KUMARAGURUCOLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University, Chennai)

COIMBATORE – 641049

REGULATIONS 2015

CURRICULUM AND SYLLABUS

1st to 8th Semesters

BE MECHATRONICS ENGINEERING

DEPARTMENT OF MECHATRONICS ENGINEERING
KUMARAGURU COLLEGE OF TECHNOLOGY

(Autonomous Institution Affiliated to Anna University, Chennai)

COIMBATORE – 641049

B.E. MECHATRONICS ENGINEERING

VISION

To achieve academic and industrial excellence in industrial automation research and innovative product development driven by mechatronics systems.

MISSION

"The Department is committed to impart the right blend of knowledge and apply the knowledge in real life situations with constant engagement in research to cater the local and global needs.

PROGRAM EDUCATIONAL OBJECTIVES (PEO):

- Develop innovative and sustainable products with multidisciplinary Engineering expertise.
- Solve complex engineering problems by applying mechanical, electrical and .computer knowledge and engage in life long learning in their profession
- Work or pursue higher education in multicultural, multilingual and multinational environment with competent oral and written communication.
- Lead and contribute in a team entrusted with professional, social and ethical responsibilities.

(A)PROGRAM OUTCOMES (PO):

Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Problem analysis: Identify, formulate, review research literature, and
3. analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
4. 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.

5. 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.
6. 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.
7. 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.
8. 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.
9. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
10. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
11. 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.
12. 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.
13. 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.

(B) PROGRAM SPECIFIC OUTCOMES (PSOs)

14. Design and develop Mechatronics systems to solve the complex engineering problem by integrating electronics, mechanical and control systems.
15. Apply the engineering knowledge to conduct investigations of complex engineering problem related to instrumentation, control, automation, robotics and provide solutions.

KUMARAGURU COLLEGE OF TECHNOLOGY, COIMBATORE 641 049
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Regulations - 2015

B.E. MECHATRONICS ENGINEERING

CURRICULUM AND SYLLABI

SEMESTER – I

	Course Code	Course Title	Category	Contact periods	Hrs/Week& Credits			
					L	T	P	C
Theory								
1.	U15EN*T*101	Technical English	HS	4	3	0	0	3
2.	U15MA*T*101	Engineering Mathematics – I	BS	5	3	2	0	4
3.	U15PH*T*101	Engineering Physics	BS	4	3	0	0	3
4.	U15CH*T*101	Engineering Chemistry	BS	4	3	0	0	3
5.	U15ME*T*101	Engineering Graphics	ES	5	2	2	0	3
6.	U15CS*T*101	Structured Programming using 'C'	ES	4	3	0	0	3
Practical								
7.	U15PH*P*101	Physics Laboratory	BS	3	0	0	2	1
8.	U15ME*P*101	Engineering Practices Laboratory	ES	3	0	0	2	1
9	U15CS*P*101	Structured Programming Laboratory using 'C'	ES	3	0	0	2	1
10.	U15GH*P*101	Personal Values -1	HS	1	1	0	0	1
TOTAL				36				23

SEMESTER – II

	Course Code	Course Title	Category	Contact periods	Hrs/Week& Credits			
					L	T	P	C
Theory								
1.	U15ENP201	Business Communication and Presentation Skills	HS	4	2	0	2	2
2.	U15MA*T*201	Engineering Mathematics – II	BS	5	3	2	0	4
3.	U15PH*T*202	Materials Science	BS	4	3	0	0	3
4.	U15CH*T*202	Applied Chemistry	BS	4	3	0	0	3
5.	U15ME*T*202	Engineering Mechanics	ES	5	3	2	0	4
6.	U15MCT201	Electronic Devices and Circuits	PC	4	3	0	0	3
Practical								
7.	U15CH*P*201	Chemistry Laboratory	BS	3	0	0	2	1
8.	U15CS*P*211	Computing Laboratory	ES	3	0	0	2	1
9	U15ECP207	Electronic Devices and Circuits Laboratory	ES	3	0	0	2	1
10.	U15GHP201	Personal Values -2	HS	1	1	0	0	1
11	U15SIP201	Social Immersion Project	HS	2	0	0	2	2
TOTAL				38				25

SEMESTER – III

Code No.	Course Title	Category	Contact Hours	L	T	P	C	Pre-requisites
THEORY								
U15MAT305	Transform methods and Partial Differential Equations	BS	4	3	2	0	4	
U15MC*T*301	Mechanics of solids for Mechatronics	ES	4	3	1	0	4	
U15MC*T*302	Mechanics of Fluids for Mechatronics	ES	4	3	1	0	4	
U15MC*T*303	Sensors and Instrumentation	PC	3	3	0	0	3	
U15MC*T*304	Electrical Machines and Drives	PC	3	3	0	0	3	
U15GS*T*001	Environmental Science and Engineering	MC	3	3	0	0	3	
PRACTICAL								
U15MC*P*301	Fluid Mechanics and Machinery Laboratory	ES	3	0	0	3	1	
U15MC*P*302	Sensors and Instrumentation Laboratory	PC	3	0	0	3	1	
U15GH*P*301	Family Values	HS	1	1	0	0	1	
	TOTAL		28				24	

Total periods – 28 **Total credits – 24**

SEMESTER – IV

Code No.	Course Title	Category	Contact Hours	L	T	P	C	Pre-requisites
THEORY								
U15MA*T*401	Numerical Methods	BS	4	3	2	0	4	
U15MC*T*401	Manufacturing Technology	PC	3	3	0	0	3	
U15MC*T*402	Industrial Electronics	PC	3	3	0	0	3	
U15 MC*T*403	Kinematics of Machinery	PC	3	3	0	0	3	
U15MC*T*404	Digital Electronics and Microprocessor	PC	3	3	0	0	3	
U15GS*T*008	Foundation skills in Integrated Product Development	EEC	3	3	0	0	3	
PRACTICAL								
U15MC*P*401	Electrical Drive System Laboratory	PC	3	0	0	3	1	
U15MC*P*402	Manufacturing Technology Laboratory	PC	3	0	0	3	1	
U15EN*P*401	Communication Skill Laboratory	MC	3	0	0	3	1	
U15GHP401	Professional Values	HS	1	1	0	0	1	
	TOTAL		29				23	

Total periods – 29 **Total credits - 23**

SEMESTER – V

Code No.	Course Title	Category	Contact Hours	L	T	P	C	Pre-requisites
THEORY								
U15MC*T*501	Signals and Systems	PC	4	3	1	0	4	
U15MC*T*502	Control Engineering	PC	4	2	2	0	3	
U15MC*T*503	Dynamics of Machinery	PC	4	2	2	0	3	
U15MC*T*504	Mechatronics for Machining	PC	3	3	0	0	3	
U15MC*T*505	Industrial Automation I	PC	3	3	0	0	3	
OE1*	Open Elective–I	OE	3	3	0	0	3	
PRACTICAL								
U15MC*P*501	Industrial Automation I Laboratory	PC	3	0	0	3	1	
U15MC*P*502	Machine Dynamics Laboratory	PC	3	0	0	3	1	
U15GHP501	Social Values	HS	1	1	0	1	1	
	TOTAL		30				22	

Total periods – 30 **Total credits - 22**

SEMESTER–VI

Code No.	Course Title	Category	Contact Hours	L	T	P	C	Pre-requisites
THEORY								
U15MC*T*601	Microcontroller and Embedded Systems	PC	3	3	0	0	3	
U15MC*T*602	Design of Machine Elements	PC	4	2	2	0	3	
U15MC*T*603	Thermodynamics and Heat Transfer	ES	4	2	2	0	3	
E1 *	Elective – I	PE	3	2	0	1	3	
E2**	Elective–II	PE	3	3	0	0	3	
OE2**	Open Elective–II	OE	3	3	0	0	3	
PRACTICAL								
U15MC*P*601	CAD/CAM Laboratory	PC	3	0	0	3	1	
U15MC*P*602	Embedded system laboratory	PC	3	0	0	3	1	
U15GH*P*601	National Values	HS	1	1	0	1	1	
	TOTAL		27				21	

Total periods – 27 **Total credits – 21**

SEMESTER–VII

Code No.	Course Title	Category	Contact Hours	L	T	P	C	Pre-requisites
THEORY								
U15MC*T*701	Robotics Engineering	PC	3	3	0	0	3	
U15MCT702	Industrial Automation II	PC	3	3	0	0	3	
U15MC*T*703	Automotive Electronics	PC	3	3	0	0	3	
E3***	Elective–III	PE	3	3	0	0	3	
E4****	Elective–IV	PE	3	3	0	0	3	
OE3***	Open Elective–III	OE	3	3	0	0	3	
PRACTICAL								
U15MCP701	Project Work Phase I	EEC	4	0	0	4	2	
U15MC*P*702	Robotics Laboratory	PC	3	0	0	3	1	
U15MC*P*703	Industrial Automation II Laboratory	PC	3	0	0	3	1	
U15GHP601	Global Values	HS	1	1	0	1	1	
	TOTAL		29				23	

Total periods – 29 **Total credits – 23**

SEMESTER–VIII

Code No.	Course Title	Category	Contact Hours	L	T	P	C	Pre-requisites
THEORY								
E5*****	Elective–V	PE	3	3	0	0	3	
E6******	Elective–VI	PE	3	3	0	0	3	
PRACTICAL								
U15MCP801	Project Work Phase II	EEC	24	0	0	24	12	
	TOTAL		30				18	

Total periods – 30 **Total credits - 18**

Total Credits (3rd to 8th Semesters) = 131

Overall Total Credits (1st to 8th Semesters) = 182

***OPEN ELECTIVE**

Code No.	Course Title	Category	Contact Hours	L	T	P	C	Pre-requisites
THEORY								
U15MC*OE*01	Robotics for Engineers	OE	3	3	0	0	3	
U15MC*OE*02	Biomimetics and bioinspired design	OE	3	3	0	0	3	
U15MC*OE*03	Textile Mechatronics	OE	3	3	0	0	3	

ELECTIVE I

Code No.	Course Title	Category	Contact Hours	L	T	P	C	Pre-requisites
THEORY								
U15MCE101	Soft Computing	PE	3	3	0	0	3	
U15MCE102	Functional programming	PE	3	3	0	0	3	
U15MCE103	Introduction to Android Programming	PE	3	3	0	0	3	

ELECTIVE II

Code No.	Course Title	Category	Contact Hours	L	T	P	C	Pre-requisites
THEORY								
U15MCE201	Machine Vision System	PE	3	3	0	0	3	
U15MC*E*202	Medical Mechatronics	PE	3	3	0	0	3	
U15MC*E*203	Digital Signal Processing	PE	3	3	0	0	3	
U15MC*E*204	Micro Electro Mechanical Systems	PE	3	3	0	0	3	
U15MC*E205*	Mobile Robotics	PE	3	3	0	0	3	

ELECTIVE III

Code No.	Course Title	Category	Contact Hours	L	T	P	C	Pre-requisites
THEORY								
U15MC*E*301	Finite Element Analysis	PE	3	3	0	0	3	
U15MC*E*302	Design of Material Handling System	PE	3	3	0	0	3	
U15MCE303	Computer Integrated Manufacturing	PE	3	3	0	0	3	

ELECTIVE IV

Code No.	Course Title	Category	Contact Hours	L	T	P	C	Pre-requisites
THEORY								
U15MCE401	Modeling and Simulation	PE	3	3	0	0	3	
U15MAT701	Probability and Applied Statistics	PE	3	3	0	0	3	
U15GST004	Operations Research	PE	3	3	0	0	3	

ELECTIVE V

Code No.	Course Title	Category	Contact Hours	L	T	P	C	Pre-requisites
THEORY								
U15MCE501	Engineering Economics and Project Management	PE	3	3	0	0	3	
U15GS*T*002	Total quality Management	PE	3	3	0	0	3	
U15GST003	Principles of Management	PE	3	3	0	0	3	
U15GST007	Professional Ethics	PE	3	3	0	0	3	

ELECTIVE VI

Code No.	Course Title	Category	Contact Hours	L	T	P	C	Pre-requisites
THEORY								
U15MC*E*601	Renewable Energy Sources	PE	3	3	0	0	3	
U15MCE602	Composite Materials and Sustainable Development	PE	3	3	0	0	3	
U15MCE603	Engineering Metrology	PE	3	3	0	0	3	

ONE CREDIT COURSES

Code No.	Course Title	Category	Contact Hours	L	T	P	C	Pre-requisites
U15MCINX	Certification Program	EEC	2	2	0	0	1	

SEMESTER I

U15ENT101 - TECHNICAL ENGLISH (Common to all branches of Engineering and Technology)	L	T	P	C
	3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Use appropriate technical vocabulary when speaking and writing to express their understanding of technical concepts. (K2)

CO2: Write with greater felicity using the register suitable in the workplace.(K3)

CO3: Interpret the graphical data and convey the idea precisely.(K4)

CO4: Compose effective emails and write officials letters with greater clarity and precision.(K4)

CO5: Make effective oral presentations on topics related to science and technology.(K3)

CO6: Exhibit sufficient language skills for the needs of the corporate sector.(K4)

CO/PO Mapping

(S/M/W indicates strength of correlation)S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1				M					M	S		M		
CO2				M					M	S		M		
CO3				S					M	S		M		
CO4									M	S		M		
CO5									M	S		M		
CO6				M					M	S		M		

Direct	Indirect
1. Internal test I 2. Internal test II 3. Assignment / Group Presentation 4. End Semester Examination	1. Course end survey

FOUNDATIONS OF TECHNICAL JARGON **9 Hours**

Parts of Speech – Word Formation – Affixing, Synonyms and Antonyms, Homonyms - Homophones and Homographs, One Word Substitutes, Nominal Compounds, Acronyms and Abbreviations, Definitions

TECHNICAL SYNTAX **9 Hours**

Tense, Voice, Kinds of Syntax, Gerund and Infinitives, Cause and effect expressions, Purpose and functional expressions, Conditional clauses, Reported speech

APPLICATIONS OF TECHNICAL SYNTAX **9 Hours**

Editing (Grammar – Concord, Articles, Parts of Speech, Modifiers – Dangling participles, Misplaced, Squinting and Punctuation), Instructions and Recommendations, Discourse markers – Process description, Writing a Paragraph – Descriptive, Narrative, Compare and Contrast, Argumentative, Evaluative, Persuasive, Sequencing of jumbled sentences

DRAFTING TECHNICAL DETAILS **9 Hours**

Note making – Linear, Report writing - Accident report, Project Proposals, Transcoding Graphics – Encoding and Decoding – Bar chart / Pie chart / Flow chart / Line graph / Tabulated data / Tree diagram or Organizational chart; Statement of Purpose

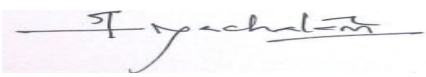
TECHNICAL CORRESPONDENCE **9 Hours**

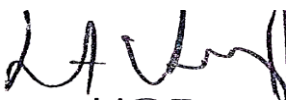
Modules of a letter – Bank Loan applications, bona-fide Certificate Industrial Visit/ In-plant Training, Letter for Organizing functions, Letter of Application and Resume ,Notices and Circulars, Agenda, Basics of E-Mail writing and E-mail etiquette.

Total: 45 Hours.

Reference Books:

1. Rizvi Ashraf. M., Effective Technical Communciation, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2008.
2. Bhatnagar R.P. & Rahul Bhargava, "English for Competitive Examinations", Macmillian Publishers, India, 1989, ISBN: 9780333925591
3. Aggarwal R.S., "A Modern Approach to Verbal & Non–Verbal Reasoning", S.Chand Publishers, India, 2012, ISBN : 8121905516





U15MAT101- ENGINEERING MATHEMATICS I (Common to all branches of Engineering and Technology)	L	T	P	C
	3	2	0	4

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Identify eigen values and eigen vectors and its role in the system of equations. (K3)
CO2: Discover the radius, centre and circle of curvature of any curves. (K4)
CO3: Solve the first order ordinary differential equations of certain types and its applications. (K3)
CO4: Compile the solution of the higher order ordinary differential equations and its applications. (K6)
CO5: Identify the maximum and minimum values of surfaces. (K3)
CO6: Extend the functions as series and find the dependency between them using Jacobian. (K2)

Pre-requisite: Differentiation and Integration

CO/PO Mapping

S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M							M	M		
CO2	S	M							M	M		
CO3	S	M							M	M		
CO4	S	M							M	M		
CO5	S	M							M	M		
CO6	S	M							M	M		

Course Assessment methods:

Direct	Indirect
1. Internal Tests 2. Assignments 3. End semester examination	Course end survey

MATRICES **9 Hours**

Rank of a matrix – Linearly dependent and independent vectors – Eigen values and eigenvectors of a real matrix – Properties of eigen values and eigenvectors – Cayley Hamilton theorem (excluding proof) – Orthogonal matrices – Orthogonal transformation of a symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation.

GEOMETRICAL APPLICATIONS OF DIFFERENTIAL CALCULUS 9 Hours

Curvature – Radius, Centre and Circle of curvature in Cartesian, Parametric and Polar form – Evolute – Envelope of family of curves with one and two parameters – Evolute as the envelope of normals – properties of evolute and envelope.

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS 9 Hours

Leibnitz's equation – Bernoulli's equation – Equations of first order and higher degree - Clairauts form – Applications: Orthogonal trajectories and simple Electric circuit problems.

HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS 9 Hours

Linear equations of second and higher order with constant coefficients – Euler's and Legendre's linear equations – Method of variation of parameters – First order Simultaneous linear equations with constant coefficients - Application - Electrical circuit. (Differential equations and associated conditions need to be given).

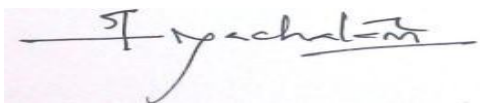
FUNCTIONS OF SEVERAL VARIABLES 9 Hours

Total derivative – Taylor's series expansion – Maxima and minima of functions of two variables – Constrained maxima and minima: Lagrange's multiplier method with single constraints – Jacobians.

L: 45Hr; T: 15Hr; TOTAL = 60 HOURS

REFERENCES

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 40th Edition.
2. Veerarajan T., Engineering Mathematics (for First Year), Tata McGraw Hill Pub. Co. Ltd., New Delhi, Revised Edition, 2007.
3. Kandasamy P., Thilagavathy K., and Gunavathy K., "Engineering Mathematics", S. Chand & Co., New Delhi, (Reprint) 2008.
4. Kreyzig E., "Advanced Engineering Mathematics", Eighth Edition, John Wiley and sons, 2010.
5. Arunachalam, T., Engineering Mathematics I, Sri Vignesh Publications, Coimbatore. (Revised) 2009.
6. Venkataraman M.K., "Engineering Mathematics", The National Pub. Co., Chennai,2003.
7. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, (2007).



U15PHT101/ ENGINEERING PHYSICS (Common to all branches of Engineering and Technology)	L	T	P	C
	3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1 Analyze and identify the crystal structure in materials
CO2 Imbibe the concept of optics, laser and their applications in engineering.
CO3 Categorize the optical fibre and apply it for various fields.
CO4 Acquire the basic knowledge in quantum mechanics
CO5 Apply the NDT techniques and modern engineering tools necessary for Engineering practice.
CO6 Emphasize the role of nuclear physics in energy production

CO-PO Mapping

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

Cos	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M										M
CO2	S	M			S							M
CO3	S	M			S							M
CO4	S	M			S							M
CO5	S	M			S							M
CO6	S	M					M					M

Course Assessment methods

Direct	Indirect
1. Internal test I 2.Internal test II 3.Assignment/ Seminar 4. End Semester Examination	1. Course end survey

CRYSTAL PHYSICS **9 Hours**

Space lattice – unit cell – lattice planes – Bravais space lattices – Miller indices – calculation of interplanar distances – Atomic radius – co- ordination number – Packing factor for SC, BCC, FCC and HCP structures – crystal imperfections – point defects – line defects – surface defects – volume defects – effect of crystal imperfections.

APPLIED OPTICS **9 Hours**

Interference – airwedge and its applications - Lasers – spontaneous and stimulated emissions – Einsteins coefficients – Nd: YAG, Co_2 and semiconductor laser – Homojunction andHetrojunction (only qualitative description) – applications – CD-ROM and holography (qualitative only) – optical fibre – principle and propagation of light in optcal fibers – Numerical aperture and acceptance angle – types of optical fibres – applications – fibre optic communication system – medical endoscopy.

QUANTUM PHYSICS **9 Hours**

Plancks quantum theory of black body radiation (derivation) – Photo electric effect – Compton effect (derivation) and experimental verification of Compton effect – De-broglies concept - Schrodinger wave equation – time independent and time dependent equations (derivations) – physical significance of wave function – particle in a box (one dimensional case) – Electron microscope – Scanning electron microscope – Transmission electron microscope.

ULTRASONICS AND NDT **9 Hours**

Introduction – production – magnetostriction effect – magnetostriction generator – piezoelectric effect – piezo electric generator –properties –detection – cavitation –acoustic grating – velocity measurement – applications –Sonar –velosity of blood flow – NDT –Liquid Penetrant method – Ultrasonic flaw detector – A scan, B scan, C scan – X- ray radiography and fluoroscopy – Thermography.

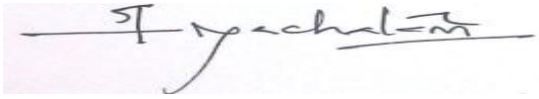
ATOMIC AND NUCLEAR PHYSICS **9 Hours**

Introduction – Atomic spectra – Molecular spectra – Applications – Raman effect – Stokes lines and anti stokes lines – Applications – Nuclear models – Liquid drop model –Nuclear fission – Theory – Energy released per fission – Chain reaction – Controlled chain reaction – Nuclear reactors – Condition for sustained chain reaction – Types of Nuclear reactors – Nuclear fusion – Thermo nuclear reactions – Differences between fission and fusion

TOTAL: 45 HOURS

REFERENCES

1. Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
2. Gopal S., Engineering Physics, Inder Publications, Coimbatore, 2006.
3. Palinisamy P.K., Engineering Physics I, Scitech Publications, Chennai, 2011.
4. Avadhanulu M.N. andKshirsagar P.G., A textbook of Engineering Physics, S.Chand & Company Ltd, New Delhi,2005.
5. Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, DhanpatRai Publications (P) Ltd., New Delhi, 2003.



U15CHT101 ENGINEERING CHEMISTRY (Common to all branches of Engineering and Technology)	L	T	P	C
	3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Assemble a battery and illustrate the phenomenon of production of electric current (K4)
CO2: Discuss the thermodynamic concepts and predict the feasibility of chemical reaction (K2)
CO3: Apply the theory of adsorption in real life situations (K3)
CO4: Outline the principles and instrumentation of spectroscopic techniques (K2)

CO/ PO MAPPING

CO/PO Mapping
(S/M/W indicates strength of correlation)S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO1	M				M							
CO2	M											
CO3	M	W				W						
CO4	M				M							

Course Assessment methods

Direct	Indirect
1. Internal test I 2.Internal test II 3.Assignment/ Seminar 4. End Semester Examination	1. Course end survey

ELECTROCHEMISTRY 9 Hours

Introduction - Electrode potential – Nernst equation and problems - Electrochemical series - Application of EMF measurements & problems - Kohlrausch law of independent migration of ions & its application - Conductometric titrations (acid - base & precipitation titration)

Electrodes : Standard and reference electrode (Hydrogen & Calomel) – Types of electrodes (Metal – Metal ion; Metal – Metal insoluble salt, Redox electrode) - Ion selective (glass electrode) – determination of pH using glass electrode
Cells : Galvanic cell – Types of concentration cells

ENERGY STORING DEVICES 9 Hours

Batteries : Primary Battery (Lechlanche & Alkaline battery) - Secondary Battery (Lead acid storage battery, Nickel - Cadmium battery & Lithium – Polymer battery) – Flow battery (Hydrogen and Oxygen Fuel Cell)

Solar Cells: Hybrid Solar cells
Nuclear Reactors: Light water nuclear power plant (nuclear fission) - ICF (nuclear fusion)

THERMODYNAMICS **9 Hours**

Introduction - Thermodynamic process (isothermic, isobaric, isochoric and adiabatic processes) - Internal energy – first law of thermodynamics (Mathematical derivation & limitation) - Enthalpy - Second law of thermodynamics - Entropy - Entropy change of an ideal gas & problems - Free energy - work function - Gibbs Helmholtz equation (derivation, applications & problems) - Van't Hoff isotherm (derivation & problems) - Van't Hoff isochore - (derivation & problems) - Third law and zeroeth law (Only statements)

SURFACE CHEMISTRY **9 Hours**

Introduction of adsorption - Types of Adsorption - Adsorption isotherm (Freundlich isotherm, Langmuir adsorption isotherm, BET isotherm) - Applications of adsorption : Role of adsorption in catalytic reactions, Ion exchange adsorption, adsorption chromatography (Column chromatography)

SPECTROSCOPY **9 Hours**

Introduction to spectroscopy - Beer Lambert's Law - Colorimetric analysis (principle, instrumentation (block diagram only) & application : Estimation of concentration of Ferrous and copper ions in solution) - UV – Visible spectroscopy (principle, instrumentation (block diagram only) & applications) - IR spectroscopy (principle, instrumentation (block diagram only) & applications) - Flame photometry (principle, instrumentation (block diagram only) & applications)

TOTAL: 45 HOURS

REFERENCES

1. Bahl B.S., Tuli G.D. and Arun Bahl., Essential of Physical Chemistry, S.Chand & Co. Ltd., New Delhi.
2. Somorjai G.A., Introduction to Surface Chemistry and Catalysis, John Wiley & Sons Inc., New York.
3. Shaw D.J., Introduction to Colloidal and Surface Chemistry, Butterworth – Heinemann Publishers
4. Syed Shabudeen, P.S. and Shoba U.S., Engineering Chemistry, Inder Publishers, Coimbatore.
5. Jain P.C. and Monika Jain, Engineering Chemistry, Dhanpatrai Pub. Co. (P) Ltd., New Delhi.
6. Puri B.R., Sharma L.R. and Pathania M.S., Principles of Physical Chemistry, ShobanLal Nagin Chand & Co., New Delhi

U15ME*T*101 ENGINEERING GRAPHICS	L	T	P	C
(Common to all branches of Engineering and Technology)	2	2	0	3

COURSE OUTCOMES:
After successful completion of this course, the students should be able to:

CO1: Construct various plane curves
CO2: Solve problems in projection of points and lines.
CO3: Develop projection of surfaces and solids.
CO4: Solve problems in sections of solids and development of surfaces.
CO5: Apply the concepts of isometric, and perspective projections
CO6: Apply free hand sketching in engineering practice.

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		M										
CO2	S	M								M		
CO3	S	M								M		
CO4	S	M								M		
CO5	S	M								M		
CO6	S	M										

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. Tutorial 6. End semester exam	Course end survey

PLANE CURVES, PROJECTION OF POINTS AND LINES **12 Hours**

Importance of graphics in design process, visualization, communication, documentation and drafting tools, Construction of curves - ellipse, parabola, and hyperbola by eccentricity method only. Orthographic projection of points.
Projections of straight lines located in first quadrant - determination of true length and true inclinations.

PROJECTIONS OF SURFACES AND SOLIDS **12 Hours**

Projections of plane surfaces - polygonal lamina and circular lamina, located in first quadrant and inclined to one reference plane., Projection of simple solids - prism, pyramid, cylinder and cone. Drawing views when the axis of the solid is inclined to one reference plane.

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES **12 Hours**

Sectioning of simple solids - prisms, pyramids, cylinder and cone. Obtaining sectional views and true shape when the axis of the solid is vertical and cutting plane inclined to one reference plane. Development of lateral surfaces of truncated prisms, pyramids, cylinders and cones.

PICTORIAL PROJECTIONS **12 Hours**

Isometric projection, Isometric scale, Isometric views of simple solids, truncated prisms, pyramids, cylinders and cones.

Perspective projection of prisms and pyramids when its base resting on the ground by vanishing point method.

FREE-HAND SKETCHING **12 Hours**

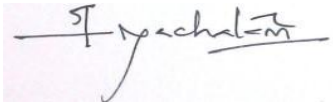
Free hand sketching techniques, sketching of orthographic views from given pictorial views of objects, including free-hand dimensioning.

Sketching pictorial views from given orthographic views.

L: 15Hrs; T: 45Hrs; TOTAL = 60 HOURS

REFERENCES

1. Basant Agrawal and CM Agrawal, Engineering Drawing, McGraw-Hill, New Delhi, First Edition, 2008.
2. Venugopal K. and Prabhu Raja V., Engineering Graphics, New Age International (P) Limited, New Delhi, 2008.
3. Nataraajan K.V., Engineering Drawing and Graphics, Dhanalakshmi Publisher, Chennai, 2005.
4. Warren J. Luzadder and Jon. M. Duff, Fundamentals of Engineering Drawing, Prentice Hall of India Pvt. Ltd., New Delhi, Eleventh Edition, 2005.
5. Gopalakirishna K.R., Engineering Drawing (Vol. I & II), Subhas Publications, 2001.



