steps to develop mental and physical health

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3		3				3		
CO2						3		3				3		
CO3						3		3				3		
CO4						3		3				3		

1 – Slight, 2 – Moderate, 3 – Substantial

**14PHL11 PHYSICAL SCIENCES LABORATORY I**  
(Common to all Engineering and Technology branches)

0      0      3      1

**PART-A: APPLIED PHYSICS LABORATORY**  
(Any five experiments)

**LIST OF EXPERIMENTS:**

1. Determination of Young's modulus of a given material using uniform bending.
2. Determination of thermal conductivity of bad conductor using Lee's disc arrangement.
3. Determination of velocity of ultrasonic waves in liquid and compressibility of liquid using ultrasonic interferometer.
4. (a) Particle size determination using diode laser.  
(b) Determination of wavelength of laser
5. Determination of specific resistance of a given coil of wire using Carey Foster bridge.
6. Determination of wavelength of Hg spectrum using spectrometer and grating.

**Demonstration**

1. Measurement of efficiency of a solar cell
2. Non destructive testing
3. Tyndall effect

**PART-B: APPLIED CHEMISTRY LABORATORY**  
(Any five experiments)

**LIST OF EXPERIMENTS:**

1. Estimation of Total, Temporary and Permanent hardness of water by EDTA method.
2. Estimation of  $Ca^{2+}$  and  $Mg^{2+}$  hardness separately by EDTA method.
3. Estimation of Alkalinity of the given water sample.
4. Conductometric titration - Mixture of acids.
5. Estimation of Hydrochloric acid using pH meter.
6. Estimation of Ferrous ion by potentiometric titration.

**Demonstration**

1. Distillation system
2. RO water treatment system
3. UV Spectrophotometer

**REFERENCES / MANUALS / SOFTWARE:**

1. Physics Laboratory Manual –Dr.K.Tamilarasan and Dr.K.Prabu
2. Chemistry Laboratory Manual- Dr.P.N.Palanisamy, P.Manikandan, A.Geetha and K.Manjularani

**TOTAL : 45**

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: describe the basics of modulus of elasticity, thermal conductivity, ultrasonic and compressibility of water, laser parameters, specific resistance of electrical conductors, and interference and diffraction of light waves
- CO2: operate the basic measuring devices, travelling microscope, Lee's disc arrangement, ultrasonic interferometer, Carrey Foster bridge and spectrometer, and to measure the related physical parameters
- CO3: analyze the hardness, amount of  $Ca^{2+}$  and  $Mg^{2+}$  ions, and presence of alkalinity in water
- CO4: employ the instruments like pH meter, conductivity meter and potentiometer for the estimation of unknown concentration of acids and ferrous ion

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		2	1		2		2					
CO2	3	3		2	1		2		2					
CO3	3	3		2	1		2		2					
CO4	3	3		2	1		2		2					

1 – Slight, 2 – Moderate, 3 – Substantial

**14MEL11 BASICS OF CIVIL AND MECHANICAL ENGINEERING LABORATORY**  
(Common to all Engineering and Technology branches)

0 0 3 1

**LIST OF EXPERIMENTS:**

1. To prepare a square or rectangular shaped two identical MS plates by cutting and filing operations
2. To prepare a square/rectangular/circular/trapezoidal/Vshaped projection and its counterpart forming from the given square or rectangular MS plates.
3. To carryout drilling, tapping and assembly on the given MS plates.
4. To carryout thread forming on a GI and PVC pipes and cut to the required length.
5. To use various pipe fitting accessories and prepare water leak proof water line from overhead tank.
6. To prepare a T/L/Lap joint from the given wooden work pieces.
7. To prepare a plywood box/tray to the given dimensions.
8. To prepare a leak proof sheet metal tray/box/funnel to the given dimensions.
9. Cutting of MS plates by gas cutting method and arc weld joining by Lap/Butt/T joint method
10. Preparing a simple PVC window/door frame assembly.
11. Preparing a simple memento or similar articles using wood/sheet metal
12. Preparing innovative articles involving waste metals.

**TOTAL : 45**

**REFERENCES / MANUALS / SOFTWARE:**

1. Introduction to basic manufacturing processes and workshop technology by Rajender Singh, New Age International (P) Limited, 2006.
2. Elements of Workshop Technology by S.K.Hajra Choudhury, Media Promoters, 2009.

**COURSE OUTCOMES:**

On completion of the course the students will be able to

- CO1: demonstrate knowledge on safety and adhere to safety features
- CO2: mark the given dimensions accurately and execute cutting and joining operations
- CO3: select methods and tools and execute the given experiments
- CO4: finish the job to the requirements and quantify the accuracy
- CO5: plan and complete simple and innovative articles

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	2		2	2	1		2	2		2		
CO2	3	1	2		2	2	1		2	2		2		
CO3	3	1	2		2	2	1		2	2		2		
CO4	3	1	2		2	2	1		2	2		2		
CO5	3	1	2		2	2	1		2	2		2		

1 – Slight, 2 – Moderate, 3 – Substantial 1

**14EGT21 COMMUNICATIVE ENGLISH II**  
( Common to all Engineering and Technology branches )

3    0    0    3

**UNIT – I** 9

**Functional Grammar:** Sentences – Affirmative / Negative – Asking questions in the simple present – Using reference words - Cause and Effect expressions. **Listening:** Listening practice - listening to different types of conversation and answering questions - listening to Audio texts and completing cloze exercises. **Speaking:** Opening a conversation and getting acquainted with people. **Reading:** Reading excerpts from a novel, itinerary, magazine and news paper articles. **Writing:** Formal Letter writing – Job Application Letter – CV and Resume – Writing Instructions

**UNIT – II** 9

**Functional Grammar:** Sentences – Interrogative & WH questions - SI units – Numerical Adjectives  
**Listening:** Listening to situation based dialogues – listening to short and long conversations in different domains of activity. **Speaking :** Conversation practice in real life situations, describing places, narration, introducing ideas. **Reading:** Reading historic writing – biographical writing – Non fictional book extracts and news feeds. **Writing:** Filling Forms – Academic Writing - Basics of Business Writing – Calling for Quotation, Placing Orders, Letter of Complaint

**UNIT – III** 9

**Functional Grammar:** Sentences – Imperative – Gerunds & Infinitives - Commonly confused words. **Listening:** Understanding the structure of conversations - Listening to academic lectures and live speech – advertisements and announcements. **Speaking:** Giving and Justifying opinions – apologizing – extempore. **Reading:** Reading Blogs - Website articles – e-mails. **Writing:** e-mails – Tweets – Texting and SMS language

**UNIT – IV** 9

**Functional Grammar:** Transformation of Sentences – Simple, Compound and Complex - Vocabulary ( single word substitute ) – conjunctions - reporting verbs – Direct and Indirect speech. **Listening:** Listening to a telephone conversation, viewing of model interviews ( face-to-face, telephonic and video conferencing). **Speaking:** Giving instructions – Role play – Interviews. **Reading:** Reading job advertisements and profile of the company concerned **Writing:** Writing Reports - Preparing a Check list

**UNIT – V** 9

**Grammar:** Analyzing sentence structures in a given short passage - Identifying parts of speech in a given short passage. **Listening:** Viewing a model group discussion and reviewing the performance of each participant – identifying the characteristics of a good listener – casual conversation. **Speaking:** Group discussion skills – initiating, turn taking and concluding the discussion. **Reading:** Making notes from long passages or any form of written materials – providing a suitable title – identifying main points, supporting points. **Writing:** Email writing – Effective use of email.

**TOTAL: 45**

**TEXT BOOKS :**

1. Dr. Elango et al. “Resonance: English for Engineers and Technologists”, Foundation, Chennai, 2013.

**REFERENCE BOOKS:**

1. Anderson, Paul V., “ Technical Communication : A Reader–Centered Approach”, Cengage.
2. Muralikrishna and Sunita Mishra, “Communication Skills for Engineers”, Pearson, New Delhi, 2011.
3. Sharma, Sangeetha and Binod Mishra, “Communication Skills for Engineers and Scientists”, PHI Learning, New Delhi, 2009.

**COURSE OUTCOMES**

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

- CO1: speak effectively, express their opinions clearly, initiate and sustain a discussion and also negotiate using appropriate communicative strategies
- CO2: write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing
- CO3: read different genres of texts, infer implied meanings and critically analyze and evaluate them for ideas as well as for method of presentation
- CO4: listen and comprehend different spoken excerpts critically and infer unspoken and implied meanings
- CO5: use functional grammar for improving employment oriented skills

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2			2	3		2		
CO2						1			1	3		1		
CO3						2			1	3		2		
CO4						1			2	3		2		
CO5						1			1	3		1		

1 – Slight, 2 – Moderate, 3 – Substantial

## 14MAT21 MATHEMATICS II

(Common to all Engineering and Technology branches)

3 1 0 4

**Pre-requisites:** Basic ideas of integration, Basic ideas of vectors and complex numbers

**UNIT – I** 9

**Multiple Integrals:** Double integration in Cartesian coordinates – Change of order of integration – Area between two curves – Triple integration in Cartesian coordinates – Volume as Triple integrals (Simple problems only).

**UNIT – II** 9

**Vector Calculus:** Gradient of a scalar point function – Directional derivative – Divergence of a vector point function – Curl of a vector – Irrotational and Solenoidal vectors – Line Integral, Surface integral and Volume integral (Concept only) – Green’s, Stoke’s and Gauss divergence theorems (Statement only) – Verification of the above theorems and evaluation of integrals using them (Simple problems only).

**UNIT – III** 9

**Analytic Functions:** Functions of a complex variable – Analytic functions – Necessary conditions and Sufficient conditions (excluding proofs) – Cauchy– Riemann equations (Statement only) – Properties of analytic function (Statement only) – Harmonic functions – Construction of Analytic functions – Conformal mapping:  $w = z + a$ ,  $az$ ,  $1/z$  – Bilinear transformation.

**UNIT – IV** 9

**Complex Integration:** Cauchy’s theorem and Cauchy’s integral formula (Statement and applications) – Taylor’s and Laurent series – Singularities – Classification – Cauchy’s Residue theorem (Statement only) – Contour integration – circular and semi-circular contours (excluding poles on real axis).

**UNIT – V** 9

**Laplace Transform:** Conditions for existence – Transform of elementary functions – Basic properties – Derivatives and integrals of transforms – Transforms of derivatives and integrals – Initial and final value theorems – Transform of unit step function – Transform of periodic functions - Inverse Laplace transform of elementary functions – Partial fraction method – Convolution theorem (Statement only) – Solution of linear ODE of second order with constant coefficients.

**Lecture: 45, Tutorial: 15, TOTAL: 60**

**TEXT BOOKS:**

- Kandasamy P., Thilagavathy K. and Gunavathy K., “Engineering Mathematics For First Year B.E/B.Tech”, Reprint Edition 2014, S.Chand and Co., New Delhi.
- Veerarajan T., “Engineering Mathematics”, (for first year), Reprint Edition 2013, Tata McGraw-Hill, New Delhi.

**REFERENCE BOOKS:**

- Grewal B.S., “Higher Engineering Mathematics”, 42<sup>nd</sup> Edition, Khanna Publications, New Delhi, 2011.
- Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, 4<sup>th</sup> Edition, Narosa Publishing House, New Delhi, Reprint 2014.
- Bali N.P. and Manish Goyal, “Text Book of Engineering Mathematics”, 8<sup>th</sup> Edition, Laxmi Publications, New Delhi, 2011.
- Ramana B.V., “Higher Engineering Mathematics”, Tata McGraw Hill Publishing Company, New Delhi, 2011.
- Kreyszig E., “Advanced Engineering Mathematics”, 10<sup>th</sup> Edition, John Wiley Sons, 2010.

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: solve problems involving double and triple integrals
- CO2: apply the concept of vectors in engineering problems
- CO3: have a clear idea about functions of complex variables and analytic function which are widely used in study of fluid and heat flow problems
- CO4: evaluate complex integrals which is extensively applied in engineering
- CO5: handle Laplace transforms to solve practical problems

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1								1		
CO2	3	3	1	1								1		
CO3	3	3										1		
CO4	3	3	1	1								1		
CO5	3	3	1	1								1		

1 – Slight, 2 – Moderate, 3 – Substantial



**14PHT21 MATERIALS SCIENCE**  
(Common to all Engineering and Technology branches)

**3 0 0 3**  
**9**

**UNIT – I**

**Crystal Physics:** Crystalline and amorphous solids – Lattice – Unit cell – Crystal systems – Bravais lattice – Lattice planes – Miller indices – Derivation of ‘d’ spacing in cubic lattice – Atomic radius – Coordination number– Packing factor for SC, BCC, FCC and HCP structures – Crystal imperfections: Point and line imperfections.

**UNIT – II**

**Conducting Materials:** 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.

**UNIT – III**

**Semiconducting Materials:** Intrinsic semiconductor – Carrier concentration derivation – Electrical conductivity and band gap (theory) – Extrinsic semiconductors – Carrier concentration derivation in n-type and p-type semiconductors – Hall effect – Determination of Hall coefficient – Applications –Solar cell – LDR.

**UNIT – IV**

**Magnetic and Superconducting Materials:** Magnetic materials - Types of magnetic materials (qualitative) – Domain theory – Hysteresis – Soft and hard magnetic materials – Applications - Transformer core – Magneto optical recording – Superconductors – Properties – Types of superconductors – BCS theory of superconductivity (qualitative) – Josephson effect - Applications of superconductors – SQUID – Cryotron – Magnetic levitation. **Dielectric Materials:** Dielectric constant – Qualitative study of polarization – Frequency and temperature dependence of polarization – Dielectric loss – Dielectric breakdown – Uses of dielectric materials (capacitor) – Ferro electric materials (qualitative).

**UNIT – V**

**Smart Materials:** Metallic glasses: Preparation (Melt spinning method only), properties and applications – Shape memory alloys (SMA): Characteristics and applications. **Nano Materials:** Low dimensional structures (quantum dot, wire and well) – Features of nano materials – Synthesis: top down and bottom up approaches – Ball milling and lithographic methods – Physical and chemical vapor phase depositions – Sol gel method – Carbon nanotubes: Structures – Properties – Fabrication by laser ablation – Applications.

**TOTAL : 45**

**TEXT BOOKS:**

1. Tamilarasan K. and Prabu K., “Engineering Physics-II”, Tata McGraw Hill Education Private Limited, New Delhi, 2014.

**REFERENCE BOOKS:**

1. Mehta and Neeraj, “Applied Physics for Engineers”, Prentice-Hall of India Private Limited, New Delhi, 2011.
2. Raghavan V., “Materials Science and Engineering: A first course”, 5<sup>th</sup> Edition, Prentice-Hall of India, New Delhi, 2009.
3. Poole Charles P. and Ownen Frank J., “Introduction to Nanotechnology”, Wiley India, 2007.
4. William Fortune Smith and Javad Hashemi, “Foundations of Materials Science and Engineering”, McGraw-Hill Education, 2006, New Delhi.
5. Pillai S.O., “Solid State Physics”, 5<sup>th</sup> Edition, New Age International, New Delhi, 2003.

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: explain the various crystal systems and crystal defects
- CO2: comprehend the theory of conducting materials
- CO3: classify the types of semiconducting materials and to illustrate the device applications
- CO4: summarize the theory and applications of magnetic, superconducting and dielectric materials
- CO5: outline the properties and applications of smart materials and nano materials

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3			2	2		2		1					
CO2	3			2	2		2		1					
CO3	3			2	2		2		1					
CO4	3			2	2		2		1					
CO5	3			2	2		2		1					

1 – Slight, 2 – Moderate, 3 – Substantial

**14CYT21 ENVIRONMENTAL SCIENCE**  
(Common to all Engineering and Technology branches)

3 0 0 3

**UNIT – I**

**Introduction to Environmental Studies and Natural Resources:** Introduction to Environmental Science – Forest resources: Use and over-exploitation, deforestation, case studies. – Water resources: Use and over-utilization 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 - effects of modern agriculture, fertilizer and pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, case studies – Land resources: Land as a resource – Conservation Practices - Role of an individual in conservation of natural resources.

**UNIT – II**

**Ecosystems:** Concept of an ecosystem – Components of an ecosystem - Structural and functional features – Functional attributes (Food chain and Food web only) –Ecological Succession- Introduction, types, characteristic features, structure and functions of the (a) Forest ecosystem (b) Aquatic ecosystems (ponds, rivers and oceans). **Biodiversity:** Introduction – Classification: genetic, species and ecosystem diversity – Bio geographical classification of India- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic, option values and ecosystem service value – Biodiversity at global, national and local level- Hotspots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – In-situ and Ex-situ conservation of biodiversity.

**UNIT – III**

**Environmental Pollution:** Definition – Causes, effects and control measures of: (a) Air pollution - Climate change, global warming, acid rain, ozone layer depletion (b)Water pollution (c) Soil pollution - Solid waste Management - Disaster management: floods, earthquake, cyclones and landslides - Role of an individual in prevention of pollution - Case studies. **Water Treatment methods:** Treatment of Water for Domestic Supply (Screening, Aeration, Sedimentation with Coagulation, Filtration and Disinfection methods) - Break point chlorination- Estimation of dissolved oxygen, BOD and COD - Sewage treatment (Primary, Secondary & Tertiary methods) – Introduction to industrial wastewater treatment using Reverse Osmosis Technology- Membrane Technology for wastewater treatment - Activated carbon in pollution abatement of wastewater.

**UNIT – IV**

**Social Issues and the Environment:** From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation– Environmental ethics - Wasteland reclamation – Environment Production Act – Air (Prevention and control of pollution) Act – Water (Prevention and control of pollution) Act – Wildlife protection Act – Forest conservation Act – Issues involved in enforcement of environmental legislation – Public awareness. **Human Population and the Environment:** Introduction - Population growth - Variation of population based on age structure - Variation among nations – Population explosion – Family welfare programme – Value Education – HIV / AIDS – Women and Child welfare – Role of Information Technology in Environment and human health – Case studies.

**UNIT – V**

**Green Chemistry for Sustainable Future:** Water the greenest solvent – Role of catalyst – Biopolymers – Biofertilizers – Principle and applications of green chemistry. **Food and Human Health:** Introduction – Classification and applications of carbohydrates, amino acids, proteins, lipids and vitamins – Food additives – Balanced food – Minerals rich, carbohydrates rich and proteins rich – Chemistry of soft drinks – Oils and fats – Simple tests for identification of adulterants in food stuffs – Impacts of fluoride and arsenic on human health – Fluoride and arsenic removal methods – Significance of iodine, iron and calcium content in human health.

**TOTAL : 45**

**TEXT BOOKS:**

- Palanisamy P.N., Manikandan P., Geetha A., Manjula Rani K., “Environmental Science”, Pearson Education, New Delhi, Revised Edition 2014.
- Anubha Kaushik, and Kaushik C.P., “Environmental Science and Engineering”, 4<sup>th</sup> multicolour Edition, New Age International (P) Ltd., New Delhi, 2014.

**REFERENCE BOOKS:**

- Erach Bharucha, “Textbook of Environmental Studies for Undergraduate Courses”, 2005, University Grands Commission, Universities Press India Private Limited, Hyderguda, Hyderabad.
- Uppal M.M. revised by Bhatia S.C., “Environmental Chemistry”, 6<sup>th</sup> Edition, Khanna Publishers, New Delhi, 2002.
- Bahl B.S. and Arun Bahl, “Advanced Organic Chemistry”, 3<sup>rd</sup> Edition, S. Chand & Co., New Delhi, 2005.

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: know the types of natural resources and the individual role in conserving the resources
- CO2: understand the ecological balance and the preservation of biodiversity
- CO3: gain the knowledge of the various types of pollution and the waste water treatment methods
- CO4: attain the knowledge of various social issues and impact of population explosion on environment
- CO5: know about the green chemistry for sustainable future, food and human health

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2			3	2	3	2	1	1				
CO2	3	2			3	2	3	2	1	1				
CO3	3	2			3	2	3	2	1	1				
CO4	3	2			3	2	3	2	1	1				
CO5	3	2			3	2	3	2	1	1				

1 – Slight, 2 – Moderate, 3 – Substantial

**14CSC11 PROBLEM SOLVING AND PROGRAMMING**  
(Common to all Engineering and Technology branches)

3    0    3    4

**UNIT – I** 9

**Introduction to Computer and Problem Solving:** Overview of computers – Applications of computers-Characteristics of computer - Basic computer Organization – Number System - Problem solving: Planning the computer program – Algorithms - Flowcharts – Pseudo codes – Structuring the logic - Top-Down design.

**UNIT – II** 9

**Case Study on Problem Solving:** Algorithm, Flowchart and Pseudo code for the problems: Exchanging the values of two variables – Finding the biggest number - Counting – Summation of numbers – Factorial computation – Generation of Fibonacci Sequence - Summation of series – Base Conversion - Reversing the digits of an Integer.

**UNIT – III** 9

**Introduction to C and Control Statements:** Overview of C – Basic structure of a C Program – Executing a C Program – C Character set – Tokens – Keywords and Identifiers – Constants – Variables – Data types - Storage classes - Managing Input and Output operations – Operators and Expressions - Decision making and Branching - Looping – break and continue statements.

**UNIT – IV** 9

**Arrays, Strings and Functions:** Arrays – One dimensional and Two dimensional arrays - Handling of character strings: Declaring and initializing string variables – String handling functions - Library functions – User defined functions: Elements of User defined Functions – nesting of functions – passing arrays to function – passing strings to functions - recursion.

**UNIT – V** 9

**Structures, Unions and Pointers:** Structure definition – Structure declaration – Accessing a structure member- Structure initialization – Array of Structures - Arrays within structures –Structures within Structures – Structures and Functions , Unions. Understanding pointers – Accessing address of a variable – Declaring pointer variables – Initialization of pointer variables – accessing a variable through its pointer – Pass by value vs. Pass by pointers.

**Lecture: 45, Practical: 45, TOTAL: 90**

**REFERENCE BOOKS:**

1. Dromey R.G., “How to Solve it by Computer”, Pearson Education, 2009.
2. Balagurusamy E., “Fundamentals of Computing and Programming“, Tata McGraw-Hill Education Pvt. Ltd, 2010.
3. Stephen G. Kochan, “Programming in C”, 3<sup>rd</sup> Edition, Pearson Education, 2005.
4. Yashavant P. Kanetkar, “ Let Us C”, BPB Publications, 2011.

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: apply fundamental principles of problem solving techniques
- CO2: develop algorithm, flowchart and pseudo code to provide solutions to problems
- CO3: develop programs using basic programming principles of C language
- CO4: implement modular programming concepts using functions
- CO5: design simple applications using arrays, structures and pointers

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3		2							2		
CO2	3	3	1		2							2		
CO3	3	3	2	1	2							2		
CO4	3	3	3	2								2		
CO5	3	3	3	2	2							2		

1 – Slight, 2 – Moderate, 3 – Substantial

# 14EET11 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

(Common to all Engineering and Technology branches)

3 0 0 3

## UNIT- I

9

**Introduction to Power Systems:** Introduction: Electric Potential, Current, Power and Energy. Generation of Electrical Energy: Sources of Energy - Renewable and Non Renewable - Power Generation: Thermal, Hydro and Nuclear Power plants - Solar and Wind (schematic arrangement and operation) Power plants - Structure of Electric Power System - Transmission and Distribution Voltages. Electrical Safety Aspects - Phase-Neutral - Earthing: Need for Earthing and Types - Domestic Wiring (Simple and staircase) - Energy Conservation and Sustainability.

## UNIT - II

9

**DC Circuits and AC Circuits:** Resistance: Resistors in Series and Parallel - Network Reduction - Voltage and Current Division Rule - Ohm's Law- Kirchoff's Laws - Mesh Analysis of Simple Resistive Networks.

**Single phase systems:** Alternating (Sinusoidal) Voltage and Current, R.M.S and Average Value, Power Factor, Form Factor and Peak Factor - AC Series Circuits (RL, RC & RLC). Three phase Systems (Qualitative only): Star and Delta Connected Systems - Line and Phase Voltage/Current - Three Phase Power Measurement by Two Wattmeter Method.

## UNIT - III

9

**Electrical Machines:** DC Machines: Construction, Principle of Operation of DC Motor-Torque Equation, Types and Applications. AC Machines: Construction and Working Principle of AC Generator, Single Phase Transformer, Three Phase Induction Motor and Single Phase Induction Motor (Split Phase and Capacitor Start Induction Motor) - Applications.

## UNIT - IV

9

**Basic Electronics:** PN Junction Diode - Operation of Rectifiers (Half wave, Full wave - Bridge Rectifiers with waveforms) and Filters - Zener Diodes - Zener Diode as Voltage Regulator - IC Voltage Regulators (78XX & 79XX) - Transistors: Types - Operation of NPN Transistor - Transistor as an Amplifier - Operation and Characteristics of SCR - UPS and SMPS (Block Diagram approach).

## UNIT - V

9

**Digital Electronics:** Introduction – Binary Number Systems and Conversions - Binary Addition and Subtraction - Logic Gates and Truth tables - Boolean Algebra - Basic Laws and Demorgan's theorem - Simplification of Boolean Functions - Full Adder and Full Subtractor - Flip Flops - Counters: Asynchronous Binary Ripple Counter .

**TOTAL: 45**

## TEXT BOOKS:

1. Prasad P.V., Sivanagaraju S. and Prasad R., "Basics of Electrical and Electronics Engineering", 1<sup>st</sup> Edition, Cengage Learning, 2013.
2. Muthusubramanian R. and Salivahanan S., "Basics of Electrical and Electronics Engineering", 1<sup>st</sup> Edition, Tata McGraw Hill, 2009.