U15CST101 STRUCTURED PROGRAMMING USING C (Common to all branches of Engineering and Technology)	L	T	P	C
	3	0	0	3

Course Outcomes (CO):
After Successful completion of this course, the students will be able to :

CO1	Explain the basics of programs and programming	K2
CO2	Select appropriate data types and control structures for solving a given problem.	K2
CO3	Illustrate the representation of arrays, strings and usage of string operations.	K3
CO4	Illustrate the importance of pointers, functions and dynamic memory allocation.	K3
CO5	Explain the fundamentals of structures and unions.	K2
CO6	Explain the basics of file handling mechanism.	K2

Pre-requisite : Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S														
CO2	S	M							W	W					
CO3	S	W							W	W					
CO4	M	W							W	W					
CO5	M	W							W	W					
CO6	M	W							W	W					

Course Assessment Methods:

Direct	Indirect
• Internal Tests • Assignments • Presentation • End Semester Exam	• Course End Survey

Course Content: **Hours**

INTRODUCTION **9**

Programs and Programming- Programming languages and Their Classification - Compiler, Linker, Loader and Interpreter – Structured Programming Concept –Algorithm – Pseudo Code – Flow Chart. Number System – Binary – Decimal – Conversion Problems.

C LANGUAGE BASICS **9**

Introduction to C Programming – Fundamentals – Structure of a C Program – Compilation And Linking Processes – Constants, Variables – Data Types – Expressions Using Operators In C – Managing Input And Output Operations – Decision Making And Branching – Looping Statements – Solving Simple Scientific And Statistical Problems.

ARRAYS AND STRINGS **9**

Arrays – Initialization – Declaration – One Dimensional And Two Dimensional Arrays. String- String Operations – String Arrays. Simple Programs - Sorting- Searching – Matrix Operations

FUNCTIONS, STORAGE CLASSES AND POINTERS **9**

Functions: Definition of function – Declaration of function – Pass by value – Pass by reference – Recursion.
Storage classes – auto, static, extern, register- scope rules.
Pointers: Definition – Initialization – Pointers arithmetic – Pointers and arrays - Dynamic memory allocation - Example Problems

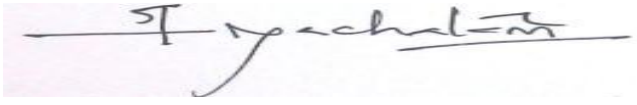
STRUCTURES, UNIONS AND FILES **9**

Structures and Unions: Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions.
Files: Introduction – Using files in C - Working with text files.

Total Hours: 45

References:

1. Pradip Dey and Manas Ghosh, "Programming in C", Second Edition, Oxford University Press, 2011.
2. Rajasekaran S, "Numerical methods in Science and Engineering-A practical approach", S.Chand and Company, New Delhi-55, 2012.
3. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
4. Byron S Gottfried and Jitendar Kumar Chhabra, "Programming with C", Tata McGraw Hill Publishing Company, Third Edition, New Delhi, 2011.
5. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007



U15PHP101 PHYSICS LABORATORY (Common to all branches of Engineering and Technology)	L	T	P	C
	0	0	2	1

COURSE OUTCOMES

CO1 Acquire practical knowledge about different physical properties of materials
CO2 Devlop skills in multidisciplinary project works and applications
CO3 Acquire skills in the experiments involving the physical phenomena like interference and diffraction

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M										M
CO2	S	M										M
CO3	S	M										M

Course Assessment methods

Direct	Indirect
1. Continuous Assessment of lab performance 2. Model Practical Examination 3. End Semester Practical Examination	1. Course end survey

LIST OF EXPERIMENTS

Any Ten Experiments

1. Lee's disc - determination of thermal conductivity of a bad conductor
2. Air wedge - determination of thickness of a given specimen.
3. Spectrometer - determination of wavelength of mercury source using grating
4. Compound pendulum - determination of accelaration due to gravity.
5. Melde's String- Determination of frequency of an electrically maintained vibrator (tuning fork)
6. Viscosity - determination of co-efficient of viscosity of a liquid by poiseuille's flow method.
7. Non-uniform bending – determination of Young's modulus
8. Ultrasonic interferometer –determination of velocity of sound and compressibility of liquid.
9. Lux meter – Determination of efficiency of a Solar cell
10. Semiconductor laser:
    a. Determination of wavelength of laser using grating
    b. Particle size determination
    c. Acceptance angle of optical fibre
11. Carey foster bridge – determination of specific resistance of given coil of wire.
12. Field along the axis of a coil – Determination of magnetic moment.

TOTAL: 30 HOURS

U15ME*P*101 ENGINEERING PRACTICES LABORATORY	L	T	P	C	
	0	0	2	1	
(Common to all branches of Engineering and Technology)					

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Select the various tools and equipments used in the fabrication workshop.
CO2: Develop various joints in carpentry, fitting,
CO3: Make simple shapes using sheet metal tools.
CO4: Demonstrate the use of welding tools to make a butt joint
CO5: Demonstrate and evaluate the parameters of basic electronic components (wires, resistors, capacitors, diodes etc.) and test the components.
CO5: Estimate DC and AC Voltage and currents using appropriate measuring instruments.

Pre-requisite: Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M				M							
CO2	M				M							
CO3	M				M							
CO4	M				M							
CO5	M				M							
CO6	M				M							

Course Assessment methods:

Direct	Indirect
1. Lab Excercises 2. Model Exam 3. End semester exam 4. Observation	Course end survey

LIST OF EXPERIMENTS

GROUP – I **21 Hours**

A. CIVIL ENGINEERING

1. Carpentry

- Study of carpentry tools
- Preparation of T joint
- Preparation of dovetail joint

2. Plumbing

- Study of pipeline joints

B. MECHANICAL ENGINEERING

1. Fitting

- Study of fitting tools

- Preparation of L joint
- Preparation of square joint

2. Sheet Metal Working

- Study of sheet metal working tools
- Preparation of cone and tray

3. Welding

- Study of arc welding tools and equipment
- Preparation of butt joint

GROUP - II (ELECTRICAL & ELECTRONICS ENGINEERING)

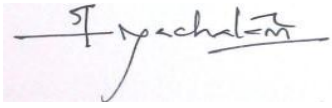
C. ELECTRICAL ENGINEERING PRACTICE **12 Hours**

- Basic household wiring using switches, fuse, indicator-lamp, etc.,
- Preparation of wiring diagrams.
- Stair case light wiring.
- Tube light wiring
- Study of iron-box, fan with regulator, emergency lamp and microwave oven.

D. ELECTRONIC ENGINEERING PRACTICE **12 Hours**

1. Assembling simple electronic component on a small PCB and Testing.
2. Soldering simple electronic circuits and checking continuity.
3. Measurements using digital multimeter.
   - DC and AC voltage measurement
   - DC and AC current measurements.
   - Resistance Measurement.
   - Continuity measurement.
4. Testing of Electronic components
   - Resistors
   - Inductors and capacitors
   - Diodes (resistance in forward bias and reverse bias)
   - Transistors
5. Study of CRO and Function generator
   - Study of Panel Controls
   - Measurement of Amplitude, Frequency, phase difference

TOTAL: 45 HOURS



U15CS*P*101	STRUCTURED PROGRAMMING LABORATORY USING C (Common to all branches of Engineering and Technology)	L	T	P	C
		0	0	2	1

Course Outcomes (CO):

After Successful completion of this course, the students will be able to :

CO1	Apply and practice logical ability to solve simple problems	**S**
CO2	Demonstrate 'C' programs for statistical and scientific problem solving.	**S**
CO3	Implement pointers, memory allocation techniques in 'C' language.	**S**
CO4	Demonstrate code reusability using recursive and non-recursive functions.	**S**
CO5	Implement appropriate structures for the given scenario.	**S**
CO6	Implement the concept of basic file handling.	**S**

Pre-requisite: Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	**Programme Outcomes(POs)**												**PSO**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	S	M													
CO2	S	M													
CO3	M	M													
CO4	M	M													
CO5	M	M													
CO6	M	W													

Course Assessment Methods:

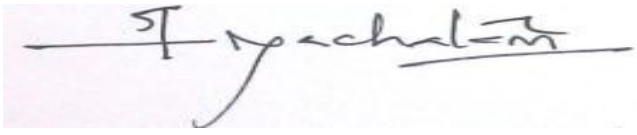
Direct	Indirect
1. Model Exam 2. Viva voce 3. End semester practical exam	Course End Survey

Course Content:

List of Experiments:

1. Simple programs
   - To find whether the given number is prime or not
   - Factorial of the given number
2. Programs involving Control and Looping Structures
   - Arithmetic Progression
   - Trigonometric series evaluation
3. Programs using Arrays
   - Sorting
   - Matrix addition and Multiplication
4. Calculation of median of a frequency distribution.
5. Evaluation of integrals
   - Trapezoidal Rule
6. String Processing
7. Program using Recursive function
8. Using pointers in C
9. Program using Functions, Structures and Files
   - Students Mark Analysis
10. Iterative method for finding Roots of the polynomials
    - Lagrange interpolation method

Total Hours: 24



U15GHP101 PERSONAL VALUES -1	L	T	P	C
(Common to all branches of Engineering and Technology)	1	0	0	1

Course outcomes:

After successful completion of the course, the student would be able to:

CO 1 : The student on taking the course shall broadly understand what is Human Excellence and act accordingly

CO 2 : The student shall acquire the ability to introspect about the purpose of his/her life and carry his/her life accordingly

CO 3 : The student shall understand the importance of nurturing the body, mind and soul

CO 4: The student shall understand the impact of his/her thoughts on his/her life

CO 5 : The student shall learn basic contemplative practices so that he/she can practice at his/her leisure

Pre-requisite: NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						W	M		W			S		
CO2						M		W				M		
CO3						W	S					M		
CO4						M	M		M			S		
CO5												M		

Course Assessment methods:

Direct	Indirect
1. Individual Assignment 2. Group Assignment 3. Presentation 4. Surprise Test 5. Practical Assessment 6. End Semester Assessment	1. Attendance and Behavioural Assessment

Introduction to Human Excellence	2 Periods
Body, Mind & Soul - Functional & Operational relationship	2 Periods
Analysis of Thought & Introspection	4 Periods

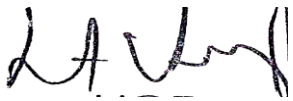
Learning Style Inventory & Neuro Linguistic Programming	2 Periods
Introduction to Contemplative Practices	6 Periods

Total Periods: 15

References Books:

1. Vethathiri's Maharishi's, ***"Yoga for Modern Age"***, The World Community Service Centre, Vedhathiri Publications 2009.
2. Swami Vivekananda, "***The Man Making Message"*** The Ramakrishna Tapovanam, Published 1972.
3. Vethathiri's Maharishi's, ***"Manavalakalai part 1,2&3"*** 1^{1th} edition, The World Community Service Centre, Vethathiri Publications,2005.
4. Laxmana Sharma, **". Who am I?"** Sri Ramanasramam Tiruvannamalai 606 603
5. Brian L Weiss, **"*Many Lives, Many Masters*"** 1st edition Published 1988 by Touchstone.
6. Sankar, **"Monk as a Man"** Penguin Books, Published 2011.
7. Norman Vincent Peale, **"Power of Positive Thinking"** Publisher Vermilion Books, 1993.

SEMESTER II



U15ENP201 – BUSINESS COMMUNICATION AND PRESENTATION SKILLS (Common to all branches of Engineering and Technology)	L	T	P	C
	2	0	2	2

COURSE OUTCOMES

After successful completion of this course, the students should be able to

CO1: Gain cognizance of Effective Business Environment (K1)
CO2: Develop a milestone for leadership and group participation (K2)
CO3: Improve critical thinking and analytical skills to facilitate effective communication(K2)

CO4: Practice and perceive the full repertoire of listening strategies (K2)
CO5: Develop effective reading and writing skills and set goals for future growth (K2)
CO6: Inculcate Spoken Communication Skills required for presentations and discussions.(K2)

COs	CO/PO mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak													
	Programme Outcomes(POs)												PSOs	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO1
CO1									S	S	M			
CO2									S	S				
CO3		S		M					S	S		S		
CO4				S					S	S				
CO5										S		S		
CO6									S	S				

Course Assessment methods

Direct	Indirect
1. Continuous assessment 2. Assignment 3. Model practical I 4. End Semester Exam	1. Course exit survey

Fundamentals of Business Communication **12 Hours**

Introduction to Business Communication - Greetings, Formal and Informal Introduction of Self and Others, Giving encouragement: Phrases for Positive Feedback, Agreeing and disagreeing – Expressions indicating frequency, Reading to Understand – Facts, Inference, Main Idea, Author's Opinion/ tone, Short prepared compositions on current affairs

Listening and Comprehending Business Communication **12 Hours**

Listening to monologues, Listening for general content- Listening to dialogues- Listening to a telephonic conversation- Listening for specific information, numbers, time, duration- Listening to conversations among three or more people - Listening to a group discussion and providing factual information, Intensive listening

Oral Business Communication **12 Hours**

Establishing Business relationships and negotiating, Describe an object or event- Describing a working mechanism- Argumentative speech about a Public issue - Responding to situations and providing solutions, Seeking Permission, Introduction to Presentation Skills - Presenting information, Giving and Getting Product and Service Information, Perceiving Visual Information, Talking about People and Places

Reading and Comprehending Business Communication **12 Hours**

Reading techniques, News Paper Reading, Reading brochures, leaflets, instruction manual- Cloze test- Reading Comprehension, Book review, Article review, Reading a Technical Report, Critical Reading (Editorial): Creative and Critical thinking

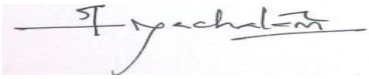
Written Business Communication **12 Hours**

Product Review, Writing a proposal for conducting science exhibition, E-mail etiquette and correspondence, Business Itinerary, Business Letters – Calling for a quotation – Placing Order – Letter of Complaint – Letter seeking Clarification – Acknowledging prompt / quality service, Letter requesting information, Letter explaining a situation, Letter of acceptance and declining, Encoding and decoding advertisements

Total: 60 Hours

Reference Books:

1. Spoken English: A foundation course for speakers of Tamil. Part I & II: Kamalesh Sadanand, Susheela Punitha. Orient Longman Publications, 2008.
2. Life Skills and Leadership for Engineers: David Goldsberg, University of Ilinois, Tata Mcgraw Hill.2007.



U15MAT201- ENGINEERING MATHEMATICS II (Common to all branches of Engineering and Technology)	L	T	P	C
	3	2	0	4

COURSE OUTCOMES

After successful completion of this course, the students should be able to:
On completion of the course, the students are expected

CO1: Evaluate double and triple integrations and enable them to find area and volume using multiple integrals. (K5)

CO2: Explain the basics of vector calculus comprising gradient, divergence and curl. (K2)

CO3: Identify the relationship between line, surface and volume integrals. (K3)

CO4: Construct analytic functions of complex variables and conformal mappings. (K6)

CO5: Summarize the basics of residues, complex integration and contour integration. (K2)

CO6: Determine Laplace transform and it to represent system dynamic models and evaluate their time responses. (K5)

Pre- requisite: Differentiation and Integration

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M							M	M		
CO2	S	M							M	M		
CO3	S	M							M	M		
CO4	S	M							M	M		
CO5	S	M							M	M		
CO6	S	M							M	M		

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Assignment 3. End semester examination	Course end survey

MULTIPLE INTEGRALS **9 Hours**

Double integration – Cartesian and polar coordinates – Change of order of integration –Change of variables between cartesian and polar coordinates - Triple integration in cartesian coordinates – Application : Area as double integral – Volume as triple integral .

VECTOR CALCULUS **9 Hours**

Gradient, divergence and curl – Directional derivative – Irrotational and solenoidal vector fields - Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelopipeds.

ANALYTIC FUNCTION **9 Hours**

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy- Riemann equations in Cartesian coordinates and sufficient conditions (excluding proofs) – Properties of analytic function – Construction of analytic function by Milne Thomson method – Conformal mapping : $w = z + c$, cz , $1/z$ and bilinear transformation.

COMPLEX INTEGRATION **9 Hours**

Statement and applications of Cauchy's integral theorem and Cauchy's integral formula (excluding proofs) – Taylor's and Laurent's series expansions – Singularities – Residues – Cauchy's residue theorem (excluding proof) – Application of residue theorem to evaluate real integrals - Unit circle and semi-circular contours (excluding poles on real axis).

LAPLACE TRANSFORM **9 Hours**

Definition - Properties – Superposition - Shift in t - Shift in s - Time Derivatives - Time Integral – Initial and Final Value Theorems – Periodic functions: sine wave, saw-tooth, square and triangular waves - Inverse Laplace Transform – Simple system dynamic models – TransferFunctions – Poles and Zeroes - Response of First-Order Systems - Solution of RC Free, Step and Sinusoidal Responses; Response of Second-Order Systems - Free Response, step Response - Convolution theorem.

L: 45Hr; T: 15Hr; TOTAL = 60 HOURS

REFERENCES

1. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, Delhi, 42nd Edition, 2012.
2. Philip D. Cha, James J. Rosenberg, Clive L. Dym, Fundamentals of Modelling and Analyzing Engineering Systems, Cambridge University Press, United Kingdom, 2000.
3 Kreyzig E., Advanced Engineering Mathematics, John Wiley & Sons (Asia), Pvt, Ltd., Singapore, 10th Edition, 2010.
4 Veerarajan T., Engineering Mathematics (for First Year), Tata McGraw Hill, Pub. Co. Ltd., New Delhi, Revised Edition, 2007.
5 Venkataraman M.K., Engineering Mathematics, Volume - II, The National Pub. Co., Chennai, 2003.
6 Kandasamy P., Thilagavathy K. and Gunavathy K., Engineering Mathematics, S. Chand & Co., New Delhi, 2008.
7 Arunachalam T. and Sumathi K., Engineering Mathematics II, Sri Vignesh Publications, Coimbatore, Third Edition, 2011.

U15PHT202/ MATERIALS SCIENCE (Common to Mechanical, Mechatronics, Aeronautical and Automobile Engineering)	L	T	P	C
	3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1 Acquire the knowledge of conducting and superconducting materials and its applications
CO2 Perceive the preambles of semiconductors and categorize its applications
CO3 Categorize the different types of magnetic materials and their applications.
CO4 Enumerate the different types of polarization in dielectric materials.
CO5 Confer the properties, preparation and applications of modern engineering materials
CO6 Recognize the basic concepts of strengthening of materials

CO-PO Mapping

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak												
Cos	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	M										M
CO2	S	M										M
CO3	S	M										M
CO4	S	M										M
CO5	S	M			M							M
CO6	S	M										M

Course Assessment methods

Direct	Indirect
1. Internal test I 2.Internal test II 3.Assignment/ Seminar 4. End Semester Examination	1. Course end survey

CONDUCTING AND SUPERCONDUCTING MATERIALS 9 Hours

Conducting Materials : Classical free electron theory of metals-Electrical conductivity – Thermal conductivity - expression – Wiedemann Franz law(derivation) – Lorentz number – drawbacks of classical theory – Fermi distribution function – density of energy states – effect of temperature on Fermi energy.

Superconducting Materials : Superconducting phenomena – properties of superconductors – Meissner effect, Isotope effect, Type I &Type II superconductors – High Tc superconductors - Applications – cryotron, magnetic levitation and squids.

SEMICONDUCTING MATERIALS 9 Hours

Origin of band gap in solids (Qualitative treatment only) - carrier concentration in an intrinsic semi conductor (derivation) – Fermi level – variation of Fermi level with temperature - Electrical conductivity – band gap semiconductor – carrier concentration in n-type and p-type semi conductors (derivation) – Variation of Fermi level with temperature and impurity concentration – Hall effect – Determination of Hall coefficient – experimental set up – Applications.

MAGNETIC & DIELECTRIC MATERIALS 9 Hours

Magnetic Materials : Properties of dia, para, ferro, anti ferro and ferri magnetic materials - Langevin's theory of paramagnetism – Weiss theory of Ferromagnetism – Domain theory of ferromagnetism - hysteresis – soft and hard magnetic materials – Ferrites – Applications - magnetic recording and readout - Storage of magnetic data, Tapes, floppy, magnetic disc drives – Bubble memory.

Dielectric Materials : Electronic, ionic, orientation and space charge polarization - Frequency and temperature dependence of polarization – Dielectric loss – Dielectric breakdown – different types of break down mechanism - Ferro electric materials - properties and applications.

NANOTECHNOLOGY AND NEW ENGINEERING MATERIALS 9 Hours

New Engineering Materials : Metallic glasses – preparation, properties and applications – shape memory alloys (SMA) – characteristics, properties of NiTi alloy applications advantages and disadvantages of SMA.

Nano Materials : synthesis - plasma arcing – Chemical vapour deposition – sol-gel - Electro deposition – ball milling – properties of nanoparicles and applications. – Carbon nano tubes – fabrication - arc method – pulsed laser deposition - Chemical vapour deposition - structure, properties & applications.

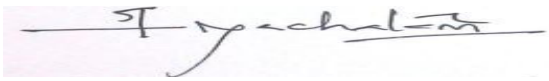
STRENGTHENING OF MATERIALS 9 Hours

Strengthening mechanisms for the improvement of mechanical properties - cold working precipitation hardening, solute hardening and diffusion hardening - Fracture-Mechanism of brittle fracture (Griffith's theory) and Ductile fracture - difference between brittle and ductile fracture - fatigue failure and its prevention - creep different stages in creep curve-Factors affecting mechanical properties Grain size and heat treatment .

TOTAL: 45 HOURS

REFERENCES

1. Pillai S.O., Solid State Physics, 5th edition, New Age International Publication, New Delhi, 2003.
2. Avadhanalu M.N. and Kshirsagar P.G., A textbook of Engineering Physics, S. Chand & Company Ltd, New Delhi, 2005
3. Gopal S., Materials Science, Inder Publications, Coimbatore, 2007
4. Rajendran V. and Marikani A., Materials science, 5th edition, Tata Mc-Graw-Hill publishing company Ltd, 2004
5. Arumugam M., Physics-II, Materials science for mechanical engineering, Anuradha agencies - publishers, Kumbakonam, 2005



U15CH*T*202 APPLIED CHEMISTRY	L	T	P	C
(Common to Mechanical, Mechatronics, Aeronautical and Automobile Engineering)	3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Classify the different types of fuels and their properties (K3)
CO2: Categorize the engineering materials and their uses (K1)
CO3: Defend the Corrosion problems (K2)
CO4: Design a water purifier (K3)
CO5: Identify the techniques of preparing metal powder (K2)

CO/ PO MAPPING

CO/PO Mapping (S/M/W indicates strength of correlation)S-Strong, M-Medium, W-Weak													
COs	Programme Outcomes(POs)												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M					M								
CO2	M		M											
CO3	M	M				M								
CO4	M					M								
CO5	S													

Course Assessment methods

Direct	Indirect
1. Internal test I 2.Internal test II 3.Assignment/ Seminar 4. End Semester Examination	1. Course end survey

FUELS AND COMBUSTION **9 Hours**

Classification of fuels - coal varieties - analysis of coal (proximate and ultimate analysis) - coke manufacture (Otto-Hoffman byproduct coke oven method) - characteristics of metallurgical coke - cracking (thermal and catalytic cracking definition only) – manufacturing of synthetic petrol (Fischer Tropsch method, Bergius process) – knocking (octane number, cetane number) - gaseous fuels (production, composition and uses of producer gas, water gas and natural gas).

Combustion : gross and net calorific value - determination of calorific value by bomb calorimeter - explosive range - spontaneous ignition temperature - flue gas analysis (Orsat apparatus).

MECHANICAL ENGINEERING MATERIALS **9 Hours**

Abrasives: Moh's scale of hardness - natural abrasives (diamond, corundum, emery, garnets and quartz) - artificial abrasives (silicon carbide, boron carbide).

Refractories: Characteristics - classification (acid, basic and natural refractories) - properties (refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling) - General manufacturing methods of refractories - preparation, properties and uses of high alumina bricks, magnesite and zirconia bricks.

Lubricants: Classification - Functions - properties (viscosity index, flash and fire point, oiliness, carbon residue, aniline point, cloud and pour point) - greases (calcium based, sodium based, lithium based) - solid lubricants (graphite, molybdenum disulphide).

CORROSION SCIENCE **9 Hours**

Corrosion: Principles of electrochemical corrosion - difference between chemical and electrochemical corrosion - factors influencing corrosion.

Types of corrosion: Galvanic corrosion - differential aeration corrosion (soil (microbial) corrosion, pitting corrosion, water line corrosion) - stress corrosion.

Corrosion control: Cathodic protection (sacrificial anode) - Protective Coatings (Paint, Electroplating of Copper).

WATER TECHNOLOGY **9 Hours**

Boiler Feed water: Requirements - disadvantages of hard water : Formation of deposits in steam boilers and heat exchangers (scale and sludge), priming, foaming, caustic embrittlement, boiler corrosion, wastage of Fuel and decrease in efficiency.

Prevention of scale formation: external treatment (ion exchange method) - internal treatment (phosphate, calgon, carbonate, colloidal) - desalination by reverse osmosis - Treatment of Domestic water

PHASE RULE AND POWDER METALLURGY **9 Hours**

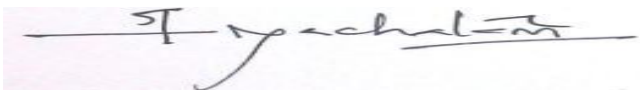
Phase rule - condensed phase rule - construction of phase diagram (thermal analysis) – Applications of phase rule: Simple eutectic system (Ag - Pb, Fe - C system).

POWDER METALLURGY: Preparation of metal powders (mechanical pulverization, atomization, chemical reduction, electrolytic process, decomposition) - mixing and blending - compacting - sintering - advantages and limitations of powder metallurgy.

TOTAL: 45 HOURS

REFERENCES

1. Samir Sarkar, Fuels and Combustion, Orient Longman, India.
2. Syed Shabudeen P.S., Engineering Chemistry II, Inder publications, Coimbatore.
3. Derek Pletcher and Frank C Walsh, Industrial Electrochemistry, Blackie Academic and Professional, London.
4. Dara S.S., A Text book of Engineering Chemistry, S. Chand Co. (P) Ltd., New Delhi
5. Jain P.C. and Monika Jain, Engineering Chemistry, Dhanpat Rai Pub. Co. (P) Ltd., New Delhi



U15ME*T*202 ENGINEERING MECHANICS (Common to CE, AUE, AE, ME, MCE & TXT)	L	T	P	C
	3	2	0	4

COURSE OUTCOMES:

After successful completion of this course, the students should be able to:

CO1: Construct free body diagrams and estimate the magnitude and direction of the resultant force
CO2: Calculate moment of inertia for various sections.
CO3: Identify the state of the object and estimate magnitude and direction of frictional force.
CO4: Solve problems related to moving objects related to principles of kinematics.
CO5: Solve problems related to moving objects related to principles of kinetics.
CO6: Estimate the velocity after impact and use of kinetics in impact of elastic bodies.

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	M										
CO2	M	M										
CO3	M	M										
CO4	M	M										
CO5	M	M										
CO6	M	M										

Course Assessment methods:

Direct	Indirect
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group presentation 5. Tutorial 6. End semester exam	Course end survey

BASICS & STATICS OF PARTICLES **9+3 Hours**

Introduction - Units and Dimensions - Laws of Mechanics Lame's theorem, Parallelogram and triangular Laws of forces – Coplanar Forces - Resolution and Composition of forces – Free body diagram - Equilibrium of a particle.

EQUILIBRIUM OF RIGID BODIES **9+3 Hours**

Moment of a force about point – Varignon s theorem- Moment of a couple-Resolution of force in to force couple system-Resultant of coplanar non concurrent system - Types of supports and their reactions- Requirements of stable equilibrium - Equilibrium of Rigid bodies in two dimensions.

PROPERTIES OF SURFACES AND SOLIDS **9+3 Hours**

First moment of area and the Centroid of sections Rectangle, circle, triangle, T section, I section Angle section and Hollow section. Second and product moments of plane area Rectangle, triangle, circle. T Section, I section, Angle section and Hollow section, Parallel axis theorem and perpendicular axis theorem - Polar moment of inertia.

FRICTION **9+3 Hours**

Frictional force-Law of coloumb friction , simple contact friction, Rolling resistance and Belt friction, Ladder friction, Wedge friction.

DYNAMICS OF PARTICLES **9+3 Hours**

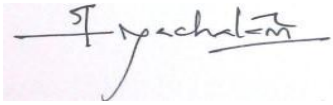
Kinematics: Rectilinear & Curvilinear motion of particles, Displacements Velocity and acceleration.

Kinetics: Newton's law, Work Energy method, Impulse and Momentum, Impact of elastic bodies.

L: 45Hrs; T: 15Hrs; TOTAL = 60 HOURS

REFERENCES

1. Sukumar T.R. and Sridhar S., Engineering Mechanics, Inder Publications, Coimbatore, 2013.
2. Hibbeller, R.C., Engineering Mechanics, Vol. I Statics and Vol. II Dynamics, Pearson Education, Asia Pvt. Ltd., 2000.
3. Ashok Gupta, Interactive Engineering Mechanics Statics A Virtual Tutor, Pearson Education, Asia Pvt. Ltd., New Delhi, 2002.
4. Palanichamy M.S., and Nagan S., Engineering Mechanics (Statics & Dynamics) Tata McGraw Hill, 2001.
5. Irving H. Shames, Engineering Mechanics – Statics and Dynamics, IV Edition, Pearson Education, Asia Pvt. Ltd., 2003.
6. Beer F.P. and Johnson Jr. E.R., Vector Mechanics for Engineers, Vol. I Statics and Vol. II Dynamics, McGraw-Hill International Edition, 2004.
7. Rajasekaran S. and Sankarasubramanian G., Fundamentals of Engineering Mechanics, Vikas Publishing House Pvt. Ltd., Second Edition, 2002.