## REFERENCE BOOKS:

1. Jegathesan V., Vinoth Kumar K. and Saravanakumar R., "Basic Electrical and Electronics Engineering", 1<sup>st</sup> Edition, Wiley India, 2011.
2. Sukhija M.S. and Nagsarkar T.K., "Basics of Electrical and Electronics Engineering", 1<sup>st</sup> Edition, Oxford University Press, 2012.
3. Smarajit Ghosh, "Fundamentals of Electrical and Electronics Engineering", 2<sup>nd</sup> Edition, PHI Learning, 2007.
4. Edward Hughes, Ian McKenzie Smith, Dr. John Hiley and Keith Brown, "Electrical and Electronics Technology", 8<sup>th</sup> Edition, Pearson Education, 2012.

## COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: develop a basic understanding of the concept of electrical systems  
CO2: analyze the DC and AC circuits  
CO3: interpret the construction and working of different types of electric machines  
CO4: discuss the basic electronic components  
CO5: distinguish analog and digital electronics

### Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3									1		
CO2	3	3	3									1		
CO3	3	3	3									1		
CO4	3	3	3									1		
CO5	3	3	3									1		

1 – Slight, 2 – Moderate, 3 – Substantial

**14PHL21 PHYSICAL SCIENCES LABORATORY II**  
(Common to all Engineering and Technology branches)

0      0      3      1

**PART-A: APPLIED PHYSICS LABORATORY**  
(Any five experiments)

**LIST OF EXPERIMENTS:**

1. Determination of band gap of a semiconductor material using post office box.
2. Determination of dispersive power of a prism using spectrometer.
3. Determination of viscosity of liquid - Poiseuille's method.
4. Determination of thickness of a thin wire – air wedge method.
5. Determination of AC frequency using Melde's string experiment.
6. Determination of hysteresis loss in a ferromagnetic material.

**Demonstration**

1. Thin film deposition using RF magnetron sputtering technique
2. Synthesis of nano-particles
3. Phase change memory materials - RW CD / DVD

**PART - B: APPLIED CHEMISTRY LABORATORY**  
(Any five experiments)

**LIST OF EXPERIMENTS:**

1. Estimation of Chloride in the given water sample.
2. Determination of Dissolved Oxygen in the given wastewater sample.
3. Estimation of Ferrous ion in the given solution.
4. Estimation of Copper in the given solution by Iodometric method.
5. Estimation of Chromium (Cr<sup>6+</sup>) in the wastewater.
6. Estimation of copper content of the given solution by EDTA method.

**Demonstration**

1. Turbidity measurement using Nephelometer
2. COD analyzer
3. Dissolved Oxygen measurement using DO analyzer

**TOTAL : 45**

**REFERENCES / MANUALS / SOFTWARE:**

1. Physics Laboratory Manual –Dr.K.Tamilarasan and Dr.K.Prabu
2. Chemistry Laboratory Manual- Dr.P.N.Palanisamy, P.Manikandan, A.Geetha and K.Manjularani

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: describe the basics of band gap of semiconductors, dispersive power of a prism, viscosity of liquids, interference of light, AC frequency and hysteresis of ferromagnetic materials.
- CO2: operate the instruments like post office box, air wedge arrangement, Melde's string apparatus and hysteresis arrangement, and to measure the related parameters
- CO3: estimate the amount of DO and chloride in a given water sample
- CO4: determine the amount of chromium, ferrous ion and copper in waste water

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		2	1		2		2					
CO2	3	3		2	1		2		2					
CO3	3	3		2	1		2		2					
CO4	3	3		2	1		2		2					

1 – Slight, 2 – Moderate, 3 – Substantial

**14EEL11 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY**  
(Common to all Engineering and Technology branches)

0      0      3      1

**LIST OF EXPERIMENTS:**

1. Control of incandescent and fluorescent lamp by simple and stair-case wiring
2. Resistor color coding and verification of Ohm's Law and Kirchhoff's Laws
3. Measurement of real power, reactive power, power factor and impedance of RC, RL and RLC circuits.
4. Measurement of Earth's resistance
5. Load test on DC shunt motor
6. Performance characteristics of single phase Transformer
7. Load test on single phase induction motor.
8. Verification of basic logic gates and their truth tables.
9. Implementation of Half wave and Full wave Rectifier with simple Capacitor Filter
10. Study of Mixie, Ceiling Fan and Vacuum Cleaner

**TOTAL : 45**

**REFERENCES / MANUALS / SOFTWARE:**

- Lab Manuals

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: create a basic electrical connections for domestic applications
- CO2: test basic electrical machines like transformer and DC motors
- CO3: construct and analyze basic electronic circuits
- CO4: measure the various electrical parameters of the circuit
- CO5: explain the working of various domestic appliances

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3									2		
CO2	3	3	3									2		
CO3	3	3	3						2			2		
CO4	3	3	3									2		
CO5	3	3	3					1				2		

1 – Slight, 2 – Moderate, 3 – Substantial

### 14MAT31 MATHEMATICS III

(Common to all Engineering and Technology Branches)

3    1    0    4

#### UNIT – I

**Fourier Series:** Dirichlet’s conditions – General Fourier series – Change of interval - Odd and even functions – Half range Sine series – Half range Cosine series – Harmonic analysis. 9

#### UNIT – II

**Partial Differential Equations:** Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Lagrange’s linear equation – Homogeneous linear partial differential equations of higher order with constant coefficients. 9

#### UNIT – III

**Applications of Partial Differential Equations:** Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two dimensional heat equation (excluding insulated edges). 9

#### UNIT – IV

**Fourier Transform:** Fourier Integral theorem (without proof) – Fourier transform pair – Properties – Transforms of simple functions – Fourier Sine and Cosine transforms – Convolution theorem and Parseval’s identity (Statement and applications only). 9

#### UNIT – V

**Z - Transform:** Definition – Elementary properties – Z-transform of some basic functions – Inverse Z-transform – Partial fraction method – Residue method – Convolution theorem – Applications of Z-transforms – Solution of difference equations. 9

**Lecture: 45, Tutorial: 15, TOTAL: 60**

#### TEXT BOOKS:

- Kandasamy P., Thilagavathy K. and Gunavathy K., “Engineering Mathematics, Volume - III”, Reprint Edition, S.Chand & Co., New Delhi, 2014.
- Veerarajan T., "Transforms and Partial Differential Equations", 3<sup>rd</sup> Reprint, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2013.

#### REFERENCE BOOKS:

- Grewal B.S., "Higher Engineering Mathematics", 43<sup>rd</sup> Edition, Khanna Publishers, Delhi, 2014.
- Jain R.K. and Iyengar S.R.K., “Advanced Engineering Mathematics”, Reprint Edition, Narosa Publishing House, New Delhi, 2014.
- Bali N.P. and Manish Goyal, “A Text Book of Engineering Mathematics”, 9<sup>th</sup> Edition, Laxmi Publications, New Delhi, 2014.
- Ramana B.V., “Higher Engineering Mathematics”, 11<sup>th</sup> Reprint, Tata McGraw Hill Publishing Company, New Delhi, 2010.
- Erwin Kreyzig, “Advanced Engineering Mathematics”, 10<sup>th</sup> Edition, Wiley & Co, 2011.

#### COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: expand a function in terms of Fourier series and apply it for solving engineering problems
- CO2: model and solve higher order partial differential equations
- CO3: apply the methods of solving PDE in practical problems
- CO4: gain knowledge on Fourier transforms
- CO5: handle problems in Z transforms and apply it to solve difference equations

#### Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	1								1	2	1
CO2	3	3	1	1								1	2	1
CO3	3	3	1	1								1	2	1
CO4	3	3	1	1								1	1	
CO5	3	3	1	1								1	1	

1 – Slight, 2 – Moderate, 3 – Substantial

## 14MET31 ENGINEERING MECHANICS

(Common to Mechanical, Mechatronics and Automobile branches)

3    1    0    4

**Pre-requisites:** Mathematics I & II, Applied Physics.

### UNIT – I

9

**Statics of Particles:** Introduction –Laws of Mechanics – Parallelogram and triangular Law of forces – Principle of transmissibility – Coplanar Forces – Resolution and Composition of force -Free body diagram–Equilibrium of a particle in plane – Forces in space - Vectorial representation of forces–Equilibrium of a particle in space.

### UNIT – II

9

**Statics of Rigid Bodies:** Moments: Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar component of moments – Varignon’s theorem– Equivalent systems of forces – Single equivalent force. Types of supports and their reactions – requirements of stable equilibrium – Equilibrium of Rigid bodies in two dimensions – Trusses: Method of joints- Method of sections, Equilibrium of Rigid bodies in three dimensions.

### UNIT – III

9

**Properties of Surfaces and Solids:** Determination of Areas and Volumes – First moment of area and Centroid of sections – T section, I section, Angle section, Hollow section from primary simpler sections – Second moment of plane areas – Parallel axis theorem and Perpendicular axis theorem—T section, I section, Angle section, Hollow sections – Polar moment of inertia – Product of inertia- Principal Moment of inertia of plane area- Mass moment of inertia – Relation to area moments of inertia.

### UNIT – IV

9

**Friction and Kinematics of Particles:** Surface Friction – Laws of dry friction – Sliding friction – Static and Kinetic friction– Ladder friction – Wedge friction – Belt friction. Rectilinear motion of particles- Displacement, velocity and acceleration, their relationship – Relative motion- Curvilinear motion – Projectile motion.

### UNIT – V

9

**Dynamics of Particles and Rigid Body:** Newton’s law, Work - Energy and Impulse - Momentum equations of particles – Impact of elastic bodies. Kinematics of Rigid body -Translation, Rotation about a fixed axis–General plane motion- Kinetics of rigid body.

**Lecture: 45, Tutorial: 15, TOTAL: 60**

### TEXT BOOKS:

1. Rajasekaran S. and Sankarasubramanian G., “Fundamentals of Engineering Mechanics”, 3<sup>rd</sup> Edition, Vikas Publishing House, Noida, 2009.
2. Beer F.P., Johnston E.R., Cornwell P. and Maurek D., “Vector Mechanics for Engineers: Statics and Dynamics”, 10<sup>th</sup> Edition, Tata McGraw Hill Publishing Company, New Delhi, 2012.

### REFERENCE BOOKS:

1. Shames Irving H., “Engineering Mechanics: Statics and Dynamics”, 4<sup>th</sup> Edition, Pearson Education Asia, New Delhi, 2014.
2. Hibbeler R.C., “Engineering Mechanics Statics and Dynamics”, 11<sup>th</sup> Edition, Pearson Education Asia, Noida, 2015.
3. Timoshenko S.P., Young D.H., Sukumar Pati, Rao J.V., “Engineering Mechanics”, 5<sup>th</sup> Edition, Tata McGraw Hill Publishing Company, New Delhi, 2013.
4. <http://nptel.ac.in/courses/122104015/>
5. <http://nptel.ac.in/courses/112103109/>

### COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: represent the forces in vector components (both 2D and 3D) and apply equilibrium conditions
- CO2: calculate the moment produced by various force systems and develop static equilibrium equations for rigid body system
- CO3: evaluate the centroid, centre of gravity and moment of inertia of geometrical shapes and solids respectively
- CO4: comprehend the effect of dry friction and its applications
- CO5: apply the different principles to study the motion of a body and analyse their constitutive equations

### Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7		PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2							2	3	3
CO2	3	3	3	2	2							2	3	3
CO3	3	3	3	2	2							2	3	3
CO4	3	3	3	2	2							2	3	3
CO5	3	3	3	2	2							2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial



**14MET33 FLUID MECHANICS AND HYDRAULIC MACHINES**  
(Common to Mechanical, Mechatronics and Automobile branches)

**3 0 0 3**

**Pre-requisites:** Physics, Mathematics I & II, Basics of Mechanical Engineering.

**UNIT – I**

**9**

**Fluid Properties and Fluid Statics:** Fluid Definition and Classification – Properties of fluids: Density, Specific Weight, Specific Volume, Specific Gravity, Viscosity, Compressibility, Bulk Modulus, Capillary and Surface Tension – Fluid statics: Concept of fluid static pressure – Pascal’s law –Absolute and Gauge pressures – Manometers: Types and Pressure measurement.

**UNIT – II**

**9**

**Fluid Kinematics and Fluid Dynamics:** Fluid Kinematics: Types of fluid flow – Continuity equation in two and three dimensions – Velocity and Acceleration of fluid particle – Velocity potential function and Stream function. Fluid dynamics: Euler's equation along a streamline –Bernoulli's equation and applications – Venturi meter, Orifice meter and Pitot tube.

**UNIT – III**

**9**

**Viscous Flow, Flow through Pipes and Dimensional analysis:** Viscous flow: Shear stress, pressure gradient relationship – Flow of viscous fluid through circular pipe – Flow through pipes: Loss of head due to friction – Minor head losses – Hydraulic gradient and Total energy lines – Flow through pipes in series and in parallel – Power transmission through pipes. Dimensional analysis: Buckingham's  $\pi$  theorem.

**UNIT – IV**

**9**

**Hydraulic Turbines:** Impact force – work done – Efficiency of stationary, moving flat and curved vanes due to moving water jet – Construction of velocity vector diagrams – Degree of reaction – Pelton wheel – Francis turbine – Kaplan turbine – working principles – velocity triangles – work done.

**UNIT – V**

**9**

**Hydraulic Pumps:** Centrifugal pump: classifications, working principle, velocity triangles, Work done. Reciprocating pump: classification, working principle- Basic principles of indicator diagram, cavitations in pumps.

**TOTAL: 45**

**TEXT BOOKS:**

- Bansal R.K., “Fluid Mechanics and Hydraulic Machines”, 9<sup>th</sup> Edition, Laxmi Publications, New Delhi, 2015.
- Rajput R.K., “A Text Book of Fluid Mechanics” 5<sup>th</sup> Edition, S.Chand & Company Ltd., New Delhi, 2012.

**REFERENCE BOOKS:**

- Som S.K., Biswas G., “Introduction to Fluid Mechanics and Fluid Machines”, 2<sup>nd</sup> Edition, Tata McGraw Hill Publishing Company, New Delhi, 2007.
- Kumar K.L., “Engineering Fluid Mechanics”, 7<sup>th</sup> Edition, Eurasia Publishing House, New Delhi, 2005.
- Frank M. White., “Fluid Mechanics”, 7<sup>th</sup> Edition, Tata McGraw Hill Publishing Company, New Delhi, 2009.
- <http://nptel.ac.in/courses/112105183/>
- <http://nptel.ac.in/courses/112105171/>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: understand the fluid flow properties
- CO2: solve the problems related to kinematics and dynamics of fluid flow
- CO3: calculate the energy losses in flow through pipes
- CO4: design the velocity triangle by various hydraulic machines
- CO5: estimate the work done by the various pumps

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2								2	2	2
CO2	3	3	3	2								2	2	2
CO3	3	2	3	2								2	2	2
CO4	3	3	3	2								2	2	2
CO5	3	3	3	2								2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

**Pre-requisites:** Circuit theory, Materials Science.

**UNIT – I**

9

**Semiconductor Devices:** Conductors, Semiconductors and Insulators – Properties of Semiconductors – PN Junction Diode - Rectifiers and Filters - Zener Diodes – Zener Diode Voltage Regulator– LEDs. Junction Transistors: Principle of Operation – CE,CB and CC Configurations, Static Characteristics – CE Transistor as an Amplifier and Switch-Construction and characteristics of FET.

**UNIT – II**

9

**Operational Amplifiers:** Introduction – Ideal operation amplifier – inverting amplifier – non-inverting amplifier – voltage follower – differential amplifier – Scale changer – Summer – instrumentation amplifier – ADC – DAC – types.

**UNIT – III**

9

**Digital Electronics:** Boolean Algebra - Number systems – Complements – Boolean postulates and laws – De-Morgan's Theorem - Minimization of Boolean expressions – Canonical forms – Minimization: Karnaugh map, Tabulation Method – Don't care conditions. Logic Gates - Implementations of Logic Functions using gates, NAND – NOR implementations.

**UNIT – IV**

9

**Combinational Circuits:** Half Adder - Full Adder – Half Subtractor - Full Subtractor – Multiplexer – Demultiplexer - Encoder / Decoder – Parity generator and checker.

**UNIT – V**

9

**Sequential Circuits:** RS, JK, JKMS, D and T Flip flops - Excitation tables –Realization of one flip flop using other flip flops – Analysis and design of sequential circuits with state diagram, State table, State minimization and State assignment - Design of Synchronous and asynchronous counters – shift register.

**Lecture: 45, Tutorial: 15, TOTAL: 60**

**TEXT BOOKS:**

1. Floyd, "Electronic Devices", 6<sup>th</sup> Edition, Pearson Education, New Delhi, 2003.
2. Anandkumar A., "Fundamentals of Digital Circuits", 2<sup>nd</sup> Edition, Prentice Hall of India, New Delhi, 2013.

**REFERENCE BOOKS:**

1. Bell, David A., "Electronic Devices and Circuits", 4<sup>th</sup> Edition, Prentice Hall of India, New Delhi, 2003.
2. Roy Choudhury, "Linear Integrated circuits", 4<sup>th</sup> Edition, New Age International, New Delhi, 2010.
3. Morris Mano M., "Digital Design", 4<sup>th</sup> Edition, Prentice Hall of India, New Delhi, 2010.
4. <http://nptel.ac.in/courses/117101106/>
5. <http://nptel.ac.in/courses/117106086/>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: interpret the basic characteristics of semiconductor devices  
 CO2: analyze the characteristics of amplifiers and its application  
 CO3: verify the Boolean functions using logic gates  
 CO4: design the combinational circuits  
 CO5: design the sequential circuits

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3		2							1	3	2
CO2	3	3	3		2							1	3	2
CO3	3	3	3		2							1	3	2
CO4	3	3	3		2							1	3	3
CO5	3	3	3		2							1	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**Pre-requisites:** Applied Physics, Mathematics – I

**UNIT – I**

**9**

**Introduction to Measurement Systems:** Functional elements of Measurement System - Methods of Measurement - Classification of Instruments – Measurement system errors - Static and dynamic characteristics of transducers – Response of zero and first order transducers - Classification of transducers - Selection of transducers.

**UNIT – II**

**9**

**Non-Electrical Transducers:** Temperature Measurement: Filled system thermometer – Bimetallic thermometer. Pressure Transducers: Elastic transducers – Bourdon gauge – Bellows – Diaphragm. Vacuum Measurement: McLeod gauge, Thermal conductivity gauge – Ionization gauge. Flow Measurement: Rotameter- Orifice. Level measurement: Float gauge.

**UNIT – III**

**9**

**Electrical Transducers:** Resistive transducers: Potentiometer, RTD, Thermistor – Thermocouple – Strain gauge – torque measurement - force measurement – Radiation Measurement using Pyrometers. Inductive transducer: LVDT, RVDT – Capacitive transducer. Flow measurement: Turbine meter – hot-wire anemometer. Level Measurement: Capacitive and Ultrasonic level sensors.

**UNIT – IV**

**9**

**Miscellaneous Transducer and Sensors:** Measurement of Humidity – Sound measurement – Piezoelectric transducer - Hall Effect transducer –Magneto elastic sensor. Digital transducers: Encoders – Fiber optic sensors – Film sensors - Introduction to MEMS and Nano sensors.

**UNIT – V**

**9**

**Applications of Sensors and Transducers:** On-board automobile sensors – Sensor for home appliances – Role of sensor in aerospace applications - Sensors for manufacturing – Medical diagnostic sensors – sensors for environmental monitoring.

**TOTAL: 45**

**TEXT BOOKS:**

1. Patranabis D., “Sensors and Transducers”, 2<sup>nd</sup> Edition, PHI, New Delhi, 2003.
2. Sawhney A.K., “A Course in Electrical and Electronic Measurement and Instrumentation”, Dhanpat Rai & Co, New Delhi, 2010.

**REFERENCE BOOKS:**

1. Ian Sinclair R., “Sensors and transducers”, 3<sup>rd</sup> Edition, Newnes, Elsevier Indian print, New Delhi, 2011.
2. Doebelin E.O., “Measurement Systems: Applications and Design”, Tata McGraw Hill, 2004.
3. Renganathan S., “Transducer Engineering”, 1<sup>st</sup> Edition, Allied Publishers Ltd., 2006.
4. Beckwith, Marangoni and Lienhard, “Mechanical Measurements”, 6<sup>th</sup> Edition, Pearson Education, New Delhi, 2007.
5. <http://nptel.ac.in/courses/112103174/pdf/mod2.pdf>
6. <http://nptel.ac.in/courses/112103174/7>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: infer the basic concepts of measurement system  
 CO2: select suitable non-electrical, electrical transducers and sensors for various measurements  
 CO3: identify suitable electrical transducers and sensors for various measurements  
 CO4: explore the various miscellaneous advanced sensors  
 CO5: identify sensors for various engineering applications and realize the concepts

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3									1	2	2
CO2	3	3	3									2	3	3
CO3	3	3	3									2	3	3
CO4	3	3	3	3								2	3	3
CO5	3	3	3	3								2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**14MTT33 MANUFACTURING PROCESSES**  
(Common to Mechatronics and Automobile branches)

**3 0 0 3**

**Pre-requisites:** Basics of Civil and Mechanical Engineering

**UNIT – I** **9**

**Foundry Technology:** Introduction to Molding and Casting. Molding sand: types, properties, preparation of green sand molding. Pattern making: Pattern materials, types and allowances. Core making: types of core, core materials, making of cores. Casting methods: Die casting, Centrifugal Castings, Investment Casting and Shell mold Casting. Defects in casting.

**UNIT – II** **9**

**Metal Forming Processes:** Rolling: Introduction, Rolling mills, Rolling operations. Extrusion: Forward and Backward extrusion, Production of seamless tubing and pipes, Cold and Hydrostatic Extrusion. Drawing: Introduction, Hot and Cold drawing, Deep drawing, Tube and wire drawing. Sheet metal and forging operations.

**UNIT – III** **9**

**Metal Removal Processes:** Lathe: types, main parts and operations, single point cutting tool nomenclature. Drilling Machine: Types, operations, types of drills, twist drill nomenclature, reaming and tapping. Milling Machine: Types, operations, types of milling cutters. Shaper and Planer: types, main parts, operations. (Numerical problems in Lathe, Drilling and Milling operations).

**UNIT – IV** **9**

**Metal Joining Processes:** Classification of Welding Process. Fusion Welding: Arc Welding, Gas Tungsten Arc welding, Gas Metal Arc Welding, Electron Beam Welding, Laser Beam Welding. Solid State Welding: Cold Welding, Ultrasonic Welding, Friction Welding, Resistance Welding and Explosive Welding. Gas welding: Oxy - Acetylene welding process. Welding defects.

**UNIT – V** **9**

**Metal Finishing Processes:** Grinding Machine: Methods of grinding, Types of grinding machines, Grinding wheel and its selection, Lapping, Honing, and super finishing operations. Broaching Machine: pull type and push type broachers, broaching methods, operations and types of broaching machines.

**TOTAL: 45**

**TEXT BOOKS:**

1. Kaushish J.P., “Manufacturing Processes”, 2<sup>nd</sup> Edition, PHI Learning Pvt. Ltd., 2013.
2. Rao P.N., “Manufacturing Technology, Volume I & II”, 3<sup>rd</sup> Edition, Tata McGraw Hill Publishing Company, New Delhi, 2014.

**REFERENCE BOOKS:**

1. Kalpakjian, S, Schmid, “Manufacturing Process for Engineering Materials”, 5<sup>th</sup> Edition, Pearson Education India, New Delhi, 2014.
2. Groover M.P., “Principles of Modern Manufacturing”, Wiley India Pvt. Ltd., New Delhi, 2014.
3. Paul Degarma E., Black J.T. and Ronald A. Kosher, “Materials and Processes in Manufacturing”, 8<sup>th</sup> Edition, Prentice Hall of India, New Delhi, 2006.
4. <http://nptel.ac.in/courses/112107145/>
5. <http://nptel.ac.in/courses/112107144/>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: demonstrate the various foundry techniques like pattern making, molding, casting, melting furnaces and inspection
- CO2: categorize various forming processes involving bulk forming and sheet metal operations
- CO3: choose the metal removal processes according to the material and geometrical design
- CO4: select the metal joining processes based on the properties of base metal
- CO5: recommend the various metal finishing processes for surface finishing operations

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1		1	2					2	2	2
CO2	3	2	2	1		1	2					2	2	2
CO3	3	2	2	1		1	2					2	2	2
CO4	3	2	2	1		1	2					2	2	2
CO5	3	2	2	1		1	2					2	2	2

**14MTL31 ANALOG DEVICES AND DIGITAL CIRCUITS LABORATORY**

**0 0 3 1**

**LIST OF EXPERIMENTS / EXERCISES:**

1. Characteristics of semiconductor diode and zener diode
2. Input and output characteristics of transistor under CE configuration
3. Drain characteristics of FET
4. Half wave and Full wave rectifier
5. Inverting and Non inverting amplifiers
6. A/D and D/A converters
7. Verification of Boolean theorems using digital logic gates
8. Design and implementation of binary adder and subtractor
9. Design and implementation of multiplexer and de-multiplexer
10. Design and implementation of encoder and decoder
11. Design and implementation of shift register
12. Design and implementation of counters

**TOTAL: 45**

**REFERENCES / MANUALS / SOFTWARE:**

1. Lab Manual

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: analyze the characteristics of semiconductor devices and its application
- CO2: design amplifiers and converters
- CO3: verify Boolean function using logic gates
- CO4: design the combinational circuits
- CO5: construct the sequential circuits using flip flops

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3		2				2	2		1	3	2
CO2	3	3	3		2				2	2		1	3	2
CO3	3	3	3		2				2	2		1	3	2
CO4	3	3	3		2				2	2		1	3	3
CO5	3	3	3		2				2	2		1	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**Prerequisite:** Engineering Practices Laboratory

**LIST OF EXPERIMENTS / EXERCISES:**

1. Measurement of temperature using Thermistor / RTD.
2. Measurement of temperature using Thermocouple.
3. Measurement of displacement using POT, LVDT & Capacitive transducer.
4. Torque / Strain Measurement using Strain Gauge.
5. Sound measurement characteristics using three way cross-over network
6. Force Measurement using load Cell.
7. Flow measurement using Orifice meter.
8. Pressure Measurement using bonded strain gauge on steel diaphragm.
9. Level Measurement using Capacitive Transmitter.
10. Speed Measurement using Encoder and Optocoupler.