U15MC*T* 201 ELECTRONIC DEVICES AND CIRCUITS	L	T	P	C
(For Mechatronics Engineering)	3	0	0	3

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Use passive elements and basic theorems to solve the electric circuits.
CO2: Relate the basic semiconductor physics to the characteristics and biasing of low powered electronic devices.
CO3: Design regulators and rectifiers using diodes.
CO4: Design amplifiers for oscillators using transistors.
CO5: Use operational amplifiers to solve simple mathematical operations and build conventional vibrators.

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	P11	P12	PSo1	PS o2
CO1	S												W	S
CO2	S												W	
CO3		S												M
CO4		S												M
CO5		S												M

Course Assessment methods:

Direct	Indirect
Internal test I Internal test II End semester Examination Assignment Group Presentation	Course end survey

CIRCUIT THEORY **9 Hours**

Network Theorems: Kirchoff's laws – Thevinin's and Norton's theorems - Superposition theorem. Two port networks: Z Parameters – Y parameters h parameters.

THEORY OF SEMICONDUCTOR DEVICES **9 Hours**

PN junction – diode equation (Derivation not required) – forward and reverse bias – Diode dc and ac resistances – Zener diode – Bipolar Junction Transistor – CE, CB and CC configurations– Biasing of a transistor; fixed bias, collector feedback bias, self bias – FET – Common source and drain characteristics of JFET and MOSFET.

APPLICATIONS OF DIODES **9 Hours**

HW and FW rectifiers – Filters with Capacitior and Inductors -Clippers and Clampers – Voltage Multipliers – Voltage regulators – Zener, series and shunt types.

AMPLIFIERS AND OSCILLATORS **9 Hours**

Small signal amplifiers – h parameter model for low frequencies – Feedback amplifiers, cascading amplifiers, differential amplifier – Oscillators – Hartley and Colpitt oscillators.

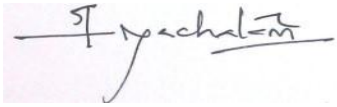
OPERATIONAL AMPLIFIERS **9 Hours**

Ideal characteristics – Inverting, Non-inverting – summer – Comparator, Integrator, differentiator – Schmitt trigger – R.C. Phase shift oscillator, Wein Bridge Oscillator – Multivibrators.

TOTAL: 45 HOURS

REFERENCES:

1. Albert Malvino and Bates J., Electronic Principles, Tata McGraw- Hill Pub. Company Ltd., 7th edition, 2008.
2. Millman J., Halkias C.C. and Satyabrata Jit, Electronic Devices and Circuits, Tata McGraw Hill, New Delhi, 2nd edition, 2008.
3. Thomas L. Floyd, Electronic Devices, Pearson Education Asia, 5th edition, 2001.
4. William Hayt, Kemmerly J. and Durban S.M., Engineering Circuit Analysis, McGraw Hill Education, 2011.
5. Sudhakar, Shyammohan and Palli S., Circuits and Networks: Analysis & Synthesis, Tata Mc Graw Hill, New Delhi, 4th edition, 2010
6. Salivahanan S., Suresh kumar N. and Vallavaraj A., Electronic Devices and Circuits, Tata Mc Graw Hill publishing company, New Delhi, 2nd edition, 2008
7. Roy Chowdhury D. and Jain Shail B., Linear Integrated Circuits, New Age Int. Pub., 4th edition, 2010



U15CH*P*201 CHEMISTRY LABORATORY	L	T	P	C
(Common to all branches of Engineering and Technology except CSE)	**0**	**0**	**2**	**1**

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Prepare standard solutions (S1)

CO2: Analyse the properties of water by applying the chemical concepts (S2)

CO3: Analyse the solutions by electrochemical and spectroscopic techniques and apply it in real life situations like corrosion, soil, water testing etc (S3)

Pre-requisites : -

CO/ PO MAPPING

CO/PO Mapping (S/M/W indicates strength of correlation)S-Strong, M-Medium, W-Weak												
COs	Programme Outcomes(POs)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	W								W			
CO2	W	M					M					
CO3		M			M				M			

Course Assessment methods

Direct	Indirect
1. Continuous Assessment of lab performance 2. Model Practical Examination 3. End Semester Practical Examination	1. Course end survey

PREPARATION OF SOLUTIONS (STANDARD)

1. Preparation of normal solutions of the following substances - oxalic acid, sodium carbonate, hydrochloric acid.
2. Preparation of phosphate buffer using Henderson equation.

WATER TESTING

3. Determination of total, temporary and permanent hardness by EDTA method.
4. Estimation of DO by Winkler's method.
5. Estimation of alkalinity by Indicator method.
6. Estimation of chloride by Argentometric method.

ELECTRO CHEMICAL ANALYSIS

7. Estimation of hydrochloric acid by pH metry.
8. Conductometric titration of mixture of acids and strong base

9. Conductometric precipitation titration using $BaCl_2$ and Na_2SO_4.
10. Estimation of Iron by Potentiometry

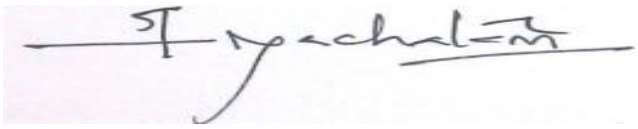
PHOTOMETRY

11. Estimation of the Ferrous ions (Thiocyanate method) by Spectrophotmetry.
12. Estimation of sodium and potassium by Flame photometry.

Total: 30 Hours

REFERENCES

1. Jeffery G.H., Bassett J., Mendham J. and Denny R.C., Vogel's Text Book of Quantitative Chemical Analysis, Oxford, ELBS, London, 2002.
2. Shoemaker D.P. and C.W. Garland., Experiments in Physical Chemistry, TataMcGraw-Hill Pub. Co., Ltd., London, 2003.
3. Shoba U.S., Sivahari R. and Mayildurai R., Practical Chemistry, Inder Publications, Coimbatore, 2011.



U15CSP211 COMPUTING LABORATORY	L	T	P	C
Common to AE,BT,CE,EIE,FT,ME,MCE,TXT	0	0	2	1

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Develop static web pages using HTML. [S]
CO2: Perform basic MATLAB operations. [S]
CO3: Make use of MATLAB to work with images and graphs. [S]
CO4: Perform integration and differentiation using MATLAB. [S]
CO5: Develop team spirit and professional attitude towards the development of simple web applications [A]

Pre-requisite: Nil

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	S	M													
CO2	S	M													
CO3	M	M													
CO4	M	M													
CO5	M	M													

Course Assessment Methods:

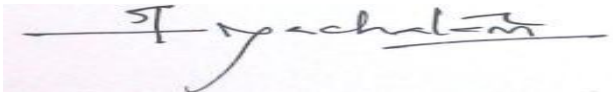
Direct	Indirect
1. Model Exam 2. Viva voce 3. End semester practical exam	Course End Survey

List of Experiments

1. Study of HTML tags
2. Design a web page using basic html tags
3. Design a webpage using table tags

4. Design a webpage using forms and frames
5. Design a webpage using list tags
6. Develop a website of your interest(include a minimum of 3 web pages)
7. Study of MATLAB functions
8. Working with matrix operations
9. Working with image arithmetic
    a. Addition of two images
    b. Subtraction of two images
10. Write a Matlab program for the following
    a. Read an image and crop
    b. Read an image and resize
11. Working with Integration and Differentiation
12. Working with graphs

TOTAL: 45 HOURS



U15ECP207	ELECTRONIC DEVICES AND CIRCUITS LABORATORY	L	T	P	C
		0	0	2	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Construct input output characteristics of electronic devices.

CO2: Measure current voltage resistance capacitance of a given circuit.

CO3: Design and construct regulators, rectifiers, amplifiers and oscillators using electronic devices and operational amplifiers.

CO4: Simulate electronic circuits using software.

Pre-requisite : Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1			S		S									M
CO2			S											M
CO3			S											M
CO4			S	S										M

Course Assessment methods:

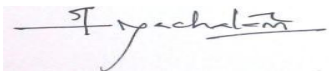
Direct	Indirect

Internal Models I Internal Models II End semester Examination	Course end survey

LIST OF EXPERIMENTS

1. Characteristics of Semiconductor diode and Zener diode
2. Input and Output characteristics of BJT
3. Characteristics of JFET
4. Frequency response of CE amplifier
5. Clipper and Clamper
6. Phase shift and Wein Bridge oscillators using OP-AMP
7. Astable multivibrator using OP-AMP
8. Monostable and Bistable multivibrator using OP-AMP
9. Voltage Regulator (Zener diode, Transistor series and shunt)
10. Half-wave and Full-wave Rectifier with and without filter.
11. Circuit design using software (Multisim, Pspice)
12. Printed Circuit Board (PCB) design and fabrication using (software) for simple circuits.

Total Hours: 45



U15GH*P*201/ PERSONAL VALUES -2	L	T	P	C
(Common to all branches of Engineering and Technology)	1	0	0	1

Course outcomes:

After successful completion of the course, the student would be able to:

CO 1 : The student shall broadly understand how negative emotions affects his/her life and keep away from them
CO 2 : The student shall be aware of the self and his/her responsibilities to himself and society at large
CO 3: The student shall understand the importance of conscious living
CO 4 : The student shall be able to better able to life by listening to inner voice
CO 5 : The student shall learn advanced contemplative practices so that he/she can practice at his/her leisure

Pre-requisite: NIL

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO 1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						S	W	W				M		
CO2						M	M	M	W			S		
CO3						W	W	W				M		
CO4								W				M		
CO5						M	W					S		

Course Assessment methods:

Direct	Indirect
1.Individual Assignment 2.Group Assignment 3.Presentation 4.Surprise Test 5.Practical Assessment 6.End Semester Assessment	1.Attendance and Behavioural Assessment

Moralization of desire 1 Periods

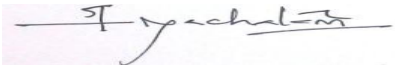
Neutralization of Anger 1 Periods

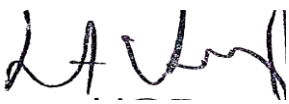
Heart Centered Living	3 Periods
Transactional Analysis	2 Periods
Self Awareness Methods	3 Periods
Advanced Contemplative Practices	5 Periods

Total Periods: 15

References Books:

1. Vethathiri's Maharishi's, ***"Yoga for Modern Age"***, The World Community Service Centre, Vedhathiri Publications 2009.
2. Swami Vivekananda, "***The Man Making Message"*** The Ramakrishna Tapovanam, Published 1972.
3. Vethathiri's Maharishi's, ***"Manavalakalai part 1,2&3"*** 1th edition, The World Community Service Centre, Vethathiri Publications,2005.
4. Devdas Medon, **"Stop Sleep Walking in Life"** Yogi Impressions Books, Published 2004.
5. Hermann Hesse, **"Siddhartha"** New Directions, Published 1922.





U15SIP201 – SOCIAL IMMERSION PROJECT

(Common to all branches of Engineering and Technology)

L	T	P	C
0	0	2	2

COURSE OUTCOMES

After successful completion of this course, the students should be able to:

CO1: Achieve the desirable awareness regarding significant social problems and identify the needs to provide a possible and innovative solution.

CO2: Acquire and demonstrate effective professional skills and qualities to deal with social issues through innovative leadership and sustainable services / approaches.

CO3: Provide students with a rich practical and socially oriented team work approach.

CO4:Improve the quality of life of individuals and communities in proposed localities.

CO5: Enhance technical knowledge in addressing the needs of a community problem.

CO6: Understand the social reality of a community and work for the essential changes to be made.

Pre-requisite: NIL

CO/PO Mapping

(S/M/W indicates strength of correlation)S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1			S			S	S							
CO2			M			S	M	M						
CO3			S			S	S		S					
CO4			S			S	S							
CO5			M			S	M							
CO6			S			S	S							

Course Assessment methods:

Direct	Indirect
1. Impact study 2. Village Visit & Observation Skill 3. Workshop participation & 4. General report preparation 5. Assignment / Team Presentation 6. End Semester Examination	1. Course end survey

Class Room Activities	Social issues / Projects (Major Area)
• Developing social consciousness • Theoretical reading (Based on the project / general) • Inculcating Social immersion andLeadership • Social immersion and Engineeringimplementation • Formation of groups • Study on the society and identifyingproblems • Analysis of problems on issue based • Multiple approaches towards the problem&Selection for addressing. • Addressing a theoretical social problem. • Providing multiple solution for theproblem • Knowledge on budgeting andfundraising. • Approaching agencies related to problems. Partnering with agencies • Presentation Skills and Movie Maker • Report preparation • Identification of causes and effects of thesocial issue	• Water / Sanitation • and Hygiene • Waste Management • Women Empowerment • Community health • Child health/ Poverty/Educati on/others • Energy management • Environment Management • Adult Education • Youth Empowerment • Green Industry Given above are the broad areas of projects recommended. Projects may varyto individuals/ groups/ class/ branch.

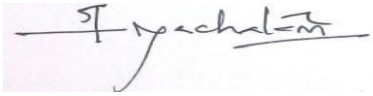
Total – 45 Hours

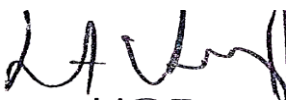
Method of End Semester Practical Evaluation :Video: 40 marks Viva voce: 60 marks

References:

1. Nicholls Alex and Murdock Alex, Social Innovation Blurring Boundaries to reconfigure markets, Palgrave Macmillan., New York, 2012. :

2. Osburg Thomas and Schmidpeter Rene`, Social Innovation Solutions for sustainable Future. Springer, Germany 2013.





SEMESTER III

U15MA*T*305	TRANSFORM METHODS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
		3	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Determine the Fourier series and half range sine and cosine Series of a function.

CO2: Find the Fourier transform, sine and cosine transform of certain functions and use Parseval's identity to evaluate integrals.

CO3: Formulate partial differential equations and solve certain types of partial differential equations.

CO4: Estimate the displacement for transverse vibrations of a stretched string and get solution for problems on Transmission line equations using Fourier series.

CO5: Apply Laplace transform methods to solve the diffusion equation.

CO6: Make use of Fourier transform methods to solve diffusion equation and Laplace equation.

Pre-requisite

1. U15MAT101 Engineering Mathematics -I
2. U15MAT201 Engineering Mathematics – II

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S													
CO2	S													
CO3	S													
CO4	S													
CO5	S													
CO6	S													

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

FOURIER SERIES **12 Hours**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic Analysis.

FOURIER TRANSFORM **12 Hours**

Infinite Fourier transform pair – Infinite Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity

PARTIAL DIFFERENTIAL EQUATIONS **12 Hours**

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions - Solution of standard types of first order partial differential equations (excluding reducible to standard types) – Lagrange's linear equation – Linear Homogeneous partial differential equations of second and higher order with constant coefficients.

SOLUTION OF WAVE EQUATIONS **12 Hours**

Fourier series method: Solution of transverse vibrations of a stretched string - Problems on Transmission line equations.

SOLUTION OF HEAT EQUATIONS **12 Hours**

Laplace Transform Method: Solution of diffusion equation. Fourier Transform Method: Solution of diffusion equation and Laplace equation.

Theory: 45 Hrs **Tutorial: 15 Hrs** **Total Hours: 60**

REFERENCES:

1. Sankara Rao K., "Introduction to partial differential equations", Prentice Hall of India, New Delhi, 2006.
2. Veerarajan T., "Engineering Mathematics", Third Edition, Tata McGraw Hill, New Delhi, 2007.
3. Grewal B S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.
4. Ian Sneddon , "Elements of partial differential equations", McGraw – Hill New Delhi, 2003.
5. Howard B.Wilson and Louis H. Turcotte, "Advanced Mathematics and Mechanics Applications Using MATLAB", McGraw Hill, 1998.

U15MC*T*301	MECHANICS OF SOLIDS FOR MECHATRONICS	L	T	P	C
		3	1	0	4

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Recognize the elastic response of the materials and types of failures
- **CO2:** Calculate the stresses and deflection in simple bars, compound bars and bi-axial load system
- **CO3:** Find the strain energy store in the member for different loadings
- **CO4:** Locate maximum values of shear force and bending moments in a given beam
- **CO5:** Calculate the stresses induced in various types of beams
- **CO6:** Estimate the slope and deflection of beams for various loading conditions
- **CO7:** Find the crippling load for a column with different end conditions
- **CO8:** Determine the power transmitting, torque carrying capacities of the circular shafts
- **CO9:** Calculate the required thickness of the pressure vessel for a given internal pressure

Pre-requisite

1. U15MET201 Engineering Mechanics
2. U15MAT101 Engineering Mathematics -I
3. U15MAT201 Engineering Mathematics - II

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO 1	PSO 2
CO1	M		M											
CO2	M		M										S	M
CO3	M		M										S	
CO4	M		M										S	M
CO5	M		M										S	W
CO6	M		M										S	W
CO7	M	M	M										S	
CO8	M		M										S	M
CO9	M		M										S	

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

ELASTIC RESPONSE OF MATERIALS 12 Hours

Introduction to elastic response – stresses (tensile, compressive, shear & bending) & strength – strain and deformation, stress-strain curve for steel - Stresses and deformation of simple and compound bars under axial loads - Elastic constants and their relations - Introduction to types of failures- strength and stiffness based design-Thermal stresses and creep. **Tutorials**: Measurement of tensile strength and modulus of elasticity.

BI-AXIAL STRESSES AND STRAIN ENERGY 12 Hours

Principal stresses – Introduction, significance, calculation of principal stresses - Mohr's circle to find principal stresses - Strain energy in gradually applied loads, suddenly applied loads and Impact loads Elements of fracture mechanics.

STRESSES IN BEAMS 12 Hours

Types of beams: supports and loads – Cantilever, Simply supported and Overhanging beams - Shear force and bending moment diagrams.

Stresses in beams – theory of simple bending and its applicability for actual conditions effect of shape of beams on stress induced - Bending stress and flexural strength.

Tutorials: Measurement of flexural strength - Shear stresses in beams.

DEFLECTION OF BEAMS 12 Hours

Elastic curve– Evaluation of beam deflection and slope: Double integration method & Macaulay's method

Columns: End conditions, equivalent length – Euler's equation and its limitations – slenderness ratio – Rankine's formula for columns

TORSION OF CIRCULAR SECTIONS AND DESIGN OF PRESSURE VESSELS 12 Hours

Analysis of torsion of circular bars – shear stress distribution – twist and torsional stiffness – Bars of solid and hollow circular sections - Thin cylinders and shells – Hoop stress and longitudinal stresses.

Theory: 45 Hrs **Tutorial: 15 Hrs** **Total Hours: 60**

REFERENCES:

1. Ramamrutham S, "Strength of materials", 14h Edition, Dhanpat Rai Publishing Company, 2014.
2. Rattan S S, "Strength of materials", 2nd edition, McGraw Hill, 2014.
3. Ferdinand Beer and Russell Johnston Jr., "Mechanics of materials", 3rd edition, Tata McGraw Hill 2007.
4. Nash W A, "Strength of materials", 4th edition, Tata McGraw Hill, 2011.

U15MCT302

MECHANICS OF FLUID FOR MECHATRONICS

L	T	P	C
3	1	0	4

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Describe the properties of fluids and its importance in selection of fluid for suitable application.
- **CO2:** Apply the concept of fluid statics to determine the pressure and forces on plane and curved surfaces.
- **CO3:** Differentiate the types of flow with its characteristics and also calculate the flow rate by applying concept of fluid kinematics and dynamics.
- **CO4:** Identify the major and minor losses involved in the fluid flow through pipes.
- **CO5:** Generate set of dimensionless parameters in fluid flow problems and also perform dimensional analysis on them.
- **CO6:** Define and classify the different types of hydraulic machines and select them based on performance for real time applications.

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	S													M
CO2	S	M												M
CO3	S													M
CO4	S													M
CO5	S	M												M
CO6	S													M

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

FLUID PROPERTIES AND FLUID STATICS 9 Hours

Fluid - definition, distinction between solid and fluid - Units and dimensions – Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapor pressure, capillary and surface tension.

Fluid statics: Pascal law - Hydrostatic law - Pressure measurements using Manometers and pressure gauges - Forces on immersed plane and curved surfaces – Buoyancy – Meta-centre - Stability of floating and submerged bodies.

FLIUD KINEMATICS AND FLUID DYNAMICS **15 Hours**

Fluid Kinematics – Lagrangian and Eulerian descriptions - Flow visualization - Lines of flow - Types of flow - Flow characteristics – concept of control volume - velocity field and acceleration -continuity equation – energy equation – momentum equation – Impact of jets - Equation of streamline - stream function - velocity potential function - circulation – flow net.

Fluid dynamics - equations of motion - Euler's equation along streamline - Bernoulli's equation – Applications - Venturi meter, Orifice meter, Pitot tube.

FLUID FLOW AND DIMENSIONAL ANALYSIS **15 Hours**

Laminar flow between parallel plates - Laminar flow through circular tubes (Hagen Poiseuille equation) - Hydraulic and energy gradient - Darcy Weisbach equation - Pipe roughness - Friction factor - Moody's diagram minor losses - Flow through pipes in series and in parallel.

Dimension and units - Buckingham π theorem - Discussions on dimensionless parameters – applications - Laws of models and similitude.

11 Hours

HYDRAULIC TURBINES

Fluid machines: definition and classification - exchange of energy - Euler's equation for turbo machines - Construction of velocity vector diagram's - head and specific work - components of energy transfer - degree of reaction.

Hydro turbines: definition and classifications - Pelton turbine - Francis turbine – propeller turbine - Kaplan turbine - working principles - velocity triangles - work done – specific speed - efficiencies - performance curve for turbines.

10 Hours

HYDRAULIC PUMPS

Pumps: definition and classifications - Centrifugal pump: classifications, working principles, velocity triangles, specific speed, efficiency and performance curves - Reciprocating pump: classification, working principles, indicator diagram, and work saved by air vessels and performance curves - Cavitations in pumps.

Theory: 45 Hrs **Tutorial: 15 Hrs** **Total Hours: 60**

REFERENCES::

1. White F M., "Fluid Mechanics", 7th Edition, Tata McGraw-Hill, New Delhi, 2011.
2. Douglas J F., Gasoriek J M., 5th Edition "Fluid Mechanics", Pearson India, 2008.
3. Cengel Y A., Cimbala J M., "Fluid Mechanics – Fundamentals and applications", 2nd Edition, McGraw Hill higher education, 2010.
4. Modi P N., Seth S M., "Hydraulics and fluid mechanics including hydraulic machines", 20th edition, Standard publishers, 2015.
5. Bansal R K., "Fluid Mechanics and Hydraulics Machines", 9th edition, Laxmi publications (P) Ltd., New Delhi, 2011.

6. Som S K. and Biswas G., “Introduction to fluid mechanics and fluid machines”, 2nd edition, Tata McGraw-Hill, 2007.
7. Kumar K L., “Engineering Fluid Mechanics”, 7th edition, Eurasia Publishing House (P) Ltd, New Delhi 2008.
8. Ramamirtham S., “Fluid Mechanics and Hydraulics and Fluid Machines”, Dhanpat Rai and Sons, Delhi, 2006.

U15MCT303 SENSORS AND INSTRUMENTATION

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Classify the transducers and instruments based on their working principles, characteristics and order of the system.
- **CO2:** Use statistical methods to compute the errors in the measurements and calculate the response of zero, 1st and second order measurement systems.
- **CO3:** Describe the working principle and characteristics of non electrical transducers Such as displacement, velocity, temperature, pressure, humidity, force and light.
- **CO4:** Describe the working principle, characteristics of non electrical transducers such as force (resistive, fiber optic and piezo), vacuum, airflow and light.
- **CO5:** Explain and differentiate various acoustic parameters and systems with their measurement transducer.
- **CO6:** Discuss about the construction, working principles and characteristics of bio medical sensors.
- **CO7:** Choose appropriate transducer and a signal conditioning circuit for a given mechatronics application.
- **CO8:** Explain the principles of various elements used in signal conditioning, conversion, acquisition and transmission. Also able to design simple circuits related signal conditioning and conversion.

Pre-requisite

1 U15MCT201 Electronic Devices and Circuits

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1					S									S
CO2		S		S										M
CO3		M	S											S
CO4		M	S											S
CO5		M	S											S
CO6		M	S											S
CO7			S		S									S
CO8			S											S

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

MEASUREMENT SYSTEMS **9 Hours**

Generalized Measurement System – Performance Characteristics: Static and Dynamic Characteristics – Errors in Measurements – statistical Analysis of errors - Calibration and Standards – Generalized Performance of Zero Order, First Order and Second Order Systems – Classifications of Transducers.

MEASUREMENT OF NON ELECTRICAL PARAMETERS-1 **9 Hours**

Linear and angular displacement: Resistive, capacitive, inductive types and Optics (encoders), proximity sensors

Velocity measurement: tachometers, tachogenerators and resolvers

Temperature measurement: Contact type: Bimetallic, RTD, Thermocouple and Thermistor

Non- Contact type: Radiation Pyrometer – Optical Pyrometer

Humidity: Capacitive and resistive and hot and wet bulbs.

Other sensors: Fire, smoke and metal detectors.

MEASUREMENT OF NON ELECTRICAL PARAMETERS-2 **9 Hours**

Force measurement: Resistive type strain gauges: Bridge configurations, Temperature compensation, Load cells, Fiber optic strain gauge- Semiconductor strain gauges- Piezo electric transducers.

Vacuum Measurement: McLeod Gauge, Thermal Conductivity Gauge – Ionization Gauge.

Airflow: Anemometers

Light: UV, IR, Light emitter and detector

Introduction to Acoustics and acoustic sensors: Ultrasonic sensor- Types and working of Microphones and Hydrophones – Sound level meters- Nuclear radiation sensors.

MEASUREMENT OF BIO SIGNALS **9 Hours**

Basic transducer principles Types – source of bioelectric potentials - electrode – electrolyte interface, electrode potential, resting and action potential – electrodes for their measurement, ECG, EEG, EMG.

SIGNAL CONDITIONING AND DATA ACQUISITION **9 Hours**

Amplification, Filtering – Level conversion – Linearization - Buffering – Sample and Hold circuit – Quantization – Multiplexer / Demultiplexer – Analog to Digital converter – Digital to Analog converter- I/P and P/I converter - Instrumentation Amplifier-V/F and F/V converter- Data Acquisition -Data Logging – Data conversion – Introduction to Digital Transmission system.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009.
2. Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2010.
3. John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 1999
4. Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

U15MC*T* 304 ELECTRICAL MACHINES AND DRIVES

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Define the basic theorems in Magnetic circuits.
- **CO2:** Construct, state the principle of operation and performance of DC motors.
- **CO3:** Construct, state the principle of operation and performance of Induction machines.
- **CO4:** Summarize the speed control methods of electrical machines
- **CO5:** Construct, state the principle of operation and performance of special machines
- **CO6:** Construct, state the principle of operation and performance of permanent magnet machines
- **CO7:** Construct, state the principle of operation and performance of linear electrical machines.

Pre-requisite

U15MCT201 Electronic Devices and Circuits

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	S													
CO2	M												M	
CO3	M												M	
CO4	M												M	
CO5	M												M	
CO6	M		M										M	

Course Assessment methods:

Direct	Indirect
Internal test I Internal test II End semester Examination Assignment	Course end survey

BASIC OF ELECTRICAL MACHINES **9 Hours**

Fundamental Equation – First Maxwell Equation (Ampere's Law) - Second Maxwell-Equation (Faraday's Law)
Lorentz Force Law - Lorentz Force - Magnetic Force - Force caused by variation of magnetic energy
Power Calculation - Average value, Rms value, efficiency
Methods of connection (three-phase systems) - Symmetrical components (+ve, -ve, Zero sequence)
Rotating field theory – Introduction

DC AND AC MACHINES 9 Hours

DC Motor – Shunt and Series - Construction – working – Armature Reactions.
3Phase Induction Motor- Construction – working – RMF - Slip- cogging – crawling.

ELECTRICAL DRIVES 12 Hours

Types of electrical drives - Factors influencing the choice of electrical drives
Speed control - DC series and Shunt motors - Armature and Field control, controlled rectifiers - Speed control of three phase induction motor - Voltage control, Voltage/frequency control, slip power recovery scheme.

SPECIAL MACHINES 6 Hours

Stepper Motor - Construction – working – Torque
Switched Reluctance Motor (SRM) - Construction – working – Torque – Characteristics

PERMANENT MAGNET MACHINES 6 Hours

Permanent Magnet DC (PMDC) Motor - Construction – working – Torque
Brushless Permanent Magnet DC (BLDC) Motors - Construction – working – Electronic commutation – Types of BLDC

LINEAR ELECTRICAL MACHINES 6 Hours

Linear Induction Motor (LIM) - Construction – Trust Equation of LIM – Eq. CKT of LIM – Characteristics of LIM – Control of LIM

CASE STUDY: Section of suitable application of each and every motor considering the selection process.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Janardanan E G., "Special Electrical Machines" PHI Learning Private Limited, Delhi, 2014.
2. Nagrath I J and Kothari D P., "Electrical Machines", 3rd Edition, Tata McGraw-Hill, New Delhi, 2006.
3. Pillai S K, "A first course on Electric drives", Wiley Eastern Limited, 1998.
4. Singh M D and Khanchandani K B., "Power Electronics", Tata McGraw-Hill, New Delhi, 1998.
5. Partab H., "Art and Science and Utilization of electrical energy", Dhanpat Rai and Sons, New Delhi, 2014.
6. Univ.-Prof. Dr.-Ing., Dr. H.C. Gerhard Henneberger , "Electrical Machines I Basics, Design, Function, Operation" ,Aachen University, 2002.

U15GST001 **ENVIRONMENTAL SCIENCE AND ENGINEERING**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Analyze the impact of engineering solutions in a global and societal context.
- **CO2:** Discuss contemporary issues that results in environmental degradation and would attempt to provide solutions to overcome those problems
- **CO3:** Highlight the importance of ecosystem and biodiversity.
- **CO4:** Ability to consider issues of environment and sustainable development in his personal and professional undertakings
- **CO5:** Paraphrase the importance of conservation of resources.
- **CO6:** Play an important role in transferring a healthy environment for future generations.

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1		M					S		M					
CO2						M				M				
CO3							M							
CO4						M	S							
CO5							S							
CO6			W				S					M		

Course Assessment methods:	
Direct	**Indirect**
Assignment Internal test Group Presentation End semester Examination	Course end survey

INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES **14 Hours**

Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people

Water resources: Use and overutilization of surface and ground water, conflicts over water, dams-benefits and problems – Water conservation, rain water harvesting, watershed management

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, 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, land degradation, man induced landslides, soil erosion and desertification – Wasteland reclamation - Role of an individual in conservation of natural resources.

ECOSYSTEMS AND BIODIVERSITY **9 Hours**

ECOSYSTEM :Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

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

ENVIRONMENTAL POLLUTION **10 Hours**

Definition – Causes, effects and control measures of: (a) Air pollution - Organic and inorganic pollution - cyclone separator, electrostatic precipitator (b) Water pollution (c) Heavy metal pollution (d) Noise pollution (e) Thermal pollution (f) Nuclear hazards – Role of an individual in prevention of pollution – Pollution case studies - Solid waste and hazardous Management: Causes, effects and control measures from factories, small scale and large scale industries – waste minimization - Disaster management: floods, earthquake, cyclone and landslides.

SOCIAL ISSUES AND THE ENVIRONMENT **7 Hours**

From Unsustainable to Sustainable development – Urban problems related to energy – Resettlement and rehabilitation of people; its problems and concerns, case studies –Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion– 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 – Human Rights.

HUMAN POPULATION AND THE ENVIRONMENT **5 Hours**

Population growth and explosion – Welfare Programme - Environment and human health – Communicable disease – Role of Information Technology in Environment and human health – Case studies.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Miller T.G, "Environmental Science", Wadsworth Publishing Co, 2013.
2. Masters G.M., and Ela W.P., "Introduction to Environmental Engineering and Science", Pearson Education Pvt., Ltd.
3. Bharucha Erach, "The Biodiversity of India", Mapin Publishing Pvt. Ltd., Ahmedabad India, 2002.
4. Trivedi R.K and Goel P.K., "Introduction to Air pollution". Techno-science Publications, 2003.
5. Trivedi R K., "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media. 1996.
6. Cunningham, Cooper W P., Gorhani E., "Environmental Encyclopedia", Jaico Publication House, Mumbai, 2001.
7. Wager K D., "Environmental Management", W.B. Saunders Co., Philadelphia, USA, 1998.
8. Townsend C., Harper J and Michael Begon, "Essentials of Ecology", Blackwell science Publishing Co., 2003.
9. Syed Shabudeen, P.S. "Environmental chemistry", Inder Publishers, Coimbatore, 2013.

U15MC*P*301 **FLUID MECHANICS AND MACHINERY LABORATORY**

L	T	P	C
0	0	3	1

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Determine the viscosity of fluids and its importance in selection of fluids
- **CO2:** Identify the different pressure measurements and able to determine the pressure in a fluid at rest and in motion.
- **CO3:** Determine the flow rate and Co-efficient of discharge for given Orificemeter and Venturimeter.
- **CO4:** Calculate the friction factor of pipes made up of various materials.
- **CO5:** Compare the performance characteristics of various hydraulic turbines.
- **CO6:** Test the performance of various positive and non-positive displacement pumps.

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	S	M							S					M
CO2	S	M							S					M
CO3	S	M							S					M
CO4	S	M							S					M
CO5	S	M							S					M
CO6	S	M							S					M

Course Assessment methods:	
Direct	**Indirect**
Lab Exercises Model Practical Examination End Semester Practical Examination Assignment	Course end survey

LIST OF EXPERIMENTS

1. Measurement of viscosity of a given liquid.
2. Measurement of Atmospheric, Absolute and Gauge Pressures.
3. Pressure Measurements using U-tube differential manometers, Bellows Pressure gauge, Bourdon tube Pressure gauge and Diaphragm Pressure gauge.
4. Determination of the Coefficient of discharge of given
   a. Orificemeter,

   b. Venturimeter
5. Flow rate measurement through Orifice by
   a. Constant Head Method
   b. Variable Head Method
6. Calculation of the rate of flow using Roto meter.
7. Determination of friction factor of given set of pipes.
8. Conducting experiments and drawing the characteristic curves of centrifugal pump / submersible pump
9. Conducting experiments and drawing the characteristic curves of reciprocating Pump.
10. Conducting experiments and drawing the characteristic curves of Gear pump.
11. Conducting experiments and drawing the characteristic curves of Pelton wheel.
12. Conducting experiments and drawing the characteristics curves of Francis turbine.
13. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

Total Hours: 45

U15MCP302 **SENSORS AND INSTRUMENTATION LABORATORY**

L	T	P	C
0	0	3	1

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Generate appropriate design procedure, suitable for signal conversion to interface with computer.
- **CO2:** Design appropriate circuits by using conventional formulas used in signal conditioning and conversion.
- **CO3:** Implement their design in bread board and test it.
- **CO4:** Generate appropriate design procedure to obtain a required measurement data for temperature, force, humidity, displacement and sound.
- **CO5:** Log the data in computer using LABVIEW/ MATLAB/SCILAB.
- **CO6:** Present data in a clear and meaningful manner.
- **CO7:** Use transducers to create simple Mechatronics applications using data logging software.

Pre-requisite

U15MCT301 Sensors and Instrumentation

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	PO11	PO12	PSO 1	PSO2
CO1			S		S									S
CO2			S											S
CO3			S											S
CO4			S	S										S
CO5			S		S									S
CO6										S				
CO7			S		S								S	S

Course Assessment methods:	
Direct	**Indirect**
Lab Exercises Model Practical Examination End Semester Practical Examination Assignment	Course end survey

LIST OF EXPERIMENTS

1. Design and testing of Digital Comparator
2. Design and testing of Voltage to frequency converter and frequency to voltage converter.
3. Design and testing of sample and hold circuit.
4. Design and testing of Flash type Analog to Digital Converters.
5. Design and testing of instrumentation amplifier using OP-AMP.
6. Displacement measurement using potentiometer and LVDT and plotting the characteristic curves.
7. Study of Characteristics and calibration of strain gauge and Load Cell
   a. Measurement of strain using resistive type strain gauges with temperature compensation and various bridge configurations.
8. Temperature measurement using Thermocouple, Thermistor and RTD and comparing the characteristics.
9. Comparison of capacitive and resistive type transducer for humidity measurement with their characteristics.
10. Measurement of sound using microphones and sound level meter.

ADDITIONAL EXPERIMENTS

11. Conversation of time domain audio signal into frequency domain signal (FFT).
12. Measurements of 3 phase power and power factor.

NOTE: Experiments 6- 9 should be logged in computer by using data acquisition system and LABVIEW/MATLAB/SCILAB.

Total Hours: 45

U15GHP301	FAMILY VALUES (Common to all branches of Engineering and Technology)	L	T	P	C
		1	0	0	1

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Acquire knowledge on the Clarity, courage, confidence, commitment, compassion this required for a good professional.
- **CO2:** Understand the concept of Karma Yoga and lead his/her life accordingly.
- **CO3:** Understand the importance of ethics in ones profession and practice it
- **CO4:** Apply leadership theories and use them in his/her profession appropriately
- **CO5:** Learn how to be an empowered professional and how to empower colleagues

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	PO11	PO12	PSO 1	PSO2
CO1						M		M	S	W		M		
CO2						S	M		W			S		
CO3						W						M		
CO4						M			M			S		
CO5						M						M		

Course Assessment methods:	
Direct	**Indirect**
Continuous Assessment	Course end survey

Introduction to Family Life – An Overall Perspective **1 Hours**

Personal & Spiritual development through good Family life **1 Hours**

Importance of Relationships & Blessings **3 Hours**

Food as Medicine – Quantum Healing **3 Hours**

Greatness of womanhood **2 Hours**

Simplified Physical Exercises (Kundalini Exercises) **5 Hours**

Total Hours: 15

REFERENCES:

1. Vethathiri's Maharishi's, "Yoga for Modern Age", The World Community Service Centre, Vedhathiri Publications, 2009.
2. Swami Vivekananda, "The Man Making Message" The Ramakrishna Tapovanam, Published 1972.
3. Vethathiri's Maharishi's, "Manavalakalai part 1,2&3" 1[1th] edition, The World Community Service Centre, Vethathiri Publications,2005.
4. Brian L Weiss, "Only Love is Real" by Grand Central Publishing, Published 1997.

SEMESTER IV

U15MA*T*401 **NUMERICAL METHODS**

L	T	P	C
3	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Solve a set of algebraic equations representing steady state models formed in engineering problems
- **CO2:** Fit smooth curves for the discrete data connected to each other or to use interpolation methods over these data tables
- **CO3:** Find the trend information from discrete data set through numerical differentiation.
- **CO4:** Estimate integrals from discrete data through numerical methods.
- **CO5:** Predict the system dynamic behaviour through solution of ODEs modeling the system
- **CO6:** Solve PDE models representing spatial and temporal variations in physical systems through numerical methods.

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	S	S							M	M				
CO2	S	S							M	M				
CO3	S	S							M	M				
CO4	S	S							M	M				
CO5	S	S							M	M				
CO6	S	S							M	M				

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

NUMERICAL SOLUTION OF ALGEBRAIC EQUATIONS **12 Hours**

Solution of nonlinear equations: False position method, Fixed point iteration method, Newton Raphson method for a single equation and a set of non- linear equations - Solution of linear system of equations: Gaussian elimination method, Gauss Jordan method and Gauss Seidel method - Matrix Inversion by Gauss Jordan method - Eigen values of a matrix by Power method.

CURVE FITTING AND INTERPOLATION **12 Hours**

Curve fitting: Method of least squares – Interpolation: Newton's forward and backward difference formulae – Divided differences – Newton's divided difference formula - Lagrange's interpolation – Inverse interpolation.

NUMERICAL DIFFERENTIATION AND INTEGRATION **12 Hours**

Numerical differentiation by using Newton's forward, backward and divided differences – Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules– Truncation error – Evaluation of double integrals.

NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS **12 Hours**

Single step methods: Taylor's series method, Euler and Improved Euler methods, Fourth order Runge – Kutta method – Multistep method: Milne's predictor - corrector method.

NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS **12 Hours**

Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain– Solution of one dimensional heat equation using Bender Schmidt and Crank Nicholson difference schemes –Solution of one dimensional wave equation by explicit scheme.

Theory: 45 Hrs **Tutorial: 15 Hrs** **Total Hours: 60**

REFERENCES:

1. Kandasamy P., Thilagavathy K. and Gunavathy K., "Numerical Methods", S.Chand Co. Ltd., New Delhi, 2007.
2. Steven C.Chapra and Raymond P. Canale, "Numerical Methods for Engineers with Programming and Software Applications", McGraw-Hill, 2004.
3. Gerald C F. and Wheatley P O., "Applied Numerical Analysis", Sixth Edition, Pearson Education Asia, New Delhi, 2002.
4. Sastry S S, "Introductory Methods of Numerical Analysis", Third Edition, Prentice – Hall of India Pvt Ltd, New Delhi, 2003.

U15MC*T* 401 MANUFACTURING TECHNOLOGY

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Define and distinguish various manufacturing processes
- **CO2:** Select and justify appropriate casting methods
- **CO3:** Anticipate general casting defects and explain their remedies
- **CO4:** Summarize various bulk deformation processes and the explain the working machineries
- **CO5:** Describe the working principles of machines and various machining processes.
- **CO6:** Choose a suitable metal joining process for a given application.

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	M												W	M
CO2	M												W	M
CO3	M												W	M
CO4	M												W	M
CO5	M												W	M
CO6	M												W	M

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

FOUNDRY TECHNOLOGY **9 Hours**

Pattern and Core making – Moulding sand – Melting furnaces: Cupola and Induction furnaces – Special casting processes – Shell, Investment, Die casting – Defects in casting.

FORMING PROCESSES **9 Hours**

Hot and Cold Working Rolling - Introduction – Rolling Mills – Rolling Operations – Forging - Introduction – Related Forging Operations – Drop forging- Extrusion and Drawing - Extrusion

Practice – Hot, Cold, Impact and Hydrostatic extrusion. Drawing Process – Defects and Residual Stresses – Drawing Equipment. Sheet metal operations – Blanking, Punching and Piercing. (Treatment is to be given only on operations)

CONVENTIONAL MACHINING PROCESS **9 Hours**

Lathes and Lathe Operations, Drilling and Drilling Machines, Reaming and Reamers, Tapping and Taps – Tool nomenclature, cutting speed, feed, machining Time calculations. (No Treatment on mechanisms).

SPECIALIZED MACHINING AND SUPER FINISHING PROCESS **9 Hours**

Milling Machines and Operations, Planning and Shaping, Broaching, Gear Hobbing and Shaping. Grinding Process – Abrasives – Finishing Operations – Lapping, Honing Burnishing. (No Treatment on mechanisms).

PRINCIPLES & APPLICATIONS OF JOINING PROCESSES **9Hours**

Gas welding, Basic Arc Welding Processes, Thermit Welding, Electron – Beam Welding, Laser – Beam Welding. Solid State Welding: Cold Welding, Ultrasonic Welding, Friction Welding, Resistance Welding and Explosive Welding. Principles and applications of Brazing and Soldering.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES::

1. Kalpakjian S., "Manufacturing Engineering and Technology", 4th edition, Pearson education India, 2009.
2. Hajra Choudhury S K. and Hajra Choudhury A K., "Elements of Workshop Technology", Volume I and II, Media Promoters and Publishers Private Limited, Mumbai, 1997.
3. Paul Degarma E, Black J T. and Ronald A Kosher, "Materials and Processes in Manufacturing", 8th edition, Hall of India, 2008.
4. Sharma P C., "A Textbook of Production Technology", S. Chand and Co., Ltd., 2009.

U15MCT402 INDUSTRIAL ELECTRONICS

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Relate the basic semiconductor physics to the properties of real power semiconductor devices and differentiate from low power devices.

CO2: Describe the concepts of operation of AC-DC converters in steady state of both continuous and discontinuous modes.

CO3: Identify the operating the single phase and three phase inverter circuits

CO4: Design a pure sine wave inverter output.

CO5: identify DC equipment with changing DC voltage

CO6: Classify and design choppers for simple electrical application

Pre-requisite

U15MCT201 Electronic Devices and Circuits

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S												S	
CO2	S												M	
CO3	S	S											M	
CO4	S		S										S	
CO5	S	M											S	
CO6	S												M	

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

POWER SEMICONDUCTOR DEVICES **9 Hours**

Diodes – Volt-Ampere Characteristics – Switching Characteristics

Thyristors – Volt-Ampere Characteristics – Switching Characteristics

Triacs – Volt-Ampere Characteristics – Switching Characteristics

Power BJT – Volt-Ampere Characteristics – Switching Characteristics

Power MOSFET – Volt-Ampere Characteristics – Switching Characteristics
Power IGBT – Volt-Ampere Characteristics – Switching Characteristics

PHASE CONTROLLED CONVERTERS **9 Hours**

Diode Rectifiers – Single phase Bridge – R, RL – Effects of Source Inductance – Distortion factor – displacement power factor
Thyristor Converter – Single phase bridge – RL – Discontinues conduction
Thyristor Converter – Three phase Bridge – Discontinuous converter..
INVERTERS **9 Hours**

Single-phase inverter – Half-bridge – center tapped inverter – Full or H- bridge inverter – Phase shit voltage control
Three-phase Inverter – Square-wave or six-step operation – Input ripple

PURE WAVE INVERTER **9 Hours**

Multi stepped inverter – 12 step inverter – 18 Step inverter.

PWM Inverter – PWM Principles – SPWM – Selected harmonic inverter

DC- DC CONVERTER **9 Hours**

DC Chopper - Step Down Converter – Step Up Converter
Buck Boost Converter – Introduction **-** Fly Back converter
Bidirectional Converter
Switching and Voltage/Current Regulation - Voltage Control mode – Current control mode.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES::

1. Bimbhra P S, "Power Electronics" Tata McGraw Hill, 2012
2. Rashid M H, "Power Electronics – Circuits Devices and Application", 4th Edition, Prentice Hall International, New Delhi, 2013.
3. Dubey G K., Doradia S R., Joshi A. and Singh, R.M., "Thyristorised Power Controllers", 2nd Edition, Wiley Eastern Limited, 2010.
4. Joseph Vithayathil, "Power Electronics – Principle and Applications", Tata McGraw-Hill Inc, New Delhi, 2010.
5. Bimal K Bose "Modern power electronics and AC Drives" Prentice Hall International, New Delhi, 2001.
6. Bimbhra P S, "Power Electronics" Tata McGraw Hill, 2012

U15MCT403 KINEMATICS OF MACHINES

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Select mechanisms to achieve desired motion transformation

CO2: Calculate the position, velocity, acceleration of multi-bar mechanisms by graphical methods

CO3: Construct a cam profile for a given application.

CO4: Calculate the primary dimensions of a gear.

CO5: Choose appropriate gear train for a given application.

CO6: Solve problems on power transmission and power loss due to friction in various machine elements.

Pre-requisite

U15MET101 Engineering Graphics

U15MET201 Engineering Mechanics

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	M												S	
CO2	M													
CO3	M		M										M	
CO4	M		W										M	
CO5	M		W										M	
CO6	M		M										M	

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

BASICS OF MECHANISMS 9 Hours

Terminology and Definitions - Degree of Freedom Mobility - Kutzbach criterion - Grashoff‟s law-Kinematic Inversions of 4-bar chain and slider crank chains – Mechanical Advantage - Transmission angle - Description of common Mechanisms - Single, double and offset slider mechanisms - Quick return mechanisms – Ratchets and escapements – Indexing Mechanisms - Rocking Mechanisms.

KINEMATICS 9 Hours

Displacement, velocity and acceleration analysis in simple mechanisms - Construction of velocity and acceleration polygons using graphical mehod - Velocity analysis: Instantaneous centre method- Acceleration analysis: Klein‟s construction - Coriolis Acceleration

KINEMATICS OF CAM 9 Hours

Classifications - Displacement diagrams – Modified uniform velocity, Parabolic, Simple harmonic and Cycloidal motions - Layout of plate cam profiles - Derivatives of Follower motion – Circular arc and tangent cams - Standard cam motion – Significance of Pressure angle and undercutting.

GEAR AND GEAR TRAINS 9 Hours

Introduction - Spur gear Terminology and definitions-Fundamental Law of toothed gearing and involute gearing - Inter changeable gears - gear tooth action - Terminology - Interference and undercutting - Non standard gear teeth- Helical, Bevel, Worm, Rack and Pinion gears (Basics only) - Gear trains - Parallel axis gear trains -Epicyclic gear trains – Differentials.

FRICTION 9 Hours

Introduction- Friction drives - Friction in screw threads – Friction clutches: cone and plate clutches - Belt and rope drives, Friction aspects in Brakes.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Shigley J E. and Uicker J J., “Theory of Machines and Mechanisms”, McGraw-Hill, Inc., 2003.
2. Rattan S S., “Theory of Machines”, 2nd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007.
3. Thomas Bevan, “Theory of Machines”, CBS Publishers and Distributors, 2003.
4. Ghosh A. And Mallick A K., “Theory of Mechanisms and Machines”, Affiliated East-West Press, Pvt. Ltd., New Delhi, 2000
5. Rao J S. and Dukkipati R V., “Mechanism and Machine Theory”, Wiley-Eastern Limited, New Delhi, 2006.
6. John Hannah and Stephens R C., “Mechanics of Machines”, Viva low-Priced Student Edition, 1999.
7. Sadhu Singh, “Theory of Machines”, Pearson Education, 2nd Edition, 2008.

U15MCT404 **DIGITAL ELECTRONICS AND MICROPROCESSOR**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Use number systems, Boolean algebra and explain various digital logic families.

CO2: Apply basic logic gates to form simple circuits and can simplify logic circuits using K-Map technique.

CO3: Design combinational logic circuits using logic Gates and explain simple memory systems.

CO4: Design flip flops and realize one flip flop using the other.

CO5: Design counters and construct their timing diagrams.

CO6: Explain the architecture of 8085 microprocessor and their peripheral ICs (8255, 8279 and 8251 A).

CO7: Write assembly language program for 8085 for the given application.

CO8: Explain the memory Mapping and I/O devices.

Pre-requisite

U15MCT201 Electronics Devices And Circuits

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	M												W	
CO2	S	W											M	
CO3	M	S	M										S	M
CO4	M	S	M										M	W
CO5	M	S	M										S	M
CO6	M												M	
CO7	M	M											S	M
CO8	M	M	M										M	

Course Assessment methods:

Direct	Indirect
Internal test I Internal test II End semester Examination Assignment	Course end survey

NUMBER SYSTEMS, DIGITAL LOGIC FAMILIES AND BOOLEAN LOGIC **9 Hours**

Introduction to Number systems: Binary, Octal, Hexadecimal, BCD, Gray code, Excess 3 code - Binary arithmetic: 1's complements, 2's complements, and Code conversions -Digital Logic Families: TTL, CMOS, NMOS, ECL- Performance comparison of various logic families- Boolean algebra: Basic Postulates and theorems, Switching functions, Canonical forms, Logic gates- Simplification using K-maps and Implementation using logic gates.

COMBINATIONAL CIRCUITS **9 Hours**

Problem formulation and design of combinational circuits: adder, subtractor, Serial adder and Subtractor - Parallel adder and Subtractor- Carry look ahead adder- BCD adder, Magnitude Comparator , parity checker Encoder , decoder, Multiplexer/ Demultiplexer , code converters, Function realization using gates and multiplexers. Implementation of Combinational circuits using Multiplexers and Demultiplexers- Memory: PROMs and PLAs.

SEQUENTIAL CIRCUITS **9 Hours**

General model of sequential circuits: Latch, Flip Flops, Level triggering, Edge triggering, Master slave configuration- Realization of one flip flop using other flip flop- Registers-Counters: Binary counters, Modulo–n counter, Decade, BCD counters, Ring counter and Johnson counter with their timing diagram.

MICROPROCESSOR 8085 **9 Hours**

Organization of 8085: Architecture, Internal Register Organization and Pin Configuration – Instruction Set of 8085 – addressing modes - instruction and machine cycles with states and timing diagram - 8085 assembly language programming.

MEMORY AND I/O INTERFACING **9 Hours**

Address space partitioning – address map – Address decoding – Designing decoder circuit for the given address map -I/O Interfacing- Data transfer schemes – programmed synchronous and asynchronous – Interrupt driven Transfer - Peripheral ICs*: 8255, 8279 and 8251 A.

* Emphasis to be given on architecture with simple applications.

Total Hours: 45

REFERENCES:

1. Morris Mano M. and Ciletti M D., "Digital Design", 4th edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
2. Donald P Leach, Albert Paul Malvino and Gautam Saha, "Digital Principles and Applications", 8th edition, Tata McGraw Hill Publishing Company Limited, New Delhi, Special Indian Edition, 2014.
3. Salivahanan S. and Arivazhagan S., "Digital Circuits and Design", 4th edition, Vikas Publishing House Pvt. Ltd, New Delhi, 2012.
4. Ramesh Gaonkar, "Microprocessor Architecture, Programming and Applications with the 8085", 6th edition, Penram International (India), 2013.
5. Aditya P Mathur, "Introduction to Microprocessor", 3rd edition, Tata McGraw Hill, New Delhi, 2003.

U15GS*T*008	FOUNDATION SKILLS IN INTEGRATED PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Analyze various factors affecting the product development decision and their importance on new product development

CO2: Comparison of various products and services, types and methods of product development, its planning and management.

CO3: Analyze and apply the requirement based on critical parameters and develop system models.

CO4: Apply and analyze the conceptualization, design prototyping, testing certification and documentation processes related to product development.

CO5: Apply and analyze concepts of product maintenance and strategies for obsolescence management, replacement and disposal.

CO6: Demonstrate understanding of product development in academic and real life situations, breakeven and tradeoff analysis in product development, IPR and security aspects related to product development.

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	M	S		S		S		W	W	M	W	S		
CO2	M		S			W			M	M	W			
CO3		M	S	W	M									
CO4			S						M	S				
CO5			M	S				M						
CO6							M					M		

Course Assessment methods:	
Direct	**Indirect**
Assignment Internal test Group Presentation End semester Examination	Course end survey

FUNDAMENTALS OF PRODUCT DEVELOPMENT 10 Hours

Global Trends Analysis and Product decision: Types of various trends affecting product decision - Social Trends (Demographic, Behavioral, Psychographic), Technical Trends (Technology, Applications, Tools, Methods), Economical Trends (Market, Economy, GDP, Income Levels, Spending Pattern, target cost, TCO), Environmental Trends (Environmental Regulations and Compliance), Political/Policy Trends (Regulations, Political Scenario, IP Trends and Company Policies); PESTLE Analysis

Introduction to Product Development Methodologies and Management: Overview of Products and Services (Consumer product, Industrial product, Specialty products etc); Types of Product Development (NPD/ Re-Engineering (Enhancements, Cost Improvements)/ Reverse Engineering/ Design Porting & Homologation); Overview of Product Development methodologies (Over the Wall/ Waterfall/ V-Model/ Stage-Gate Process/ Spiral/Systems Engineering/ Agile); Product Life Cycle (S- Curve, Reverse Bathtub Curve); Product Development Planning and Management (Budgeting, Risk, Resources and Design Collaboration, Scheduling, Change Management, Product Cost Management).

REQUIREMENTS AND SYSTEM DESIGN 8 Hours

Requirement Engineering: Types of Requirements (Functional, Performance, Physical, Regulatory, Economical, Behavioral, Technical, Stakeholder, Environmental, Industry specific, Internal-Company Specific); Requirement Engineering (Gathering (VOC), Analysis (QFD), Design Specification); Traceability Matrix and Analysis; Requirement Management .

System Design & Modeling: Introduction to System Modeling; System Optimization; System Specification; Sub-System Design; Interface Design.

DESIGN AND TESTING 13 Hours

Conceptualization: Industrial Design and User Interface Design; Introduction to Concept generation Techniques; Concept Screening & Evaluation - Concept Design, S/W Architecture, Hardware Schematics and simulation.

Detailed Design: Component Design and Verification; High Level Design/Low Level Design of S/W Programs, S/W Testing; Hardware Schematic, Component design, Layout and Hardware Testing.

Prototyping: Types of Prototypes (Mockups, Engineering Assessment Prototype, Alpha, Beta, Gama); Introduction to Rapid Prototyping and Rapid Manufacturing.

System Integration, Testing, Certification and Documentation: Manufacturing/Purchase and Assembly of Systems; Integration of Mechanical, Embedded and S/W systems; Introduction to Product verification processes and stages – Industry specific (DFMEA, FEA, CFD); Introduction to Product validation processes and stages - Industry specific (Sub-system Testing/ Integration Testing/ Functional Testing/ Performance Testing / Compliance Testing); Product Testing standards and Certification – Industry specific; Product Documentation (Compliance Documentation, Catalogue, Brochures, user manual, maintenance Manual, Spares Parts List, Warranty, Disposal Guide, IETMS, Web Tools).

SUSTENANCE ENGINEERING AND END-OF-LIFE (EOL) SUPPORT **6 Hours**

Sustenance: Maintenance and Repair; Enhancements.

Product EoL: Obsolescence Management; Configuration Management; EoL Disposal.

BUSINESS DYNAMICS – ENGINEERING SERVICES INDUSTRY **8 Hours**

The Industry: Engineering Services Industry – Overview; Product development in Industry versus Academia.

The IPD Essentials: Introduction to vertical specific product development processes; Product development Trade-offs; Intellectual Property Rights and Confidentiality; Security and Configuration management.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES::

1. "Foundation Skills in Integrated Product Development (FSIPD)", 1st Edition, Published by NASSCOM, 2013.
2. Ulrich Karl T. and Eppinger Steven D, "Product Design and Development", 5th edition, McGraw-Hill, 2012.
3. Kevin N Otto, "Product design – Techniques in Reverse Engineering and New Product Development", PEARSON, New Delhi, 2011.

U15MC*P*401 **ELECTRICAL DRIVE SYSTEM LABORATORY**

L	T	P	C
0	0	3	1

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Test and assess the performances of the DC motors and AC motor for varying load.
- **CO2:** Control the speed of AC and DC motor.
- **CO3:** Test the working of semiconductor devices
- **CO4:** Convert DC supply to required AC frequency
- **CO5:** convert fixed or constant dc supply to variable dc supply
- **CO6:** Analyze and present the findings of experimental observations in both written and oral format.