**TOTAL: 45**

**REFERENCES / MANUALS / SOFTWARE:**

1. Lab Manual

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: perform the measurements of different physical parameters  
 CO2: analyse the characteristics of sensor measurement system  
 CO3: realize sensors for various engineering applications

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3						2	1		2	3	3
CO2	3	3	3						2	1		2	3	3
CO3	3	3	3						2	1		2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**14MTL33 MANUFACTURING PROCESSES LABORATORY**  
(Common to Mechatronics and Automobile branches)

**0 0 3 1**

**LIST OF EXPERIMENTS / EXERCISES:**

1. Exercises using Lathe – Step turning
2. Exercises using Lathe – Taper turning and Knurling
3. Exercises using Lathe – Thread Cutting
4. Exercises using Lathe – Eccentric turning
5. Exercises using Milling machine – Spur gear milling
6. Exercises using Milling machine – Contour / Key way milling
7. Exercises using Shaper / planner Machine – Key way / Dove tail shape Cutting
8. Exercises using Drilling machine- Drilling, Reaming and Tapping
9. Exercises using grinding machine – Cylindrical grinding
10. Exercises using grinding machine – Surface grinding
11. Exercises on Preparation of green sand mould with solid and split patterns
12. Exercises on TIG / MIG Welding (Lap and Butt joint)

**TOTAL: 45**

**REFERENCES / MANUALS / SOFTWARE:**

1. Lab Manual
2. Kaushish J.P., “Manufacturing Processes”, 2<sup>nd</sup> Edition, PHI Learning Pvt. Ltd., 2013.
3. Hajra Choudhury S.K. and Hajra Choudhury A.K., “Elements of Workshop Technology”, 14<sup>th</sup> Edition, Volume I and II, Media Promoters and Publishers, Mumbai, 2009.
4. <http://nptel.ac.in/courses/112107084/>
5. <http://nptel.ac.in/downloads/112105127>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: design and develop the parts of machine elements using various machine tools  
 CO2: develop green sand moulds using standard patterns  
 CO3: create the joints using TIG / MIG welding setup

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1		2	2		2	2		2	3	2
CO2	2	2	2	1		2	2		2	2		2	3	2
CO3	2	2	2	1		2	2		2	2		2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial

**14MAT42 STATISTICS AND NUMERICAL METHODS**  
(Common to Mechanical, Mechatronics and Automobile Engineering)

**3    1    0    4**  
**9**

**UNIT – I**

**Testing of Hypothesis:** Large sample tests – Z-test for single mean and difference of means – Small sample tests – Student’s t-test for significance of means – F-test for comparison of variances – Chi-square test for goodness of fit and independence of attributes.

**UNIT – II**

**Design of Experiments:** Analysis of variance – One way classification – Completely Randomized Design – Two way classifications – Randomized Block Design – Three way classifications – Latin Square Design.

**UNIT – III**

**Solution to Algebraic and Transcendental Equations:** Method of false position – Newton-Raphson method – Solution of linear system of equations – Direct methods: Gauss elimination method and Gauss - Jordan method – Iterative methods: Gauss Jacobi and Gauss-Seidel methods.

**UNIT – IV**

**Interpolation:** Interpolation with equal intervals: Newton’s forward and backward difference formulae – Interpolation with unequal intervals: Lagrange’s interpolation formula – Newton’s divided difference formula. **Numerical Differentiation and Integration:** Differentiation using Newton’s forward, backward and divided difference interpolation formulae – Numerical integration: Trapezoidal rule – Simpsons 1/3<sup>rd</sup> rule.

**UNIT – V**

**Numerical Solution of First order Ordinary Differential Equations:** Single step methods: Taylor series method – Euler method – Modified Euler method – Fourth order Runge-Kutta method – Multi step methods: Milne’s predictor corrector method – Adam’s Bashforth method.

**Lecture: 45, Tutorial: 15, TOTAL: 60**

**TEXT BOOKS:**

1. Manish Goyal, “Statistics and Numerical Methods”, 1<sup>st</sup> Edition, Laxmi Publications, New Delhi, 2010.
2. Veerarajan T., “Probability, Statistics and Random Processes”, Reprint Edition, Tata McGraw Hill Publishing Company, New Delhi, 2014.
3. Kandasamy P., Thilakavathy K. and Gunavathy K., “Numerical Methods”, Reprint Edition, S.Chand & Co, New Delhi, 2014.

**REFERENCE BOOKS:**

1. Walpole R.E., Myers R.H., Myers S.L. and Ye K., "Probability and Statistics for Engineers and Scientists", 9<sup>th</sup> Edition, Pearson Education, Asia, 2012.
2. Johnson R. and Gupta C.B., "Miller and Freund’s Probability and Statistics for Engineers", 11<sup>th</sup> Edition, Pearson Education, Asia, 2011.
3. Sankara Rao K., "Numerical Methods for Scientists and Engineers", 3<sup>rd</sup> Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
4. Jain M.K., Iyengar S.R.K. and Jain R.K., “Numerical Methods for Scientific and Engineering Computation”, 6<sup>th</sup> Reprint, New Age International Pvt. Ltd., New Delhi, 2014.

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: Identify large and small samples and apply suitable tests for getting required results
- CO2: Handle design of experiments problems
- CO3: Solve algebraic and transcendental equations numerically where analytical methods fail to give solution
- CO4: Gain knowledge in the concept of interpolation
- CO5: Understand the concept of numerical differentiation and integration and apply numerical techniques for solving first order ordinary differential equations

**Mapping of Course Outcomes (COs) with Program Outcomes (POs) and Program Specific Outcomes (PSOs)**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		1	1							1	1	1
CO2	3	3		1	1							1	1	1
CO3	3	3		1	1							1		
CO4	3	3		1	1							1		
CO5	3	3		1	1							1	1	1

1 – Slight, 2 – Moderate, 3 – Substantial



**14EET44 ELECTRICAL MACHINES**  
(Common to Mechatronics, ECE & EIE branches)

3    0    0    3

**Pre-requisites:** Basics of Electrical and Electronics Engineering

**UNIT – I** 9

**D.C. Machines:** Construction of D.C. Machine - Principle and Theory of Operation of D.C. Generator - EMF Equation- Characteristics. Tics of D.C. Generators - Principle and Operation of D.C. Motor – Back E.M.F - Torque Equation - Types of D.C. Motors and their Characteristics – Swinburne’s Test -Starters - Speed Control of D.C. Motors - Applications.

**UNIT – II** 9

**Transformer:** Principle - Construction Details of Shell and Core Type Transformers - EMF Equation - Regulation and Efficiency of a Transformer - OC and SC Test of Transformers –Load Test - Equivalent Circuit – All day Efficiency - Auto Transformer - Introduction to Three Phase Transformer.

**UNIT – III** 9

**Three Phase Induction Machine:** Three Phase Induction Motor: Construction and Principle of Operation - Classification of Induction Motor –Torque Equation-Torque-Slip Characteristics-Starters: Need and its Types– Star-Delta Starter – Speed Control-Applications-Principle of Operation of Induction Generator.

**UNIT – IV** 9

**Synchronous Machines:** Construction and Principle of Operation as Alternator - EMF Equation - Voltage Regulation by EMF Method. Synchronous Motor: Principle of Operation - Starting Methods - V and Inverted V Curves - Synchronous Condenser - Applications.

**UNIT – V** 9

**Single Phase Induction Motor and Special Machines:** Single Phase Induction Motor: Principle of Operation - Double Field Revolving Theory - Types: Split Phase Type, Capacitor Type and Shaded Pole Type – Applications. Special Machines: Construction, Principle of Operation and Applications: Stepper Motor – Universal Motor-Servo Motor-Brushless DC Motor.

**TOTAL: 45**

**TEXT BOOK:**

1. Mehta V.K. and Rohit Mehta, “Principles of Electrical Machines”, 2<sup>nd</sup> Edition, S.Chand & Co. Ltd., India, 2002.

**REFERENCE BOOKS:**

- 1 Fitzgerald A.E., Kingsley C. and Stephen Umans, “Electric Machinery”, Tata McGraw Hill, 2010.
- 2 Bhattacharya S.K., “Electrical Machines”, 2<sup>nd</sup> Edition, Tata McGraw Hill, New Delhi, 2014.
- 3 Cotton H., “Advanced Electrical Technology”, Reem Publications, 2011.
- 4 Nagrath I.J. and Kothari D.P., “Electrical Machines”, Tata McGraw - Hill, 2010.
- 5 Gupta J.B., “Theory and Performance of Electrical Machines”, S.K. Kataria & Sons, New Delhi, 2013.
- 6 <http://nptel.ac.in/courses/108105017/>
- 7 <http://nptel.ac.in/courses/108106072/>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: develop knowledge on construction and working of DC and AC machine
- CO2: examine the construction and working of Transformers
- CO3: determine the performance characteristics of the electrical machine
- CO4: select electrical machines for various applications
- CO5: explain the various tests, starting and speed control techniques

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2									1	1	1
CO2	3	2	2									1	1	1
CO3	3	3	3									1	2	2
CO4	3	3	3									2	3	3
CO5	3	3	2									1	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

**14MET41 STRENGTH OF MATERIALS**  
(Common to Mechanical, Mechatronics and Automobile branches)

**3 1 0 4**

**Pre-requisites:** Engineering Mechanics, Mathematics I & II.

**UNIT – I** **9**

**Stress, Strain, and Deformation of Solids:** Rigid and deformable bodies – Stability, Strength and Stiffness, Tensile, compressive and shear stresses, strain, Poisson’s ratio – lateral stress. Deformation of simple and compound bars – Relation between elastic constants – Thermal stresses – Strain Energy in uniaxial loads – gradually applied load, suddenly applied load and impact load.

**UNIT – II** **9**

**Analysis of State of Stress:** Biaxial state of stress – thin cylinders and shells – Deformation in Thin cylinders and spherical shells. Thick Cylinder – Lamé’s Equation. Biaxial stresses at point – stresses on inclined planes – Principal planes and stresses – Mohr’s circle for biaxial stress- Maximum shear stress.

**UNIT – III** **9**

**Transverse Loading on Beams and Stresses in Beams:** Beams – types and transverse loading on beams-shear force and bending moment in beams – cantilevers, simply supported and overhanging beams-Point of contra flexures. Theory of simple bending – analysis of stress- load carrying capacity.

**UNIT – IV** **9**

**Deflection of Beams and Columns:** Elastic curve of neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Double integration method, Macaulay’s method, Area moment theorems for computation of slopes and deflection in beams. Columns: End condition –Equivalent length of column – Euler’s equation – Slenderness ratio – Rankine’s formula for columns.

**UNIT – V** **9**

**Torsion on Circular Shafts and Coiled Helical Springs:** Torsion of circular shaft – Shear stress distribution – hollow and solid circular section. Torsional rigidity – stepped shaft – Twist and torsional stiffness - Torsion on springs – Wahl's factor of springs stresses in helical springs under torsion loads-stiffness and deflection of springs under axial load.

**Lecture: 45, Tutorial: 15, TOTAL: 60**

**TEXT BOOKS:**

1. Rajput R.K., “Strength of Materials”, 4<sup>th</sup> Edition, S.Chand & Co, New Delhi, 2012.
2. Bansal R.K., “Strength of Materials”, 4<sup>th</sup> Edition, Lakshmi Publications, New Delhi, 2014.

**REFERENCE BOOKS:**

1. Timoshenko S.P., “Elements of Strength of Materials”, 10<sup>th</sup> Edition, Tata McGraw Hill Publishing Company, New Delhi, 2010.
2. Sadhu Singh, “Strength of Materials”, 11<sup>th</sup> Edition, Khanna Publishers, New Delhi, 2014.
3. Popov E.P., “Engineering Mechanics of Solids”, 2<sup>nd</sup> Edition, Prentice-Hall of India, New Delhi, 1998.
4. <http://nptel.ac.in/courses/112107147/>
5. <http://nptel.ac.in/courses/105105108/>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: solve the stress and strain relations for simple and compound bars
- CO2: analyze the biaxial state of stresses in thin, thick cylinders and spherical shells
- CO3: plot the shear force and bending moment diagrams and analyze the bending stresses
- CO4: estimate the slope and the deflection of beams and the strengths of columns
- CO5: design and analyze the torsional behavior of shafts and springs

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2							2	3	3
CO2	3	3	3	3	2							2	3	3
CO3	3	3	3	3	2							2	3	3
CO4	3	3	3	3	2							2	3	3
CO5	3	3	3	3	2							2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**14MET43 KINEMATICS OF MACHINERY**  
(Common to Mechanical and Mechatronics branches)

3    1    0    4

**Pre-requisites:** Engineering Mechanics, Engineering Drawing.

**UNIT – I** 9

**Basics of Mechanisms:** Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler’s criterion – Grashof’s Law – Kinematic inversions of four-bar chain and slider crank chains – Limit positions – Mechanical advantage – Transmission Angle. Description of common Mechanisms – Quick return mechanisms – Ratchets and escapements – Indexing Mechanisms – Rocking Mechanisms.

**UNIT – II** 9

**Kinematics of Mechanisms:** Velocity and Acceleration of simple mechanisms: Analytical solution for slider crank mechanism- Velocity analysis using instantaneous centre method- Klien’s construction for slider crank mechanism, oscillating cylinder and swivel bearing mechanisms - Velocity and Acceleration of simple mechanisms by relative velocity method- Coincident points –Coriolis Acceleration component.

**UNIT – III** 9

**Kinematics of Cam:** Cams- Types of cams and followers, displacement, velocity and acceleration curves for uniform velocity, uniform acceleration and retardation, SHM and cycloidal curves. Layout of profile of plate cams of above-types with reciprocating and oscillating followers like knife – edge follower, roller and flat faced followers. High speed cams – circular arc and tangent cams – Standard cam motion – Pressure angle and undercutting.

**UNIT – IV** 9

**Kinematics of Gears and Gear Trains:** Theory of Gearing – gear nomenclature, law of gearing, tooth forms, minimum number teeth, length of arc of contact, contact ratio and interference. Gear trains – types, velocity and torque calculation- Parallel axis and epicyclic gear trains.

**UNIT – V** 9

**Gyroscope:** Angular velocity, Acceleration, Gyroscopic couple – Gyroscopic effect on Naval ships, Stability of an automobile- Rigid disc at an angle fixed to a rotating shaft.

**Lecture: 45, Tutorial: 15, TOTAL: 60**

**TEXT BOOKS:**

- Rattan S.S., “Theory of Machines” 4<sup>th</sup> Edition, Tata McGraw Hill Publishing Company, New Delhi, 2014.
- Shigley J.E., Uicker J.J., “Theory of Machines and Mechanisms”, 4<sup>th</sup> Edition, Oxford University Press, 2014.

**REFERENCE BOOKS:**

- Rao J.S., Dukupati R.V., “Mechanism and Machine Theory”, 2<sup>nd</sup> Edition, New Age International Pvt. Ltd., Publishers, New Delhi, 2014.
- Bevan Thomas, “Theory of Machines”, 3<sup>rd</sup> Edition, C B S Publishers & Distributors, New Delhi, 2005.
- Ballaney P.L., “Theory of Machines”, 3<sup>rd</sup> Edition, Khanna Publishers, New Delhi, 2004.
- <http://nptel.ac.in/courses/112104121/>
- <http://www.nptelvideos.in/2012/12/kinematics-of-machines.html>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: design and analyze the various mechanisms
- CO2: analyze and draw the velocity and acceleration diagrams of mechanisms
- CO3: plot and analyze the profile of various cam mechanisms for different applications
- CO4: solve and evaluate the kinematics aspects of gears and gear trains
- CO5: solve and analyze gyroscopic effects for various applications

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2	2							2	3	2
CO2	2	3	3	3	2							2	3	2
CO3	1	2	2		2							2	3	2
CO4	2	2	3	1								2	3	2
CO5	3	3	3		1							2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial

**Pre-requisites:** Applied physics

### UNIT – I

9

**Basics of Thermodynamics and First Law of Thermodynamics:** Thermodynamics – Microscopic and macroscopic point of view – Systems, properties, process, path, cycle. Thermodynamic equilibrium – Zeroth law of Thermodynamics – internal energy, enthalpy, specific heat capacities  $C_V$  and  $C_P$ , Relationship between  $C_V$  and  $C_P$ . First law of Thermodynamics – Application to closed and open systems – Steady Flow Energy Equation (SFEE) – Simple problems.

### UNIT – II

9

**Second Law of Thermodynamics and Entropy:** Second Law of thermodynamics – Kelvin Planck and Clausius Statements – Equivalents of Kelvin Planck and Clausius statements. Reversibility – Irreversibility, reversible cycle – Heat engine, heat pump and refrigerator. Carnot cycle and Clausius theorem, the property of entropy, the inequality of Clausius – Entropy principle – General expression for entropy – Simple problems in entropy.

### UNIT – III

9

**Internal Combustion Engines:** Classification of IC engines - IC engine components and functions. Valve timing diagram and port timing diagram – principle of working and comparison of two stroke and four stroke engines, Comparison of petrol and diesel engines. Fuel supply system-Types - Ignition Systems - Types- Lubrication systems - Types - Cooling systems-Types. Gas power cycles: Otto, Diesel and Dual cycles with p-V and T-s diagrams- workdone and efficiency calculations (Simple problems only).

### UNIT – IV

9

**Psychrometry, Refrigeration and Air-conditioning:** Psychrometry - Psychrometric properties and Processes (Simple processes only) – Dalton’s law of partial pressure – Psychrometric chart. Principle of refrigeration – Components of refrigeration system – working of vapour compression refrigeration cycle with p-h and T-s diagrams. Refrigerants - properties and selection. Working vapour absorption refrigeration cycle. Human comfort – Air-conditioning-Types, summer, winter and year round air-conditioning systems.

### UNIT – V

9

**Heat Transfer:** Basic Concepts – Mechanism and modes of Heat Transfer. Fourier’s Law of heat Conduction - Differential equation of heat conduction. Convection - Heat transfer coefficient– Types of Convection – Free and Forced Convection– Simple problems. Radiation - Stefan Boltzman Law, Kirchoff’s Law – Black Body concept – Grey body radiation.

**Lecture: 45, Tutorial: 15, TOTAL: 60**

### TEXT BOOKS:

1. Cengel Yunus A. and Boles Michael A., “Thermodynamics: An Engineering Approach”, 5<sup>th</sup> Edition, McGraw-Hill, New York, 2010.
2. Rajput R.K., “Thermal Engineering”, 9<sup>th</sup> Edition, Laxmi publications, New Delhi, 2013.

### REFERENCE BOOKS:

1. Kothandaraman C.P., Domkundwar S. and Domkundwar A.V., “A Course in Thermal Engineering”, 5<sup>th</sup> Edition, Dhanpatrai & Co. Pvt. Ltd., New Delhi, 2004.
2. Rajput R.K., “Heat and Mass Transfer”, S.Chand & Co. Ltd., New Delhi, 2011.
3. Nag P.K., “Engineering Thermodynamics”, 5<sup>th</sup> Edition, Tata McGraw Hill Publishing Company, New Delhi, 2013.
4. <http://nptel.ac.in/downloads/112108149/>
5. <http://web.mst.edu/~gbert/basic/entropy.html>

### COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: analyze the basic concepts, first law of thermodynamics and its applications  
 CO2: interpret concepts of second law of thermodynamics and entropy  
 CO3: perceive the principle parts of engines and their working principle  
 CO4: apply the thermodynamic relations in physical problems and infer psychrometric chart and solve the problems related Refrigeration and Air conditioning  
 CO5: solve the problems which involves conduction, convection and radiation heat transfers

### Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2									1	2	2
CO2	3	3	2									1	2	2
CO3	2	2	3	2	1	3	3					1	3	3
CO4	2	2	3	2	1	3	3					1	3	3
CO5	3	3	2	2	1	2	2					1	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

**Pre-requisites:** Sensors and signal processing

### UNIT – I

9

**Linear and Angular Measurements:** Basic concepts: Legal metrology- Precision- Accuracy- Types of errors – Standards of measurement- Traceability – Interchangeability and selective assembly. Introduction to fits and tolerances, gauge blocks, limit gauges - Gauge design. Comparators: mechanical, electronic, optical and pneumatic. Angular measurement: bevel protractor - Angle gauges - Sine bar.

### UNIT – II

9

**Surface Finish:** Measurement of surface finish: Terminology – Geometrical irregularities – Roughness – Waviness. Surface-roughness measurement methods: Peak and valley height method, Center line average (CLA) method, RMS method and Ten point height method. Stylus probe instrument – Tomlinson surface meter – Talysurf.

### UNIT – III

9

**Form Measurement:** Screw thread metrology: Terminology- Errors in thread – Pitch error – Measurement of various elements of thread: Two and three-wire method - Best wire size - Thread gauges - Floating carriage micrometer. Measurement of gears: Terminology- Measurement of various elements of gear - Tooth thickness: Gear tooth vernier, Constant chord, Base tangent method, Parkinson Gear Tester.

### UNIT – IV

9

**Interferometry and LASER Metrology:** Interferometry: Principle of light wave interference – Optical flats – Flatness checking – Michelson and NPL flatness interferometer. LASER Metrology: Laser interferometer – Constructional features, sources of error, measurement of positional error, straightness and flatness of machine tools - Laser Alignment Telescope - Laser Micrometer.

### UNIT – V

9

**Advances in Metrology:** Coordinate Measuring Machine (CMM): Types - Constructional features-Possible causes of errors in CMM - Probing system – Performance and applications of CMM. Autocollimator-Profile projectors-Optical 3D measuring instruments -Automatic gauging. Machine Vision System: Applications of machine vision in measurement- In process and On line measurement.

**TOTAL: 45**

### TEXT BOOKS:

1. Jain R.K., “Engineering Metrology”, Khanna Publishers, New Delhi, 2013.
2. Doebelin E.O., “Measurement System Applications and Design”, Tata McGraw Hill Publishing Company, New Delhi, 2008.

### REFERENCE BOOKS:

1. Connie Dotson, “Fundamentals of Dimensional Metrology”, Thomas Asia, Singapore, 2006.
2. Gupta I.C., “A Text Book of Engineering Metrology”, 7<sup>th</sup> Edition, Dhanpat Rai & Sons, New Delhi, 2003.
3. Groover M.P., “Automation, Production System and Computer Integrated Manufacturing”, Prentice-Hall of India, Delhi, 2007.
4. Bewoor A.K. and Kulkarni V.A., “Metrology and Measurement”, Tata McGraw Hill Publishing Company, New Delhi, 2009.
5. <http://nptel.ac.in/courses/112106138/>
6. <http://nptel.ac.in/courses/112106179/>

### COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: infer linear and angular measurements using various instruments  
 CO2: determine the surface roughness and form features  
 CO3: perform the thread and gear metrology  
 CO4: appraise laser interferometry and recent advancements in metrology  
 CO5: make profile measurements using Coordinate Measuring Machine (CMM)

#### Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2							2	2	2
CO2	3	2	2	2	2							2	2	2
CO3	3	2	2	2	2							2	2	2
CO4	3	2	2	2	2							2	2	2
CO5	3	2	2	2	2							2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

**14EEL44 ELECTRICAL MACHINES LABORATORY**  
(Common to Mechatronics & EIE branches)

**0 0 3 1**

**LIST OF EXPERIMENTS / EXERCISES:**

1. Open circuit and load characteristics of separately excited DC shunt generator.
2. Load characteristics of DC series motor.
3. Swinburne's Test.
4. Speed control of DC shunt motor.
5. Open circuit and short circuit tests on single phase transformer.
6. Load test on three-phase alternator.
7. Regulation of three phase alternator by EMF method.
8. Load test on three phase squirrel cage induction motor.
9. Load test on three phase slip ring induction motor.
10. V and inverted V curves of three phase synchronous motor.

**TOTAL: 45**

**REFERENCES / MANUALS / SOFTWARE:**

1. Nagrath I.J. and Kothari D.P., "Electrical Machines", Tata McGraw Hill, 2010.
2. Lab Manual

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: analyze the characteristics of DC and AC machines
- CO2: test the speed control techniques of DC machines
- CO3: predetermine the regulation and efficiency of various machines
- CO4: analyze the characteristics of synchronous motor
- CO5: estimate the performance of rotating machines by conducting suitable load tests

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2					2	1		1	2	2
CO2	3	3	2	2					2	1		1	2	2
CO3	3	3	2	2					2	1		1	2	2
CO4	3	3	2	2					2	1		1	2	2
CO5	3	3	2	2					2	1		1	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

**14MTL41 a) FLUID MECHANICS AND MACHINERY LABORATORY  
b) METROLOGY LABORATORY**

**0      0      3      1**

**LIST OF EXPERIMENTS / EXERCISES:**

**a) FLUID MECHANICS & MACHINERY LABORATORY**

1. Determination of co-efficient of discharge for (a) Venturimeter and (b) Orifice meter.
2. Study on (a) Friction or Major losses in pipes and (b) Minor losses in pipes.
3. Study on performance characteristics of Pelton turbine (constant head method only).
4. Study on performance characteristics of Francis turbine (constant head method only).
5. Study on performance characteristics of Kaplan turbine (constant head method only).
6. Study on performance characteristics of Centrifugal pump.
7. Study on performance characteristics of Reciprocating pump.

**b) METROLOGY LABORATORY**

1. Calibration of Vernier / Micrometer; static characteristic study- Measurement of Components like V block etc.
2. Calibration of Dial Gauge; static characteristic study; Use of dial gauge as measuring device and Comparator.
3. Calibration of Vernier height gauge and depth gauge, measurement of components.
4. Calibration of Gear Tooth Vernier; static characteristics study; Measurement of gear tooth thickness.
5. Calibration of profile projector and measurement of micro components.
6. Study of Autocollimator, Surface roughness tester and coordinate measuring machine (CMM).

**TOTAL: 45**

**REFERENCES / MANUALS / SOFTWARE:**

1. Fluid Mechanics and Machinery Lab Manual
2. Metrology Lab Manual
3. Jain R.K., “Engineering Metrology”, Khanna Publishers, New Delhi, 2013.
4. <https://eerc03-iiith.vlabs.ac.in>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: create empirical investigation and quantitative assessment methods for venturimeter, orificemeter and losses in pipes through written and oral reports
- CO2: demonstrate the performance and characteristics of different types of turbines and pumps
- CO3: interpret the fundamentals of calibration and measurements processes and perform the characteristics on instruments
- CO4: carry out measurements of linear, angular metrics and gear parameters
- CO5: apply autocollimator, surface roughness tester, and coordinate measuring machine (CMM) for measurement

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2					2	2		2	2	2
CO2	3	2	2	2					2	2		2	2	2
CO3	3	2	2	2					2	2		2	2	2
CO4	3	2	2	2					2	2		2	2	2
CO5	3	2	2	2					2	2		2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

**LIST OF EXPERIMENTS / EXERCISES:**

1. Study of electrical and electronics symbols.
2. Circuit design of solid state emergency light and beeper circuit.
3. Design of DC power supply unit.
4. Line diagram of wiring of a drawing hall.
5. Connection diagram of 3 point starter and DOL starter.
6. Winding diagram of lap and wave connected DC machines.
7. Introduction to machine drawing - dimensioning, sectional views, abbreviations and conventions, welding symbols, surface finish symbols, limits, fits and tolerances.
8. Free hand sketching of machine elements - keys, pin joints, fasteners, hexagonal and square head bolts and nuts, conventional representation of threads.
9. Part and assembly drawing of joints / couplings.
10. Part and assembly drawing of bearings / valves.
11. Part and assembly drawing of screw jack / tail stock.
12. Part and assembly drawing of connecting rod assembly.

**TOTAL: 45****REFERENCES / MANUALS / SOFTWARE:**

1. Lab manual
2. CAD Software

**COURSE OUTCOMES**

On completion of the course the students will be able to

CO1: interpret the detailed and assembly drawings of various machine parts conforming to IS conventions

CO2: design the technical drawing of mechatronics related components with exact dimensions in appropriate views

CO3: create electrical and electronics circuits for real time applications

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2		3		3				2	2		2	2	2
CO2	2	1	3		3				2	2		2	2	2
CO3	2	1	3		3				2	2		2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial



**14EET53 CONTROL SYSTEMS**  
(Common to EEE, EIE, ECE and Mechatronics branches)

3    1    0    4

**UNIT – I** 9

**Mathematical Modeling:** History of control systems - Classification of control Systems - Basic Structure: Open Loop and closed loop Systems - Transfer Function and state space models (Physical and phase variable model): Electrical Systems, Mechanical Systems, Electromechanical systems: Gear Trains and DC Motor - Electrical analogy of Mechanical Systems - Reduction of multiple subsystems: Block diagram reduction, Signal flow graphs.

**UNIT – II** 9

**Time Response of Systems:** Poles, Zeros and System Response -Type and order of System - Significance of test signals - First order system - Second order system: Classification and nature of response - Step response of second order underdamped System - Time domain specifications - Steady state error and error constant - Generalized error series.

**UNIT – III** 9

**Stability Analysis:** Concepts of Stability - Pole location and stability - Routh Hurwitz Criterion - Root locus Technique - Effect of addition of poles and zeros on stability.

**UNIT – IV** 9

**Frequency Response of Systems:** Concept of frequency Response - Frequency response analysis: Bode plot and polar plot - Stability analysis in frequency domain: Nyquist stability criterion - Frequency domain specifications.

**UNIT – V** 9

**Compensators:** Need for compensator - Types of compensation - Cascade compensators: Types, Transfer function and Physical realization - Effect of ideal compensation on time response: P, PI, PD and PID - Design of lag and lead compensator via root locus.

**Lecture:45, Tutorial:15, TOTAL: 60**

**TEXT BOOKS:**

1. Nagrath I.J. and Gopal M., "Control Systems Engineering", 5<sup>th</sup> Edition, New Age International Publishers, New Delhi, 2011.
2. Norman S. Nise, "Control Systems Engineering", 6<sup>th</sup> Edition, Wiley Publishers, 2011.

**REFERENCE BOOKS:**

1. Gopal M., "Control Systems: Principles and Design", 4<sup>th</sup> Edition, Tata McGraw Hill, New Delhi, 2012.
2. Kuo B.C., "Automatic Control Systems", 9<sup>th</sup> Edition, John Wiley and Sons, New York, 2009.
3. Ogata K., "Modern Control Engineering", 5<sup>th</sup> Edition, Pearson Education/ PHI, New Delhi, 2010.
4. <http://nptel.ac.in/courses/108101037/15>
5. <http://nptel.ac.in/courses/108102043/>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: analyze the various components of control system
- CO2: analyze various steady state errors for the continuous systems
- CO3: analyze the time and frequency response of the systems
- CO4: examine the stability of the systems
- CO5: design compensator and controller

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3		2							1	3	2
CO2	3	3	3		2							1	3	2
CO3	3	3	3		2							1	3	2
CO4	3	3	3		2							1	3	2
CO5	3	3	3		2							1	3	2

1 – Slight, 2 – Moderate, 3 – Substantial

## 14MTT51 MICROPROCESSOR AND MICROCONTROLLER APPLICATIONS

3    0    0    3

### UNIT - I 9

**8086 Microprocessor:** 8086 Architecture – Pin configuration – Register organization – Memory organization – memory and I/O decoding – Interrupts.

### UNIT - II 9

**8051 Microcontroller:** Selection of Microcontrollers - 8051 Microcontroller Architecture – Pin configuration – Memory organization – Special function registers – Program Counter – PSW register – Stack and stack pointer.

### UNIT -III 9

**8051 Assembly language/Embedded C Programming:** Introduction to assembly language and Embedded C programming – Instruction set – Addressing modes – I/O port programming – Timer programming – Counter programming – Serial communication programming – Interrupt programming.

### UNIT -IV 9

**Peripheral Interfacing:** Introduction to Embedded C programming – Peripheral interfacing: Switch – Keypad – LCD – LED – A/D and D/A converters – High Power devices using relays. Speed control: DC Motor –Stepper motor.

### UNIT -V 9

**Microcontroller for Mechatronics Applications:** Interfacing of sensors: Temperature – Pressure – Level – Proximity switches. Interfacing of actuators: Servo motor – Actuation of pneumatic cylinders. RF module Interfacing – IR module interfacing. Case studies: Automotive applications, Robotic applications, Aerospace applications.

**TOTAL: 45**

#### TEXT BOOKS:

- Mazidi Muhammad Ali, Mazidi Janice Gillispie and McKinlay Rolin, “The 8051 Microcontroller and Embedded Systems”, 2<sup>nd</sup> Edition, Prentice Hall of India, New Delhi, 2013.
- Sunil Mathur, “Microprocessor 8086 Architecture, Programming and Interfacing”, PHI Learning Ltd., New Delhi, 2013.

#### REFERENCE BOOKS:

- Uffenbeck John E., “The 80x86 Family: Design, Programming and Interfacing”, 3<sup>rd</sup> Edition, Prentice Hall of India, New Delhi, 2002.
- Patel, “The 8051 Microcontroller based Embedded Systems”, 1<sup>st</sup> Edition, Tata McGraw Hill Publishing Company, New Delhi, 2014.
- Ayala Kenneth J., “The 8051 Microcontroller”, 3<sup>rd</sup> Edition, Thomson Delmer Learning, Singapore, 2007.
- <http://nptel.ac.in/courses/117104072/5>
- <http://nptel.ac.in/courses/106108100/7>

#### COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: infer the basic concepts of 8086 microprocessor
- CO2: interpret the basic concepts of 8051 microcontroller
- CO3: construct assembly/Embedded C programming using 8051 microcontroller
- CO4: interface peripheral devices with microcontroller
- CO5: develop microcontroller based mechatronics applications

#### Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	3	3	2		2								1	1	1
CO2	3	3	2		2								1	1	1
CO3	3	3	3	2	3								2	3	3
CO4	3	3	3		2								1	2	2
CO5	3	3	3	3	2	1	1						2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**14MTT52 CNC TECHNOLOGY**  
(Common to Mechatronics and Mechanical branches)

**3 0 0 3**

**Pre-requisites:** Manufacturing Processes

**UNIT – I** **9**

**Basic Concepts of Metal Cutting and CNC Machines:** Introduction – Mechanics of chip formation-Mechanics of oblique cutting- Cutting forces and power- Tool life –Surface finish-Machinability. CNC machines: Classification – Construction details: Structure, Configuration of CNC system – Interfacing – Monitoring – Diagnostics – Machine data – Compensations for Machine accuracy – DNC – Adaptive control CNC systems.

**UNIT – II** **9**

**Drives and Controls:** Drive Mechanism, gearbox, Spindle Drives, Axes drives - Magnetic Levitation and Linear motors. Timing belts and pulleys, Spindle bearing – Arrangement and installation. Slide ways. Re-circulating ball screws – Backlash measurement and compensation, linear motion guide ways.

**UNIT – III** **9**

**Part Programming of CNC Machines:** Part Program Terminology - G and M Codes – Types of interpolation. CNC part programming – Manual part programming (Turning and Milling). Various programming techniques – APT programming for various machines in ISO and FANUC - CAM packages for CNC machines.

**UNIT – IV** **9**

**Tooling For CNC Machines:** Interchangeable tooling system – Preset and qualified tools – coolant fed tooling system – Modular fixturing – Quick change tooling system – Automatic head changers – Tooling requirements for Turning and Machining centres – Tool holders – Tool assemblies – Tool Magazines – ATC Mechanisms – Automatic Pallet Changer-Tool management. Principles of location, clamping and work holding devices.

**UNIT – V** **9**

**Economics of CNC Machines and Retrofitting:** Factors influencing selection of CNC Machines – Cost of operation of CNC Machines – Practical aspects of introducing CNC machines in industries – Maintenance features of CNC Machines – Preventive Maintenance, Other maintenance requirements. Retrofitting- Necessary for Retrofitting-Advantages.

**TOTAL: 45**

**TEXT BOOKS:**

- Kalpakistan S. and Schmid S.R., “Manufacturing Engineering and Technology”, 5<sup>th</sup> Edition, Pearson Education India, New Delhi, 2014.
- Radhakrishnan P., “Computer Numerical Control Machines”, New Central Book Agency, 2013.
- Narang J.S. and Narang V.D.S., “CNC Machines and Automation”, Dhanpat Rai and Co. Pvt. Ltd., 2014.

**REFERENCE BOOKS:**

- HMT Limited, “Mechatronics”, Tata McGraw-Hill, New Delhi, 2001.
- I.V Thyer G.E., “Computer Numeric Control of Machine Tools”, 2<sup>nd</sup> Edition, Butterworth- Heinemann, Burlington, 1996.
- Adithan M. and Pabla B.S., “CNC Machines”, 2<sup>nd</sup> Edition, New Age International Pvt. Ltd., New Delhi, 2008.
- <http://nptel.ac.in/courses/112103174/35>
- <http://nptel.ac.in/courses/112105211/>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: estimate the parameters of metal cutting and comprehend the basic components involved in a CNC system
- CO2: choose the appropriate drives and controls for CNC machines
- CO3: develop Part Programming for various machining process
- CO4: select various tooling systems and fixtures
- CO5: compute operation and maintenance cost of CNC machines

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2								2	2	2
CO2	2	3	2									2	2	2
CO3	2	3	3		3							2	2	2
CO4	2	3	2	1	3							2	2	2
CO5	2	3	2	1	1	1					2	2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

**Pre-requisites:** Engineering Mechanics, Kinematics of Machinery, Strength of Materials

**UNIT – I**

9

**Force Analysis:** Inertia forces and D’Alembert’s principle–Inertia force Analysis in Reciprocating Engines – Gas Forces – Equivalent masses –Bearing loads – Crank shaft Torque – Fly wheels–turning moment diagrams and fluctuation of energy in reciprocating engine mechanisms, coefficient of fluctuation of energy and speed, weight of flywheel. **Laboratory Practice:** Determine the moment of inertia of a block using turn table apparatus and flywheel by oscillating method.

**UNIT – II**

9

**Balancing:** Static and dynamic balancing –Balancing of rotating masses –Balancing of single cylinder Engine –Balancing of Multi-cylinder Engine –Partial balancing of locomotive Engines – Balancing of radial engine – Direct and reverse crank method. **Laboratory Practice:** Dynamic balancing of rotating masses.

**UNIT – III**

9

**Free and Forced Vibrations:** Basic features of vibratory systems–types–Single degree of freedom system–Longitudinal Vibrations, Transverse vibration of beams–Natural frequency by energy method, Dunkerly’s method–Critical speed-damped free vibration of single degree freedom system–Types of damping–free vibration with viscous damping, Critically damped system, under damped system. Response to periodic forcing –Harmonic Forcing –Forcing caused by unbalance – Support motion–Logarithmic decrement–magnification factor – Force transmissibility and amplitude transmissibility – Vibration isolation. **Laboratory Practice:** Determine the natural frequency of given spring using spring mass system and given shaft using whirling of shaft apparatus. Determine the transmissibility ratio of given eccentric mass in vibration table

**UNIT – IV**

9

**Torsional Vibrations:** Torsional systems- Natural frequency of single, two and three rotor systems, Torsionally Equivalent System – Stepped shaft and Geared shaft. **Laboratory Practice:** Determine the natural frequency of torsional vibration of single rotor system.

**UNIT – V**

9

**Governors:** Types –Centrifugal governors –Gravity controlled and spring controlled centrifugal governors – Characteristics –Effect of friction –Controlling Force. **Laboratory Practice:** Determine the characteristics of governor using universal governor apparatus. (Porter, Proell and Hartnell governors)

**Lecture:45, Practical:15, TOTAL: 60**

**TEXT BOOKS:**

1. Rattan S.S., “Theory of Machines” 4<sup>th</sup> Edition, Tata McGraw Hill Publishing Company, New Delhi, 2014.
2. Shigley J.E. and Uicker J.J., “Theory of Machines and Mechanisms”, 4<sup>th</sup> Edition, Oxford University Press, 2014.

**REFERENCE BOOKS:**

1. Brar J.S. and Bansal R.K., “A Text book of Theory of Machines”, 5<sup>th</sup> Edition, Laxmi Publication Pvt. Ltd., New Delhi, 2015.
2. Sadhu Singh, “Theory of Machines”, 2<sup>nd</sup> Edition, Pearson Education, New Delhi, 2006.
3. Bevan and Thomas, “Theory of Machines”, 3<sup>rd</sup> Edition, CBS Publishers and Distributors, New Delhi, 2005.
4. Rao J.S. and Dukupati R.V., “Mechanism and Machine Theory”, 2<sup>nd</sup> Edition, New Age International Pvt. Ltd., Publishers, New Delhi, 2014.
5. <http://nptel.ac.in/courses/112101096/>
6. <http://nptel.ac.in/courses/112104114/>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: assess inertia force, torque for reciprocating mechanisms and parameters of flywheel
- CO2: analyze the static and dynamic unbalance of revolving and reciprocating masses
- CO3: determine the frequencies of free and forced vibrations
- CO4: evaluate, analyze and demonstrate the frequencies of torsional vibration
- CO5: estimate the characteristics of different types of governors

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1							2	3	3
CO2	3	3	2	3	1							2	3	3
CO3	3	3	3	3	2							2	3	3
CO4	3	3	3	3	2							2	3	3
CO5	3	3	2	2	1							2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**Pre-requisites:** Problem Solving and Programming, Sensors and Transducers

**UNIT – I**

9

**Virtual Instrumentation:** Historical perspective and Traditional bench-top instruments – General functional description of a digital instrument – Block diagram of a Virtual Instrument – Physical quantities and analog interfaces – Hardware and Software – Advantages of Virtual Instruments over conventional instruments – Architecture of a Virtual Instrument and its relation to the operating system.

**UNIT – II**

9

**VI Software Tools:** Graphical user interfaces – Controls and Indicators – ‘G’ programming/ modular programming – Data types – Data flow programming – Editing, Debugging and Running a Virtual Instrument – Graphical programming palettes and tools – Function and Libraries – VI and sub-VI, Structures: FOR Loops, WHILE loops, Shift Registers, CASE structure, Formula nodes, Sequence structures, Timed looped structures.

**UNIT – III**

9

**VI Programming Techniques:** Arrays and Clusters: Array operation – Bundle/Unbundle and Bundle/Unbundle by name – Plotting data: graphs and charts – String and File I/O: High level and Low level file I/O’s – Attribute nodes – Local and global variables.

**UNIT – IV**

9

**Data Acquisition Hardware:** Basics of DAQ Hardware and Software – Concepts of Data Acquisition and terminology – Installing Hardware and drivers – Configuring and addressing the hardware – Digital and Analog I/O function – Real time Data Acquisition – USB based DAQ.

**UNIT – V**

9

**VI applications:** Advantages and Applications – Advanced concepts – TCP/IP VI’s – PXI – Instrument Control – Image acquisition – Motion Control – Signal processing – Signal analysis: Power spectral analysis – Control design and simulation.

**Practical**

1. Develop graphical program in FOR/WHILE Loop operations.
2. Develop graphical program in String functions.
3. Develop graphical program in Case/Sequence structure operations.
4. Develop graphical programming using Array and Clusters.
5. Develop graphical program in SubVI’s
6. Develop graphical program in formula / property node operations.
7. Develop graphical program using local and global variables
8. Develop graphical program File Input / File Output function Read / write an XML file.
9. Develop graphical program for real time interface with temperature measurement system.
10. Develop graphical programming for client – server architecture using TCP/IP
11. Develop graphical programming in vision assistant

**Lecture:45, Practical:15, TOTAL: 60**

**TEXT BOOKS:**

1. Jeffery Travis and Jim Kring, “LabVIEW for Everyone: Graphical programming made easy and Fun”, 3<sup>rd</sup> Edition, Pearson Education, India, 2009.
2. Gupta, Joseph and John, “Virtual Instrumentation using LabVIEW”, 2<sup>nd</sup> Edition, Tata McGraw Hill, 2010.
3. Rick Bitter, “LabVIEW Advanced Programming Techniques”, 2<sup>nd</sup> Edition, Taylor & Francis Group, 2006.

**REFERENCE BOOKS:**

1. “LabVIEW Basics I and II Manual”, National Instruments, 2005.
2. Paton and Barry, “Sensor, Transducers and LabVIEW”, Prentice Hall, New Jersey, 2000.
3. Minura and Bruce, “LabVIEW for Data Acquisition”, Prentice Hall, New Jersey, 2005.
4. <http://www.ni.com/white-paper/4752/en/>
5. <http://www.ni.com/data-acquisition/what-is/>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: demonstrate the basic concepts about virtual instrumentation  
 CO2: interpret the software tools in virtual instrumentation  
 CO3: develop programming through LabVIEW graphical programming environment  
 CO4: experiment with data acquisition hardware and LabVIEW software  
 CO5: select the hardware and software concept of data acquisition system for advanced applications

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2									2	2	2
CO2	3	3	3		2							2	3	3
CO3	3	3	3		2							2	3	3
CO4	3	3	3		3							2	3	3
CO5	3	3	3	3	3							2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**LIST OF EXPERIMENTS / EXERCISES:****Assembly Language Programming**

1. Arithmetic functions using 8086 Microprocessor
2. Arithmetic functions using 8051 Microcontroller.

**Embedded C Programming and interfacing using 89c51 Microcontroller**

3. Interfacing of switch , LED and seven segment LED
4. Interfacing of LCD
5. Interfacing of DC motor
6. Interfacing of stepper motor
7. Interfacing of servo motor
8. Actuation of pneumatic cylinders
9. Interfacing of high power devices
10. Interfacing of pressure, temperature, proximity, level switch etc., for a given case study

**TOTAL: 45****REFERENCES / MANUALS / SOFTWARE:**

1. Mazidi Muhammad Ali, Mazidi Janice Gillispie and McKinlay Rolin, “The 8051 Microcontroller and Embedded Systems”, 2<sup>nd</sup> Edition, Prentice Hall of India, New Delhi, 2013.
2. Embedded C Programming Manual
3. Microcontroller Programming Software for 89c51 Microcontroller and Dumper kits

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: build programming for microprocessor 8086 and 89c51  
 CO2: design interfacing circuits with 89c51 microcontroller  
 CO3: make use of hardware for interfacing  
 CO4: develop a microcontroller based system for mechatronics applications

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3		3				2	1		2	3	2
CO2	3	3	3		3				2	1		2	3	2
CO3	3	3	3		3				2	1		2	3	2
CO4	3	3	3	3	3		1		2	1		3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**LIST OF EXPERIMENTS:**

1. Study of G codes and M codes for machining centre and turning centre
2. Programming and machining of given component using HMT VMC 200T
3. Programming and machining of given component using HMT CNC T70
4. Programming and machining of given component using CNC turning centre
5. Programming and simulation of given component using MASTER CAM (Lathe)
6. CNC code generation of given component using MASTER CAM (Lathe) and interfacing it to CNC turning centre
7. Programming and machining of given component using CNC machining centre
8. Programming and simulation of given component using MASTER CAM (Milling)
9. CNC code generation of given component using MASTER CAM (Mill) and interfacing it to CNC machining centre

**TOTAL: 45**

**REFERENCES / MANUALS / SOFTWARE:**

1. Radhakrishnan P., “Computer Numerical Control Machines”, New Central Book Agency, 2013.
2. Laboratory manual

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: practice and execute the part program using CNC trainer machines
- CO2: develop, simulate and execute part program using CNC production machines
- CO3: simulate using CAM package and interface the developed program with the machines

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2			2	3	1						2	2	2
CO2	2			2	3	1						2	2	2
CO3	2			2	3	1						2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

**14EGL41 COMMUNICATION SKILLS LABORATORY**  
( Common to all Engineering and Technology branches )

**0   0   3   1**

**LIST OF EXPERIMENTS:**

1. Listening Skills: Listening activity using software package in the communication laboratory - Listening to native speakers - Developing oral communication by imitating the model dialogues. Listening for specific information – Listening to improve pronunciation – Listening and typing – Filling the blanks–TV programmes and News.

**Audio Visual Lab: Activity based learning**

2. Activity based Reading Skills: Reading for getting information and understanding; scanning, skimming and identifying topic sentences – Reading for gaining knowledge-Group activity.

3. Activity based Writing Skills: Preparing a draft – Word editing features, editing and proof reading; Writing a short essay using the draft prepared - Group activity.

4. Speaking Skills: Verbal and Non-Verbal Communication; Introducing oneself -Describing a place, Expressing views and opinions; Giving a presentation on a Topic - eye contact, speaking audibly, clearly and with confidence; Group discussion.Conversations – Face-to-Face conversation – Simulated Telephonic Conversation.

**Career Lab**

5. Interview Skills: Introducing oneself – Answering other FAQ’s. Presentation Skills: Elements and structure of effective presentation – Presentation Tools – Voice modulation – Body language –Video samples. Group Discussion: Structure of Group Discussion – Strategies in group discussion - Team work – Video Samples. Soft Skills: Fundamentals of Soft Skills – Work Place Culture and Inter-Personal Relationships.

**TOTAL : 45**

**REFERENCES / MANUALS / SOFTWARE:**

1. Orell Digital Language Lab Software

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1:     communicate efficiently in real life and career related situations
- CO2:     demonstrate good Presentation skills and team skills
- CO3:     familiarize in using modern communication software packages to enhance their soft skills

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1									3	3		2		
CO2									2	3		1		
CO3									1	3		2		

1 – Slight, 2 – Moderate, 3 – Substantial



## 14GET61 ECONOMICS AND MANAGEMENT FOR ENGINEERS

(Common to all Engineering and Technology branches)

3 0 0 3

### UNIT – I

9

Economics – Basics Concepts and Principles – Demand and Supply – Law of demand and Supply – Determinants – Market Equilibrium – Circular Flow of Economic activities and Income.

### UNIT – II

9

National Income and its measurement techniques. Inflation - Causes of Inflation – Controlling Inflation – Business Cycle. Forms of business – Management Functions: Planning, Organizing, Staffing, Leading and Controlling - Managerial Skills - Levels of Management - Roles of manager.

### UNIT – III

9

Marketing - Core Concepts of Marketing - Four P's of Marketing - New product development - Product Life Cycle - Pricing Strategies and Decisions.

### UNIT – IV

9

Operations Management - Resources - Types of Production system - Site selection, Plant Layout, Steps in Production Planning and Control - Inventory - EOQ Determination.

### UNIT – V

9

Accounting Principles – Financial Statements and its uses – Depreciation: Straight Line and Diminishing Balance Method – Break Even Analysis – Capital Budgeting: Meaning – Types of decisions – Methods (Theory).

**TOTAL : 45**

### TEXT BOOK:

1. “Economics and Management for Engineers”, Compiled by Department of Management Studies, Kongu Engineering College, McGraw-Hill Education, India, 2013.

### REFERENCE BOOKS:

1. Geetika, Piyali Ghosh and Purba Roy Choudhury, “Managerial Economics”, 1<sup>st</sup> Edition, Tata McGraw-Hill, New Delhi, 2008.
2. Jeff Madura, “Fundamentals of Business”, Cengage Learning Inc., India, 2007.
3. Stanley L. Brue and Campbell R. McConnell, “Essentials of Economics”, Tata McGraw-Hill, New Delhi, 2007.
4. Jain S.P., Narang K.L. and Simi Agrawal, “Accounting for Management”, 1<sup>st</sup> Edition, Tata McGraw-Hill, New Delhi, 2009.

### COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: estimate market equilibrium and interpret national income calculation and inflation issues
- CO2: categorize the forms of business and analyse the functions of management
- CO3: appraise marketing management decisions
- CO4: apply appropriate operation management concept in business situations
- CO5: interpret financial and accounting statements

### Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1	1	2			3		2	2	2	3	2		2
CO2		1	2			2	2	2	2	2	3	2		2
CO3	1	2	1			2		2	2	2	3	2	1	2
CO4	1	2	1			2		2	2	2	3	2		2
CO5	2	2				2		2	2	2	3	2		2

1 – Slight, 2 – Moderate, 3 – Substantial

**Pre-requisites:** Electrical Machines, Analog and digital electronics

**UNIT – I**

9

**Power Electronics Devices:** Concept of Power Electronics – Power electronic systems – Power Semiconductor Devices - Principle of operation – Steady state and switching characteristics of power diodes, power BJT, power MOSFET, IGBT – Firing circuit for thyristor- Steady state and switching characteristics of SCR –Two transistor model of SCR – DIAC – TRIAC – GTO.

**UNIT – II**

9

**AC-DC and DC-AC Converters:** Principle of phase controlled converter with R and RL load - freewheeling Diode- single phase full wave converter – single phase semi converter – three phase semi converter – three phase fully controlled converter – Introduction to inverter –1 $\phi$  and 3 $\phi$  Voltage source inverters –PWM inverters – Types - Applications.

**UNIT – III**

9

**DC - DC and AC - AC Converter:** DC Chopper – Control strategies – Principle of operation – Step up and step down chopper – Voltage, current and load commutated choppers - Single phase AC voltage controller – On - off control and phase control – Sequence control of AC voltage controller – 1 $\phi$  Step up and step down cycloconverters - Applications.

**UNIT – IV**

9

**Electric Drives: DC Drives -** Introduction to DC drives – Basic performance equations of DC motor – single phase DC drives – three phase DC drives – Types – Chopper Drives – two quadrant chopper drive – four quadrant chopper drive.

**UNIT – V**

9

**AC Drives:** Introduction – Induction motor drives – speed control of 3-phase induction motor – stator voltage control – stator frequency control – stator voltage and frequency control – stator current control – static rotor resistance control – slip power recovery control.

**TOTAL: 45**

**TEXT BOOKS:**

1. Bimbhra B.S., “Power Electronics”, 5<sup>th</sup> Edition, Kanna Publishers, New Delhi, 2012.
2. Rashid M.H., “Power Electronics: Circuits Devices and Application”, 3<sup>rd</sup> Edition, Prentice Hall India, New Delhi, 2004.
3. Gopal K. Dubey, “Fundamentals of Electrical Drives”, 2<sup>nd</sup> Edition, Narosal Publishing House, New Delhi, 2001.

**REFERENCE BOOKS:**

1. Lander W., “Power Electronics”, 3<sup>rd</sup> Edition, McGraw-Hill, New York, 1993.
2. Dubey G.K., Doradia S.R., Joshi A., and Singh R.M., “Thyristorised Power Controllers”, Wiley Eastern Ltd., New Delhi, 2005.
3. Singh M.D. and Khanchandani K.B., “Power Electronics”, 2<sup>nd</sup> Edition, Tata McGraw-Hill, New Delhi, 2007.
4. <http://nptel.ac.in/downloads/108101038/>
5. <http://nptel.ac.in/courses/108108077/>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: assess the static and switching characteristics of power solid state devices  
 CO2: analyze the performance of AC – DC and DC – AC converters  
 CO3: evaluate the performance of DC – DC and AC – AC converters  
 CO4: examine the speed control technique of DC drive  
 CO5: investigate the speed control technique of AC drive

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	2							2	1	1
CO2	3	3	3	3	3							2	3	3
CO3	3	3	3	3	3							2	3	3
CO4	3	3	2	3	1							2	2	2
CO5	3	3	2	3	1							2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

**14MTT62 FLUID POWER SYSTEM**  
(Common to Mechatronics and Mechanical branches)

**3 0 0 3**

**Pre-requisites:** Fluid Mechanics and Machinery

**UNIT – I** **9**

**Fundamentals of Hydraulic System:** Basics of fluid power system – Advantages and applications of Fluid power systems – Fluid properties – Pascal’s Law and its application – Losses in pipes, valves and fittings – Fluid power symbols – Hydraulic pumps: Gear, Vane and Piston pumps, Pump Performance, Characteristics and Selection - Sizing of pumps.

**UNIT – II** **9**

**Control Components of Hydraulic System:** Direction control valves: Three way valve, Four way valve, Check valve and shuttle valve – Actuation mechanisms in DCV – Pressure control valves: Pressure relief, Pressure Reducing, Counter balance, Sequencing and Unloading Valves – Flow control valves and its types – Proportional Valves – Servo valves: Mechanical type and Electrohydraulic servo valves.

**UNIT – III** **9**

**Pneumatic System and Actuators:** Properties of Air - Perfect Gas laws – Compressors: piston, screw and vane compressor – Fluid conditioning Elements: Filter Regulator and Lubricator unit, Pneumatic silencers, After coolers, Air dryers – Air control valves – Fluid power actuators: Linear and Rotary actuators – types – Cushioning mechanism in cylinders – Sizing of Actuators.

**UNIT – IV** **9**

**Fluid Power Circuit Design:** Basic pneumatic circuits – Pneumatic vacuum systems –Electrical components and electrical controls for Fluid power circuits – Cascade Circuit design method (two / three cylinder circuits) – Introduction to Fluid logic devices and applications – Accumulator – Types and application circuits – Pressure intensifier circuits – PLC applications in Fluid power circuit.

**UNIT – V** **9**

**Industrial Circuits and Maintenance:** Industrial circuits: Speed control circuits – Regenerative cylinder circuits – Pump unloading circuit – Double pump circuit – Counter balance valve circuit – Hydraulic cylinder sequencing circuit – Automatic cylinder reciprocating circuit – Cylinder synchronizing circuits – Fail safe circuits - Sealing devices: Types and materials –Safety aspects in Fluid Power System, Installation, Maintenance and trouble shooting of Fluid Power systems.

**TOTAL: 45**

**TEXT BOOKS:**

- Esposito Anthony, “Fluid Power with Applications”, 7<sup>th</sup> Edition, Pearson Higher Education, New York, 2015.
- Majumdar S.R., “Oil Hydraulic Systems – Principles and Maintenance”, 2<sup>nd</sup> Edition, Tata McGraw-Hill, New Delhi, 2012.
- Majumdar S.R., “Pneumatic Systems – Principles and Maintenance”, 2<sup>nd</sup> Edition, Tata McGraw-Hill, New Delhi, 2015.

**REFERENCE BOOKS:**

- Jegadeesa T., “Hydraulics and Pneumatics”, I.K International Publishing House Pvt. Ltd., New Delhi, 2015.
- Pippenger, John and Hicks, Tyler, “Industrial Hydraulics”, 3<sup>rd</sup> Edition, Tata McGraw-Hill, New Delhi, 1987.
- Sullivan James A., “Fluid Power - Theory and Applications”, 4<sup>th</sup> Edition, Prentice Hall International, New Jersey, 1998.
- <http://nptel.ac.in/courses/112106175/1>
- <http://nptel.ac.in/courses/112102011/>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: identify fluid power components and their symbols as used in industry and also select suitable pump for hydraulic power pack
- CO2: choose appropriate control valves for fluid power applications
- CO3: select pneumatic components and fluid power actuators for low cost automation
- CO4: design and construct a fluid power circuits real time applications
- CO5: design, construct, test, install, maintain and trouble shoot fluid power circuits for engineering applications

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2			1	1				1	1	2	2
CO2	2	2	3	1		1	1					2	3	3
CO3	2	2	3	1	2	1	1				2	2	3	3
CO4	2	3	3	1	2	1	1				1	2	3	3
CO5	2	3	3	1		3	1				2	1	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

## 14MTT63 PROGRAMMABLE AUTOMATION CONTROLLERS

3    0    0    3

**Pre-requisites:** Sensors and Transducers

### UNIT – I

9

**Device Layer Components:** Introduction – Input Devices: Pushbuttons – types – NPN – PNP Proximity Sensors – Reed Switches – Encoders – MCB. Output Devices: Relays – contactors – OLR – DOL Starter - Solenoid valves.

### UNIT – II

9

**Programmable Logic Controller:** Introduction – Architecture of PLC – Principles of operation – Advantages – Programming devices – Types of PLC – I/O modules: Discrete I/O modules – Analog I/O modules – CPU processor memory module – Selection, Maintenance and troubleshooting of PLC. Introduction to Soft PLCs.

### UNIT – III

9

**Programming of PLC:** Sourcing and sinking concept – Ladder diagram – Conversion of relay ladder to PLC ladder diagram – Instructions: Arithmetic – Data manipulation – Timer – Counter. PLC Advanced functions: Analog PLC operation – networking of PLC– PLC-PID functions. Simple programmes.

### UNIT – IV

9

**Distributed Control System:** Evolution – Architectures Comparison – Local control unit – Operator interfaces – Low level and high level operator interfaces – Operator displays -Applications of DCS.

### UNIT – V

9

**SCADA:** Definition – Elements of SCADA – SCADA control – Remote terminal units – Master station – Communications protocols in SCADA – Applications of SCADA.

**TOTAL: 45**

### TEXT BOOKS:

1. Petruzella Frank D., “Programmable Logic Controllers”, 2<sup>nd</sup> Edition, McGraw-Hill, New York, 2015.
2. Stuart Boyer A., “SCADA Supervisory Control and Data Acquisition”, 4<sup>th</sup> Edition, ISA, USA, 2010.

### REFERENCE BOOKS:

1. Webb John W. and Reis Ronald A., “Programmable Logic Controllers: Principles and Applications”, 5<sup>th</sup> Edition, Prentice Hall of India, New Delhi, 2011.
2. Lucas M.P., “Distributed Control System”, Van Nostrand Reinhold Co. New York, 1986.
3. McMillan G.K., “Process/Industrial Instruments Handbook”, 5<sup>th</sup> Edition, Tata McGraw-Hill, New York, 2009.
4. <http://nptel.ac.in/courses/112102011/11>
5. <http://nptel.ac.in/courses/112102011/12>

### COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: infer field I/O devices used in industries
- CO2: interpret PLC architecture and I/O modules
- CO3: develop and Implement PLC programming for simple process control case studies
- CO4: adapt the concepts of DCS and SCADA
- CO5: combine programming concepts of PLC, DCS and SCADA to develop industrial control functions

### Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1									1	2	1
CO2	3	2	2	2	1							2	2	1
CO3	3	3	3	3	3	3						3	3	3
CO4	3	3	3	3	3							2	3	3
CO5	3	3	3	3	3	2						3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**LIST OF EXPERIMENTS / EXERCISES:**

1. Study of SCR characteristics.
2. Study of MOSFET and IGBT characteristics.
3. R, RC and UJT firing circuits for SCR.
4. Single phase half controlled & fully controlled converters.
5. Voltage commutated chopper.
6. IGBT based PWM inverter.
7. Single-phase Cycloconverter.
8. Simulation of closed loop control of converter fed DC motor.
9. Simulation of VSI fed three phase induction motor.
10. Simulation of closed loop control of chopper fed DC motor.

**TOTAL: 45****REFERENCES / MANUALS / SOFTWARE:**

1. Lab manual
2. MATLAB/SIMULINK Software

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: verify the characteristics of power devices and analyze the roll of triggering circuits  
 CO2: analyze the performance of rectifier and chopper  
 CO3: analyze the performance of inverter and cycloconverter  
 CO4: design and analysis of DC drives using MATLAB / SIMULINK  
 CO5: design and analysis of AC drives using MATLAB / SIMULINK

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2					2	1			1	1
CO2	3	3	3	2					2	1			2	2
CO3	3	3	3	2					2	1			2	2
CO4	3	3	3	2	3				2	1			3	3
CO5	3	3	3	2	3				2	1			3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**LIST OF EXPERIMENTS/EXERCISES:**

1. Design and testing of Hydraulic circuit for speed control of hydraulic motor and cylinder.
2. Design and testing of Pneumatic circuits for speed control – Meter in, Meter out and Bleed off circuits.
3. Design and testing of Pneumatic circuits with logic controls – AND valve and OR valve.
4. Design and testing of Sequential circuit with pneumatic control (with and without pneumatic timers).
5. Design and testing of Pneumatic circuit with vacuum cup and rod less cylinder.
6. Design and simulation of sequential fluid power circuits.
7. Design and testing of Electro-hydraulic circuit with pressure sequence valve.
8. Design and testing of Pneumatic circuits with cylinder synchronization.
9. Design and testing of Electro Pneumatic sequential circuit with limit switches.
10. Design and testing of Hydraulic circuit with Proportional control of Pressure and Flow.
11. Design and simulation of electro pneumatic circuit with timers and counters.
12. Disassembling and Assembling of hydraulic pumps and Valves.

**TOTAL: 45**

**REFERENCES / MANUALS / SOFTWARE:**

1. “Hydraulic Power Pack – Instruction Manual”, Mansco Fluidtek Private Ltd., Coimbatore.
2. “Automation Studio Exercise Circuits”, Janatics Ltd., Coimbatore.
3. “Pneumatics-Basic level TP101 Text Book”, 5<sup>th</sup> Edition, Festo Ltd., 1999.
4. “Electro Pneumatics-Basic level TP201 Text Book”, 10<sup>th</sup> Edition, Festo Ltd., 1990.
5. Lab Manuals
6. <http://www.hydraulicspneumatics.com/other-technologies/chapter-4-iso-symbols>
7. <http://www.hydraulicspneumatics.com/200/TechZone/HydraulicPumpsM/Article/False/6401/TechZone-HydraulicPumpsM>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: identify the fluid power components and their symbols as used in industry
- CO2: design, construct and test fluid power circuits with pneumatic, electrical, PLC and logic control for low cost automation
- CO3: develop and simulate fluid power circuits using simulation software for industrial applications

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2		1						1	2	2	2
CO2	2	3	3		3						2	2	3	3
CO3	2	2	3		3						1	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**LIST OF EXPERIMENTS / EXERCISES:**

1. Construction of Ladder programming for Boolean, math, compare operations.
2. Logical testing of field devices such as, Pushbutton, selector switch , proximity sensor, Relay, Contactor etc., by using PLC.
3. Level control using PLC.
4. Linear and sequential actuation of Pneumatic cylinder with Timer and counter functions.
5. Interfacing of AC drive with PLC and SCADA using Soft PLC.
6. Temperature control using PLC and SCADA.
7. Flow and Pressure Measurement and Control using PLC and SCADA.
8. Introduction to Servo control using PLC and SCADA.
9. Servo control application: Pick and Place function.
10. Servo control application: Profile making

**TOTAL: 45****REFERENCES / MANUALS / SOFTWARE:**

1. Petruzella Frank D., “Programmable Logic Controllers”, 2<sup>nd</sup> Edition, McGraw-Hill, New York, 2015.
2. Software: Rs Logix 500, Rs Emulate 500, Rs Linx, Factory talk view studio, Rs logix 5000.
3. Lab Manual

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: build and simulate PLC programming for discrete and analog I/Os  
 CO2: develop hard wiring with PLC and field I/Os  
 CO3: construct SCADA programming with data logging and trending  
 CO4: combine PLC and SCADA for real process plant control

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3				2	1		2	3	3
CO2	3	3	3	3	3				2	1		2	3	3
CO3	3	3	3	3	3				2	1		2	3	3
CO4	3	3	3	3	3				2	1		2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**14GET71 TOTAL QUALITY MANAGEMENT**  
(Common to all Engineering and Technology branches)

**3 0 0 3**  
**9**

**UNIT – I**

**Quality (Basic concepts and principles):** Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs, Basic concepts of Total Quality Management, Historical Review. Principles of TQM, Leadership – Concepts, Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers to TQM Implementation.

**UNIT – II**

**TQM Principles and strategies :** Customer satisfaction – Customer Perception of Quality, Customer Complaints, Customer Retention, Employee Involvement – Motivation, Empowerment, Teams, Recognition and Reward, Performance Appraisal, Benefits. Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development

**UNIT – III**

**TQM Tools (Process Control):** The seven tools of quality, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Process capability, Concept of six sigma, New seven Management tools.

**UNIT – IV**

**TQM Tools:** Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA, Poka Yoke.

**UNIT – V**

**Quality Systems -**Need for ISO 9000 and Other Quality Systems, ISO 9000:2008 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, Introduction to TS 16949, QS 9000, ISO 14000, ISO 18000, ISO 20000, ISO 22000.

**TOTAL : 45**

**TEXT BOOKS:**

1. Besterfield, Dale H. et al., “Total Quality Management”, 3<sup>rd</sup> Edition (Revised), Pearson Education, 2011.
2. Subburaj Ramasamy, “Total Quality Management”, Tata McGraw Hill, New Delhi, 2008.

**REFERENCE BOOKS:**

1. Feigenbaum A.V., “Total Quality Management”, 4<sup>th</sup> Edition, Tata McGraw Hill, New Delhi, 2004.
2. Suganthi L. and Samuel A. Anand, “Total Quality Management”, PHI Learning, New Delhi, 2011.
3. Evans James R. and Lindsay William M., “The Management and Control of Quality”, 7<sup>th</sup> Edition, South-Western (Thomson Learning), 2011.

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: understand the meaning of quality and its importance
- CO2: know the principles of total quality management and peculiarities of their implementation
- CO3: develop in-depth knowledge on various tools and techniques of quality management
- CO4: learn the applications of quality tools and techniques in both manufacturing and service industry
- CO5: develop analytical skills for investigating and analyzing quality management issues in the industry and suggest implement able solutions to those

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						2	2	3	2	2	2	3		3
CO2						3	2	3	3	3	2	3		3
CO3	3	2	2	2	2	2		1	2	2	3	2		3
CO4	2	2	2	2	2	2		1	2	2	3	2		3
CO5						3	3	2	3	2	2	2		3

1 – Slight, 2 – Moderate, 3 – Substantial



**14MTT71 MICRO ELECTRO MECHANICAL SYSTEMS**  
(Common to Mechatronics & EIE branches)

**3 0 0 3**

**Pre-requisites:** Applied physics, Engineering Mechanics, Sensors and Transducers

**UNIT – I** **9**

**Microsystems:** Overview-Microsystems - Working principle of Microsystems - Scaling laws - Scaling in geometry - Scaling in rigid body dynamics - Scaling in electrostatic forces - Scaling in electromagnetic forces - Scaling in electricity - Scaling in fluid mechanics - Scaling in heat transfer.

**UNIT – II** **9**

**Microsensors and Actuators:** Micro sensors - Micro actuation techniques - Micropump – Micromotors – Microvalves – Microgrippers - Micro accelerometers.

**UNIT – III** **9**

**Micro System Fabrication:** Substrates - Single crystal silicon wafer formation - MEMS materials - Photolithography - Ion implantation - Diffusion - Oxidation - CVD - Physical Vapor Deposition - Deposition by epitaxy – Etching process.

**UNIT – IV** **9**

**Micro System Manufacturing and Design:** Bulk Micromanufacturing - Surface Micromachining – LIGA – SLIGA. Micro system packaging – Materials - Die level - Device level - System level - Packaging techniques - Surface bonding - Wire bonding – Sealing - Design considerations.

**UNIT – V** **9**

**Micro System Applications:** Applications of micro system in – Automotive - Bio medical – Aero space – Telecommunications field. Basic exposure to software for MEMS design – Intellisuite.

**TOTAL: 45**

**TEXT BOOKS:**

- Mohamed Gad-el-Hak, “The MEMS Hand Book”, CRC Press, Florida, 2005.
- Tai-Ran Hsu, “MEMS and Microsystems: Design and Manufacture”, 2<sup>nd</sup> Edition, John Wiley and Sons, New York, 2008.

**REFERENCE BOOKS:**

- Fatikow S. and Rembold U., “Microsystem Technology and Microrobotics”, Springer-Verlag, Berlin Heidelberg, 2014.
- Gardner Julian W., Varadan Vijay K. and AwadelKarim Osama O., “Microsensors MEMS and Smart Devices”, John Wiley & Sons, New York, 2001.
- Marc Madou, “Fundamentals of Microfabrication”, 2<sup>nd</sup> Edition, CRC press, New York, 2011.
- Trimmer W., “Micromechanics and MEMS: Classic and Seminar papers to 1990”, IEEE Press, 1997.
- Tay Francis E.H. and Choong W.O, “Microfluidics and BioMEMS Applications”, Springer- Science+Business Media B.V., 2013.
- [nptel.ac.in/courses/117105082/](http://nptel.ac.in/courses/117105082/)
- <http://www.nptelvideos.in/2012/12/mems-microsystems.html>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: assess the scaling laws in microsystems
- CO2: select suitable micro sensors and actuators
- CO3: fabricate microsystems for specific applications
- CO4: design and develop microsystem manufacturing process and packaging
- CO5: develop a design procedure for microproducts

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3		2							1	3	3
CO2	3	3	3		2							2	3	3
CO3	3	3	3	3	2							2	3	3
CO4	3	3	3	3	2							2	3	3
CO5	3	3	3	3	2							2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**Pre-requisites :** Kinematics of Machinery, Machine Dynamics

**UNIT – I** 9

**Introduction:** History of robotics – Components of industrial robot - Degree of Freedom – Type of Joints - Classification of robots – Work volume - Reference frames – Programming modes - Robot specifications - Precision of movements: Accuracy, resolution, repeatability and dexterity – Singularity – Robot languages - Robot applications.

**UNIT – II** 9

**End Effectors:** Types of end effectors - Mechanical Gripper - Vacuum cup - Magnetic gripper - Special types of grippers- Gripper force analysis. **Frame Transformation:** Descriptions: Position, Orientation and Frames - Matrix representation: Point, vector, frame and rigid body - Homogeneous Transformation matrices – Representation: Translation, Rotational and Combined transformation – simple problems.

**UNIT – III** 9

**Robot Kinematics:** Forward and inverse kinematics – Equations for position and orientation – Denavit- Hartenberg Representation of forward kinematic equations: Two and Three link planar, PUMA and SCARA - Inverse kinematic equation: Two and three link planar.

**UNIT – IV** 9

**Velocity and Static Force:** Introduction - Linear and angular velocities of a rigid body - Velocity propagation – Derivation of the Jacobian for serial manipulator – Identification of Singularities - Static force analysis of serial manipulator.

**UNIT – V** 9

**Robot Dynamics:** Acceleration of a rigid body - Inertia of a link - Equation of motion: Lagrangian formulation – Euler-Lagrange formulation - Newton Euler formulation. **Trajectory Planning:** Joint space trajectory: Point to point and Continuous path planning - Cartesian space trajectory – Simple problems.

**TOTAL: 45**

**TEXT BOOKS :**

1. Saeed B. Niku, “Introduction To Robotics: Analysis, Control, Applications”, 2<sup>nd</sup> Edition, Wiley India Pvt. Limited, 2012.
2. Groover M.P., “Industrial Robotics, Technology, Programming and Applications”, 2<sup>nd</sup> Edition, Tata Mcgraw-Hill, New Delhi, 2012.
3. Robert J. Schilling, “Fundamentals of Robotics: Analysis and Control”, 1<sup>st</sup> Edition, Prentice- Hall of India Pvt. Ltd., 2007.

**REFERENCE BOOKS:**

1. Craig John J., “Introduction to Robotics: Mechanics and Control”, 3<sup>rd</sup> Edition, Pearson Education, New Delhi, 2005.
2. Saha S.K., “Introduction to Robotics”, 2<sup>nd</sup> Edition, Tata Mcgraw-Hill, New Delhi, 2014.
3. Richard D. Klafter, Thomas A. Chmielewski and Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., 2006.
4. Fu K.S., Gonzalez R.C. and Lee C.S.G., "Robotics: Control, Sensing, Vision and Intelligence", 13<sup>th</sup> Reprint Edition, Tata McGraw Hill, New Delhi, 2015.
5. Mark W. Spong and Vidyasagar M., “Robotics Dynamics and Control”, 1<sup>st</sup> Edition, John Wiley & Sons, New York, 2008.
6. Deb S.R. and Deb Sanksha, ‘Robotics Technology and Flexible Automation’, 2<sup>nd</sup> Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
7. <http://nptel.ac.in/courses/112101099/>
8. <http://nptel.ac.in/courses/112108093/>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: interpret the features of an industrial robot  
 CO2: estimate the gripping force of robot end effector  
 CO3: develop the forward and inverse kinematics for serial manipulator  
 CO4: analyse the velocity and static force of serial manipulators  
 CO5: formulate robot dynamics and trajectory

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2							2	3	3
CO2	3	3	3	3	2							2	3	3
CO3	3	3	3	3	2							2	3	3
CO4	3	3	3	3	2							2	3	3
CO5	3	3	3	3	2							2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**LIST OF EXPERIMENTS /EXERCISES:**

1. Part and Assembly drawing of Couplings using Pro-E/ SOLIDWORKS.
2. Part and Assembly drawing of Bearings using Pro-E/ SOLIDWORKS.
3. Part and Assembly drawing of Valves using Pro-E/ SOLIDWORKS.
4. Modeling and Drafting of Machine Elements i.e. Tail Stock/ Screw Jack / Connecting Rod using Pro-E/ SOLIDWORKS.
5. Structural analysis of a given component using ANSYS.
6. Thermal analysis of a given application using ANSYS.
7. Modal analysis of a given model using ANSYS.
8. Contact analysis of a model using ANSYS.
9. Shear Force and bending moment diagram using ANSYS.
10. Vibration analysis of an object using ANSYS.
11. Modeling and analyzing of any part models using CAD and CAE packages.