Pre-requisite

1. U15MCT402 - Industrial Electronics
2. U15MCT304 - Electrical Machines and Drives

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	M	M											M	
CO2	M		M										M	
CO3	M	M	M										M	
CO4	M		M										M	
CO5	M		M										M	
CO6		S								S				

Course Assessment methods:	
Direct	**Indirect**
Lab Exercises Model Practical Examination End Semester Practical Examination Assignment	Course end survey

LIST OF EXPERIMENTS

Electrical Machines

1. Load test on DC Shunt motor
2. Load test on DC series motors
3. Speed control of DC shunt motor (Armature and Field Control)
4. Load Test on Three Phase Squirrel Cage Induction motor

5. Speed control of three phase slip ring induction motor
6. Speed control of DC shunt motor using controlled rectifiers
7. Speed control of BLDC motor
8. Speed control of Stepper motor.
9. Voltage / Frequency control of three phase induction motor using inverter.

Power Electronics

1. Study of SCR, MOSFET & IGBT characteristics.
2. UJT, R and RC firing circuits for SCR.
3. IGBT based PWM inverter (single phase).
4. SCR / TRIAC phase control circuits.
5. Study of half controlled & fully controller converters.
6. Speed control of DC shunt motor using three phase fully controlled converter.
7. IGBT Chopper.

Total Hours: 45

U15MC*P*402 **MANUFACTURING TECHNOLOGY LABORATORY**

L	T	P	C
0	0	3	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Perform various operations in lathe.
CO2: Inspect the manufactured components using suitable measurement techniques
CO3: Read and interpret the shop floor drawings.
CO4: Perform various milling operation for a given drawing.
CO5: Demonstrate various grinding operations.
CO6: Perform machining operation in shaping and slotting machine.

Pre-requisite

1. U15MCT401 Manufacturing Technology

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O 1	PSO 2
CO1	W									M				W
CO2	M									M				W
CO3	W									M				W
CO4	W									M				W
C05	W									M				W
C06	W									M				W

Course Assessment methods:	
Direct	**Indirect**
Lab Exercises Model Practical Examination End Semester Practical Examination Assignment	Course end survey

LIST OF EXPERIMENTS

1. Experiment on mechanical measurement (linear and angular measurement).
2. Turning : Step, taper
3. Thread cutting
4. Knurling
5. Tapping
6. Boring

7. Surface Milling
8. Gear Cutting
9. Grinding (surface, cylindrical and center less)
10. Cutting key way (shaping and slotting machine)
11. Dove Tail Cutting

Total Hours: 45

U15ENP401

COMMUNICATION SKILL LABORATORY

L	T	P	C
0	0	3	1

(Common to all branches of Engineering and Technology)

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Imparting the role of communicative ability as one of the soft skills needed for placement
CO2: Developing communicative ability and soft skills needed for placement
CO3: Making students Industry-Ready through inculcating team-playing capacity

Pre-requisite

1. U15ENT101 / Functional English I
2. U15ENT201 / Functional English II

CO/PO Mapping
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1										S				
CO2										S				
CO3										S				

Course Assessment methods:	
Direct	**Indirect**
Lab Exercises Model Practical Examination End Semester Practical Examination Assignment	Course end survey

GRAMMAR IN COMMUNICATION **9 Hours**

Grammar and Usage – Building Blocks, Homonyms, Subject and Verb Agreement, Error Correction - Grammar Application, Framing Questions – Question words, Verbal Questions, Tags, Giving Replies –Types of Sentences, Listening Comprehension –Listening and Ear training.

ASSERTIVE COMMUNICATION **9 Hours**

Listening Comprehension in Cross–Cultural Ambience, Telephonic Conversations/Etiquette, Role Play Activities, Dramatizing Situations- Extempore – Idioms and Phrases.

CORPORATE COMMUNICATION **9 Hours**

Video Sensitizing, Communicative Courtesy – Interactions – Situational Conversations, Time Management, Stress Management Techniques, Verbal Reasoning, Current Affairs – E Mail Communication / Etiquette.

PUBLIC SPEAKING **9 Hours**

Giving Seminars and Presentations, Nuances of Addressing a Gathering - one to one/ one to a few/ one to many, Communication Process, Visual Aids & their Preparation, Accent Neutralization, Analyzing the Audience, Nonverbal Communication.

INTERVIEW & GD TECHNIQUES **9 Hours**

Importance of Body Language –Gestures & Postures and Proxemics, Extempore, Facing the Interview Panel, Interview FAQs, Psychometric Tests and Stress Interviews, Introduction to GD, Mock GD Practices.

Total Hours: 45

REFERENCES:

1. Bhatnagar R P. and Rahul Bhargava, "English for Competitive Examinations", Macmillian Publishers, India, 1989.
2. Devadoss K. and Malathy P., "Career Skills for Engineers", National Book Publishers, Chennai, 2013.
3. Aggarwal R S., "A Modern Approach to Verbal & Non–Verbal Reasoning", S.Chand Publishers, India, 2012.

U15GHP401	PROFESSIONAL VALUES (Common to all branches of Engineering and Technology)	L	T	P	C
		1	0	0	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Acquire knowledge on the Clarity, courage, confidence, commitment, compassion this required for a good professional.

CO2: Understand the concept of Karma Yoga and lead his/her life accordingly.

CO3: Understand the importance of ethics in ones profession and practice it

CO5: Apply leadership theories and use them in his/her profession appropriately

CO6: Learn how to be an empowered professional and how to empower colleagues

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	PO11	PO12	PSO 1	PSO2
CO1		M	W			W	M	M	M			M		
CO2		W				M	S	M	M			S		
CO3					M		S	S	W	W		M		
CO4		W				M	M	M	S	W		M		
CO5		W				M	M	W	M			M		

Course Assessment methods:	
Direct	**Indirect**
1.Individual Assignment 2.Group Assignment 3.Presentation 4.Surprise Test 5.Practical Assessment 6.End Semester Assessment	Course end survey

Introduction to Professional Values **1 Hours**

Concept of Integral Karma Yoga **3 Hours**

Professional Ethics	**3 Hours**
Eastern and Western Leadership Theories	**2 Hours**
Empowerment of a Professional	**4 Hours**
Advanced Contemplative Practices with Demonstrations	**2 Hours**

Total Hours: 15

REFERENCES::

1. Vethathiri's Maharishi's, "Yoga for Modern Age", The World Community Service Centre, Vedhathiri Publications, 2009.
2. Swami Vivekananda, "The Man Making Message" The Ramakrishna Tapovanam, Published 1972.
3. Vethathiri's Maharishi's, "Manavalakalai part 1,2&3" 1^{1th} edition, The World Community Service Centre, Vethathiri Publications,2005.
4. Brian L Weiss, "Only Love is Real" by Grand Central Publishing, Published 1997.

SEMESTER V

U15MCT501 **SIGNALS AND SYSTEMS**

L	T	P	C
3	1	0	4

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Explain the role of signals in the design of Mechatronics systems and also classify signals and systems based on their properties

CO2: Describe the operations carried out on signals and anticipate their effect on signals

CO3: Distinguish continuous and discrete signals and able to convert continuous signal into discrete by applying sampling theorem

CO4: Anticipate the problems related to sampling and their effect on signal reconstruction.

CO5: Express the importance of correlation and power spectral density in signal analysis.

CO6: Derive and compute the system response for standard test signal inputs for LTI systems

CO7: Model a system using block diagram, integral-differential and state –space techniques

CO8: Apply Fourier transform technique to analyze systems in frequency domain.

Pre-requisite

1. U15MAT101 Engineering Mathematics – I
2. U15MAT201 Engineering Mathematics – II

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M												W	
CO2	M												W	
CO3	M												W	
CO4	M		W		M								W	
CO5	M		W										W	
CO6	M	M	M										M	M
CO7	M	M	M										M	
CO8	M	M	M										M	M

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination	Course end survey

Assignment	

INTRODUCTION TO SIGNALS AND SYSTEMS **12Hours**

Importance of signals and systems: Mechatronics system and data transmission as examples- Classification of signals: Continuous time and discrete time, even, odd, periodic and non periodic, deterministic and non deterministic, energy and power- **Operations on signals**: Amplitude scaling, addition, multiplication, differentiation, integration (accumulator for DT), time scaling, time shifting and folding, precedence rule- **Elementary signals**: exponential, sine, step, impulse and its properties, ramp, rectangular, triangular, signum, sinc- **Systems**: Definition, Classification: linear and non linear, time variant and invariant, causal and non-causal, static and dynamic, stable and unstable, invertible.

SAMPLING AND RECONSTRUCTION **12Hours**

Representation of continuous time signals by its samples - Sampling the Nyquist theorem – Sinc interpolation - Reconstruction of a signal from its samples, aliasing – discrete time processing of continuous time signals, sampling of band pass signals. Practical sampling and reconstruction using MATLAB.

CORRELATION AND SPECTRAL DENSITY **12Hours**

Definition of Correlation and Spectral Density, conceptual basis, auto-correlation, cross correlation, energy/power spectral density, properties of correlation and spectral density, inter relation between correlation and spectral density.

SYSTEM ANALYSIS **12Hours**

System modeling: Input output relation, impulse response - Definition of impulse response, convolution integral, convolution sum, computation of convolution integral using graphical method for unit step to unit step, unit step to exponential, exponential to exponential and unit step to rectangular, rectangular to rectangular only. Computation of convolution sum by all methods. Properties of convolution, system interconnection, system properties in terms of impulse response and step response in terms of impulse response.

SYSTEM ANALYSIS IN FREQUENCY DOMAIN USING FOURIER TRANSFORM **12Hours**

Definition and necessity of CT and DT Fourier series and Fourier transforms- Analogy between CTFS, DTFS and CTFT, DTFT- CT Fourier series, CT Fourier transform and its properties, problem solving using properties: amplitude spectrum, phase spectrum of the signal and system - Interplay between time and frequency domain using sinc and rectangular signals. Analysis of LTI system using Fourier Transform.

Theory: 45 Hrs **Tutorial: 15 Hrs** **Total Hours: 60**

REFERENCES::

1. Simon Haykin and Barry Van Veen ,"Signals and Systems", 2nd edition, Wiley India.
2. Lathi B P., "Linear Systems and Signals", 2nd edition, Oxford University Press, 2004.
3. Alan V Oppenheim, Alan S Willsky and Hamid Nawab S., "Signals and Systems", 2nd edition, Pearson Education, 1997.
4. Mrinal Mandal and Amrit Asif,"Continuous and Discrete Time Signals and Systems", Cambridge University Press, 2007.
5. John G Proakis and Dimitris G Manolakis, "Digital Signal Processing: Principles, Algorithms and Applications", Pearson India, 2007.

U15MC*T*502 CONTROL ENGINEERING

L	T	P	C
2	2	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Know the significance to control engineering and the basic construction of control systems

CO2: Write mathematical equations for model mechanical, electrical systems and can able to compute transfer function using block diagram and signal flow graph methods

CO3: Analyze the 1st and 2nd order systems in time domain for various test signals

CO4: Calculate steady state errors and derive generalized error series in the time domain analysis

CO5: Analyze the 1st and 2nd order systems in frequency domain using Bode and Polar plots

CO6: Calculate the stability of the system using Routh Hurwitz, Nyquist and Root Locus techniques

CO7: Define process and write process equations for a given problem

CO8: Explain and draw the response curves of continuous and discontinuous controllers and develop circuits using pneumatic and electronic systems

CO9: Explain the importance of controller tuning with the help of Z-N method and also explain various special controllers.

Pre-requisite

1. U15MAT101 Engineering Mathematics – I
2. U15MAT201 Engineering Mathematics – II
3. U15MCT501 Signals And Systems

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PS O2
CO1	S													
CO2	S													
CO3	S		M											
CO4	S													
CO5		M	M										M	
CO6	S												M	
CO7	M													
CO8	S													
CO9	S													

Course Assessment methods:

Direct	Indirect
Internal test I Internal test II End semester Examination Assignment	Course end survey

INTRODUCTION **12Hours**

Open loop and closed loop systems - Examples - Elements of closed loop systems - Transfer function of elements - Modeling of physical systems - Mechanical systems - Translational and Rotational systems - Electrical networks - Block diagram – Signal flow graph - Mason's gain formula. Transfer function - Transfer function of DC servomotor, AC servomotor.

TIME DOMAIN ANALYSIS **12Hours**

Standard Test signals – Time response of second order system - Time domain response Performance criteria - Types of systems - Steady state error constants - Generalized error series.

FREQUENCY RESPONSE OF SYSTEMS **12Hours**

Frequency domain specifications - correlation between time and frequency response for second order systems-Bode plots- Assessment of stability - Gain Margin and phase Margin Assessment – Lead, lag and Lead lag compensation using Bode Plot - Polar plots. **Tutorials**: Bode plot and polar plot using MATLAB.

STABILITY OF CONTROL SYSTEMS **12Hours**

Characteristic equation - Routh Hurwitz criterion of stability - Nyquist stability - Nyquist stability criterion - Assessment of relative stability – Gain and Phase Margin. Root Locus concept - Root Locus procedure - Root Locus construction - Root contours- **Tutorials**: Stability analysis of higher order systems using MATLAB

PROCESS CONTROL **12Hours**

Process definition, equation and dynamics - Discontinuous and continuous controllers- Realization of both the controllers using Electronics and pneumatics- Tuning of controller: Ziegler-Nicholas PID controller tuning- **Special controllers**: feed forward, ratio, cascade control and adaptive control.

SELF STUDY: Transfer function of Synchro and stepper motor

Theory: 45 Hrs **Tutorial: 15 Hrs** **Total Hours: 60**

REFERENCES:

1. Nagrath I J. and Gopal M., "Control Systems Engineering", 5th edition, Prentice Hall of India, New Delhi, 2009.
2. Katsuhiko Ogata, "Modern Control Engineering", 5th edition, Prentice Hall India, 2010.
3. R.C Dorf and R.H. Bishop, "Modern Control systems", 12th edition, Pearson India, 2014.
4. Curtis D Johnson, "Process control Instrumentation technology", Prentice Hall India, 2006.
5. Singh S K., "Computer aided process control", Prentice Hall India, 2004.

U15MC*T*503 DYNAMICS OF MACHINERY

L	T	P	C
2	2	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Differentiate and calculate various forces acting on rigid bodies under dynamic conditions

CO2: Calculate the energy requirements in flywheel.

CO3: Explain the significance of balancing and solve balancing problems related to rotating and reciprocating masses

CO4: Differentiate free and forced vibration and their importance in design

CO5: Calculate the response for free and forced vibration of systems having single degree of freedom

CO6: Summarize and determine various parameters involved in controlling mechanisms such as governors and gyroscopes

Pre-requisite

U15MET202 Engineering Mechanics

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO 3	PO 4	PO5	P O6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PS O 1	PSO 2
CO1	S													
CO2	S													
CO3	S	S	S										M	
CO4	S	S	S										M	
CO5	S	M	M										M	
CO6	M													

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

FORCE ANALYSIS 13 Hours

Rigid Body dynamics in general plane motion – Equations of motion.-Dynamic force analysis – Inertia force and Inertia torque –D'Alemberts principle –The principle of superposition – Dynamic Analysis in Reciprocating Engines – Gas Forces- Equivalent masses-Bearing loads

- Crank shaft Torque- Turning moment diagrams–Flywheels– Engine shaking Forces – Cam dynamics-Unbalance, Spring Surge and Windup.

BALANCING **12 Hours**

Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine - Balancing of Multi cylinder Engines: Inline and V-Engines - Balancing of linkages - Introduction to balancing machines.

FREE VIBRATION **13 Hours**

Basic features of vibratory systems - idealized models, Basic elements and lumping of parameters- Degrees of freedom – Single degree of freedom – Free vibration- Equations of motion-natural frequency-Types of Damping- Damped vibration-critical speeds of simple shaft-Torsional systems: Natural frequency of two and three rotor systems.

FORCED VIBRATION **9 Hours**

Response to periodic forcing - Harmonic Forcing - Forcing caused by unbalance-Support motion - Force transmissibility and amplitude transmissibility - Vibration isolation. Significance of vibration exposure and control.

MECHANISM FOR CONTROL **13 Hours**

Governors: Types - Centrifugal governors: Gravity and spring controlled – Inertia governors - Controlling Force – Gyroscopes: Gyroscopic forces and Torques - Gyroscopic stabilization - Gyroscopic effects in Automobiles, ships and airplanes.

CASE STUDY:

Isolation of vibrations in Automobiles - Engine - Suspensions.

Theory: 45 Hrs **Tutorial: 15 Hrs** **Total Hours: 60**

REFERENCES:

1. Rattan S S., "Theory of Machines", 2nd edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007.
2. Khurmi R S.and Gupta J K. "Theory of machines", S. Chand and Company Ltd, New Delhi, 2003.
3. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 2003.
4. Ghosh A and Mallick A K., "Theory of Mechanisms and Machines", Affiliated East-West Press, Pvt. Ltd., New Delhi, 2000
5. Shigley J E. and Uicker J J., "Theory of Machines and Mechanisms", McGraw-Hill, Inc., 2003.
6. Rao J S and Dukkipati R V., "Mechanism and Machine Theory", Wiley-Eastern Limited, New Delhi, 2006.
7. John Hannah and Stephens R C., "Mechanics of Machines", Viva low-Priced Student Edition, 1999.
8. Sadhu Singh, "Theory of Machines", 2nd edition, Pearson Education, 2008.

U15MC*T*504 MECHATRONICS FOR MACHINING

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Define the fundamentals of CNC and DNC Machines
CO2: Describe the constructional features of CNC machines
CO3: Develop a CNC Part programming for the basic milling operations
CO4: Develop a CNC Part programming for the basic turning operations
CO5: Explain the working principle of mechanical and electrical energy based unconventional machining processes.
CO6: Explain the working principle of chemical and thermal energy based unconventional machining processes.

Pre-requisite

1. U15MC*T*401 Manufacturing Technology

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	M												W	
CO2	M		W										M	W
CO3	M	M	M		M								M	M
CO4	M	M	M		M								M	M
CO5	M		W											M
CO6	M		W											M

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

INTRODUCTION **6 Hours**

History - Classification, Comparison between conventional and non-conventional machining process - Introduction to Computer Numerical Control, Features of CNC Machines - Different types of CNC machines – Advantages and disadvantages of CNC machines DNC and Adaptive control - Maintenance features of CNC Machines.

COMPONENTS OF CNC MACHINES AND TOOLING **10 Hours**

Description of CNC components: Structure, Drive Mechanism, gearbox, Main drive, feed drive, Spindle Motors, Axes motors - Spindle bearing - Slide ways – Re circulating ball screws – Backlash measurement and compensation, linear motion guide ways - Tool magazines, ATC, APC, Chip conveyors - Types of measuring systems in CNC machines –Magnetic Sensors for Spindle Orientation. Qualified and pre-set tooling – Principles of location – Principles of clamping – Work holding devices. Retrofitting of Conventional Machine Tools.

CNC PART PROGRAMMING AND MAINTENANCE **11 Hours**

Part Program Terminology- G and M Codes – Types of interpolation Methods of CNC part programming – Manual part programming: Fixed cycle, canned cycle – Computer Assisted part programming – APT language – CNC part programming using CAD/CAM-Introduction to Computer Automated Part Programming.

Factors influencing selection of CNC Machines - Practical aspects of introducing CNC machines in industries.

UNCONVENTIONAL MACHINING PROCESSES I **9 Hours**

Abrasive Jet Machining – Water Jet Machining – Ultrasonic Machining - Working Principles – Equipment – Process parameters – MRR-Variation in techniques used – Applications.

Electric Discharge Machining (EDM) - Working Principles-Equipments-Process Parameters-MRR- Electrode / Tool – Power Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications.

UNCONVENTIONAL MACHINING PROCESSES II **9 Hours**

Chemical Machining and Electro-Chemical Machining - Etchants – Maskant-Techniques of applying maskants-Process Parameters -Principles of Electro Chemical Machining- Applications - Laser Beam machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining (EBM) ,Principles-Equipment-Types-Beam control techniques – Applications.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Radhakrishnan P., "Computer Numerical Control Machines", New Central Book Agency, 2011.
2. Groover M P., "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall, 2007.
3. Yorem Koren, "Computer Control of Manufacturing Systems", Pitman, London, 1987.
4. Vijay K Jain "Advanced Machining Processes", first edition, Allied Publishers Pvt. Ltd., New Delhi, 2007.
5. Benedict G F. "Nontraditional Manufacturing Processes", Marcel Dekker Inc., New York, 1987
6. Pandey P C and Shan H S. "Modern Machining Processes", Tata McGraw-Hill, New Delhi, 1980.

U15MC*T*505 INDUSTRIAL AUTOMATION I

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Describe the concept of fluid power and use symbols of various components used in fluid power

CO2: Outline the importance of PLC, DCS, SCADA in industrial automation

CO3: Design fluid power circuits by selecting appropriate control valves and actuators

CO4: Describe the hardware and architecture of PLCs and also identify the analogy of relay logic components

CO5: Write PLC program using ladder diagram for simple applications

CO6: Summarize the common faults and troubleshooting methods for fluid power circuits

CO7: Summarize various maintenance procedures practiced in industry for PLC based control systems

Pre-requisite

1. U15MCT302 Mechanics of Fluid for Mechatronics
2. U15MCT404 Digital Electronics and Microprocessor

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	M													
CO2	M													
CO3	S				M								S	M
CO4	S													M
CO5	S				M								S	M
CO6	M													
CO7	M													

Course Assessment methods:

Direct	Indirect
Internal test I Internal test II End semester Examination Assignment	Course end survey

INTRODUCTION **5 Hours**

Role of automation in industries, Benefits of automation –Introduction to fluid power, Advantages of fluid power, Application of fluid power system - Types of fluid power systems - Introduction to automation tools: Low cost automation, PLC, DCS, SCADA - Automation strategy evolution.

COMPONENTS OF FLUID POWER SYSTEMS **12 Hours**

Classifications and working principles of Pumps – compressors – linear actuators – rotary actuators – directional control valves – pressure control valves – Proportional valves – Servo valves – flow control valves – accumulators - intensifiers

DESIGN OF FLUID POWER CIRCUITS **10 Hours**

Speed control circuits, synchronizing circuit and industrial application circuits – copying circuit and press circuit - accumulator circuits –Pneumohydraulic circuit - Electro Hydraulic circuits – Electro Pneumatic circuits - Sequential circuit design for simple applications using cascade method , step counter method and Karnaugh-Veitch mapping method

PLC HARDWARE MODULES AND PROGRAMMING **11 Hours**

CPU – processor's function – PLC system memory and application memory – input modules – output modules – module selection

Introduction to IEC 61131 - System functions – sequence control – ladder logic – programming sequences – limitation of ladder programming – logic instruction sets – standard PLC functions – special function relays – data handling instructions – arithmetic instructions – data manipulation – program subroutines – programming examples.

APPLICATION AND MAINTENANCE **7 Hours**

PLC applications in fluid power control- PLC as robot controller and FMS – PLC to factory automation – PLC in process control

Failure and trouble shooting in fluid power systems- PLC maintenance – internal PLC faults – faults external to PLC – programmed error – watch dogs – safety – hardware safety circuits – troubleshooting.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Anthony Esposito, "Fluid Power with Applications", 7th edition, Pearson Education Inc., 2014.
2. Majumdar S R., "Pneumatic systems – Principles and maintenance", Tata McGraw-Hill, 2009.
3. James A Sullivan, "Fluid Power: Theory and Applications ", 4th edition, C.H.I.P.S, 2007
4. Frank D Petruzella, "Programmable Logic Controllers", 3rd edition, McGraw-Hill Companies, 2013.
5. Lukcas M P., "Distributed Control Systems", Van Nostrand Reinhold Co., New York, 1986.
6. John W Webb and Ronald A Reis, "Programmable Logic Controllers – Principles and Applications", 5th Edition, Prentice Hall Inc., New Jersey, 2003.
7. Krishnakant, "Computer Based Industrial Control", 2nd edition, Prentice Hall of India, 2014.

U13MC*P* 501	**INDUSTRIAL AUTOMATION I LABORATORY**	L	T	P	C
		0	0	3	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Select the actuators and valves for the design of fluid power circuits

CO2: Design and simulate the fluid power circuits using software tool

CO3: Test the simulated output by constructing the fluid power circuits using suitable actuators and valves

CO4: Write a program to control various actuators using PLCs

CO5: Develop a simple process logic using relay module

CO6: Analyze and present the findings of experimental observations in both written and oral format

Pre-requisite

1. U15MCT505 Industrial Automation I

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	S	M							S				S	M
CO2	S	M			S				S				S	M
CO3	S	M			S				S				S	M
CO4	S	M			S				S				S	M
CO5	S	M			S				S				S	M
CO6	S									S				

Course Assessment methods:	
Direct	**Indirect**
Lab Exercises Model Practical Examination End Semester Practical Examination Assignment	Course end survey

LIST OF EXPERIMENTS

1. Design and testing of the following hydraulic circuits:
    a. Pressure control
    b. Flow control

2. Design and testing of sequential circuit using an Electro hydraulic Trainer kit.
3. Design and testing of hydraulic circuits using PLC
4. Design and testing of the following pneumatic circuits:
    a. Pressure control
    b. Flow control
5. Design and testing of Sequential circuit using an Electro pneumatic Trainer kit.
6. Design and testing of pneumatic circuits using PLC
7. Simulation of basic hydraulic, pneumatic and electrical circuits using Automation Studio software.
8. PLC programming for industrial process system.
9. Process logic development using Relay Logic module.
10. PLC digital, analog signal interface with field devices.

Total Hours: 45

U15MC*P*502 **MACHINE DYNAMICS LABORATORY**

L	T	P	C
0	0	3	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Relate the different characteristics of governors and verify gyroscopic relation.
CO2: Draw the cam profile with different followers and Study of jump phenomenon.
CO3: Identify the system response, natural frequency and resonance for free, forced and torsional vibrations.
CO4: Identify the system response, natural frequency and resonance for whirling of shaft.
CO5: Experimental verification of dynamic balancing of rotating and reciprocating masses.
CO6: Analyze and present the findings of experimental observations in both written and oral format.

Pre-requisite

1. U15MC*T*503 – Dynamics of Machinery

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

Cos	Programme Outcomes(Pos)													
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	S													
CO2	S			W										
CO3	S			W									W	
CO4	S			W									W	
CO5	S			M										M
CO6										S				

Course Assessment methods:	
Direct	**Indirect**
1. Lab Exercises 2. Model Practical Examination 3. End Semester Practical Examination 4. Assignment	Course end survey

LIST OF EXPERIMENTS

1. Governors – Determination of sensitivity, effort, etc. for watt, porter, proell, Hartnell governors
2. Cam – Study of jump phenomenon and drawing profile of the cam.

3. Motorized Gyroscope-Determination of Gyroscopic couple Verification of Laws.
4. Bifilar Suspension and Compound Pendulum – Determination of Moment of Inertia of Rod.
5. Turn Table – Determination of Moment of Inertia of Disc and Ring.
6. Epicyclic Gear Train Apparatus – Gear Ratio and Torques.
7. Balancing of rotating masses (Static and Dynamic Balancing)
8. Balancing of reciprocating masses.
9. A) Helical Spring – Natural Frequency of Longitudinal Vibrations
   B) Transverse Vibrations Verification of Dunkerley's Rule.
10. Rotor Systems – Natural Frequency of Torsional Vibrations.
11. A) Whirling of Shaft – Determination of Critical Speed
    B) Vibrating Table – Determination of Transmissibility Ratio.

Total Hours: 45

U15GHP501

SOCIAL VALUES

(Common to all branches of Engineering and Technology)

L	T	P	C
1	0	0	1

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Acquire knowledge about how societies are formed and social values are created.
- **CO2:** Understand and empathize various social issues and contribute towards finding a solution
- **CO3:** Understand the causes of disparity among human beings
- **CO4:** Know about social welfare organizations and to use social media effectively
- **CO5:** Understand various social parameters that influences individual and society at large

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

Cos	Programme Outcomes(Pos)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	PO11	PO12	PSO 1	PSO2
CO1		W				M	W	M	W			M		
CO2		W	W			W	M	M		W		M		
CO3		W				M	W	S				M		
CO4		W				S		M	W	M		S		
CO5			W		W	M	W			W		M		

Course Assessment methods:	
Direct	**Indirect**
1.Individual Assignment 2.Group Assignment 3.Presentation 4.Surprise Test 5.Practical Assessment 6.End Semester Assessment	Course end survey

Introduction to Social Values – Society **1 Hours**

Development of Science, Education, Politics & Economics **3 Hours**

Disparity among human beings **3 Hours**

Social Issues & Welfare	**3 Hours**
Social Welfare Organizations	**2 Hours**
Yogasanas & Meditation	**2 Hours**

Total Hours: 15

REFERENCES::

1. Swami Vivekananda, "Prosperous India" 1stedition, The Ramakirshna Mission Institute of Culture, 1937.
2. Fritz Schumacher, "Small is Beautiful", The Blond & Briggs, Published 1973.
3. Vethathiri Maharishi, "Logical Solutions for the Problems of Humanity", The World Community Service Centre, Vethathiri Publications, 1999.
4. Sarvepalli Radhakrishnan, "The Source Book on Indian Philosophy", Princeton, N.J. : Princeton University Press, 1957.
5. Sarvepalli Radhakrishnan, "Religion, Science and Culture", The Orient Paperbacks, India, Published 1994.
6. Vethathiri's Maharishi's, "Vethathirian Principles of Life" The World Community Service Centre, Vethathiri Publications, 2003.