**TOTAL: 45****REFERENCES / MANUALS / SOFTWARE:**

1. Lab Manuals
2. Pro-E/ SolidWorks
3. ANSYS

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: explore various CAD packages and CAE tools  
 CO2: interpret drawings and develop machine components using standard CAD packages  
 CO3: solve the structural, contact and vibrational problems with different loadings using analysis tools

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	2	3				2	3		2	2	2
CO2	2	1	3	2	3				2	3		2	2	2
CO3	2	1	3	2	3				2	3		2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

**LIST OF EXPERIMENTS:**

1. Study the functions of ABB IRB 1410 industrial robot- components, drive system and end effectors.
2. Virtual reality robot programming for different tasks- Painting, Pick and place, Switch off intruder alarm, Stacking of blocks and Machining of billets.
3. Robot programming exercises - Point-to-point programming.
4. Robot programming exercises - Continuous path programming.
5. Robot programming exercises - Pick and place of components.
6. On-line Inspection and sorting of components using Machine Vision system.
7. Study of Fire Bird – V robot and its accessories.
8. Development of embedded programming for motion control using Fire Bird – V robot.
9. Development of embedded programming for velocity control using Fire Bird – V robot.
10. Development of embedded programming for path planning using Fire Bird – V robot.
11. Development of embedded programming for obstacle avoidance using Fire Bird – V robot.
12. Programming for sbRIO - Mobile robot using LabVIEW.

**TOTAL: 45****REFERENCES / MANUALS / SOFTWARE:**

1. Lab Manuals
2. ABB Robot Studio Manual
3. Fire Bird – V Software and Hardware manual, NEX Robotics, Bombay.

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: analyze the industrial robot work cell problems and program through ON-line and OFF-line mode  
 CO2: develop an embedded program for mobile robot applications  
 CO3: develop an inspection system using machine vision system

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3				2	1		2	3	3
CO2	3	3	3	3	3				2	1		2	3	3
CO3	3	3	3	3	3				2	1		2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

## 14MTP71 DESIGN AND FABRICATION PROJECT

### COURSE OUTCOMES

On completion of the course the students will be able to

CO1: identify and formulate the problem and conceptualize the methodology of the project

CO2: design the components and systems using mechatronic principles

CO3: fabricate a mechatronics system utilizing experimental skills

CO4: plan and execute the project as a team

CO5: compile the findings and conclude with oral/written reports

### Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2	2	2	2	3	3	3	2	3	3
CO2	3	3	3	3	3	2	2	2	3	3	3	2	3	3
CO3	3	3	3	3	3	2	2	2	3	3	3	2	3	3
CO4	3	3	3	3	3	3	3	3	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	3	3	3	3	3	3	3

# 14GET81 PROFESSIONAL ETHICS AND HUMAN VALUES

(Common to all Engineering and Technology branches)

3 0 0 3

## UNIT – I

9

Understanding: Morals – Values-Ethics– Honesty – Integrity – Work Ethic – Service Learning – Civic Virtue – caring – Sharing – Courage – Valuing Time – Co-operation – Commitment – Empathy –Self-Confidence – Character – Spirituality- Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry.

## UNIT – II

9

Moral dilemmas – moral autonomy – Kohlberg's theory – Gilligan's theory – consensus and controversy – Models of Professional Roles – theories about right action – Self-interest – customs and religion- uses of ethical theories. Meaning of Engineering experimentation - engineers as responsible experimenters.

## UNIT – III

9

Codes of ethics for engineers - a balanced outlook on law - the challenger case study. Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk, Bhopal Gas Tragedy and Chernobyl case studies.

## UNIT – IV

9

Collegiality and loyalty – respect for authority – collective bargaining – confidentiality – conflicts of interest – occupational crime – professional rights – employee rights – discrimination – Intellectual Property Rights (IPR) – Multinational corporations.

## UNIT – V

9

Environmental ethics - Computer ethics – weapons development-engineers as managers-consulting engineers-engineers as expert witnesses and advisors -moral leadership-sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of Electronics and Telecommunication Engineers(IETE).

**TOTAL : 45**

### TEXT BOOKS:

1. Martin Mike and Schinzinger Roland, “Ethics in Engineering”, 4<sup>th</sup> Edition, Tata McGraw-Hill, New Delhi, 2014.
2. Govindarajan M., Natarajan S., and Senthil Kumar V.S., “Engineering Ethics”, Prentice Hall of India, New Delhi, Reprint 2013.

### REFERENCE BOOKS:

1. Fleddermann Charles D., “Engineering Ethics”, 4<sup>th</sup> Edition, Pearson Education/Prentice Hall, New Jersey, 2014.
2. Harris Charles E., Protchard Michael S. and Rabins Michael J., “Engineering Ethics: Concepts and Cases”, 4<sup>th</sup> Edition Wadsworth Thompson Learning, United States, 2008.
3. Seebauer Edmund G. and Barry Robert L., “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2008.

### COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: understand the components of ethics and values
- CO2: understand the knowledge interpersonal and organizational issues in ethics
- CO3: acquire knowledge on ethical theories and their application
- CO4: highlight ethical issues in risky situation
- CO5: understand the role of professional bodies

### Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						3		3	2	2		2		2
CO2						3		3	2	3		2		2
CO3						3	2	3	2	1		2		2
CO4						3	3	3	2	3		2		2
CO5						2	2	3	2	2		2		2

1 – Slight, 2 – Moderate, 3 – Substantial

## 14MTP81 PROJECT WORK

### COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: analyze any complex engineering problem to provide appropriate research based solution
- CO2: design the components and systems using fundamental engineering principles
- CO3: develop /fabricate a mechatronics system utilizing experimental / analytical / simulation skills
- CO4: plan and execute the project as a team
- CO5: compile the findings and conclude with oral / written reports

### Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2	2	2	2	3	3	3	3	3	3
CO2	3	3	3	3	3	2	2	2	3	3	2	3	3	3
CO3	3	3	3	3	3	3	2	2	3	3	3	3	3	3
CO4	2	2	2	2	2	3	2	3	3	3	2	3	3	3
CO5	3	3	3	3	2	3	2	3	3	3	2	3	3	3

**14MET54 OPERATIONS RESEARCH**  
(Common to Mechanical, Mechatronics and Automobile branches)

**3 0 0 3**

**Pre-requisites:** Mathematics I, Mathematics II, Statistics and Numerical Methods

**UNIT – I** **9**

**Linear Models:** Introduction-Phases of OR study – Formation of LPP - Canonical form of LPP- Solutions to LPP: Graphical Solution, Simplex Algorithm, Artificial Variables Technique – Big M method, Two Phase method.

**UNIT – II** **9**

**Transportation, Assignment problems and Sequencing problems:** Transportation-Mathematical formulation-Basic Feasible solutions-NWC, LCM, VAM. Optimality test – MODI technique. Assignment problems- Mathematical formulation – Hungarian Algorithm. Sequencing Problems- n jobs 2 machine, n jobs 3 machine, n jobs m machine and 2 jobs n machine problems.

**UNIT– III** **9**

**Network models:** Shortest route – minimal spanning tree - maximum flow models-Project Management: Construction of networks- activity and event based diagrams, PERT- CPM-problems – Cost analysis and crashing of networks.

**UNIT – IV** **9**

**Inventory Models:** Types of Inventory- EOQ – Deterministic inventory models – Price break problems – stochastic inventory models- multi item deterministic models- selective inventory control techniques.

**UNIT – V** **9**

**Queuing and Replacement Models:** Queuing models – queuing systems and structures – notations–parameter – single server and multiserver models – Poisson input – exponential service – constant rate service – infinite population. Replacement Models: Replacement of Items due to deterioration with and without time value of Money -Individual and group replacement policy.

**TOTAL: 45**

**TEXT BOOKS:**

- Vohra N.D., “Quantitative Techniques in Management”, 4<sup>th</sup> Edition, McGraw Hill Education, 2009.
- Gupta P.K. and Hira D.S., “Operations Research”, 7<sup>th</sup> Edition, S.Chand and Company Ltd., New Delhi, 2014.

**REFERENCE BOOKS:**

- Taha, Hamdy A., “Operation Research: An Introduction”, 9<sup>th</sup> Edition, Pearson Education, 2014.
- Hiller Frederick S. and Lieberman Gerald J., “An Introduction to Operations Research”, 9<sup>th</sup> Edition, McGraw-Hill Science, 2011.
- Panneerselvam R., “Operations Research”, 2<sup>nd</sup> Edition, PHI Learning, 2009.
- <http://nptel.ac.in/courses/112106134/3>
- <http://nptel.ac.in/courses/110106059/>

**Course Outcomes:**

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: formulate and solve linear programming problems
- CO2: propose solutions to transportation and assignment problems
- CO3: evaluate optimal job sequence that minimizes the make span
- CO4: construct networks and analyze optimality for various applications
- CO5: identify inventory models and solve for optimality
- CO6: assess queuing characteristics and solve problems
- CO7: determine the optimum replacement period for capital equipment’s and items that fail suddenly

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2						2	2	1	2
CO2	3	3	3	2	2						2	2	1	2
CO3	3	3	3	2	2						2	2	1	2
CO4	3	3	3	2	2						2	2	1	2
CO5	3	3	3	2	2						2	2	1	2
CO6	3	3	3	2	2						2	2	1	2
CO7	3	3	3	2	2						2	2	1	2

1 – Slight, 2 – Moderate, 3 – Substantial



# 14EIT52 BIOMEDICAL INSTRUMENTATION

(Common to EIE & Mechatronics branches)

3 0 0 3

## UNIT – I

9

**Human Physiological Systems:** Cell and its structure-Resting and action potentials-Different systems of human body: Skeletal system-Circulatory system-Respiratory system-Excretory system-Central nervous system-Peripheral nervous system. **Physiological Transducers:** Introduction-Classification of transducers-Displacement, position and motion transducers: Piezo electric transducers-Ultrasonic transducers-Transducers for body temperature measurements: Thermocouples-Electrical resistance Thermometer-Thermistors. Optical fibre sensors.

## UNIT – II

9

**Bio Potential Electrodes and Bio signal Acquisition:** Components of the Bio medical instrument system-Electrodes: Micro electrode-depth and needle electrode-surface electrodes. Amplifiers: Medical preamplifiers-Chopper amplifiers-Isolation amplifier. **Biomedical Recorders and Patient Safety:** ECG-EEG-EMG-EOG-ERG: Lead systems, recording methods and typical waveforms. Patient safety: Electrical shock hazards-leakage currents-Safety codes for electro medical equipment-Electrical safety analyzer.

## UNIT – III

9

**Non Electrical Parameters Measurement and Diagnostic Procedures:** Patient monitoring systems: Measurement of heart rate-Blood pressure Measurement- Cardiac output. Pulmonary function analysers: Pulmonary function measurements - Spirometry. Blood gas analyzers: Blood pH measurement-Measurement of blood pCO<sub>2</sub>-Blood pO<sub>2</sub> measurement.Oximeters: Pulse oximeter.

## UNIT – IV

9

**Modern Medical Imaging Systems:** Radiography and fluoroscopy-X-ray machine-Endoscopes-Computer tomography-Thermography-Ultrasonic imaging systems-Magnetic resonance imaging-Positron emission tomography-Single photon emission computed tomography.

## UNIT – V

9

**Applications of Bio medical Devices:** Physiological assist devices: Pacemakers: Ventricular asynchronous pacemaker-Ventricular synchronous pacemaker. Defibrillators: A.C.Defibrillator- D.C.Defibrillator - Synchronised d.c defibrillator. Heart lung machine-Kidney machine. **Operation Theatre Equipment:** Surgical diathermy-Short wave diathermy-Micro wave diathermy. Ventilators- Lithotriptors: The stone disease problem-First lithotripter machine.

**TOTAL : 45**

## TEXT BOOKS:

1. M.Arumugam, "Bio-Medical Instrumentation", 2<sup>nd</sup> Edition, Anuradha Agencies, 2014.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", 2<sup>nd</sup> Edition, Tata McGraw-Hill, New Delhi, 2012.
3. Leslie Cromwell, "Biomedical Instrumentation and Measurement", 2<sup>nd</sup> Edition, Prentice hall of India, New Delhi, 2007.

## REFERENCE BOOKS:

1. John G. Webster, "Medical Instrumentation Application and Design", 4<sup>th</sup> Edition, John Wiley and Sons, NewYork, 2015.
2. Dr.O.N.Pandey, "Fundamentals of Biomedical Instrumentation", 4<sup>th</sup> Edition, S.K.Kataria & Sons, New Delhi, 2013.
3. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", 4<sup>th</sup> Edition, Pearson Education, 2002.
4. R.Ananda Natarajan, "Bio Medical Instrumentation and Measurements", 1<sup>st</sup> Edition, PHI Learning Pvt. Ltd., New Delhi, 2011.
5. Myer Hutz, "Standard Hand Book of Biomedical Engineering and design", 1<sup>st</sup> Edition, Tata McGraw-Hill, New Delhi, 2003.

## COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: understand and analyze biomedical instrumentation systems and their applications to various industries
- CO2: analyze the acquisition concepts in the bio potential recorders
- CO3: identify the various electrical parameters of the human system
- CO4: understand various imaging modalities in hospitals
- CO5: apply the familiarized therapeutic concepts in the recent trends of biomedical devices

### Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	1							2	3	3
CO2	3	3	3	3	2							2	3	3
CO3	3	3	2	2	1							2	3	3
CO4	3	3	3	3	3							2	3	3
CO5	3	3	3	3	3							2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**Pre-requisites:** Strength of Materials

**UNIT – I**

**9**

**Design Fundamentals:** Design Process - Computer aided design - Optimum design – Material Standards - Industrial design form and shape design, embodiment design and design for manufacture (Qualitative treatment only). Types of loads -Stresses - Static, varying, thermal, impact and residual. Factors of safety - Theories of failure – Stress concentration factors - S-N curves and its applications.

**UNIT – II**

**9**

**Design of Shafts, Keys and Couplings:** 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.

**UNIT – III**

**9**

**Design of Spur, Helical, Bevel and Worm Gears:** Principles of gear tooth action - Gear correction - Gear Materials- Gear tooth failure modes. Design of spur, helical, bevel and worm gears – Multi speed gear box design -Spur gear - Forward Traverse.

**UNIT – IV**

**9**

**Design of Brakes and Clutches:** Brakes – Types – Dynamic and thermal aspects of Braking – Braking system in automobiles. Design of clutches – Single plate – Multi plate –Conical clutch – Over running clutch.

**UNIT – V**

**9**

**Design of Bearings and Springs:** Study of Bearings - Design of Bearings – Sliding contact –Rolling contact – Cubic mean load. Design of Journal Bearings – Calculation of Bearing dimensions – Design of Helical, Leaf springs – Types of springs – Wahl factor – Problems.

**TOTAL: 45**

**TEXT BOOKS:**

- Shigley, Richard G. Budynas and Keith Nisbett J., “Mechanical Engineering Design”, 10<sup>th</sup> Edition, McGraw-Hill International Edition, New York, 2015.
- Bhandari V.B., “Design of Machine Elements”, 3<sup>rd</sup> Edition, Tata McGraw Hill, New Delhi, 2010.
- Pandya N.C. and Shah C.S., “Machine Design”, 18<sup>th</sup> Edition, Anand, Charotar Publishing House Pvt. Ltd., 2012.

**REFERENCE BOOKS:**

- Prabhu T.J., “Design of Transmission Elements”, T.J. Prabhu Publications, 2005.
- Kulkarni S.G., “Machine Design: Solved Problems”, Tata McGraw-Hill, New Delhi, 2008.
- Maitra G.M. and Prasad L.N., “Hand Book of Mechanical Design”, 2<sup>nd</sup> Edition, Tata McGraw-Hill, New Delhi, 2005.
- <http://nptel.ac.in/courses/112105124/>
- <http://nptel.ac.in/downloads/112105125/>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: analyze and select mechanical components in typical engineering design scenarios
- CO2: design the shafts, keys and couplings with proper assumptions
- CO3: design and analyze the spur, helical, bevel, worm gear drives and multi speed gear box
- CO4: design and analyze the clutches and braking systems
- CO5: design and analyze the bearings and springs

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	2							3	2	2
CO2	3	2	3	2	2							1	2	2
CO3	3	3	3	2	2							2	2	2
CO4	3	3	3	2	2							3	2	2
CO5	3	3	3	2	2							2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

# 14MEO01 INTRODUCTION TO AIRCRAFT SYSTEMS

(Common to Mechanical and Mechatronics branches)

3 0 0 3

## UNIT – I

9

**Introduction to Aircrafts:** Basic components of an Aircraft, Structural members, Aircraft Axis System, Aircraft Motions, Control surfaces and High lift Devices. Types of Aircrafts –Lighter than Air/Heavier than Air Aircrafts Conventional Design Configurations based on Power Plant Location, Wing vertical location, intake location, Tail Unit Arrangements, Landing Gear Arrangements. Unconventional Configurations-Biplane, Variable Sweep, Canard Layout, Twin Boom Layouts, Span loaders. Advantages and disadvantages of these Configurations.

## UNIT – II

9

**Aircraft Systems and Aerofoil:** Aerofoil Nomenclature, Types of Aerofoil, Wing Section–Aerodynamic Center, Aspect Ratio –Pressure Distribution over a wing section. Types of Aircraft Systems –Introduction to Mechanical, Electrical, Hydraulic and Avionics Systems.

## UNIT– III

9

**Basic Principles of Flight:** Significance of speed of Sound, Air speed and Ground Speed, Properties of Atmosphere. Generation of Lift, Drag, Pitching moments, Types of Drag, Lift curve, Drag Curve, Lift/Drag Ratio Curve, Factors affecting Lift and Drag. Lifting surfaces-lift and drag, angle of attack, centre of pressure and its effects.

## UNIT – IV

9

**Stability and Control:** Degree of Stability–Lateral, Longitudinal and Directional Stability Controls of Aircraft. Taxying, Landing, Gliding and Turning –Forces acting on an Aero plane during a Turn, Correct and incorrect Angles of Bank.

## UNIT – V

9

**Aircraft Performance and Maneuvers:** Taking off, climbing, Power Curves, Maximum and minimum speeds of horizontal flight, Effects of Changes of Engine Power, Effects of weight on performance, Effects of Altitude on Power Curves, Aerobatics, Inverted Maneuvers, Maneuverability.

**TOTAL: 45**

### TEXT BOOKS:

1. Kermode A.C., “Mechanics of Flight”, 5<sup>th</sup> Edition, Pearson Education, New Delhi. 2009.
2. Shevell, “Fundamentals of Flight”, 2<sup>nd</sup> Edition, Pearson Education, New Delhi. 2003.

### REFERENCE BOOKS:

1. Anderson, Dave “Introduction to Flight”, 7<sup>th</sup> Edition, McGraw-Hill, 2011.
2. Ian Moir, Allan Seabridge “Aircraft Systems: Mechanical, Electrical and Avionics Subsystems Integration”, 3<sup>rd</sup> Edition, Wiley, 2011.
3. Delp Frank, and Kroes, Michael J. and Watkins, William A., “Aircraft Maintenance & Repair”, 7<sup>th</sup> Edition, Glencoe & McGraw-Hill, 2013.
4. <http://nptel.ac.in/courses/101105022/>
5. <http://nptel.ac.in/courses/101106041/>

### COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: identify and configure the various types of aircrafts available
- CO2: analyze and demonstrate the issues in designing new aircraft
- CO3: exhibit the basic principles of flight
- CO4: reveal the stability and control aspects of the aircrafts
- CO5: analyze aircraft performance and maneuvers

### Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2											2	1	1
CO2	3	3	3	2	3	2						3	2	2
CO3	3	3	2	2	3	2						3	2	2
CO4	3	3	3	2	3	2						3	2	2
CO5	3	3	2	2	3	2						3	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

**14MTE02 EMBEDDED PROGRAMMING FOR MECHATRONICS SYSTEMS**

**3      0      0      3**

**Pre-requisites:** Microprocessors and Microcontrollers

**UNIT – I** **9**

**PIC Microcontroller:** Architecture of PIC 18 – Pin Description – Memory organization: Program memory – Data Memory – I/O Ports – Timers – Counters – Capture/ Compare /PWM mode – External Hardware Interrupts– USART – ADC.

**UNIT – II** **9**

**PIC 18 Embedded C Programming:** I/O ports: Register configuration–programming – Timers: modes–programming – Counters – ADC: configuration registers–programming – External Hardware Interrupts: types–programming.

**UNIT – III** **9**

**I/O Interfacing using PIC 18 Microcontroller:** Sensor interfacing – LED interfacing – LCD interfacing – Motor interfacing – High power devices using relays - Case studies: Automotive applications - Robotic applications.

**UNIT – IV** **9**

**ATMEGA 8 Microcontroller:** Architecture of ATMEGA 8 – Pin Description–. Memory organization: Program memory – Data Memory - I/O Ports – Timers – Counters – Analog comparator – Serial Peripheral Interface – USART – External Hardware Interrupts – ADC.

**UNIT – V** **9**

**ATMEGA 8 Embedded C Programming:** I/O ports: Register configuration–programming – Timers: modes–programming – Counters – ADC: configuration registers–programming – External Hardware Interrupts: types – programming.

**TOTAL: 45**

**TEXT BOOKS:**

1. Mazidi, Muhammad Ali, Mckinlay, Rolin D., and Causey Danny, “PIC Microcontroller and Embedded Systems using Assembly and C for PIC 18”, Pearson Education Asia, 2015.
2. Data sheet – ATMEGA 8.

**REFERENCE BOOKS:**

1. Peatman John B., “Design with PIC Microcontrollers”, Pearson Education, New Delhi, 2009.
2. Valvano Jonathan W., “Embedded Microcomputer Systems: Real Time Interfacing”, 3<sup>rd</sup> Edition, Thomson Asia, Singapore, 2011.
3. Data sheet –PIC18FXXX.
4. <http://nptel.ac.in/courses/101106041/>
5. <http://nptel.ac.in/downloads/108105057/>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: interpret architecture and interfacing concepts of PIC18 microcontroller
- CO2: develop embedded programming using PIC18 microcontrollers
- CO3: interpret architecture and features of ATMEGA 8 microcontroller
- CO4: build embedded programming using PIC18 microcontroller
- CO5: design interfacing circuits for real time applications using PIC18 microcontroller

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2								2	3	
CO2	3	3	3	3	3							2	3	3
CO3	3	3	2	2								2	3	
CO4	3	3	3	3	3							2	3	3
CO5	3	3	3	3	3							2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**Pre-requisites:** Sensors and Transducers, Control Systems

**UNIT – I**

9

**Introduction to Process Dynamics:** Process Control - Automatic Process Control - Need for Automatic Process Control in Industry - Mathematical Modeling of Processes – First Order Process Systems - level, temperature and pressure - Second Order Process Systems - Interacting and Non-Interacting Systems.

**UNIT – II**

9

**Process Characteristics and Control Modes:** Batch and Continuous Process - Self Regulation - Servo and Regulator Operation. Automatic Controller - Process Characteristics - Control System Parameters - Discontinuous Controller Modes - Continuous Controller Modes - Composite Control Modes.

**UNIT – III**

9

**Controller Tuning:** Evaluation Criteria: Performance Criteria - Controller Tuning: Process Reaction Curve Method - Ziegler-Nichols Method - Damped Oscillation Method - Frequency Response Method of Tuning - Self Tuning Controllers.

**UNIT – IV**

9

**Control Systems with Multiple Loops:** Advanced Control Systems - Feed Forward Control - Cascade Control - Ratio Control - Selective Control Systems - Split-Range Control - Adaptive Control - Inferential Control – Multi Variable Control.

**UNIT – V**

9

**Process Instrumentation:** Signal converters: I/P and P/I – Control valves: characteristics, valve positioner, selection of control valves - Introduction to transmitters, two wire and four wire transmitters, Smart and Intelligent Transmitters.

**TOTAL: 45****TEXT BOOKS:**

1. George Stephanopoulos, “Chemical Process Control-An Introduction to Theory and Practice”, 1<sup>st</sup> Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.
2. Johnson C.D., “Process Control Instrumentation Technology”, 8<sup>th</sup> Edition, Prentice-Hall, New Delhi, 2006.
3. Krishnaswamy K., “Process Control”, 2<sup>nd</sup> Edition, New Age International Pvt. Ltd. Publishers, New Delhi, 2013.

**REFERENCE BOOKS:**

1. Wayne Bequette B., “Process Control: Modeling, Design and Simulation”, PHI Learning Pvt. Ltd., New Delhi, 2012.
2. Singh S.K., “Process Control: Concepts, Dynamics and Applications”, PHI Learning Pvt. Ltd., New Delhi, 2009.
3. Surekha Bhanot, “Process Control Principles and Applications”, 1<sup>st</sup> Edition, Oxford University Press, 2008.
4. <http://nptel.ac.in/courses/103103037/>
5. <http://nptel.ac.in/courses/103105064/>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: develop the dynamics of processes using mathematical approach  
 CO2: interpret the characteristics of processes and propose the suitable control modes  
 CO3: examine the tuning of controllers  
 CO4: recommend the advanced control system for various process  
 CO5: choose the instrumentation to control the process

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	1							2	3	3
CO2	3	3	3	3	2							2	3	3
CO3	3	3	3	3	3							2	3	3
CO4	3	3	3	3	1							2	3	3
CO5	3	3	3	3	1							2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial



**14MTE04 APPLIED FINITE ELEMENT ANALYSIS**

**3 0 0 3**

**UNIT – I**

**9**

**Introduction:** Introduction to finite element analysis – Discretization – Matrix algebra – Gauss elimination method – Governing equations for continuum – Classical Techniques in FEM. Weighted residual method – Ritz method. Potential energy approach – Galerkin approach for one and two dimensions.

**UNIT – II**

**9**

**One Dimensional Elasticity Problems:** 1-D Finite element modeling – Bar Element – Beam Element- Coordinates and shape functions – Assembly of stiffness matrix and load vector –Formulation of Element Matrices and Equations - Analysis of Truss and Beam problems – Applications to Heat Transfer problems.

**UNIT – III**

**9**

**Two Dimensional Elasticity Problems:** Introduction to 2-D Finite element modeling – Plane stress – Plane Strain – Displacement Equations – Element Matrices – Element Equations – Formulation using Natural Coordinates.

**UNIT – IV**

**9**

**Axisymmetric Elements:** Axisymmetric formulation – Element stiffness matrix and force vector – Galerkin approach – Body forces and temperature effects – Stress calculations – Boundary conditions – Applications to cylinders under internal or external pressures – Rotating discs.

**UNIT – V**

**9**

**Isoparametric Elements for Two Dimensional Continuum:** Four node quadrilateral elements – Shape functions – Element stiffness matrix and force vector – Numerical integration - Stiffness integration – Stress calculations.

**TOTAL: 45**

**TEXT BOOKS:**

1. Cook R.D., Malkus D.S., Plesha M.E. and Witt R.J., “Concepts and Applications of Finite Element Analysis”, 4<sup>th</sup> Edition, John Wiley & Sons, 2007.
2. Rao S.S., “The Finite Element Method in Engineering”, Butterworth-Heinemann, 2010.

**REFERENCE BOOKS:**

1. Logan D.L., “A First Course in the Finite Element Method”, 3<sup>rd</sup> Edition, Thomson Learning, 2011.
2. Reddy J.N., “An Introduction to the Finite Element Method”, Tata McGraw Hill, International Edition, 2006.
3. Hutton David V., “Fundamentals of Finite Element Analysis”, Tata McGraw-Hill, New York, 2005.
4. <http://nptel.ac.in/courses/112104193/>
5. <http://nptel.ac.in/courses/112104116/>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: comprehend the finite element concepts used for designing engineering components
- CO2: derive the element matrix equation for solving one dimensional structural problems for different applications
- CO3: compute the results for a 3D domain using simple two dimensional assumptions for different applications
- CO4: solve and analyze the engineering problems using axisymmetric assumptions
- CO5: comprehend the effective usage of isoparametric elements and Numerical integration techniques used in FEM

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	3					1		1	3	3
CO2	3	3	3	3	3							1	3	3
CO3	3	3	3	3	3					1		1	3	3
CO4	3	3	3	3	3							1	3	3
CO5	3	3	3	3	3							1	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**Pre-requisites:** Fluid Mechanics and Machinery, Thermodynamics and heat transfer

**UNIT – I** **9**

**Engine Components:** Components of an Automobile – Engine Terminology – Types of engines: Petrol & Diesel - 2 Stroke and 4 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.

**UNIT – II** **9**

**Transmission Systems:** Clutch – Types and Construction – Clutch operation: Electromagnetic – Mechanical – Hydraulic – Vacuum. Gear Boxes: Manual and Automatic – Simple Floor Mounted Shift Mechanism – Over Drives – Transfer Box - Fluid flywheel - Torque converter – Propeller shaft – Slip Joint – Universal Joints – Differential and Rear Axle – Hotchkiss Drive and Torque Tube Drive.

**UNIT – III** **9**

**Steering, Brakes and Suspension:** Wheels and Tyres – Wheel Alignment Parameters. Steering: Steering Geometry - Types of steering gear box – Davis and Ackermann steering mechanism - Power Steering – Electronic Steering. Types of Front Axle. Suspension systems: Types of suspension springs – Plastic, Air and Independent suspension system – Shock absorbers – Active vibration control. Braking Systems: Types and Construction – Hydraulic brakes - Diagonal Braking System – Antilock Braking System.

**UNIT – IV** **9**

**Battery and Lighting System:** Types of batteries - Construction, Operation and Maintenance. Electrical systems: Lighting – Wiring circuit - Head lights – Switches – Indicating lights. Accessories: Direction indicators – Windscreen wiper – Horn – Speedometer – Heaters – Air conditioner.

**UNIT – V** **9**

**Alternate Energy Sources:** Use of Natural Gas, LPG, Bio diesel, Gasohol and Hydrogen in Automobiles - Electric and Hybrid Vehicles, Fuel Cells. Cost benefit analysis of various alternate energy sources for automobiles.

**TOTAL: 45**

**TEXT BOOKS :**

1. Kirpal Singh, “Automobile Engineering”, 13<sup>th</sup> Edition, Volume I & II, Standard Publishers, New Delhi, 2012.
2. Ganesan V., “Internal Combustion Engines”, 4<sup>th</sup> Edition, Tata McGraw-Hill, New Delhi, 2012.

**REFERENCE BOOKS:**

1. Crouse William H. and Anglin Donald L., “Automotive Mechanics”, 10<sup>th</sup> Edition, Tata McGraw-Hill, New Delhi, 2008.
2. Heitner Joseph, “Automotive Mechanics”, 2<sup>nd</sup> Edition, East-West Press, New Delhi, 2006.
3. Tom Denton, “Automobile Electrical and Electronics Systems”, 4<sup>th</sup> Edition, Edward Arnold Publishers, 2013.
4. Heinz Heisler, “Advanced Vehicle Technology”, 2<sup>nd</sup> Revised Edition, Butterworth-Heinemann Ltd., 2002.
5. <http://nptel.ac.in/downloads/112104033/>
6. <http://nptel.ac.in/downloads/108103009/>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: identify the IC engine components and its function  
 CO2: categorize the types of transmission system  
 CO3: choose appropriate suspension, brake and steering systems for automobile applications  
 CO4: design the circuit for automotive electrical systems  
 CO5: analyze the use of alternate fuel sources recommended for automobiles

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2		1	2	1	1		1				2	2	1
CO2	2	2	2		1							1	2	1
CO3	2				1							1	2	1
CO4	2	3	3	2	2			1				3	3	2
CO5	2		3	3	3	3	3	1				3	2	1

1 – Slight, 2 – Moderate, 3 – Substantial



## 14GEE81 ENTREPRENEURSHIP DEVELOPMENT

(Common to all Engineering and Technology branches except Civil and Chemical Engg.)

3 0 0 3

### UNIT – I

**Entrepreneurship Concepts:** Meaning and concept of entrepreneurship, Role of Entrepreneurship in Economic Development. Factors affecting Entrepreneurship – Creativity, Innovation and Entrepreneurship, Intrapreneurship

9

### UNIT – II

**Entrepreneur:** Definition, Entrepreneurial Motivation, Characteristics of Entrepreneurs, Distinction between an Entrepreneur and a Manager.

9

### UNIT – III

**Business Plan:** Objectives of a Business Plan, Business Planning Process, Opportunity Identification and Selection, Contents of a Business Plan, Functional Plans.

9

### UNIT – IV

**Entrepreneurial Eco System:** Forms of Business Ownership, Sources of Finance, Institutional Support to Entrepreneurs.

9

### UNIT – V

**Small Business Management:** Definition of Small Scale Industries, Strengths and Weaknesses of Small Business, Growth Strategies in Small Scale Enterprises, Sickness in Small Enterprises – Symptoms, Causes and Consequences.

9

**TOTAL : 45**

### TEXT BOOK:

1. S.S.Khanka, “Entrepreneurial Development”, 4<sup>th</sup> Edition, S.Chand & Company Ltd., 2012.
2. Madhurima Lall and Shikha Sahai, “Entrepreneurship”, 2<sup>nd</sup> Edition, Excel Books, New Delhi, 2008.

### REFERENCE BOOKS:

1. Raj Shankar, “Entrepreneurship, Theory and Practice”, Vijay Nicole Imprints Pvt. Ltd., Chennai 2012.
2. Barringer and Ireland, “Entrepreneurship”, 3rd Edition, Pearson Education, 2012.
3. Zimmer and Scarborough, “Essentials of Entrepreneurship and Small Business Management”, 5<sup>th</sup> Edition, PHI Learning Pvt. Ltd., 2009.

### COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: understand the concepts of entrepreneurship and its importance
- CO2: understand the traits of an entrepreneur and the sources of his motivation
- CO3: understand the components of a business plan
- CO4: demonstrate knowledge of various sources of finance and institutions supporting entrepreneurship
- CO5: understand the nature of small business and causes of industrial sickness

### Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						1	3	2	3		3	2	1	1
CO2						1	3	2	3		3	2	1	1
CO3				2		1	3	2	3		3	2	1	1
CO4				1		1	3	2	3		3	2	1	1
CO5		2		2		1	3	2	3		3	2	1	1

1 – Slight, 2 – Moderate, 3 – Substantial

**14MTE06 ADVANCED SENSORS AND NETWORKING**

(Common to Mechatronics and EIE branches)

**3 0 0 3****Pre-requisites:** Sensors and Transducers**UNIT – I** **9****Introduction to Sensors:** Introduction –Sensor Classification – Sensor Characteristics and Terminology – Physical Effects Employed for Signal Transduction – Mathematical Model of Transducer – Zero, I and II order transducers – Choice of Sensor – New Sensor Materials and Technologies – Standards, Temperature Scales and Units and relations of physical quantities.**UNIT – II** **9****Chemical Sensors:** Molecular Recognition – Signal Transduction – Electrochemical Sensors: Amperometric and Voltammetric Sensors – Potentiometric Sensors – Evanescent wave Sensors – Multisensory Arrays – Biosensors – Humidity Sensors.**UNIT – III** **9****Optic Sensors:** Fundamentals of light – Electromagnetic Optics Spectrum – Propagation of light Lambert – Beer Law – Interactions of Light: Absorption, Scattering, Dispersion, Polarization, Diffraction and Interference – Optical Sources – Optical Detectors – Optical Components – Fiber Optic Sensors: Intensity Modulated Sensors – Diffraction Grating Sensors – Interferometric Sensors.**UNIT – IV** **9****Fundamentals of Wireless Communication:** Fundamentals of Wireless Communication Technology – The Electromagnetic Spectrum – Radio propagation Mechanisms – Characteristics of the Wireless Channel - wireless sensor networks (WSNs): concepts and architectures. Design Challenges in Sensor Networks.**UNIT – V** **9****Wireless Sensor Networks (WSNs):** Single node architecture: hardware and software components of a sensor node - WSN Network architecture: - data relaying and aggregation strategies - Issues in WSN routing–OLSR–Localization–Indoor and Sensor Network Localization-absolute and relative localization. QOS in WSN – Energy Efficient Design.**TOTAL: 45****TEXT BOOKS :**

1. John Vetelino and Aravind Reghu, “Introduction to Sensors”, CRC Press, 2010.
2. Francis To So Yu and Shizhuo Yin, “Fiber Optic Sensors”, CRC Press, 2008.
3. Holger Karl and Andreas Willig “Protocols and Architectures for Wireless Sensor Networks”, Wiley, 2005.

**REFERENCE BOOKS:**

1. Jacob Fraden, “Handbook of Modern Sensors”, Springer, 2010
2. Jiri Janata, “Principles of Chemical Sensors”, Springer, 2009.
3. Pavel Ripka and Alois Tipek, “Modern Sensors Handbook”, ISTE Ltd, 2007
4. Jon S. Wilson, “Sensor Technology Handbook”, Newnes, 2005.
5. Kazem Sohraby, Daniel Minoli and Taieb Znati, “Wireless Sensor Networks-Technology, Protocols, and Applications”, John Wiley, 2007.
6. <http://nptel.ac.in/courses/112106140/>
7. <http://nptel.ac.in/courses/106105160/37>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: interpret the basic concepts of sensors and its characteristics  
 CO2: demonstrate the advanced concepts of chemical sensors  
 CO3: analyze the characteristics of optic sensor measurement system  
 CO4: explain the concepts, network architectures and applications of wireless sensor networks  
 CO5: analyze the protocol design issues of wireless sensor networks

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2									2	2	2
CO2	3	2	2	2								2	2	2
CO3	3	3	3									2	3	3
CO4	3	3	3	3								2	3	3
CO5	3	3	3	3								2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**14MTE07 AUTOMOTIVE ELECTRONICS**  
(Common to Mechatronics, ECE and EIE branches )

**3 0 0 3**

**Pre-requisites:** Sensors and Transducers

**UNIT – I** **9**

**Introduction:** Evolution of electronics in automobiles – Introduction to Euro I, Euro II, Euro III, Euro IV, Euro V standards – Equivalent Bharat Standards. Charging systems: Working, charging circuit diagram – Alternators – Requirements of starting system - Starter motors and starter circuits.

**UNIT – II** **9**

**Sensors and Actuators:** Working principle and characteristics of sensors: Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, exhaust gas oxygen sensor. Study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator and vacuum operated actuator.

**UNIT – III** **9**

**Ignition and Injection Systems:** Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition – Distribution less ignition - Direct ignition – Spark Plugs. Electronic fuel Control - Basics of combustion – Engine fuelling and exhaust emissions – Electronic control of carburetion – Petrol fuel injection – Diesel fuel injection.

**UNIT – IV** **9**

**Engine and Emission Control Systems:** In vehicle networks: CAN, LIN, FLEXRAY, MOST, KWP2000. Control modes for fuel control-engine control subsystems – Ignition control methodologies – Engine management system. Catalytic converter – EGR – SCR – DeNox Trap. Diagnostics systems in modern automobiles.

**UNIT – V** **9**

**Chassis and Safety Systems:** Electronic transmission control. Traction control system – Adaptive cruise control – Electronic control of automatic transmission - Antilock braking system - Electronic Stability Program – Electronic suspension system – Working of airbag and role of MEMS in airbag systems –seat belt tensioners. Centralized door locking system – Climate control of cars.

**TOTAL: 45**

**TEXT BOOKS:**

- Tom Denton, “Automobile Electrical and Electronics Systems”, 4<sup>th</sup> Edition, Edward Arnold Publishers, London, 2013.
- Ribbens William B., “Understanding Automotive Electronics”, 7<sup>th</sup> Edition, Butterworth- Heinemann, Burlington, 2012.

**REFERENCE BOOKS:**

- Hollebeak, Barry, “Automotive Electricity, Electronics & Computer Controls”, Delmar Publishers, New York, 2002.
- Tim, Gilles, “Automotive Engines: Diagnosis, Repair, Rebuilding”, 7<sup>th</sup> Edition, Delmar Publishers, New York, 2015.
- Donald Christiansen and Charles K. Alexander, “Standard Handbook Of Electronic Engineering”, 5<sup>th</sup> Edition, McGraw-Hill, 2005.
- Robert Bosch GmbH, “Automotive Hand Book”, 9<sup>th</sup> Edition, Wiley, 2014.
- <http://nptel.ac.in/downloads/108103009/>
- <http://nptel.ac.in/courses/108108076/>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: adapt to the continuous changes in emission and safety norms of India
- CO2: analyze the use of electronic ignition and injection system used in automobile
- CO3: identify the various sensors and actuators for automotive applications
- CO4: design the control system for ECU used in engine management system
- CO5: utilize the safety systems for automobile upgradation

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	
CO1	3	2	2	1		2	3						2	1	2
CO2	3	3	3	3	2	1	1						2	3	3
CO3	3	3	3	3		1	1						2	3	3
CO4	3	3	3	3	2	1	2						2	3	3
CO5	3	1	2	2		3	1						2	1	2

1 – Slight, 2 – Moderate, 3 – Substantial

## 14MTE08 COMPUTER INTEGRATED MANUFACTURING

3    0    0    3

**Pre-requisites:** Manufacturing Process, CNC Technology, Programmable Automation Controller

### UNIT – I

9

**Introduction:** Introduction to CAD/CAM – Manufacturing Planning, Manufacturing control - Concurrent Engineering - CIM concepts – Computerized elements of CIM system –Types of production – Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems. Basic Elements of an Automated system – Levels of Automation. Lean Production and Just-In-Time Production- Kanban System, Business Process Re-engineering (BPR).

### UNIT – II

9

**Production Planning & Control and Computerised Process Planning:** Process Planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and Master Production Schedule – Material Requirement Planning – Capacity Planning - Control Systems - Shop Floor Control - Inventory Control. Brief on Manufacturing Resource Planning (MRP-II) and Enterprise Resource Planning (ERP) – Supply Chain Management (SCM) – Simple Problems.

### UNIT – III

9

**Cellular Manufacturing:** Group Technology(GT), Part Families – Parts Classification and Coding – Simple Problems in Opitz Coding system – Production Flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method – Arranging Machines in a GT cell – Hollier Method – Simple Problems.

### UNIT – IV

9

**Flexible Manufacturing System (FMS) and Automated Guided Vehicle System (AGVS):** Types of Flexibility – FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance Technology – Vehicle Management & Safety. Automated Storage systems – Performance –Methods.

### UNIT – V

9

**Computer Aided Quality Control:** Computers in QC, Automated Inspection Methods and Principles, Contact Inspection Methods, Non Contact Inspection Methods, Machine Vision System, Optical Inspection Method, Sensors, Co-ordinate Measuring Machine, Computer Aided Testing , Integration of CAQC with CAD/CAM.

**TOTAL: 45**

### TEXT BOOKS:

- Groover M.P., “Automation, Production System and Computer Integrated Manufacturing”, 3<sup>rd</sup> Edition, Prentice-Hall of India, New Delhi, 2014.
- Radhakrishnan P. and Subramanyan S. and Raju V., “CAD/CAM/CIM”, 3<sup>rd</sup> Edition, New Age International Publishers, New Delhi, 2014.

### REFERENCE BOOKS:

- Koren, Yoram, “Computer control of Manufacturing Systems”, McGraw Hill, New Delhi, 2009.
- Bedworth David D., Henderson Mark R. and Wolfe Philip M., “Computer Integrated Design and Manufacturing”, Tata McGraw Hill, New Delhi, 2008.
- Rao P.N., “CAD/CAM: Principles and Applications”, 3<sup>rd</sup> Edition, Tata McGraw Hill Publishing Company, 2010.
- [nptel.ac.in/courses/108105063/pdf/L-01\(SM\)\(IA&C\)%20\(\(EE\)NPTEL\).pdf](http://nptel.ac.in/courses/108105063/pdf/L-01(SM)(IA&C)%20((EE)NPTEL).pdf)
- [nptel.ac.in/courses/112103174/module1/lec2/3.html](http://nptel.ac.in/courses/112103174/module1/lec2/3.html)

### COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: apply CIM concepts in manufacturing industries
- CO2: develop a process plan and material requirement plan for a product
- CO3: identify the parts by using different coding methods
- CO4: design flexible manufacturing layout for a machine cell
- CO5: utilize various computer aided quality control techniques and inspection techniques

#### Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	2	2							2	3	3
CO2	2	3	3	2	2							2	2	2
CO3	2	3	2	1	2							2	2	2
CO4	3	3	2	2	2							2	3	2
CO5	2	3	2	2	3							2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial

**14MTE09 DSP PROCESSORS AND ARCHITECTURE**

**3      0      0      3**

**Pre-requisites:** Sensors and Transducers, Numerical methods

**UNIT – I** **9**

**Introduction to Digital Signal Processing:** Introduction to Digital signal-processing - The sampling process - Discrete time sequences - Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT) - Linear time-invariant systems - Digital filters - Decimation and interpolation. Analysis and Design tool for DSP Systems: DSP using MATLAB.

**UNIT – II** **9**

**Computational Accuracy in DSP Implementations:** Number formats for signals and coefficients in DSP systems - Dynamic Range and Precision - Sources of error in DSP implementations - A/D Conversion errors - DSP Computational errors - D/A Conversion Errors - Compensating filter.

**UNIT – III** **9**

**Architectures for Programmable DSP Devices:** Basic Architectural features - DSP Computational Building Blocks - Bus Architecture and Memory - Data Addressing Capabilities - Address Generation Unit - Programmability and Program Execution - Speed Issues - Features for External interfacing.

**UNIT – IV** **9**

**Execution Control and Pipelining:** Hardware looping - Interrupts - Stacks - Relative Branch support - Pipelining and Performance - Pipeline Depth - Interlocking - Branching effects - Interrupt effects - Pipeline Programming models.

**UNIT – V** **9**

**Programmable Digital Signal Processors:** Commercial Digital signal-processing Devices - Data Addressing modes of TMS320C54XX DSPs - Data Addressing modes of TMS320C54XX Processors - Memory space of TMS320C54XX Processors - Program Control - TMS320C54XX instructions and Programming - On-Chip Peripherals - Interrupts of TMS320C54XX processors.

**TOTAL: 45**

**TEXT BOOKS:**

1. Venkata Ramani B. and Bhaskar M., "Digital Signal Processors, Architecture, Programming and Applications", Tata McGraw-Hill Company Pvt. Ltd., 2004.
2. Avtar Singh and Srinivasan S., "Digital Signal Processing Implementations: Using DSP Microprocessors With Examples from TMS320C54xx", Thomson Publications, 2004.

**REFERENCE BOOKS:**

1. Woon-Seng Gan, Sen M. Kuo, "Embedded Signal Processing with the Micro Signal Architecture", Wiley-IEEE Press, 2007.
2. Jonatham Stein, "Digital Signal Processing: A Computer Science Perspective", John Wiley, 2009.
3. Phil Lapsley, Jeff Bier, Edward A. Lee and Amit Shoham, "DSP Processor Fundamentals, Architectures & Features", S. Chand and Co., 1997.
4. <http://nptel.ac.in/courses/117102060/>
5. [nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/.../Pdf/Lesson-7.pdf](http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/.../Pdf/Lesson-7.pdf)

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: learn the basic concepts in digital signal processing techniques
- CO2: infer computational accuracy in DSP implementations
- CO3: demonstrate the concepts of programmable DSP devices
- CO4: examine control and pipelining of programming models
- CO5: select the various digital signal processor

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2		2							1	2	2
CO2	3	3	3		2							1	2	2
CO3	3	2	2		2							1	2	2
CO4	3	3	3		2							1	2	2
CO5	3	2	2		2							2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial

## 14MTE10 MICROFLUIDICS AND BIO-MEMS

3    0    0    3

**Pre-requisites:** Fluid Mechanics , Micro Electro Mechanical Systems

**UNIT – I** **9**

**Microfluidics:** Introduction- Origin, Definition, Benefits, Challenges, Commercial activities, Physics of miniaturization, Scaling laws. Hydrodynamics of microfluidic systems – micro hydrodynamics – interface phenomena – Capillary flows - microfluidics of drops and bubbles.

**UNIT – II** **9**

**Fluid Mechanics:** Introduction- Intermolecular forces, States of matter, Continuum assumption, Governing equations, Constitutive relations. Gas and liquid flows, Boundary conditions, Slip theory, Transition to turbulence, Low Re flows, Entrance effects, Capillary flows. **Electrokinetics:** Electro hydrodynamics fundamentals. Electro-osmosis, Electrophoresis of particles, Dielectrophoresis

**UNIT – III** **9**

**Microfluidics Components:** Micropumps, Check-valve pumps, Valve-less pumps, Peristaltic pumps, Rotary pumps, Centrifugal pumps, Ultrasonic pump, EHD and MHD pumps. Microvalves, Pneumatic valves, Thermo pneumatic valves, Thermo mechanical valves, Piezoelectric valves, Electrostatic valves, Electromagnetic valves, Capillary force valves. Microflow sensors, Differential pressure flow sensors, Thermal flow sensors. Microreactors, microchannels, microneedles, microreservoirs.

**UNIT – IV** **9**

**Introduction to bio-MEMS:** Materials for BioMEMS, BioMEMS fabrication, Introduction to silicon device fabrication, LIGA. Soft fabrication and polymers (soft-lithography, micromolding, microstereolithography, thick-film deposition. Microfluidic principles. Micro total analysis system ( $\mu$ TAS), Lab-on-a-chip. Microarrays: polymerase chain reactor (PCR), DNA chip, functional genomics, Bioinformatics.

**UNIT – V** **9**

**Applications of Microfluidics:** Detection, DNA & protein analysis, Cellular studies, Medical diagnostics, Drug discovery, Diagnostics, Bio-sensing and Commercial examples.

**TOTAL: 45**

### TEXT BOOKS :

- Patrick Tabeling, “Introduction to Microfluidics”, Oxford University Press, Oxford, 2010.
- Nam-Trung Nguyen and Steven T. Wereley, “Fundamentals and Applications of Microfluidics”, 2<sup>nd</sup> Edition, Artech House, 2006.

### REFERENCE BOOKS:

- Gerald Urban, “BioMEMS”, Springer Science & Business Media, 2007.
- Steven Saliterman, “Fundamentals of BioMEMS and Medical Microdevices”, SPIE Press, 2006.
- Marc J. Madou, “From MEMS to Bio-MEMS and Bio-NEMS: Manufacturing Techniques and Applications” CRC Press, 2011.
- <http://nptel.ac.in/courses/112106169/>
- <http://nptel.ac.in/courses/112104181/>

### COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: assess the effects of scaling in microfluidics
- CO2: analyse the mechanics and electro kinetics of fluids
- CO3: select microfluidic components for the required applications
- CO4: design and analyze a bio-MEMS system
- CO5: interpret the application of microfluidics with medical problems

#### Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2		2							2	2	2
CO2	3	3	2		2							2	2	2
CO3	3	2	2		2							2	2	2
CO4	3	3	3	2	2	1	1					2	3	3
CO5	3	3	3	2	2	1	1					2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**Pre-requisites:** Industrial Robotics

**UNIT – I** 9

**Introduction:** Mobile Robots – Types of mobile robots: Automated Guided vehicles (AGVs)- Service robots- Cleaning robots – Social Robots – Field Robots –Inspection and exploration robots- Humanoid robots– Nuclear robots – Underwater Robots - Autonomous Surface Vessels. Applications of mobile robots.