SEMESTER VI

U15MCT601 **MICROCONTROLLER AND EMBEDDED SYSTEMS**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Differentiate microcontroller from microprocessor and explain the general architecture of microcontrollers

CO2: Explain the applications of micro controllers and differentiate few microcontroller cores based on their construction and applications

CO3: Summarize the memory organization and internal communication of 8051 and PIC micro controller.

CO4: Program, 8051 using different addressing modes and effectively use the timers, counters and interrupts for a given application

CO5: Describe the architecture of real time operating systems with inter task communication

CO6: Design embedded system scheme for few real time domestic, auto and space applications

Pre-requisite

1. U15MCT 405 Digital Electronics And Microprocessor

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

Cos	Programme Outcomes(Pos)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	W												W	W
CO2	M												W	W
CO3		M	W										W	W
CO4	M	M	M										M	M
CO5	W	M	M										W	W
CO6	M	M	M										S	M

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

INTRODUCTION TO EMBEDDED SYSTEMS **6 Hours**

Overview of Embedded Systems: Architecture, Application areas-Categories of embedded systems-specialties of embedded systems- Recent trends in embedded systems- Brief introduction to embedded microcontroller cores: CISC, RISC, ARM and DSP.

THE MICROCONTROLLER ARCHITECTURE **8 Hours**

Introduction to 8051 Microcontroller: Architecture, Pin configuration, Memory organization, Input /Output Ports, Counter and Timers, Serial communication and Interrupts.

ASSEMBLY LANGUAGE PROGRAMMING OF 8051 **9 Hours**

Instruction set, Addressing modes, Development tools, Assembler Directives, Programming based on Arithmetic & Logical operations, I/O parallel and serial ports, Timers & Counters, and ISR

PIC MICROCONTROLLER **9 Hours**

Introduction – CPU architecture – Instruction set – Addressing modes – Loop timing – Timers – Interrupt logic – I/O expansion – IIC bus operation– A/D converter.

EMBEDDED / REAL TIME OPERATING SYSTEM **9 Hours**

Architecture of kernel, Task and Task scheduler, Semaphores and shared data, Priority inversion problem, Mailboxes, Message queues, Event registers, Pipes, Timers, Memory management, Interrupt service routines. Off-the-Shelf Operating Systems- Embedded Operating Systems, Real Time Operating System (RTOS) and Handheld Operating Systems.

EMBEDDED SYSTEM – DESIGN CASE STUDIES **4 Hours**

Washing machines – Cruise control – antilock braking systems – satellite launch control.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Mazidi M A, Mazidi J G. and McKinlay R D., "The 8051 Microcontroller & Embedded systems", 2nd Edition, Pearson, 2008.
2. Kenneth J Ayala and Dhananjay V Gadre, "The 8051 Microcontroller & Embedded Systems using Assembly and C" Cengage Learning (India edition), 2010
3. Shibu K V., "Introduction to Embedded Systems" McGraw Hill, 2009.
4. Andrew N Sloss, Dominic Symes and Chris Wright, "ARM system developer's guide", Elsevier, 2010.

U15MCT602 DESIGN OF MACHINE ELEMENTS

L	T	P	C
2	2	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Recognize the design process and the factors influencing it and design the simple components for static loading

CO2: Estimate the life of the components subjected to varying loads

CO3: Design the circular shafts based on strength and rigidity, keys and couplings for power transmission

CO4: Design the welded joints and threaded joints subjected to static loads

CO5: Design the springs subjected to static and dynamic loads

CO6: Select the rolling contact bearings for static and cyclic loads

CO7: Select the lubricants and bearing dimensions for hydrodynamic bearings

Pre-requisite

1. U15MET201 Engineering Mechanics
2. U15MCT403 Mechanics of Solids for Mechatronics
3. U15MCT 304 Mechanics of Fluid for Mechatronics

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

Cos	Programme Outcomes(Pos)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	S	M	W										W	
CO2	S	M											W	W
CO3	S	M											M	W
CO4	S	M											M	
CO5	S	M											M	
CO6	S												M	
CO7	S												W	

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

DESIGN PROCESS AND DESIGN FOR STATIC LOAD **9 Hours**

Machine Design – Design Process – Factors influencing design – Calculation of stresses for various load combinations - theories of failure – Factor of safety – Design of curved beams – Crane hook and 'C' frame – Design of levers

DESIGN OF FLUCTUATING LOAD **8 Hours**

Stress concentration – causes & remedies – fluctuating stresses – fatigue failures – S-N curve – endurance limit – notch sensitivity – endurance strength modifying factors – design for finite and infinite life – cumulative damage in fatigue failure – Soderberg, Gerber, Goodman, Modified Goodman diagrams – Fatigue design of components under combined stresses

DESIGN OF SHAFTS, KEYS AND COUPLINGS **7 Hours**

Shaft design on the basis of strength, torsional rigidity and lateral rigidity and A.S.M.E. code – Design of keys and splines – Design of flange coupling and flexible bushed pin coupling

DESIGN OF JOINTS AND SPRINGS **10 Hours**

Threaded fasteners – Bolts of uniform strength – Bolts under tension – Eccentrically loaded bolted joints Welded joints – Welding symbols – Stresses in butt and fillet welds, Design of Welded Joints for static loads – Axially loaded unsymmetrical welded joints, Eccentric load in the plane of welds – theory of bonded joints

Design of springs

Types – applications and materials for springs – Stress and deflection equations for helical compression springs – Style of ends – Design of helical compression and tension springs – Springs in series and parallel – Introduction to Concentric helical springs, Helical torsion Spring, Multi-leaf springs – Surge in springs

ROLLING CONTACT AND SLIDING CONTACT BEARINGS **11 Hours**

Types of rolling contact Bearings – Static and dynamic load carrying capacities, Stribeck's Equation, Equivalent bearing load – Load-life relationship – Selection of rolling contact bearings – Design for cyclic loads and speed – mounting of bearings – Types of failure in rolling contact bearings – causes and remedies.

Sliding contact Bearings Lubricating oils: Properties, additives, selection of lubricating oils, Properties & selection of bearing materials – Theory of Hydrodynamic Lubrication, Pressure Development in oil film, Parameters of bearing design, Length to Diameter ratio, Unit bearing Pressure, Radial Clearance, minimum oil film thickness

Theory: 45 Hrs **Practical: 15 Hrs** **Total Hours: 60**

REFERENCES::

1. Bhandari V B., "Design of Machine Elements", 2nd edition, Tata McGraw Hill Publication Co. Ltd., 2007.
2. Shigley J E. and Mischke C R., "Mechanical Engineering Design", 8th edition, McGraw Hill International, 2008.
3. Prabhu T J, "Fundamentals of Machine Design", Bharat Institute of Science and Technology, 1999.
4. Alfred Hall, Alfred Holowenko, Herman Laughlin and Somani S, "Machine design", Tata McGraw Hill, 2007.

U15MCT603 **THERMODYNAMICS AND HEAT TRANSFER**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Define the laws of thermodynamics and calculate the properties of the system

CO2: Estimate the various air standard cycle efficiency and describe the working of I.C engines

CO3: Explain the various modes of heat transfer for different applications.

CO4: Describe the boundary layer concepts and different modes of convection

CO5: Explain the different laws in radiation heat transfer concepts.

CO6: Discuss the concepts of mass transfer and derive their correlations.

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

Cos	Programme Outcomes(Pos)													
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PS O 1	PSO 2
CO1	M								W	W				
CO2	M	W							W	W				
CO3	M								W	W			W	
CO4	M								W	W				
CO5	M								W	W				
CO6	M								W	W				

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

LAWS OF THERMODYNAMICS 9 Hours

Systems-closed and open systems – properties, processes and cycles - equilibrium - work and heat transfers-first law for a closed system and flow processes - enthalpy - second law – entropy - entropy change - reversibility.

AIR-STANDARD CYCLES **9 Hours**

Air standard cycles: Carnot cycle - Otto cycle - Diesel cycle(descriptive only) - Brayton cycle (descriptive only) - two stroke and four stroke engines - SI, and CI engines.

HEAT TRANSFER : CONDUCTION **9 Hours**

Basic Concepts - Mechanism of Heat Transfer - Conduction, Convection and Radiation - Fourier Law of Conduction - General Differential equation of Heat Conduction - Cartesian and Cylindrical Coordinates - One Dimensional Steady State Heat Conduction - Conduction through Plane Wall, Cylinders and Spherical systems.

CONVECTION AND RADIATION **9 Hours**

Convection: Basic Concepts – Heat Transfer Coefficients – Boundary Layer Concept – Types of Convection – Forced Convection – External Flow and Internal Flow.

Radiation: Basic Concepts, Laws of Radiation – Stefan Boltzman Law, Kirchoffs Law – Black Body and Grey body radiation.

MASS TRANSFER **9 Hours**

Basic Concepts – Diffusion Mass Transfer – Fick's Law of Diffusion – Steady state Molecular Diffusion – Convective Mass Transfer – Momentum, Heat and Mass Transfer Analogy – Convective Mass Transfer Correlations.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Rattan S S, "Theory of Machines'', Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2009.
2. Uicker J J., Pennock G R. and Shigley J E., "Theory of Machines and Mechanisms", Oxford University Press, 2003.
3. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 2010.
4. Ghosh A and A K Mallick, "Theory of Mechanisms and Machines", 3rd edition, East West Press Pvt. Ltd, 2009.
5. Norton R L., "Kinematics and Dynamics of Machinery", Tata McGraw Hill, 2009.
6. Hannah J. and Stephens R C., "Mechanics of Machines", Viva Low-Prices Student Edition, 1999.

U15MCP601 CAD/CAM LABORATORY

L	T	P	C
0	0	3	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Draft different two dimensional views for the given components.

CO2: Model and assemble a given three dimensional engineering components

CO3: Perform structural analysis on simple structures.

CO4: Perform thermal analysis on simple structures.

CO5: Generate CNC programs for a given components to work with CNC machines.

CO6: Analyze and present the findings of experimental observations in both written and oral format.

Pre-requisite

1. U15MCT504 Mechatronics for Machining

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PS O2
CO1	S				S								M	
CO2	M				S								M	
CO3	M		M		S								M	
CO4	M		M		S								M	
CO5	M				S									
CO6	M									S				

Course Assessment methods:

Direct	Indirect
Lab Exercises Model Practical Examination End Semester Practical Examination Assignment	Course end survey

LIST OF EXPERIMENTS

COMPUTER AIDED DESIGN AND ANALYSIS LAB

1. 3D Modeling using appropriate software of given components / product assemblies (at least 2 components/product assemblies)
2. Analysis of engineering problems using FEA package (any 2 components)

COMPUTER AIDED MANUFACTURING LAB

1. Given a component drawing to write the manual part programming and execute on CNC Milling Machine
2. Generation of NC codes and simulation of tool path using Master CAM software.
3. Post processing of NC code file for various controllers.

Total Hours: 45

U15MC*P*602 **EMBEDDED SYSTEM DESIGN LABORATORY**

L	T	P	C
0	0	3	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Perform arithmetic operations in 8051architecture
CO2: Perform signal conversion using 8051architecture
CO3: Generate and execute program to control the speed of DC and stepper motor using 8051 architecture.
CO4: Write programs and interface sensors to measure temperature and load with microchip controller and PSOC Controllers
CO5: Communicate with the Personal computer using UART protocol
CO6: Analyze and present the findings of experimental observations in both written and oral format.

Pre-requisite

1. U15MCT404 Digital Electronics And Microprocessor
2. U15MCT601 Microcontrollers And Embedded Systems

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

Cos	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO2
CO1	M													
CO2	M													
CO3	M													
CO4	M												M	
CO5	M													
CO6										S				

Course Assessment methods:	
Direct	**Indirect**
Lab Exercises Model Practical Examination End Semester Practical Examination Assignment	Course end survey

LIST OF EXPERIMENTS

1. Arithmetic operations (addition, subtraction, multiplication, ascending, descending) using 8051 architecture.
2. Analog to digital conversion in 8051 architecture.

3. Stepper motor controller in 8051 architecture.
4. DC motor controller interface using 8051 architecture.
5. Interface an ADC and a temperature sensor to measure temperature using 8051 architecture.
6. Interface LCD with Microchip Controller.
7. Development of hypothetical Switch Protocol using GPIO and timer using ARM7and PSoC3
8. Utilization of capacitive sensing (CapSense) module of PSoC3 board for simple applications.
9. Implementation of combination Lock with CapSense Swipe.
10. Pulse Width Measurement.
11. Development of simple hand shaking protocol using UART
12. Measurement of Strain using strain gauge.
13. Wireless LED display control system similar to traffic light.

Total Hours: 45

U15GHP601

NATIONAL VALUES

(Common to all branches of Engineering and Technology)

L	T	P	C
1	0	0	1

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Acquire knowledge on the Enlightened Citizenship
- **CO2:** Understand and know the greatness of India and Indian Culture.
- **CO3:** Aware of the messages of India to the world
- **CO4:** Aware of the uniqueness of India beings
- **CO5:** Know about social welfare organizations and to use social media effectively
- **CO6:** know about the inspiring Indian personalities and emulate them

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	PO11	PO12	PSO 1	PSO2
CO1		W				M		M				M		
CO2		W				S	W	S	M	M		M		
CO3		W	W		W	M	W	M	M	M		M		
CO4		W				M	W	M	W	W		M		
CO5						W	M	W	W	W		S		

Course Assessment methods:	
Direct	**Indirect**
1.Individual Assignment 2.Group Assignment 3.Presentation 4.Surprise Test 5.Practical Assessment 6.End Semester Assessment	Course end survey

Enlightened Citizenship **2 Hours**

Greatness of India & Indian Culture **2 Hours**

Uniqueness of India **2 Hours**

Famous Indian Personalities **2 Hours**

India's messages to the world **3Hours**

Meditation & Yogasanas **4 Hours**

Total Hours: 15

REFERENCES:

1. Gurcharan Das, "India Grows at Night", Penguin *Books* India, Published September 2012.
2. Swami Vivekananda, "Prosperous India" 1st edition, The Ramakirshna Mission Institute of Culture, 1937.
3. Sarvepalli Radhakrishnan, "The Source Book on Indian Philosophy", Princeton, N.J. : Princeton University Press, 1957.
4. Amartya Sen, "The Argumentative Indian", Allen Lane, Published 2005.

SEMESTER VII

U15MCT701 ROBOTICS ENGINEERING

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Define robotic terminologies and apply the concept of degrees of freedom for a particular robotic configuration.

CO2: Select an appropriate gripper for a given application and also estimate the force components acting on a gripper.

CO3: Develop homogeneous transformation matrices to solve kinematic problems.

CO4: Effectively apply DH notations for direct kinematic problems.

CO5: Explain various motion planning algorithms.

CO6: Apply Lagrangian and Newton-Euler methods to analyze dynamic characteristics of a robot

CO7: Describe various control strategies used in robot control.

CO8: Explain various programming techniques used in industrial robots.

Pre-requisite

1. U15MCT303 Kinematics of Machinery
2. U15MCT301 Sensors and Instrumentation
3. U15MCT505 Industrial Automation

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	S												M	M
CO2	S	M											S	M
CO3	S		W										M	M
CO4	S		W		M								M	M
CO5	S												M	M
CO6	S	M											M	M
CO7	S												M	M
CO8	S				S								M	M

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

INTRODUCTION **6 Hours**

Brief History, Types of robots, Overview of robot subsystems, resolution, repeatability and accuracy, Degrees of freedom of robots, Robot configurations and concept of workspace, Mechanisms and transmission - Applications.

KINEMATICS OF ROBOTS **9 Hours**

Introduction - Matrix Representation - Homogeneous transformation matrices – Forward and Inverse kinematics Equations: Position and Orientation -Denavit- Hartenberg Representation of forward kinematics equations of robots- Degeneracy and Dexterity.

DYNAMICS OF ROBOTS **11 Hours**

Introduction- Differential motions of a frame – Jacobian – Singularities – Lagrangian and Newton-Euler formulations – Basics of Trajectory Planning.

MOTION CONTROL AND SOFTWARE INTERFACES **11 Hours**

Introduction to Laplace transform and transfer functions - Independent joint control, PD and PID controllers- Software interfaces: Low level interfaces, IO digital signals, Fieldbuses – Data protocols and connections

END EFFECTORS **4 Hours**

End effectors and Different types of grippers, vacuum and other methods of gripping - Grippers force analysis-Gripper design-Simple problems

ROBOT PROGRAMMING **4 Hours**

Robot programming: Introduction; On-line programming: Manual input, lead through programming, teach pendant programming; Off-line programming languages, Simulation.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES::

1. Saeed B Niku, 'Introduction to Robotics', 2nd edition, Prentice Hall of India, 2010.
2. Mikell P Groover, "Industrial Robots - Technology, Programming and Applications", McGraw Hill, New York, 2008.
3. Norberto Pires, 'Industrial Robots programming: Building Applications for the Factories of the Future', 1st edition, Springer, 2012
4. Nagrath and Mittal, "Robotics and Control", Tata McGraw-Hill, 2003.
5. Spong and Vidhyasagar, "Robot Dynamics and Control", John Wiley and sons, 2008.
6. Fu K S, Gonzalez R C, Lee C S G, "Robotics, control, sensing, Vision and Intelligence", McGraw Hill International, 1987
7. Steve LaValle, "Planning Algorithms", Cambridge Univ. Press, New York, 2006.
8. Howie Choset, Kevin Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki and Sebastian Thurn, "Principles of Robot Motion: Theory, Algorithms, and Implementations", Prentice Hall of India, 2005.

U15MCT702 INDUSTRIAL AUTOMATION II

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Classify the different types of communication protocols
- **CO2:** Explain the importance of SCADA systems
- **CO3:** Summarize the fundamentals of Distributed control systems
- **CO4:** Design power supply, panel disk control for automation.
- **CO5:** Describe various safety related parameters in designing automated system

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO 2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O 1	PSO 2
CO1	M		W										M	M
CO2	M		M		M								M	M
CO3	M												M	M
CO4	M	M	W										M	M
CO5	M												M	M

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

INDUSTRIAL COMMUNICATION PROTOCOLS 11Hours

Definition of protocol, Introduction to Open System Interconnection (OSI) model, Communication standard (RS232, RS485), Modbus (ASCII/RTU), Introduction to third party interface, concept of OPC (Object linking and embedding for Process Control), HART Protocol: Introduction, frame structure, programming, implementation examples, benefits, advantages and limitation.

Foundation Fieldbus H1: Introduction, frame structure, programming, implementation examples, benefits, advantages and limitation. Comparison of HART, Foundation Fieldbus, Devicenet, Profibus, Controlnet, Industrial Ethernet.

SCADA SYSTEMS 11Hours

Concept of SCADA systems, Programming techniques for : Creation of pages, Sequencing of pages, Creating graphics & animation, Dynamos programming with variables, Trending,

Historical data storage & Reporting, Alarm management, reporting of events and parameters, Comparison of different SCADA packages, Interfacing PLC and SCADA using communication links, Development stages involved for PLC based automation systems, Application Development using SCADA system.

DISTRIBUTED CONTROL SYSTEMS 11Hours

DCS introduction, Various function Blocks, DCS components/block diagram, DCS Architecture of different makes, comparison of these architectures with automation pyramid, DCS specification, latest trend and developments, DCS support to Enterprise Resources Planning (ERP), performance criteria for DCS and other automation tools.

INDUSTRIAL WIRING CONTROL 7 Hours

Introduction – Drawings – wire types and preparation – soldering and termination - Connection and routing – Hardware – Components: active and passive – Earthing – PLC wiring

PROCESS SAFETY MANAGEMENT 5 Hours

Introduction to process safety, IEE Regulations, risk, risk terminologies, consequence and risk, risk measurement, Process Hazard Analysis

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. John W Webb and Ronald A Reis, "Programmable logic controllers: Principles and Applications", Prentice Hall India, 2003.
2. Michael P Lukas, "Distributed Control systems", Van Nostrand Reinfold Company, 1995.
3. Frank D Petruzella, "Programmable Logic Controllers", 3rd edition, McGraw-Hill Companies, March 2013.
4. Ian G Warnock, "Programmable Controllers Operation and Application", Prentice Hall International, UK, 1992.
5. Krishnakant , "Computer Based Industrial Control", Prentice Hall of India, 1997.
6. Frank R. Spellman 'A Guide to Compliance for Process Safety Management/Risk Management Planning (PSM/RSP)', CRC Press, 1998.
7. Bob Mercer, 'Industrial Control Wiring Guide', 2nd edition, Newnes, 2001.

U15MC*T*703 AUTOMOTIVE ELECTRONICS

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Describe the changes took place over the industrial revolution in automobile industry
- **CO2:** Describe the working of various parts of automobile systems.
- **CO3:** State the working principle of automotive sensors.
- **CO4:** Select the sensor for appropriate application
- **CO5:** Explain the working of Engine control systems.
- **CO6:** Explain about the safety and comfort system.

Pre-requisite

1. U15MC*T*303 Sensors and Instrumentation
2. U15MC*T*601 Microcontrollers and Embedded Systems

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	M												W	
CO2	M												M	
CO3	M												M	
CO4	M												M	
CO5	M												W	
C06	M												W	

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

INTRODUCTION **9 Hours**

Automotive Fundamentals - automobile physical configuration - Evolution of electronics in automobiles

Electronics Fundamentals – Diodes - Rectifier Circuit – Transistors - Field Effect Transistors –
transistor amplifiers - operational amplifiers

BASICS OF ENGINES **9 Hours**

Engines Operating principles of IC engine – major engine components – engine cylinder arrangements – the ignition systems – working of the carburetor

Electronic Engine Control - exhaust emissions - engine functions and control - definition of engine performance terms - electronic fuel control system - electronic ignition

SENSORS AND ACTUATORS 9 Hours

APPLICATIONS OF SENSORS AND ACTUATORS - Mass air flow (MAF) rate - Exhaust gas oxygen concentration (possibly heated) - Throttle plate angular position - Crankshaft angular position/RPM - Coolant temperature - Intake air temperature - Manifold absolute pressure (MAP) - Differential exhaust gas pressure - Vehicle speed - Transmission gear selector position - Air conditioner clutch engaged - Brake on/off - Wide open throttle - Closed throttle

ENGINE CONTROL SYSTEMS 9 Hours

DIGITAL ENGINE CONTROL FEATURES - Engine Crank (Start) - Engine Warm-Up - Open-Loop Control - Closed-Loop Control - Hard Acceleration - Deceleration and Idle

IN VEHICLE NETWORKS: CAN standard, format of CAN standard – diagnostics systems in modern automobiles

CHASSIS, COMFORT AND SAFETY SYSTEMS 9 Hours

Traction control system – Cruise control system– electronic control of automatic transmission antilock braking system – electronic suspension system –airbag systems – centralized door locking system – Navigation systems – climate control of cars.

CASE STUDY: Design of the Passenger comfort and safety systems.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Tom Denton, "Automobile Electrical and Electronics Systems", Edward Arnold Publishers, 2004.
2. William B Ribbens, "Understanding Automotive Electronics", 5th edition, Newnes Publishing, 2003
3. Robert Bosch GmbH, "BOSCH Automotive Handbook", 9th edition, Bentley publishers, 2014.
4. Barry Hollembeak, "Automotive Electricity, Electronics and Computer Controls", Delmar Publishers, 2001.
5. Warren M Farnell, "Fuel System and Emission controls", Check Chart Publication, 2000.
6. Ronald K Jurgon, "Automotive Electronics Handbook", McGraw-Hill, 1999.

U14MC*P*701 PROJECT WORK PHASE I

L	T	P	C
0	0	4	2

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Design, analyze, realize / simulate a physical system by using the technology they learnt during the program.

CO2: Integrate various systems into one Mechatronics product.

CO3: Work in a team with confined time duration.

CO4: Disseminate his work both in oral and written format.

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO11	PO 12	PS O 1	PSO 2
CO1	S	S	S	S	S		M	M				S	S	S
CO2	S	S	S	S	S	M	M	M				S	S	S
CO3									S					
CO4										S	S			

Course Assessment methods:	
Direct	**Indirect**
End Semester Viva Voice Interdisciplinary work Publication Working model/ simulation result Innovation Report with good referencing	Course end survey

Students in the form of group, not exceeding 4 members in a group to carry out their main project. It should be a Mechatronics project. However, special considerations can be given for interdisciplinary measurement and computer based simulation projects. This exception should be recorded and approved by the department committee. Management related projects will not be allowed. The interdisciplinary projects will carry more weightage. It is mandatory to publish their main project in national/international level conferences to appear in the viva-voce exam.

U15MC*P*702 **ROBOTICS LABORATORY**

L	T	P	C
0	0	3	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Control mobile robots using different sensors and actuators.

CO2: Model kinematics of robotics arm using mathematical software.

CO3: Manipulate an industrial robot using a machine vision system and HMIs

CO4: Handle a robot model using the robotics simulation software.

CO5: Apply control algorithms in a robot

CO6: Analyze and present the findings of experimental observations in both written and oral format.

Pre-requisite

1. U15MCT701 – Robotics Engineering

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	S	M	M	W									S	S
CO2	S	S	M	W									S	S
CO3	M			S									W	W
CO4				S									M	W
CO5	S		M	S									M	M
CO6										S				

Course Assessment methods:	
Direct	**Indirect**
Lab Exercises Model Practical Examination End Semester Practical Examination Assignment	Course end survey

LIST OF EXPERIMENTS

1 Study of different types of robots based on configuration and application.
2 Study of different type of links and joints used in robots
3 Study of components of robots with drive system and end effectors.
4 Modeling Forward and inverse kinematics for robotic arm using Mathematical Software
5 Offline programming of an Industrial robot using Robotics simulation Software
6 Setup and program a station with conveyor tracking using the Robotics simulation Software
7 Vision-Based Control on an Industrial Robot
8 Writing and verifying a Program for point to point operations for mobile robots
9 Obstacle Avoidance of a mobile robot with Ultrasonic Sensor
10 Tilt sensing for an autonomous mobile robot using accelerometer sensor.

11 Line following robot
12 Speech recognition and object recognition algorithm in a robot.

U15MC*P*703 **INDUSTRIAL AUTOMATION II LABORATORY**

L	T	P	C
0	0	3	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Select the suitable communication protocol for the process control applications.
CO2: Use different sensors and actuators to control various industrial parameters: temperature, pressure, level and flow.
CO3: Construct a SCADA HMI screen for the process automation.
CO4: Build a communication network between PLC, HMI and field devices.
CO5: Make use of GSM module to interface with PLC, filed devices and SCADA systems.
CO6: Inspect and control the industrial process using SCADA systems.
CO7: Analyze and present the findings of experimental observations in both written and oral format.

Pre-requisite

1. U15MCT505 Industrial Automation I
2. U15MCT702 Industrial Automation II
3. U15MCP501 Industrial Automation I Laboratory

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	M	M											S	M
CO2	S	S	S	M	M								S	S
CO3	M	W	S		S								S	M
CO4	M	M	M		S								S	M
CO5	M	M	M		S								S	M
CO6	S	M	M		S								M	M
CO7										S				

Course Assessment methods:	
Direct	**Indirect**
Lab Exercises Model Practical Examination End Semester Practical Examination Assignment	Course end survey

LIST OF EXPERIMENTS

1. Study of industrial process automation and communication network architecture
2. Construct a communication network for process control(HMI, Filed devices)
3. Build a Real time data logging and data processing system
4. Design to control process parameters such as level, flow, temperature and pressure using closed loop control system
5. Development of SCADA HMI for process automation
6. Test the digital I/O functions using SCADA panel.
7. design a T-junction traffic light controller using SCADA
8. Development of SCADA systems for automating bottle filling systems
9. Development of SCADA systems for Monitoring and control of fluid power systems.
10. Implementation of GSM module to interface with PLC, Field devices and SCADA systems

Total Hours: 45

U15GHP701

GLOBAL VALUES

(Common to all branches of Engineering and Technology)

L	T	P	C
1	0	0	1

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Understand importance of ecology and its preservations
- **CO2:** Understand the various global issues and their causes and solutions.
- **CO3:** Approach any problem holistically as against giving a reductionist solution
- **CO4:** Learn impact of globalization on various factors such as environment, local population
- **CO5:** Learn to integrate and understand how an Individual peace impacts world peace

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10	PO11	PO12	PSO 1	PSO2
CO1		W					M	M	M	M		M		
CO2		W				M	S	S	M	M		M		
CO3		W	W		W	M	M	M	W	W		M		
CO4		W				S	M	M	W	W		M		
CO5						W	W	W				S		

Course Assessment methods:	
Direct	**Indirect**
1.Individual Assignment 2.Group Assignment 3.Presentation 4.Surprise Test 5.Practical Assessment 6.End Semester Assessment	Course end survey

Introduction to Global Values **1 Hours**

Introduction to Systems Thinking **1 Hours**

Ecology, ecological imbalances and its solution **3 Hours**

Globalisation Vs Localisation – an economic and Spiritual Perspective	**3 Hours**
Global Issues & Solutions	**3Hours**
Advanced Contemplative Practices	**4 Hours**

Total Hours: 15

REFERENCES:

1. Vethathiri's Maharishi's, "World peace" The World Community Service Centre, Vethathiri Publications, 1957.
2. Fritz Schumacher, "Small is Beautiful", The Blond & Briggs, Published 1973.
3. Noam Chomsky, "Profit over People", Seven Stories Press, Published 1999.
4. Vethathiri's Maharishi's, "Atomic Poison" The World Community Service Centre, Vethathiri Publications, 1983.

SEMESTER VIII

U15MC*P*801 PROJECT WORK PHASE II

L	T	P	C
0	0	24	12

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Design, analyze, realize / simulate a physical system by using the technology they learnt during the program.

CO2: Integrate various systems into one Mechatronics product.

CO3: Work in a team with confined time duration.

CO4: Disseminate his work both in oral and written format.

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO 3	PO 4	PO5	P O6	PO 7	PO 8	PO 9	PO10	PO11	PO1 2	PS O 1	PSO 2
CO1	S	S	S	S	S		M	M				S	S	S
CO2	S	S	S	S	S	M	M	M				S	S	S
CO3									S					
CO4										S	S			

Course Assessment methods:	
Direct	**Indirect**
End Semester Viva Voice Interdisciplinary work Publication Working model/ simulation result Innovation Report with good referencing	Course end survey

Students in the form of group, not exceeding 4 members in a group to carry out their main project. It should be a Mechatronics project. However, special considerations can be given for interdisciplinary measurement and computer based simulation projects. This exception should be recorded and approved by the department committee. Management related projects will not be allowed. The interdisciplinary projects will carry more weightage. It is mandatory to publish their main project in national/international level conferences to appear in the viva-voce exam.

OPEN ELECTIVE

U15MC*OE*01 ROBOTICS FOR ENGINEERS

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Define robotic terminologies and explain the importance of kinematics and dynamics in robotics.
- **CO2:** Summarize the different types of robotic control system.
- **CO3:** Explain the basics of drives in robotics.
- **CO4:** Illustrate different sensors used in robotics.
- **CO5:** Explain the basics of machine vision and their operation.
- **CO6:** Explain the application of robotics

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O 1	PSO 2
CO1	S													
CO2	S	M												
CO3	S		W											
CO4	S		W		M									
CO5	S													
CO6	S	M												

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

INTRODUCTION **10 Hours**

Evolution of robotics - Laws of robotics – classification - robot anatomy – specification – Resolution, repeatability and precision movement. Introduction to robot arm kinematics and dynamics – planning of manipulator trajectories.

ROBOTIC DRIVES AND CONTROL **10 Hours**

Hydraulic, Electric and Pneumatic drives – linear and rotary actuators – end-effectors – classification-control of robot manipulator - variable structure control – non-linear decoupled and feedback control – effect of external disturbance – PID control scheme – resolved motion control - computed torque control, force control of robotic manipulators. Adaptive control.

SENSORS **10 Hours**

Need for sensing system - classification of robotic sensors - status sensors, environmental sensors, quality control sensors, safety sensors and work cell control sensors.– non optical and optical position sensors – velocity sensors – proximity sensors – contact and noncontact type – touch and slip sensors – force and torque sensors – selection of right sensors.

MACHINE VISION SYSTEM **10 Hours**

Image Sensing and Digitizing - Image definition, Image acquisition devices, specialized lighting techniques. Digital Images - Sampling, Quantization and Encoding. Image storage. Image Processing and Analysis Data reduction – digital conversion and windowing. Segmentation – Thresholding, Edge detection and Region growing. Binary Morphology and grey morphology operations. Feature Extraction, Object recognition, Depth measurement.

APPLICATION **5 Hours**

Introduction - Delivery Robots – Intelligent vehicles – Survey and inspection robots – Space Robots – Autonomous aircrafts – Underwater Inspection – Agriculture and Forestry.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Saeed B Niku, 'Introduction to Robotics', 2nd edition, Prentice Hall of India, 2010.
2. S. R. Deb and S. Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill Education Pvt. Ltd, 2010.
3. Mikell P. Groover, "Industrial Robots - Technology, Programming and Applications", McGraw Hill, New York, 2008.
4. Fu K S, Gonzalez R C, Lee C.S.G, "Robotics : Control, Sensing, Vision and Intelligence", McGraw Hill, 1987
5. Ramesh Jam, Rangachari Kasturi, Brain G. Schunck, "Machine Vision", Tata McGraw-Hill, 1991.
6. Yoremkoren, "Robotics for Engineers", McGraw-Hill, USA, 1987.
7. P.A. Janaki Raman, "Robotics and Image Processing", Tata McGraw-Hill, 1991.

U15MC*OE*02 **BIOMIMETICS AND BIO INSPIRED DESIGN**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Appreciate the various biological systems which can be adopted for engineering design

CO2: Discuss the functional units of muscle and muscle adaptation for novel design.

CO3: Explain the various sensing systems of biology and correlate it with engineering systems.

CO4: Describe various natural mechanisms to adopt in developing robots and automation solution

CO5: Explain various natural materials and provide alternate solutions for existing systems.

CO6: Explain the efficient control systems of nature and apply to solve simple problems.

CO7: Apply concepts of biology to develop simple systems.

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO 2	PO 3	PO 4	PO5	P O6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	S													
CO2	S	M					S							
CO3	S		S				S							
CO4	S	S					S							
CO5	S	S					S							
CO6	S						S							
CO7	S						S							

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

LEARNING FROM NATURE **9 Hours**

Introduction - Mimicking and Inspiration of Nature - Synthetic Life - Artificial Life - Three main strands of development in Biomimetics- Three levels of learning from nature- Exceptional

scientific and technological nature of Biomimetics- Artificial Intelligence - Nature as a Model for Structures and Tools - Constructing Structures from Cells - Biologically Inspired Mechanisms - Pumping Mechanisms - Controlled Adhesion - Biologically Inspired Structures - Defense and Attack Mechanisms in Biology - Materials and Processes in Biology - Spider Web : Strong Fibers- Multifunctional Materials - Bio-Sensors- Robotics Emulating Biology - Interfacing Biology and Machines- Aerodynamic and Hydrodynamic Mobility.

BIOLOGICAL MECHANISMS AS MODELS FOR MIMICKING 6 Hours

Introduction- Muscle Function- The Functional Units- The Sarcomere- Muscle Design- Not all Sarcomeres Are Alike- Rearranging the Sarcomeres, Muscle Morphology- Muscle Adaptation- Biomimetics of Muscle Design.

MECHANIZATION OF COGNITION 6 Hours

Mechanized Cognition: The Most Important Piece of AI- Training and Education- Language Cognition- Sound Cognition- Visual Cognition.

EVOLUTIONARY ROBOTICS AND OPEN-ENDED DESIGN AUTOMATION 6 Hours

Introduction -Machine Bodies and Brains- Morphology Representations- Evolving Machines in Physical Reality- The Economy of Design Automation- Future Challenges: Principles of Design- Research Methodology

ROBOTIC BIOMIMESIS OF INTELLIGENT MOBILITY, MANIPULATION, AND EXPRESSION 6 Hours

Introduction- Mobility and Motility: Flying, Walking, Crawling, Manipulation- Behavior, Expressivity- Robotic Materials, Structures, and Manufacturability

MULTIFUNCTIONAL MATERIALS 6 Hours

Introduction- Multifunctional Composites - Heating Functionality- Healing Functionality- Sensing Functionality: Integrating Sensing into Composites, Sensor Communications and Power, Mechanical Integration, Data Management and Sensors for Structural Health Monitoring.

BIOMIMETIC AND BIOLOGICALLY INSPIRED CONTROL 6 Hours

Review of the Development of System Control- Sensory-Motor Organization- Optimal Motion Formation- Mechanical Interaction and Environmental Adaptation

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Yoseph Bar- Cohen, "Biomimetics: Biologically Inspired Technologies", CRC press, 2006.
2. Arnim von Gleich, Christian Pade, Ulrich Petschow and Eugen Pissarskoi, "Potentials and Trends in Biomimetics", Springer Science & Business Media, 2010.
3. Benyus, Janine M, "Biomimicry: Innovation Inspired by Nature". New York: Harper Collins, 1997.

U15MC*OE*03 TEXTILE MECHATRONICS

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Describe various process and machines involved in spinning

CO2: Explain various process and machines involved in weaving

CO3: Summarize the objectives and process variables of processing machines.

CO4: Explain various stages of automation scopes in spinning

CO5: Describe various stages of automation scopes in weaving

CO6: Explain the role of CAD/CAM/CIM in textile manufacturing

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O 1	PSO 2
CO1	M													M
CO2	M													M
CO3	M													M
CO4	M													M
CO5	M													M
CO6	M													M

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

INTRODUCTION TO TEXTILE TECHNOLOGY **4 Hours**

History of textile technology and its advancements, introduction to textile fibers, overview of textile manufacturing, Introduction to automation in textile industries.

BASICS OF SPINNING **8 Hours**

Spinning process flow chart – Objectives and process variables of textile spinning machineries: Mixing, Blow room, Carding, Draw frame, Combing, Speed frame, Ring frame, rotor spinning.

BASICS OF WEAVING **8 Hours**

Weaving process flowchart – Objectives and process variables in weaving preparatory: Winding, Warping, Sizing and beaming. Objectives and process variables in weaving: drawing in, knotting, denting and weaving.

BASICS OF PROCESSING **5 Hours**

Objectives and process variables in processing machines: Singeing, Desizing, Scouring, Bleaching, Mercerizing, Dyeing, Printing, Finishing.

AUTOMATION IN SPINNING MACHINERY **8 Hours**

Machinery material flow and its variation controls – Feeders & Stop motions – Auto levelers – Safety switches – Production and quality monitors – Full doff and pre-set length monitors. Data acquisition system for spinning preparatory, ring spinning – rotor spinning.

AUTOMATION IN WEAVING MACHINERY **8 Hours**

Yarn cleaner controls – Knotter / splicer carriage controls – Warping machine monitors and controls – sizing machine monitors and controls – Auto reaching / drawing in and knotting machine monitors and controls – Data acquisition system in weaving preparatory and weaving – humidification systems .

APPLICATIONS **4 Hours**

CAD / CAM / CIM in spinning, Weaving, Dyeing, Printing, Apparel production – Electronics data interchange - Robotics in textile industries

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Chattopadhyay R, "Advances in Technology of Yarn Production", NCUTE, IIT Delhi, 2002.
2. Oxtoby E, "Spun Yarn Technology", butter worth's, London, 2002.
3. Lord P R. and Mohammed M H., "Weaving – Conversion of Yarn to Fabric", Merrow Publication, 2001.
1. Krishna Kant, "Computer – Based Industrial Control", 2nd edition, PHI Learning Pvt Ltd, New Delhi, 2011.
2. Venkatachalam A and Ashok Kumar L, "Monograph on — Instrumentation & Textile Control Engineering" – 2005.
3. Berkstresser G A, Buchanan D R and Grady P, "Automation in the Textile Industry from Fibers to Apparel", The Textile Institute, UK, 1995.
4. "Textiles Go On-line", the textile Institute, UK, 1996.
5. Nalura B C. "Theory and Applications of Automation Controls", New Age International (P) Ltd Pub, 1998.

ELECTIVE I

U15MCE101 **SOFT COMPUTING**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Implement numerical methods in soft computing.
CO2: Explain the fuzzy set theory.
CO3: Explain optimization techniques.
CO4: Discuss the supervised and unsupervised learning networks
CO5: Summarize on neuro fuzzy modeling
CO6: Demonstrate some applications of computational intelligence

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

Cos	Programme Outcomes(Pos)													
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O 1	PSO 2
CO1	S	M	W		M								W	
CO2	M	M	W		M								M	
CO3	S	S	W		M								M	W
CO4		M	M		M								M	
CO5		M	M		M								M	
CO6	M	M	M		M								M	M

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

FUZZY SET THEORY **10 Hours**

Introduction to Neuro – Fuzzy and Soft Computing – Fuzzy Sets – Basic Definition and Terminology – Set-theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Tsukamoto Fuzzy Models – Input Space Partitioning and Fuzzy Modeling.

OPTIMIZATION **8 Hours**

Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton's Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithms – Simulated Annealing – Random Search – Downhill Simplex Search.

NEURAL NETWORKS 10 Hours

Supervised Learning Neural Networks – Perceptrons - Adaline – Backpropagation Mutilayer Perceptrons – Radial Basis Function Networks – Unsupervised Learning Neural Networks – Competitive Learning Networks – Kohonen Self-Organizing Networks – Learning Vector Quantization – Hebbian Learning.

NEURO FUZZY MODELING 9 Hours

Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling – Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.

APPLICATIONS OF COMPUTATIONAL INTELLIGENCE 8 Hours

Printed Character Recognition – Inverse Kinematics Problems – Automobile Fuel Efficiency Prediction – Soft Computing for Color Recipe Prediction.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Jang J S R., Sun C T. and Mizutani E., "Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson Education 2004.
2. Timothy J Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997.
3. Davis E Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.
4. Rajasekaran S and Pai G A V., "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003.
5. Eberhart R, Simpson P and Dobbins R., "Computational Intelligence - PC Tools", AP Professional, Boston, 1996.
6. Cromwell, Weibell and Pfeiffer, "Biomedical Instrumentation and Measurements", 2nd Edition, Prentice Hall of India, 2007.

U15MC*T*102 FUNCTIONAL PROGRAMMING

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Classify and make use of python programming elements to solve and debug simple logical problems.

CO2: Interpret the problem and able to identify checkpoints to create ordered programs.

CO3: Apply the concept of data structures to solve simple non deterministic problems

CO4: Make use of object oriented concepts to build real time applications

CO5: Use various functions to manipulate hold set of values

CO6: Solve complex problems using loop functions

CO7: Perform arithmetic operations and able to print output

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	M				M									M
CO2	M				M									M
CO3	M				M									M
CO4	M				M									M
CO5	M				M									M
CO6	M				M									M
CO7	M				M									M

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

INTRODUCTION TO FUNCTIONAL PROGRAMMING: 3 Hours

PYTHON

Why Python is popular? - The Python Programming Language - What Is a Program? - What Is Debugging? – **Errors:** Syntax Errors, Runtime Errors and Semantic Errors - The first program-

Essentials for programming: Values and Types, Variables, Variable Names, Keywords, Operators, Operands, Expressions, Statements- **Mode of programming**: Interactive Mode and Script Mode- Operations: Order of Operations and String Operations – Comments.

FUNCTIONS, CONDITIONALS AND RECURSION **6 Hours**

Function Calls - Type Conversion Functions - Math Functions – Composition - Adding New Functions - Definitions and Uses - Flow of Execution - Parameters and Arguments - Variables and Parameters Are Local- Stack Diagrams - Fruitful Functions and Void Functions - Why Functions?- Importing with from. Modulus Operator - Boolean Expressions - Logical Operators - Conditional Execution - Alternative Execution - Chained Conditionals - Nested Conditionals - Stack Diagrams for Recursive Functions - Infinite Recursion - Keyboard Input.

FRUITFUL FUNCTIONS AND ITERATIONS **4 Hours**

Significant functions : Return Values , Incremental Development, Composition, Boolean Functions, More Recursion, Leap of Faith and checking types - **Iterations:** Multiple Assignment, Updating Variables, The while Statement, break, Square Roots and Algorithms.

STRINGS, LISTS AND DICTIONARIES **8 Hours**

Strings: A String Is a Sequence , len, Traversal with a for Loop, String Slices, Strings Are Immutable, Searching, Looping and Counting- String Methods, The in Operator and String Comparison – **Lists:** A List Is a Sequence, Lists Are Mutable, Traversing a List- List Operations - List Slices - List Methods - Map, Filter, and Reduce - Deleting Elements - Lists and Strings - Objects and Values – Aliasing - List Arguments- **Dictionaries:** Dictionary as a Set of Counters, Looping and Dictionaries, Reverse Lookup, Dictionaries and Lists, Memos, Global Variables, Long Integers.

TUPLES AND FILES **6 Hours**

Tuples: Tuples Are Immutable, Tuple Assignment, Tuples as Return Values, Variable-Length Argument Tuples, Lists and Tuples- Dictionaries and Tuples -Comparing Tuples- Sequences of Sequences- **Files:** Persistence, Reading and Writing, Format Operator, Filenames and Paths, Catching Exceptions, Databases, Pickling and Pipes.

INTRODUCTION TO CLASSES AND OBJECTS **3 Hours**

Classes and Objects: User defined types, Attributes, rectangles and copying- **Classes and Functions:** Time, Pure functions and modifiers- **Classes and Methods:** object oriented features, polymorphism and type based dispatch- **Inheritance:** Card Objects, Class Attributes, Comparing Cards, Inheritance Class Diagrams and Data Encapsulation.

30 Hours

LIST OF EXPERIMENTS

1. Use tuples and lists to assign and hold multiple values.
2. Use lists to manipulate sets of values.
3. Use slices to obtain parts of lists and to manipulate lists.

4. Use range () to generate lists containing sequences of integers.
5. Use for loops to iterate through predefined lists of objects.
6. Use while loops to iterate until satisfactory exit conditions are obtained.
7. Use break to program more flexible loop exit conditions.
8. Read lines of input from the user, without giving a prompt. When the input line is **quit**, stop accepting input. As output, print the input lines in reverse order, one on each output line. The line **quit** should not be included in the output.
9. Write a program to Convert a Decimal number to Binary number
10. Write a function roots that computes the roots of a quadratic equation. Check for complex roots and print an error message saying that the roots are complex.

Theory: 30Hr **Practical: 15 Hrs** **Total Hours: 45**

REFERENCES::

1. Allen B Downey, "Think Python", O'Reilly Media, Inc, 2012
2. Mark Lutz, "Learning Python", 5th edition, O'Reilly Media, Inc., 2013.
3. Alex Martelli, "Python in a Nutshell", 2nd edition, O'Reilly Media, Inc., 2006.
4. Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", O'Reilly Media, Inc, 2009.

U15MCE103 **INTRODUCTION TO ANDROID PROGRAMMING**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Explain about the architecture of android programming
- **CO2:** Explain about java and xml based coding
- **CO3:** Use android studio components
- **CO4:** Apply android studio function and layout for simple application
- **CO5:** Develop systematically sequenced application using android studio.
- **CO6:** Create real time applications using hardware.

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O 1	PSO 2
CO1	M												M	
CO2	M												M	
CO3	M		S		S								M	
CO4	M				S								M	
CO5	M												M	M
CO6	M				S								M	M

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

INTRODUCTION 9 Hours

Architecture Fundamentals – Linux Kernel – Android Libraries – Android Runtime – Android Application framework – Android Application.

Fundamentals of Android Application – Android SDK – Eclipse and ADT - JRE and JDK – Android Studio

BASICS OF PROGRAMMING 9 Hours

Basics of JAVA – Java Identifiers – Keywords – Literals – Variables – Code Blocks – Comments – Operators and Expressions – Statements, Physical line and Logical Line

Basics of XML – XML writing – content and markup – elements, openings closing and empty element tags – attribute.

ANDROID'S APPLICATION COMPONENTS 9 Hours

Components – Services – Activities – Content Providers – Broadcast receivers – views – fragments – intents – layouts – manifest – resources

ANDROID STUDIO 9 Hours

Android studio features – Toolbar – tool button – project tool window – status bar – navigation bar – tab bar – android studios workspace – palette – component tree – context menu – layout view window – properties windows – source code / XML editor

Program Structure – Java Packages – Using packages – file structure of android project – application resources – android device navigation – deigning effective navigation.

APPLICATION DEVELOPMENT AND DEPLOYMENT 9 Hours

Application Navigation: navigation with Up and Back – switch views – sibling screens - indirect notification

Action Bar And Navigation Drawers: action bar - action button - prioritize actions - navigation drawer - navigation hub

User Information and Location: retrieve a contact list - Location awareness

Deployment: Emulator – android device - testing your android app – USB Debugging mode

CASE STUDY: Design of the Passenger comfort logging system using android.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Sam key "Android programming in a Day: The power Guide for Beginners In Android App Programming" 2015
2. Kevin Lyn "Android programming: A step by step guide for beginners! Create your own apps! " 2015
3. Mark L Murphy "The Busy Coder's Guide to Advanced Android Development", Commons Ware, LLC. Jul 2009: Version 1.0
4. Rick Rogers, John Lombardo, Zigurd Mednieks, Blake Meike "Android Application Development: Programming with Google SDK", O'Reilly publication, 2009.
5. Barry Burd "Android Application Development All-in-One for Dummies" 2nd edition, Wiley publications, 2015.
6. Herbert Schildt, "Java: The Complete Reference", 9th Edition, Mc Graw Hill Education, 2014.
7. Charles F Goldfarb, Paul Prescod "The XML Handbook" 3rd edition, Pearson Education, 2001.

ELECTIVE II

U15MC*E*201 MACHINE VISION SYSTEM

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Summarize acquisition and processing methods of digital image along with their applications
- **CO2:** Design filters for image enhancement.
- **CO3:** Compare image enhancement in spatial domain with frequency domain
- **CO4:** Describe about image segmentation techniques
- **CO5:** Choose appropriate segmentation techniques for different applications
- **CO6:** Provide solution to complex problems involving image processing

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1		W											W	
CO2	M	M	S		M								W	
CO3	M	M	S		M								W	
CO4	M	M											S	M
CO5			S		M								S	M
CO6	M	M	S	M	M								S	S

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

INTRODUCTION **7 Hours**

Digital image representation; fundamental steps in image processing; elements of digital image processing systems: image acquisition: Vision System: Basic Components – Elements of visual perception, Lenses: Pinhole cameras, Gaussian Optics – Cameras – Camera-Computer interfaces, storage, processing and display.

DIGITAL IMAGE FUNDAMENTALS **6 Hours**

Structure of the human eye; image formation; brightness adaptation and discrimination; a simple image model; uniform and non-uniform sampling and quantization; some basic relationships between pixels; neighbors of a pixel; Connectivity; Labeling. Distance measures; imaging geometry.

IMAGE ENHANCEMENT IN THE SPATIAL DOMAIN 9 Hours

Basic gray level transformations-histogram processing-Enhancement using arithmetic/logic operations-Basics of spatial filtering-comparison between smoothing and sharpening spatial filters.

IMAGE ENHANCEMENT IN THE FREQUENCY DOMAIN 9 Hours

1D Fourier transform-2D Fourier transform and its Inverse-Smoothing & sharpening.
Frequency domain filters (Ideal, Butterworth, Gaussian)-homomorphic filtering.

MACHINE VISION 7 Hours

Segmentation – Thresholding, Edge detection and Region growing. Binary Morphology and grey morphology operations. Feature Extraction, Object recognition, Depth measurement.

APPLICATIONS 7 Hours

Transforming sensor reading, Mapping Sonar Data, Aligning laser scan measurements - Vision and Tracking: Following the road, Iconic image processing, Multiscale image processing, Video Tracking - Learning landmarks: Landmark spatiograms, K-means Clustering, EM Clustering.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Ramesh Jam, Rangachari Kasturi, Brain G Schunck, "Machine Vision", Tata McGraw-Hill, 1991.
2. Janaki Raman P A, "Robotics and Image Processing", Tata McGraw-Hill, 1991.
3. Rafael C Gonzalez and Richard E Woods, "Digital Image Processing", 6th Indian Reprint, Pearson Education Asia/Addison Wesley publishing company, 2008.
4. Anil K Jain, "Fundamentals of Digital Image Processing", Prentice-Hall of India, New Delhi, 2001.
5. Maher A Sid-Ahmed, "Image Processing Theory, Algorithms and architectures", McGraw-Hill, 1995.
6. William K Pratt, "Digital Image Processing", 2nd edition, Wiley-Inter Science Publication, 1991.
7. Arthur K Wreeks, "Fundamentals of Electronics Image Processing", Prentice-Hall of India, New Delhi, 2001.

U15MC*E*202 MEDICAL MECHATRONICS

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Explain different measurement techniques used in physiological parameters measurement.

CO2: Describe the different sensors and transducer principles used in bio medical application

CO3: Describe the signal conditioning circuits used in biomedical engineering.

CO4: Comment on various measurement systems used in diagnostics.

CO5: Comment on various monitoring systems used in diagnostics

CO6: Differentiate the working of recorders and explain the advanced systems used in medicine.

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO 3	PO 4	PO5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO11	PO 12	PS O 1	PSO 2
CO1	M													M
CO2	M			W										M
CO3	M			M										M
CO4	M	W												M
CO5	M	W												M
CO6	M				M									M

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

INTRODUCTION **9 Hours**

Cell structure – electrode – electrolyte interface, electrode potential, resting and action potential , source of bioelectric potentials – electrodes for their measurement, ECG, EEG, EMG – machine description – methods of measurement – three equipment failures and trouble shooting.

BIO-MEDICAL SENSORS AND TRANSDUCERS 9 Hours

Basic transducer principles Types — resistive, inductive, capacitive, fiber-optic, photoelectric, chemical, active and passive transducers and their description and feature applicable for biomedical instrumentation – Bio, Nano sensors and application.

SIGNAL CONDITIONING AND DISPLAY 9 Hours

Input isolation, DC amplifier, instrumentation, charge amplifier, power amplifier, and differential amplifier – feedback, op-Amp-electrometer amplifier, carrier Amplifier – instrument power supply, basis of signal conversion and digital filtering, data reduction technique – time and frequency domain technique.

MEDICAL MEASUREMENT AND MONITORING SYSTEMS 9 Hours

Blood pressure measurement: by ultrasonic method – plethysmography – blood flow measurement by electromagnetic flow meter, cardiac output measurement by dilution method – phonocardiography – vector cardiography. Heart lung machine – artificial ventilator – Anesthetic machine – Basic ideas of CT scanner – MRI and ultrasonic scanner – cardiac pacemaker –defibrillator patient safety - electrical shock hazards - Centralized patient monitoring system.

RECORDERS AND ADVANCED SYSTEMS 9 Hours

Oscillagraphic – galvanometric - thermal array recorder, photographic recorder, storage oscilloscopes, electron microscope.Biotelemetry, Diathermy,Audiometers, Dialysers, Lithotripsy. **CASE STUDIES: Hot wire Anemometry for respiratory flow measurements.**

Theory: 45 Hrs Total Hours: 45

REFERENCES:

1. Khandpur R S., "Handbook of Biomedical Instrumentation", TMH, 2009
2. Cromwell, Weibell and Pfeiffer, "Biomedical Instrumentation and Measurements", 2nd edition, Prentice Hall of India, 2007.
3. Geddes L A. and Baker L E., "Principles of Applied Bio-medical Instrumentation", 3rd edition, John Wiley and Sons, 1995.
4. Tompkins W J., "Biomedical Digital Signal Processing", Prentice Hall of India, 1998.
5. Arumugam M, "Bio-Medical Instrumentation", Anuradha Agencies, 2003.

U15MC*E*203 DIGITAL SIGNAL PROCESSING

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Explain the characteristics of discrete-time signals and discrete systems
CO2: Explain the Properties of Z transform and DFT
CO3: Analyze the discrete time systems using mathematical tools.
CO4: Illustrate efficient computation of DFT
CO5: Describe Filters and their structures
CO6: Illustrate the design of FIR and IIR filters
CO7: Discuss advanced features and architecture of generic P-DSP

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1	M	W											W	
CO2	M	M	W										W	
CO3	M	M	W	W									M	
CO4	W	M											W	
CO5			M										M	
CO6			M										M	
CO7			W	M									M	W

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

DISCRETE TIME SIGNALS AND SYSTEMS **9 Hours**

Representation of a CT signal by samples – Sampling theorem – Reconstruction of a signal from its samples – Aliasing – DT Signals – Impulse, Step, Pulse, Sine, Exponential – Properties of DT signals - Transformation of independent variable – Shifting, scaling, folding - Discrete Time LTI systems – Properties – Impulse response – Convolution sum – Properties of Convolution.

Z-TRANSFORM AND SYSTEM ANALYSIS **9 Hours**

DTFT – Properties - Z transform – Forward Transform - Inverse Transform using Partial Fractions - Properties – Pole-Zero plot– Difference Equations - Transfer function - Analysis of Discrete Time systems using DTFT and Z Transform.

DISCRETE FOURIER TRANSFORM **9 Hours**

Introduction to DFT – Properties of DFT – Efficient computation of DFT – FFT algorithms – Introduction to Radix - n algorithms – Radix – 2 FFT – Decimation-in-Time and Decimation–in-Frequency algorithms – Butterfly diagram.

DESIGN OF DIGITAL FILTERS **9 Hours**

FIR filter design: Linear phase characteristics - Windowing Technique –Rectangular, Hamming, Hanning, Blackmann windows – IIR filter design: Analog filter design - Butterworth and Chebyshev approximations – Impulse invariance and Bilinear transformations - FIR and IIR filter structures – Direct form I and II - cascade and parallel forms – Finite Precision effects.

ADVANCED TOPICS AND PROGRAMMABLE DSP CHIPS **9 Hours**

Concepts of multi-rate signal processing – Decimation and interpolation by integer factor – Sampling rate conversion – Introduction to DSP architecture - Von Neumann, Harvard, Modified Harvard architectures – MAC unit–Multiple ALUs Modified Bus structures and memory access schemes in P-DSP – Multiple access memory – Multi-ported memory – VLIW architecture –Pipelining – Special addressing modes

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Mrinal Mandel and Amir Asif, "Continuous and Discrete Time Signals and Systems", Cambridge International Student Edition, Cambridge University Press, 2007.
2. John G Proakis and Dimitris G Manolakis, "Digital Signal Processing, Principles, Algorithms and Applications", 3rd Edition, PHI, 2000.
3. Venkataramani B, Bhaskar M, "Digital Signal Processors, Architecture, Programming and Applications", Tata McGraw Hill, New Delhi, 2003.
4. Johny R Johnson, "Introduction to Digital Signal Processing", PHI, 2009.
5. Yang, Won Young, "Signals and Systems with MATLAB", Springer International Edition, 2009.
6. Steven W Smith, "The Scientists and Engineer's Guide to Digital Signal Processing", California Technical Publishing, 1997.
7. James H McClellan, Ronald W Schafer, Mark A Yoder, "Signal Processing First", 2nd edition, 2003.

U15MC*E*204 **MICRO ELECTRO MECHANICAL SYSTEMS**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Explain the evolution of micro and smart system.
- **CO2:** Illustrate about various sensors and actuating system.
- **CO3:** Classify the Micro machining techniques in MEMS.
- **CO4:** Evaluate a proper scaling method.
- **CO5:** Determine packaging techniques in MEMS and smart system.
- **CO6:** Discuss various applications of MEMS.

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

Cos	Programme Outcomes(Pos)													
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2
CO1	S													
CO2	M													
CO3	S													
CO4		S											S	
CO5	S												S	
CO6	S	M	M										S	M

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

INTRODUCTION **9 Hours**

Overview - Microsystems and microelectronics - definition-MEMS materials-scaling laws scaling in geometry-scaling in rigid body dynamics- scaling in electrostatic forces- scaling in electricity- scaling in fluid mechanics- scaling in heat transfer.

MICRO SENSORS AND ACTUATORS **9 Hours**

Working principle of Microsystems - micro actuation techniques - micro sensors-types –Micro actuators – types – micro pump – micro motors – micro – valves – micro grippers –micro Accelerometers

FABRICATION PROCESS **9 Hours**

Substrates-single crystal silicon wafer formation-Photolithography-Ion implantation-Diffusion –Oxidation-CVD-Physical vapor deposition-Deposition by epitaxy-etching process.

MICRO SYSTEM MANUFACTURING **9 Hours**

Bulk Micro manufacturing- surface micro machining – LIGA – SLIGA - Micro system packaging-materials - die level-device level-system level-packaging techniques - die preparation - surface bonding -wire bonding - sealing.

MICRO SYSTEM DESIGN **9 Hours**

Design considerations-process design-mask layout design- mechanical design-applications of micro systems in automotive industry, bio medical, aero space and telecommunications.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Tai-Ran Hsu, "MEMS & Microsystems Design and Manufacture", Tata McGraw-Hill, 2006.
2. Mohamed Gad-el-Hak, "The MEMS Hand book", CRC press, 2005.
3. Julian W Gardner, Vijay K Varadan, Osama O Awadel Karim, "Microsensors MEMS and Smart Devices", John Wily and sons Ltd., 2001.
4. Fatikow S,Rembold U, "Microsystem Technology and Microrobotics", Springer-Verlag Berlin Heidelberg , 1997.
5. Francis E H Tay and W O Choong, "Microfludics and BioMEMS Applications", Springer, 2002.

U15MC*E*205 **MOBILE ROBOTICS**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Explain robot locomotion
CO2: Apply kinematics models and constraints
CO3: Implement vision algorithms for robotics
CO4: Implement robot localization techniques
CO5: Explain robot mapping techniques
CO6: Describe SLAM algorithms
CO7: Explain planning and navigation in robotics

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

Cos	Programme Outcomes(Pos)													
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PSO 1	PSO 2
CO1	S													M
CO2	S		M		M									M
CO3	S				M									M
CO4	S													M
CO5	S													M
CO6	S													M
CO7	S													M

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

LOCOMOTION AND KINEMATICS **9 Hours**

Introduction to Robotics - key issues in robot locomotion - legged robots - wheeled mobile robots - aerial mobile robots - introduction to kinematics - kinematics models and constraints - robot maneuverability

ROBOT PERCEPTION **9 Hours**

Sensors for mobile robots - vision for robotics - cameras - image formation - structure from stereo - structure from motion - optical flow - color tracking - place recognition - range data

MOBILE ROBOT LOCALIZATION **9 Hours**

Introduction to localization - challenges in localization - localization and navigation - belief representation - map representation - probabilistic map-based localization - Markov localization - EKF localization - UKF localization - Grid localization - Monte Carlo localization - localization in dynamic environments

MOBILE ROBOT MAPPING **9 Hours**

Autonomous map building - occupancy grip mapping - MAP occupancy mapping - SLAM - extended Kalman Filter SLAM - graph-based SLAM - particle filter SLAM - sparse extended information filter - fastSLAM algorithm

PLANNING AND NAVIGATION **9 Hours**

Introduction to planning and navigation - planning and reacting - path planning - obstacle avoidance techniques - navigation architectures - basic exploration algorithms

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Roland Seigwart, Illah Reza Nourbakhsh, and Davide Scaramuzza, "Introduction to autonomous mobile robots", Second Edition, MIT Press, 2011.
2. Sebastian Thrun, Wolfram Burgard, and Dieter Fox, "Probabilistic Robotics", MIT Press, 2005.
3. Howie Choset, Kevin M. Lynch , Seth Hutchinson , George A. Kantor , Wolfram Burgard , Lydia E. Kavraki , Sebastian Thrun , "Principles of Robot Motion: Theory, Algorithms, and Implementations", A Bradford Book, 2005.
4. Gregory Dudek and Michael Jenkin, "Computational Principles of Mobile Robotics", Second Edition, Cambridge University Press, 2010.
5. Maja J. Mataric, "The Robotics Primer", MIT Press, 2007.

ELECTIVE III

U15MC*E*301 **FINITE ELEMENT ANALYSIS**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Develop the governing equations for a continuum.
CO2: Model and assemble the stiffness matrices for 1D, 2D elements.
CO3: Fit distributions to data
CO4: Apply Axisymmetric formulation and Isoparametric formulation concepts
CO5: Choose the appropriate element type for a particular application.
CO6: Apply the FEM for plate bending and thermal analysis.

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	S			W										
CO2	S													
CO3	S													
CO4	S													
CO5	S				M								W	
CO6	S				M								W	

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

INTRODUCTION **9 Hours**

Historical background – Introduction to FEA – Review of Matrix Algebra and Gaussian elimination – Governing equations for continuum – Spring assemblage – Stiffness method & Potential Energy Approach – Galerkin's weighted residual method

ONE DIMENSIONAL ELEMENTS – BAR, PLANE TRUSS & BEAM **9 Hours**

Bar element - Stiffness Matrix in local and global coordinates, Computation of Stress – Potential Energy and Galerkin's residual method – Solution of Plane Truss – Beam element – Stiffness and assembly of stiffness matrices - Potential energy and Galerkin's approach

PLANE STRESS & PLANE STRAIN – CST & LST APPROACH **8 Hours**

Binomial, Poisson and Normal distributions – properties- Fitting of Binomial, Poisson and normal distributions to data

AXISYMMETRIC ELEMENTS AND ISOPARAMETRIC FORMULATION **10 Hours**

Axisymmetric formulation – Stiffness Matrix – Pressure Vessel Analysis – Applications – Isoparametric formulation – Formulation for Bar and Plane Elements – Numerical Integration – Gaussian & Newton-Cotes Quadrature – Evaluation of Stiffness Matrix by Gaussian Quadrature.

PLATE BENDING AND THERMAL ANALYSIS **9 Hours**

Basic Concepts of Plate Bending – Element Stiffness Matrix and Equations – Heat Transfer – Basic Differential Equation and Units – 1d and 2d formulation

CASE STUDY: Finite Element Analysis on Bicycle Frame, Finite Element Analysis on V-belt pulley of a fodder crushing machine

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Daryl L Logan, "A First course in the Finite Element Method", 4th edition, Thomson Learning, 2007.
2. Chandrupatla T R. and Belegundu A D.,"Introduction to Finite Elements in Engineering", 3rd edition, Pearson Education, 2002.
3. David V Hutton "Fundamentals of Finite Element Analysis", McGraw-Hill International Edition, 2004.
4. Rao S S., "The Finite Element Method in Engineering", Butterworth-Heinemann, 2005.
5. Reddy J N, "An Introduction to the Finite Element Method", 3rd edition, Tata McGraw Hill, 2005.

U15MC*E*302 **DESIGN OF MATERIAL HANDLING SYSTEMS**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Recognize the need and types of the Material Handling Equipment
- **CO2:** Calculate the power requirements for a given belt conveyor
- **CO3:** Select the components for the belt conveyors
- **CO4:** Select and design the conveyors for the particular application
- **CO5:** Differentiate the conveyors and elevators and design the bucket and cage elevators
- **CO6:** Design the various elements of the hoists

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1														
CO2	M													
CO3	M		M										M	
CO4	M	W	S			W							M	W
CO5	M	W	M										M	
CO6	M		M										M	

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

MATERIAL HANDLING EQUIPMENTS (MHE) **4 Hours**

Materials and Bulk materials – Types of material handling equipment – selection and applications of MHE.

BELT CONVEYORS **12 Hours**

General components of belt conveyors - Selection of belt speed and belt width – Drive unit design: Power requirement – coupling types and selection – Speed reduction: gearbox types and selection – Shaft and Pulley design – selection of Idlers and Idlers spacing – Safety devises for belt conveyors

DESIGN OF OTHER CONVEYORS **10 Hours**

Apron conveyors, Screw conveyors, Cleat conveyors and Pneumatic conveyors

ELEVATORS **11 Hours**

Conveyors and Elevators – Bucket elevators: centrifugal type and continuous type bucket elevators – Design of bucket elevators – Safety devices for bucket elevators

Cage elevators: Shaft way, guides, counter weights – safety devises

HOIST **10 Hours**

Design of Hoisting elements: Welded and roller chains – Hemp wire and ropes – Design of ropes – Pulley – sprockets and drums

Load handling attachments – Forged and Eye hooks – crane grabs – lifting magnets – Grabbing attachments – arresting gears and brakes

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Rudenko N., "Materials handling equipment", ELnvee Publishers, 1970.
2. Fenner & Dunlop, "Conveyor Handbook"
2. David V Hutton "Fundamentals of Finite Element Analysis", McGraw-Hill International Edition, 2004.
3. Alexandrov M, Materials Handling Equipments, MIR Publishers, 1981

U15MC*E*303 **COMPUTER INTEGRATED MANUFACTURING**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Describe the concept of automation and rapid prototyping processes
CO2: Classify the different types of material handling & storage system with principles and applications
CO3: Explain the importance of group technology and cellular manufacturing
CO4: Summarize the fundamentals of flexible manufacturing systems
CO5: Make use of computers to prepare the product and process plan
CO6: Discuss the importance of MRP, Inventory control, JIT and lean manufacturing techniques

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	M												W	
CO2	M													
CO3	M	W												
CO4	M												W	
CO5		W								M				
CO6	M													

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

INTRODUCTION TO AUTOMATION AND PROTOTYPING **9 Hours**

Automation: Introduction, automation principles and strategies, basic elements of advanced functions, levels modeling of manufacturing systems

Definitions, evolution, CAD for RPT, Product design and rapid product development, conceptual design, detail design, prototyping, Fundamentals of RP systems, 3D solid modeling software and their role in RPT, creation of STL file

RAPID PROTOTYPING PROCESSES **5 Hours**

Stereo lithography - Solid Ground Curing - Fusion Deposition Modeling - Laminated Object Manufacturing - Selective Laser sintering -3D Printing

MATERIAL HANDLING SYSTEMS **6 Hours**

Introduction, material handling systems, principles and design, material transport system: transfer mechanisms automated feed cut of components, performance analysis, uses of various types of handling systems including Automated Guided Vehicles and its various guiding technologies.

STORAGE SYSTEMS **3 Hours**

Performance, location strategies, conventional storage methods and equipment's, automated storage systems.

AUTOMATED MANUFACTURING SYSTEMS **7 Hours**

Components, classification, overview, group technology and cellular manufacturing, parts classification and coding, product flow analysis, cellular manufacturing, application considerations in Group Technology

FLEXIBLE MANUFACTURING SYSTEMS **5 Hours**

Introduction, components, application, benefits, planning and implementation, transfer lines and fundamentals of automated production lines, application.

MANUFACTURING SUPPORT SYSTEMS **10 Hours**

Process planning and concurrent engineering- process planning, CAPP, CE and design for manufacturing, advanced manufacturing planning, production planning and control system, master production schedule, MRP- Capacity planning, shop floor control, inventory control, MRP-II, J.I.T production systems -Lean and agile manufacturing.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Groover M P., "Automation, Production Systems and Computer Integrated manufacturing", 2nd Edition, Pearson Education, 2004.
2. Radhakrishnan P, Subramanyan S and Raju V., "CAD/CAM/CIM", 2nd edition, New Age International (P) Ltd., New Delhi, 2008.
3. Yoremkoren, "Computer Integrated Manufacturing System", McGraw-Hill, 2007.
4. Pham D T and Dimov S S, "Rapid manufacturing", Springer-Verlag, London, 2011.
5. Chee Kai Chua, Kah Fai Leong, Chu Sing Lim, "Rapid Prototyping: principles and applications" Wiley, 2010.
6. Ibrahim Zeid, Sivasubramanian R, "CAD/CAM: Theory & Practice" 2nd edition, McGraw Hill, Singapore, 2009.

ELECTIVE IV

U15MCE401 MODELING AND SIMULATION

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Define the simulation and its importance in creation of models for real time systems.
CO2: Describe the different types of systems and models.
CO3: Discuss the properties of random numbers, techniques for generating pseudo random numbers.
CO4: Test the random numbers to check whether it is suitable for simulation of real time systems.
CO5: Generate the random variables using sampling techniques of continuous and discrete distributions.
CO6: Analyze and evaluate the simulation models using goodness of fit tests.
CO7: Design and analyze the model using simulation software packages.

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	M													
CO2	M													
CO3	M													
CO4	M												M	M
CO5	M												M	M
CO6	M	M		W									M	M
CO7	M	M			M		`						M	M

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

SYSTEM AND SYSTEM ENVIRONMENT 9 Hours

Component of a System – Continuous and discrete systems – Types of model; Steps in Simulation study; Simulation of an event occurrence using random number table – Single server queue –two server queue – inventory system.

RANDOM NUMBER GENERATION **9 Hours**

Properties of random numbers – Generation of Pseudo – random numbers – techniques of generating pseudo random numbers; Test for random numbers: the Chisquare test-the kolmogrov Smirnov test – Runs test – Gap test – poker test.

RANDOM – VARIATE GENERATION **9 Hours**

Inverse transform technique for Exponential, Uniform, triangular, weibull, Empirical, Uniform and discrete distribution, Acceptance rejection method for Poisson and gamma distribution, Direct Transformation for normal distribution.

ANALYSIS AND EVALUATION OF MODEL **9 Hours**

Data collection, identifying the distribution, Parameter estimation, goodness of fit tests, verification and validation of simulation models.

SIMULATION SOFTWARE PACKAGES **9 Hours**

Comparison and selection of General Purpose Simulation System (GPSS), SIMSCRIPT, SLAM, Arena simulation language, Modeling basic operations using Arena – An Electronic Assembly and testing system, Development of simulation models using Arena simulation package for queuing system, Production system, inventory system, Arena Integration and customization. Simulation Case Study of a Metal-Parts Manufacturing Facility.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Banks J., Carson J.S. and Nelson B.L., "Discrete – Event System Simulation", 3rd Edition, Pearson Education, Inc 2005.
2. David Kelton W and Randall P Sowdowski, "Simulation with Arena", 2nd Edition, McGraw Hill, 2002.
3. Geoffrey Gorden, "System Simulation", Prentice Hall of India, 2003.
4. Narsingh Deo., "System Simulation with Digital Computer", Prentice Hall of India, 2003.

U15MAT701

PROBABILITY AND APPLIED STATISTICS

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Compute measures of central tendencies and dispersions.

CO2: Correlate the dependent variables.

CO3: Analyze random or unpredictable experiments and investigate salient features of random experiments.

CO4: Construct probabilistic models for observed phenomena through distributions which play an important role in many engineering applications

CO5: Analyze sample data and interpret the same for population.

CO6: Analyze the experimental designs for one way, two way and three way classified data.

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	S	S							M	M				
CO2	S	S							M	M				
CO3	S	S							M	M				
CO4	S	S							M	M				
CO5	S	S							M	M				
CO6	S	S							M	M				

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

STATISTICAL MEASURES **5 Hours**

Measures of central tendency: Mean, Median and Mode – Measures of variation: Range, Mean deviation, standard deviation and coefficient of variation.

CORRELATION AND REGRESSION **4 Hours**

Correlation: Karl Pearson's coefficient of correlation – Spearman's Rank Correlation – Regression lines.

PROBABILITY AND RANDOM VARIABLES **9 Hours**

Axioms of probability - Conditional probability – Total probability – Baye's theorem - Random variables – Distribution function – properties – Probability mass function – Probability density function – moments.

STANDARD DISTRIBUTIONS **9 Hours**

Binomial, Poisson and Normal distributions – Moments, Moment Generating functions and properties for the above distributions - Fitting of Binomial and Poisson distributions.

TESTING OF HYPOTHESIS **9 Hours**

Testing of hypothesis for large samples (single mean, difference of means, single proportion, difference of proportions) – Small samples tests based on t and F distributions (single mean, difference of means, paired *t*- test and variance ratio test) – Chi-square test for independence of attributes and goodness of fit.

DESIGN OF EXPERIMENTS **9 Hours**

Analysis of Variance (ANOVA): Completely Randomized Design (CRD) – Randomized Block Design (RBD) – Latin Square Design (LSD) - Factorial Design: 2^2 design.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Veerarajan T., "Probability, Statistics and Random Processes", Tata McGraw Hill, 3rd edition, 2008.
2. Gupta S P., "Statistical Methods", Sultan Chand and Sons Publishers, 2004.
3. Johnson R A., "Miller and Freund's Probability and Statistics for Engineers", 6th edition, Pearson Education, Delhi, 2000.
4. Gupta S C. and Kapur J N., "Fundamentals of Mathematical Statistics", 11th extensively revised edition, Sultan Chand & Sons, 2007
5. Walpole R E., Myers S L. and Keying Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education Inc, 2002.
6. Gupta S.C. and Kapoor.V.K., "Fundamentals of Applied Statistics", Sultan Chand, New Delhi, 4th Edition, 2014.

U15GS*T*004 **OPERATIONS RESEARCH**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Apply linear programming model and assignment model to domain specific situations

CO2: Analyze the various methods under transportation model and apply the model for testing the closeness of their results to optimal results

CO3: Apply the concepts of PERT and CPM for decision making and optimally managing projects.

CO4: Analyze the various replacement and sequencing models and apply them for arriving at optimal decisions

CO5: Analyze and apply appropriate inventory techniques in domain specific situations.

CO6: Analyze and apply appropriate queuing theories in domain specific situations

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1	S	S		S									W	
CO2	S	S		S									W	
CO3	S	S		S						S			W	
CO4	S	S		S									W	
CO5	S	S		S									W	
CO6	S	S		S									W	

Course Assessment methods:	
Direct	**Indirect**
Assignment Internal test Group Presentation End semester Examination	Course end survey

LINEAR MODEL **9 Hours**

The phases of OR study – formation of an L.P model – graphical solution – simplex algorithm – artificial variables technique (Big M method, two phase method), duality in simplex.

TRANSPORTATION AND ASSIGNMENT PROBLEM **9 Hours**

Transportation model – Initial solution by North West corner method – least cost method – VAM. Optimality test – MODI method and stepping stone method. Assignment model – formulation – balanced and unbalanced assignment problems.

PROJECT MANAGEMENT BY PERT & CPM **9 Hours**

Basic terminologies – Constructing a project network – Scheduling computations – PERT - CPM – Resource smoothening, Resource leveling, PERT cost.

REPLACEMENT AND SEQUENCING MODELS **9 Hours**

Replacement policies - Replacement of items that deteriorate with time (value of money not changing with time) – Replacement of items that deteriorate with time (Value of money changing with time) – Replacement of items that fail suddenly (individual and group replacement policies).

Sequencing models- n job on 2 machines – n jobs on 3 machines – n jobs on m machines, Traveling salesman problem.

INVENTORY AND QUEUING THEORY **9 Hours**

Variables in inventory problems, EOQ, deterministic inventory models, order quantity with price break, techniques in inventory management.

Queuing system and its structure – Kendall's notation – Common queuing models - M/M/1: FCFS/∞/∞ - M/M/1: FCFS/n/∞ - M/M/C: FCFS/∞/∞ - M/M/1: FCFS/n/m

Theory: 45Hours **Total Hours: 45**

REFERENCES:

1. Taha H A., "Operation Research", Pearson Education, 2007.
2. Hira and Gupta "Introduction to Operations Research", S.Chand and Co.2002
3. Hira and Gupta "Problems in Operations Research", S.Chand and Co.2008
4. Wagner, "Operations Research", Prentice Hall of India, 2000
5. S.Bhaskar, "Operations Research", Anuradha Agencies, Second Edition, 2004.

ELECTIVE V

U15MC*E*501	ENGINEERING ECONOMICS AND PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Define the principles of engineering economy followed by basic methods for carrying out economic studies considering the time value of money

CO2: Differentiate between the macro and micro economics

CO3: Explain the various functions of finance and accounting process

CO4: Explain on how to estimate a cost involved in a project

CO5: Explain the various risks that are involved in a project

CO6: Explain and illustrate on how to manage various functions of the project

CO7: Describe on the function of financial systems in India

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12	PS O 1	PSO 2
CO1						S	M				S			
CO2						S	M				S			
CO3						S	S				S			
CO4						S	S				S			
CO5						S	S				S			
CO6						S	S				S			
CO7						S					S			

Course Assessment methods:	
Direct	**Indirect**
Assignment Internal Test Group Presentation End semester Examination	Course end survey

PRINCIPLES OF ENGINEERING ECONOMICS **9 Hours**

Basic principles – Time value of money, Quantifying alternatives for decision making, Cash flow diagrams. Arithmetic gradient, Geometric gradient – Theory of demand and supply – price

mechanisms – factors of production – land, labour, capital and organization – National income – Difficulties in estimation – Micro and Macro Economics.

INTRODUCTION TO FINANCIAL MANAGEMENT AND ACCOUNTING **9 Hours**

Scope & Functions of Finance – Role of Finance Manager – Goals of Financial Management – Profit Maximization Vs. Wealth Maximization – Organization of the Finance Function.
Accounting Principles and Conventions – Double Entry system – Journal, Ledger, Trial Balance and Preparation of Final Account.

PROJECT RISK AND MANAGEMENT **9 Hours**

Project Risk – Sensitivity Analysis – Scenario Analysis – Risk Analysis – Procedure for Developing an NPW Distribution – Expected Value and Variance – Decision Rule.
Engineers, Projects, and Project Management – Project Planning – Project Scheduling – Staffing and Organizing – Team Building – Project Control – Estimating and Contracting.

EQUIPMENT ECONOMICS **9 Hours**

Equipment costs, Ownership and operating costs, Buy/Rent/Lease options, Replacement analysis. Cost estimating: Types of Estimates, Approximate estimates – Unit estimate, Factor estimate, Cost indexes, parametric estimate, and Life cycle cost.

INDIAN FINANCIAL SYSTEM **9 Hours**

Reserve bank of India – Functions – Commercial banking system –Development financial institutions – IDBI –ICICI – SIDBI – IRBI – NABARD– Investment institutions – UTI – Insurance companies – Indian capital market – Stock market – Functions – Role of the public sector – Privatization – Multinational corporations and their impact on the Indian economy.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Agarwal A N., "Indian Economy", New Age International Pub. (P) Limited, 1978
2. Michael Jones, "Accounting for Non-Specialists", John Wiley & Sons, 2002
3. Narayanaswamy R., "Financial Accounting: A Managerial Perspective", 5th Edition, PHI, 2014.
4. Ostwald, P. F., "Construction Cost Analysis and Estimating", Prentice Hall, Upper Saddle River, New Jersey, 2001.

U15GS*T*002 TOTAL QUALITY MANAGEMENT

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Apply & analyze quality concepts and philosophies of TQM
- **CO2:** Apply concepts of continuous improvement
- **CO3:** Apply TQM concepts to enhance customer satisfaction and deal with customer related aspects.
- **CO4:** Apply and analyze the quality tools, management tools and statistical fundamentals to improve quality
- **CO5:** Apply and analyze the TQM tools as a means to improve quality
- **CO6:** Understand quality systems, procedures for its implementation, documentation and auditing

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1		M		M							M			
CO2		M		M							M			
CO3		M		M							M			
CO4					S						M			
CO5		M			S						M			
CO6					W						M			

Course Assessment methods:	
Direct	**Indirect**
Assignment Internal Test Group Presentation End semester Examination	Course end survey

INTRODUCTION **9 Hours**

Definition of Quality, Dimensions of Quality, Quality costs, Top Management Commitment, Quality Council, Quality Statements, Barriers to TQM Implementation, Contributions of Deming, Juran and Crosby, Team Balancing

TQM PRINCIPLES **9 Hours**

Customer satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Continuous Process Improvement,5S, Kaizen, Just-In-Time and TPS

STATISTICAL PROCESS CONTROL **9 Hours**

The seven tools of quality, New seven Management tools, Statistical Fundamentals – Measures of central Tendency and Dispersion, Population and Sample, Normal Curve, Control Charts for variables and attributes, Concept of six sigma.

TQM TOOLS **9 Hours**

Quality Policy Deployment (QPD), Quality Function Deployment (QFD), Benchmarking, Taguchi Quality Loss Function, Total Productive Maintenance (TPM), FMEA

QUALITY SYSTEMS **9 Hours**

Need for ISO 9000 and Other Quality Systems, ISO 9001:2008 Quality System – Elements, Implementation of Quality System, Documentation, Quality Auditing, ISO 14001:2004.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Dale H.Besterfiled, "Total Quality Management", Pearson Education India, 2011.
2. James R.Evans and William M. Lidsay, "The Management and Control of Quality", South-Western (Thomson Learning), 2008.
3. Feigenbaum. A. V. "Total Quality Control", McGraw-Hill Professional, 4th edition, 2004
4. Oakland.J.S. "Total Quality Management", Butterworth – Hcinemann Ltd., Oxford, 2003.
5. Bhaskar S. "Total Quality Management", revised edition, Anuradha Agencies, Chennai, 2007.
6. Narayana V. and Sreenivasan, N.S. "Quality Management – Concepts and Tasks", New Age International, 2007.
7. Zeiri, "Total Quality Management for Engineers", Wood Head Publishers, 1991.

U15GS*T*003 PRINCIPLES OF MANAGEMENT

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Apply the concepts of management and administration and analyze the evolution of management thoughts.
- **CO2:** Apply the concepts of planning, forecasting and decision making.
- **CO3:** Analyze organizational structures and apply staffing concepts.
- **CO4:** Analyze the motivational and leadership theories.
- **CO5:** Apply & analyze the communication and controlling processes.
- **CO6:** Analyze the various international approaches to management

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2
CO1											M			
CO2											M			
CO3											M			
CO4									M		M			
CO5										M	M			
											M			

Course Assessment methods:	
Direct	**Indirect**
Assignment Internal Test Group Presentation End semester Examination	Course end survey

MANAGEMENT CONCEPTS **9 Hours**

Management – Definition – Importance – Functions – Skills required for managers - Roles and functions of managers – Science and Art of Management –Management and Administration. Evolution of Classical, Behavioral and Contemporary management thoughts.

PLANNING **9 Hours**

Nature & Purpose – Steps involved in Planning – Forms of Planning – Types of plans – Plans at Individual, Department and Organization level - Managing by Objectives. Forecasting – Purpose – Steps and techniques. Decision-making – Steps in decision making.

ORGANISING 9 Hours

Nature and Purpose of Organizing - Types of Business Organization - Formal and informal organization – Organization Chart – Structure and Process – Strategies of Departmentation– Line and Staff authority – Benefits and Limitations. Centralization Vs De-Centralization and Delegation of Authority. Staffing – Manpower Planning – Recruitment – Selection – Placement – Induction.

DIRECTING & CONTROLLING 9 Hours

Nature & Purpose – Manager Vs. Leader - Motivation - Theories and Techniques of Motivation.
Leadership – Styles and theories of Leadership.
Communication – Process – Types – Barriers – Improving effectiveness in Communication.
Controlling – Nature – Significance – Tools and Techniques.

CONTEMPORARY ISSUES IN MANAGEMENT 9 Hours

Corporate Governance Social responsibilities – Ethics in business – Recent issues.
American approach to Management, Japanese approach to Management, Chinese approach to Management and Indian approach to Management.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Tripathy PC and Reddy PN, "Principles of Management", Tata McGraw-Hill, 4th Edition, 2008.
2. Dinkar Pagare, "Principles of Management", Sultan Chand & Sons, 2000.
3. Kanagasapapathi. P (2008) Indian Models of Economy, Business and Management, Prentice Hall of India, New Delhi, ISBN: 978-81-203-3423-6.
4. G.K.Vijayaraghavan and M.Sivakumar, "Principles of Management", Lakshmi Publications, 5th Edition, 2009.
5. Bhaskar S. "Principles Of Management", Anuradha Agencies, Chennai, 2011.
6. Harold Koontz & Heinz Weihrich, "Essentials of Management – An International perspective", 8th edition. Tata McGraw-Hill, 2009.
7. Charles W.L. Hill and Steven L McShane – Principles of Management, Tata Mc Graw-Hill, 2009.

U15GS*T*007 **PROFESSIONAL ETHICS**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

- **CO1:** Analyze the various concepts and theories of engineering ethics.
- **CO2:** Apply concepts of ethics and analyze