**UNIT – II** 9

**Mobile robot Engineering:** Mobile Robot subsystems – Fundamentals of wheeled and legged mobile robot. Kinematics models of mobile robots: Kinematic Models and Constraints – Hilare mobile robots – Car-like mobile robots –Mobile Robot Maneuverability-Mobile Robot Workspace. Motion Control.

**UNIT– III** 9

**Locomotion:** Introduction- Legged Mobile Robots- Leg configurations and stability- Examples of legged robot locomotion- Wheeled Mobile Robots- Wheeled locomotion: the design space- Wheeled locomotion: case studies.

**UNIT – IV** 9

**Perception and Localization:** Sensors for mobile robots –Representing Uncertainty- Feature Extraction -Mobile robot localization- Challenge of Localization: Noise and Aliasing - Map Representation - Probabilistic Map based Localization - Probabilistic Map-Based Localization.

**UNIT – V** 9

**Planning and Navigation:** Introduction- Competences for Navigation: Planning and Reacting- Navigation Architectures- Modularity for code reuse and sharing- Control localization- Techniques for decomposition- Case studies: tiered robot architectures.

**TOTAL: 45**

**TEXT BOOKS:**

1. Roland Siegwart, Illah Reza Nourbakhsh and Davide Scaramuzza, “Introduction to Autonomous Mobile Robots”, 2<sup>nd</sup> Edition, MIT Press, Cambridge, 2011.
2. Farbed Fahimi, “Autonomous Robots – Modeling, Path Planning and Control”, Springer, 2009.
3. Alonzo Kelly, “Mobile Robotics: Mathematics, Models and Methods”, Cambridge University Press, 2013.

**REFERENCE BOOKS:**

1. Ingemar J. Cox, and Gordon Thomas Wilfong, “Autonomous Robot Vehicles”, Springer, 2012.
2. Spyros G Tzafestas, “Introduction to Mobile Robot Control”, 1st Edition, Elsevier, 2014.
3. Ulrich Nehmzow, “Mobile Robotics: A Practical Introduction”, Springer Science & Business Media, 2012.
4. <https://mitpress.mit.edu/books/introduction-autonomous-mobile-robots>
5. <http://www.doabooks.org/doab?func=search&uiLanguage=en&template=&query=mobile+robotics>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: identify various domains for robotic systems applications
- CO2: develop the kinematic model of mobile robots
- CO3: analyse the different concepts of locomotion
- CO4: select the sensory devices for localization
- CO5: apply the concepts of planning and navigation

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	2							2	3	3
CO2	3	3	3	3	2							2	3	3
CO3	3	3	3	3	2							2	3	3
CO4	3	3	3	3	2							2	3	3
CO5	3	3	3	3	2							2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**14MTE12 NANOTECHNOLOGY**  
(Common to Mechatronics and EIE branches)

**3 0 0 3**

**Pre-requisites:** Applied Physics, Applied Chemistry, Material Science

**UNIT – I**

**9**

**Nanomaterials:** Introduction to nanomaterials - Scientific revolutions of nanotechnology - Evolution of band structure and Fermi surface - Bonding in solids: Ionic bonding, Covalent bond, Metallic bond, Intermolecular bonds, Dispersion bonds, Dipole bonds, Hydrogen bonds.

**UNIT – II**

**9**

**Nanostructures:** Classification of nanostructures - zero, one, two and three dimensional nanostructures. Size effects in nanostructures. Chemistry of nanoshapes - Surface to volume ratio. Smart materials - Shape Memory Alloys: shape memory effects.

**UNIT – III**

**9**

**Synthesis of Nanomaterials:** Methods of nanomaterial preparation - Top down and bottom up approach: mechanical grinding, wet chemical synthesis, gas phase synthesis, Chemical vapour deposition. Film Deposition Method - Lithography - Material removing techniques: Etching, Chemical and Mechanical Polishing.

**UNIT – IV**

**9**

**Properties of Nanoparticles:** Surface properties of nanoparticles - Mechanical, electronic, optical, magnetic, thermal and chemical properties. Size dependent properties.

**UNIT – V**

**9**

**Fields of Nanotechnology:** Quantum dots - properties and applications. Carbon nanotubes - physical properties and applications. Magnetic materials: Dia and Paramagnetic materials - Quantum theory of paramagnetic materials – Nanodevices: Electronic, magnetic, photonic, mechanical, fluidic, and biomedical Nanodevices.

**TOTAL: 45**

**TEXT BOOKS:**

1. Charles P. Poole and Frank J. Owens, “Introduction to Nanotechnology”, Wiley Interscience, 2007.
2. Mark A. Ratner and Daniel Ratner, “Nanotechnology: A gentle introduction to the next Big Idea”, Prentice Hall, P7R, 1<sup>st</sup> Edition, 2003.
3. T. Pradeep, “Nano the Essential Nanoscience and Nanotechnology”, Tata McGraw hill, 2008.

**REFERENCE BOOKS:**

1. Mick Wilson, Kamali Kannargare and Geoff Smith, “Nano technology: Basic Science and Emerging Technologies”, Overseas Press, 2005.
2. Dutta J. and Hoffmann H., “Nanomaterials”, Top Nano, 2004.
3. Rajendran V., “Material Science”, Tata McGraw Hill, New Delhi, 2011.
4. <http://nptel.ac.in/courses/118102003/>
5. <http://nptel.ac.in/courses/118104008/>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: infer the basic concepts of nanomaterials
- CO2: classify the different nanostructures
- CO3: investigate the different methods in synthesis of nanomaterials
- CO4: determine the properties of different nanomaterials
- CO5: recommend the nanostructured materials for real time engineering applications

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2		2							2	2	2
CO2	3	3	3		2							2	2	2
CO3	3	3	3		2							2	2	2
CO4	3	3	3	2	2							2	2	2
CO5	3	3	3	3	2							2	2	2

1 – Slight, 2 – Moderate, 3 – Substantial



## 14MTE13 PRECISION EQUIPMENT DESIGN

3    0    0    3

**Pre-requisites:** Engineering Metrology, Control Systems

**UNIT – I** **9**

**Introduction to Precision Equipment Design:** Introduction, Fundamentals of Economic Analysis, The Role of a Design Engineer, Principles of accuracy, repeatability and resolution, Optical sensor systems, Sensor Mounting and Calibration, Beyond Intelligent manufacturing, Reconfigurable systems.

**UNIT – II** **9**

**Error Assessment and Inspection:** Introduction to Errors and error measurements, Propagation of errors, Motion errors principle –translational body, rotational body, geometric and kinematic errors, Other types of errors in machines – thermal, cutting force induced, environmental error, Methodologies of error elimination, Future vision in machine error inspection, CNC machine error assessment – positioning accuracy using Laser interferometer, contouring assessment using kinematic ball bar system.

**UNIT – III** **9**

**Design Strategies and Machine Key Components:** Standard sizes, Precision engineering principles –design, modeling and simulation , Design roadmap – conceptual analysis, materials selection, kinematic design of bearing and guide ways, Structural analysis – static and dynamic analysis , Key components – guide ways – selection , precision linear and rotating movement.

**UNIT- IV** **9**

**Parallel Kinematic Machines (PKM):** Introduction, Comparison of Serial and parallel systems, Precision design of a PKM – need of PKM - low cost, degrees of freedom, workspace volume, high stiffness and agility, repeatability in movement, low inertia, Configurations and characteristic issues – Design principles – Kinematic modeling.

**UNIT- V** **9**

**Precision Control:** Fundamentals of motion control , system modeling and performance assessment , linear dynamics, nonlinear dynamics – force ripple, friction, hysteresis, incorporating nonlinear dynamics, Control design strategies – ripple compensation, RBF compensation, internal model control. Case Study – Design of piezoelectric actuator.

**TOTAL: 45**

**TEXT BOOKS:**

1. Samir Mekid, “Introduction to Precision Machine Design and Error Assessment”, CRC-Press, Taylor and Francis Group, New York, 2013.
2. Alexander H. Slocum, “Precision Machine Design”, Prentice Hall Publishers, 2009.

**REFERENCE BOOKS:**

1. Nakazawa H., “Principles of Precision Engineering”, Oxford University Press, Oxford, 2011.
2. Smith S.T. and Chetwynd D.G., “Foundations of Ultra – Precision Mechanism Design”, Gordon and Breach Publishers, Switzerland, 2008.
3. Moore W.R., “Foundations of Mechanical Accuracy”, The Moore Special Tool Company, Bridgeport, Connecticut, 1970.
4. <http://nptel.ac.in/courses/112106137/>
5. <http://nptel.ac.in/courses/112104121/1>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: assess the suitability of equipment designs concepts for specific applications
- CO2: inspect the errors in various machines like CNC machines
- CO3: analyze the design strategies of several machine tools and choose the appropriate design approach
- CO4: perform kinematic analysis for various mechanisms
- CO5: develop the complete control of the mechanical system to achieve a better positioning and often compensating for errors

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	2							2	3	3
CO2	3	3	3	2	2							2	3	3
CO3	3	3	3	3	2							2	3	3
CO4	3	3	3	3	2							2	3	3
CO5	3	3	3	3	2							2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**Pre-requisites:** Manufacturing Processes, Economics and Management for Engineers and Statistics and Numerical Methods

**UNIT – I** 9

**Concept of PM and Demand Forecasting:** Objectives of Production Management – Production systems-concept-types-Productivity. Product Design and analysis: Process planning and design- Economic Analysis- Designing for customer-Designing for manufacture and assembly. Demand forecasting: Time series - Moving Average – Exponential Smoothing – Trend Projections – Regression and Correlation Analysis - Forecast errors.

**UNIT – II** 9

**Facility Design:** Plant location: Factors affecting plant location – Center of Gravity Method – Factor Rating Method – Breakeven Analysis Method. Plant layout: classification – layout design procedures- assembly Line Balancing. Material handling systems: unit load concept – Material handling principles- classification of material handling equipments.

**UNIT – III** 9

**Aggregate Planning and ERP:** Aggregate planning strategies-Methods-Master Production Schedule. Material requirement planning (MRP)-BOM- Lot sizing in MRP- Capacity Requirement Planning- MRP II. Enterprise Resource Planning (ERP)-Modules-steps in ERP implementation- ERP products.

**UNIT – IV** 9

**Supply Chain Management (SCM):** Elements of SCM - Supply chain performance- drivers and metrics- planning demand and supply- planning inventory- supply chain coordination - bullwhip effect – transportation networks- inbound & outbound logistics – reverse logistics – warehouse management.

**UNIT – V** 9

**Lean and Agile Systems:** Toyota production systems – Types of wastes - Lean principles – lean tools – Value stream mapping – current state map, future state map, 5S, Kanban, TPM, SMED, Visual management, kaizen. Agile manufacturing – Fundamental structure – Agility through Management, Technology, Manufacturing strategy, competitive driver.

**TOTAL: 45**

**TEXT BOOKS:**

1. Panneerselvam R., “Production and Operations Management”, 3<sup>rd</sup> Edition, PHI learning, New Delhi, 2012.
2. Buffa E.S. and Sarin R.K., “Modern Production / Operations Management”, 8<sup>th</sup> Edition, Wiley India Pvt. Ltd., New Delhi, 2013.

**REFERENCE BOOKS:**

1. Devadhasan S.R., Mohansivakumar V., Murugesh R. and Shalij P.R., “Lean and Agile Manufacturing- Theoretical, Practical and Research Futurities”, PHI Learning, New Delhi, 2012.
2. Sunil Chopra and Peter Meindl, “Supply Chain Management – Strategy, Planning and Operation”, 5<sup>th</sup> Edition, Prentice Hall, New Delhi, 2014.
3. Robert Jacobs F., Nicholas Aquilano, Ravi Shankar and Richard Chase, “Operations and Supply Management (SIE)”, 12<sup>th</sup> Edition, Tata McGraw-Hill Education Pvt. Ltd., New Delhi, 2010.
4. <http://nptel.ac.in/courses/112102107/>
5. <http://nptel.ac.in/courses/112102106/>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: adapt production planning concepts and forecast the demand
- CO2: select proper location for a plant and design the layout
- CO3: develop aggregate and facility requirement plan for a manufacturing company
- CO4: utilize the concept of supply chain management
- CO5: apply various lean and agile principles in a manufacturing/service enterprise

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	3	2						2	2	1	2
CO2	3	2	2	2	2						2	2	1	2
CO3	3	2	2	3	2						2	2	1	2
CO4	2	2	2	2	2						2	2	1	2
CO5	2	2	2	2	2						2	2	1	2

1 – Slight, 2 – Moderate, 3 – Substantial

**UNIT – I** **9**

**Fundamentals:** Introduction to Mechatronics systems – Key elements – Mechatronics design process – Types of Design: Traditional and Mechatronics design - Integrated product design - Advanced approaches in Mechatronics - Industrial design and ergonomics, safety.

**UNIT – II** **9**

**System Modelling:** Introduction - Model categories - Fields of application - Model development - Model verification - Model validation - Simulators and Simulation – Design of mixed system: Electro mechanical system design – Model transformation – Domain independent description forms: Bond graph and Block Diagram - Simulator coupling.

**UNIT – III** **9**

**System Interfacing:** Introduction – Elements of data acquisition and control system – Overview of I/O process - Installation of I/O card and software – TIA/EIA serial interface standards (RS232/422/485) – General Purpose Interface Bus (IEEE 488) - GUI card – Ethernet switch - Man Machine Interfaces.

**UNIT – IV** **9**

**Case Study on Mechatronics Systems:** Semi-Active Wheel Suspension - Internal Combustion Engine with Drive Train - Camera Winder - Auto focus Camera - Disk Drive – Transducer calibration system - Strain gauge weighing system - Controlling temperature of a hot/cold reservoir using PID – pH Control system.

**UNIT – V** **9**

**Case Study on Advanced Systems:** Mechatronics control in Automated Manufacturing - Electronics engine management system - Control of pick and place robot – Automatic washing machine - Artificial Intelligence in Mechatronics: Neural network and Fuzzy logic system.

**TOTAL: 45**

**TEXT BOOKS:**

1. Devdas Shetty and Richard A. Kolk, “Mechatronics System Design”, Thomson Learning/ Vikas Publishing House, New Delhi, 2011.
2. Bolton W., “Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering”, 2<sup>nd</sup> Edition, Addison Wesley Longman Ltd., New York, 2011.
3. Georg Pelz, “Mechatronic Systems: Modeling and Simulation with HDLs”, John Wiley & Sons Ltd, New York, 2003.

**REFERENCE BOOKS:**

1. Bishop Robert H., “Mechatronics Hand book”, CRC Press, London, 2007.
2. Bradley D. Dawson, Burd N.C. and Loader A.J., “Mechatronics: Electronics in Products and Processes”, Chapman and Hall, London, 1994.
3. Shuvra Das, “Mechatronics Modelling and Simulation using Bond Graphs”, CRC Press, Taylor and Francis Group, 2009.
4. nptel.ac.in/courses/112103174/pdf/mod1.pdf
5. nptel.ac.in/courses/107106009/Downloads/LECTURE28.pptx

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: identify the necessary components for mechatronics system design
- CO2: model the mechatronics system
- CO3: select the suitable interface for mechatronics system
- CO4: develop the physical system based on mechatronics design process
- CO5: build the mechatronics systems for real time applications

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	1							2	3	3
CO2	3	3	3	3	3							2	3	3
CO3	3	3	3	3	1							2	3	3
CO4	3	3	3	3	2	2	1	1	2	2	3	2	3	3
CO5	3	3	3	3	2	2	1	1	2	2	3	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

**UNIT – I**

9

**Introduction and Mechanical Energy Based Processes:** Unconventional machining processes – Need – Classification of modern machining processes. Abrasive Jet Machining (AJM), Water Jet Machining (WJM), Abrasive Water Jet Machining (AWJM), Ultrasonic Machining (USM) - Working Principles – Equipments – Process parameters – MRR - Applications.

**UNIT – II**

9

**Electrical Energy and Thermal Energy Based Processes:** Electric Discharge Machining (EDM): Working Principle – equipments used - Process Parameters - Surface Finish - MRR - electrode / Tool – Power and control circuits - Tool Wear – Dielectric – Flushing – Applications. Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining (EBM), Wire cut EDM – Principles – Equipment –Types - Beam control techniques – Applications.

**UNIT – III**

9

**Chemical and Electro-Chemical Energy Based Processes:** Chemical Machining: Etchants used – maskant - techniques of applying maskants - Process Parameters – Surface finish and MRR - Applications. Electro-Chemical Machining: Principles of ECM – equipments used - Surface Roughness and MRR - Electrical circuit - Process Parameters. ECG and ECH – Working principle - Applications.

**UNIT – IV**

9

**Liquid Based and Solid Based RP Processes:** Fundamentals of RP systems - 3D solid modeling software and their role in RPT. Stereolithography (SLA): Principle - Process parameters - Process details - Machine details – Applications. Solid Ground Curing - Principle - Process parameters - Process details - Machine details – Applications. Fusion Deposition Modeling, Laminated Object Manufacturing - Principle - Process parameters - Process details - Machine details – Applications.

**UNIT – V**

9

**Powder Based RP Systems and Rapid Tooling:** Selective Laser Sintering (SLS): Principle - Process parameters - Process details - Machine details – Applications. Laser Engineered Net Shaping and 3-Dimensional Printers. Rapid Tooling: Soft Tooling - Hard Tooling – Applications of RP in Automotive Industry, Aerospace Industry and Biomedical Industry.

**TOTAL: 45****TEXT BOOKS:**

- Gary F. Benedict, “Nontraditional Manufacturing Processes”, CRC Press, Taylor and Francis Group, Special Indian Edition, 2011.
- Chua C.K., Leong K.F. and Lim C.S., “Rapid Prototyping: Principles and Applications”, 3<sup>rd</sup> Edition, World Scientific Publishing Company Pvt. Ltd., Singapore, 2010.

**REFERENCE BOOKS:**

- McGeough J.A., “Advanced Methods of Machining”, Springer International Edition, 2014.
- Jain Vijay K., “Advanced Machining Processes”, Allied Publishers Pvt. Ltd., New Delhi, 2009.
- Pandey P.C. and Shan H.S., “Modern Machining Processes” Tata McGraw-Hill, New Delhi, 2007.
- Ian Gibson, David W. Rosen and Brent Stucker, “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, 2<sup>nd</sup> Edition, Springer US, 2015.
- <http://nptel.ac.in/courses/112105126/7>
- <http://nptel.ac.in/courses/112107077/38>

**COURSE OUTCOMES**

On completion of the course the students will be able to

- CO1: choose mechanical energy based unconventional machining processes for various applications  
 CO2: apply electrical and thermal energy based unconventional machining processes  
 CO3: utilize chemical and electro-chemical energy based processes for machining  
 CO4: adapt various liquid, solid based and powder based rapid prototyping processes  
 CO5: identify the various rapid tooling process and its capabilities

**Mapping of COs with POs and PSOs**

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	1		1				1	2	3	2
CO2	3	2	2	2	1		1				1	2	3	2
CO3	3	2	2	2	1		1				1	2	3	2
CO4	3	2	2	2	1		1				1	2	3	2
CO5	3	2	2	2	1		1				1	2	3	2

1 – Slight, 2 – Moderate, 3 – Substantial

## 14MTO03 MACHINE VISION AND IMAGE PROCESSING

3    0    0    3  
9

### UNIT – I

**Processing of Information in the Human Visual System:** Design and structure of eye– Adaptation to different light level– Rod and Cone Responses– Motion Sensitivity in the Retina. **Machine vision system:** Specification– Part Presentation– Performance requirement– Information Interfaces– Installation Space– Environment.

### UNIT – II

**Designing a Machine Vision System:** Camera types– Field view– Resolution: camera sensor resolution, Spatial resolution, Measurement of accuracy, Calculation of resolution, Resolution for a Line Scan Camera – Camera Calibration: Calibration and Orientation techniques - Choice of camera, Frame grabber and hardware platform– Pixel rate– Lens design– Choice of illumination– Mechanical Design– Electrical Design.

### UNIT – III

**Lighting System:** Demands on machine vision lighting – Light and light perception – Light sources– Light Color and Part Color: Monochromatic light, white light, UV, IR and Polarized lighting– Light filters. **Camera Computer Interface:** Analog camera buses – Parallel digital camera buses– Standard PC buses – Computer buses – Driver software.

### UNIT – IV

**Image Processing Fundamentals:** Image sampling and quantization– Image enhancement: Gray Value Transformations, Radiometric Calibration, Image Smoothing– Geometric transformation– Image segmentation– Feature extraction: Region Features, Gray Value Features, Contour Features–Morphology– Edge extraction– Fitting and Template matching.

### UNIT – V

**Applications and Case Studies:** Diameter Inspection of Rivets– Tubing Inspection– Machine Vision in Manufacturing– Glue Check under UV Light– Completeness Check of automotive control component– Multiple Position and Completeness Check of small hybrid circuit– Pin Type Verification– Type and Result Data Management of spark plugs– Robot Guidance.

**TOTAL: 45**

#### TEXT BOOKS:

- Alexander Hornberg, “Handbook of Machine Vision”, Wiley-VCH, 2006.
- Carsten Steger, Markus Ulrich and Christian Wiedemann, “Machine Vision Algorithms and Applications”, Wiley-VCH, Weinheim, 2007.
- Jain Anil K., “Fundamentals of Digital Image Processing”, Pearson, 2015.

#### REFERENCE BOOKS:

- Davies E.K., “Machine Vision: Theory, Algorithms, Practicalities”, 3<sup>rd</sup> Edition, Elsevier, 2005.
- Milan Sonka, “Image Processing Analysis and Machine Vision”, Vikas Publishing House, 2007.
- Buchanan W., “Computer Busses: Design and Application”, CRC Press, 2000.
- <http://nptel.ac.in/courses/117105079/>
- <http://nptel.ac.in/courses/106105032/>

#### COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: interpret the fundamental concepts of vision system
- CO2: choose the components for designing the machine vision system
- CO3: learn about the concept of lighting system and various computer interfaces
- CO4: identify the concept of image processing techniques
- CO5: analyze the machine vision system through real time applications

#### Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2		2							1	2	2
CO2	3	2	2	2	2							1	2	2
CO3	3	2	2		2							1	2	2
CO4	3	2	2	2	2							1	2	2
CO5	3	3	3	2	2							1	3	3

1 – Slight, 2 – Moderate, 3 – Substantial

## 14MT004 INDUSTRIAL AUTOMATION PROTOCOLS

3    0    0    3

### UNIT – I

9

**Introduction to Networks in Industrial Automation:** Information flow requirements – Hierarchical communication model – Data Communication basics – OSI reference model – Industry Network – Recent networks.

### UNIT – II

9

**Data Network Fundamentals:** EIA 232 interface standard – EIA 485 interface standard – EIA 422 interface standard – Serial interface converters – Data link control protocol – Media access protocol: Command/response – Token passing and CSMA/CD – TCP/IP – Bridges – Routers – Gateways – Standard ETHERNET Configuration.

### UNIT – III

9

**HART and MODBUS Protocol:** Introduction – Evolution of signal standard – HART communication protocol – Communication modes – HART Networks– HART commands – HART applications – MODBUS protocol structure – Function codes – Troubleshooting.

### UNIT – IV

9

**Fieldbus and Profibus:** Fieldbus – Introduction, General Fieldbus architecture, Basic requirements of Fieldbus standard, Fieldbus topology, Interoperability and Interchangeability. Profibus: Introduction, Profibus protocol stack, Profibus communication model, Communication objects, System operation and Troubleshooting – Foundation fieldbus versus Profibus.

### UNIT – V

9

**AS-interface (AS-i), Devicenet and Industrial Ethernet:** **AS interface:** Introduction, Physical layer, Data link layer and Operating characteristics. **Devicenet:** Introduction, Physical layer, Data link layer and Application layer. **Industrial Ethernet:** Introduction, 10Mbps Ethernet and 100Mbps Ethernet - Introduction to OLE for process control (OPC).

**TOTAL: 45**

#### TEXT BOOKS:

1. Bela G. Liptak and Halit Eren, “Instrument Engineers Handbook: Process Software and Digital Networks”, Volume 3, 4<sup>th</sup> Edition, CRS Press, 2011.
2. Mackay S., Wright E., Reynders D. and Park J., “Practical Industrial Data Networks: Design, Installation and Troubleshooting”, Newnes Publication, Elsevier, 2004.

#### REFERENCE BOOKS:

1. Hughes T.A., “Programmable Logic Controllers: Resources for Measurements and Control Series”, 4<sup>th</sup> Edition, ISA Press, 2004.
2. Berge J., “Field Buses for Process Control: Engineering, Operation, and Maintenance”, ISA Press, 2004.
3. Buchanan W., “Computer Busses: Design and Application”, CRC Press, 2000.
4. Bowden R., “HART Application Guide”, HART Communication Foundation, 1999.
5. [nptel.ac.in/courses/106105080/pdf/M1L2.pdf](http://nptel.ac.in/courses/106105080/pdf/M1L2.pdf)
6. [nptel.ac.in/courses/108106022/LECTURE%2010.pdf](http://nptel.ac.in/courses/108106022/LECTURE%2010.pdf)
7. <http://nptel.ac.in/courses/108105062/37>
8. <http://nptel.ac.in/courses/108105062/37>

#### COURSE OUTCOMES

On completion of the course the students will be able to

- CO1: demonstrate the basic network requirements for Industrial automation
- CO2: infer the data network fundamentals
- CO3: implement the HART and MODBUS Protocol for Networked Industrial Automation
- CO4: recommend the FIELDBUS AND PROFIBUS for industrial automation network
- CO5: realize the functions of Ethernet in industrial network

#### Mapping of COs with POs and PSOs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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CO2	3	2	2		1							1	2	2
CO3	3	3	3	2	1							2	3	3
CO4	3	3	3	2	1							2	3	3
CO5	3	2	2	2	1							2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial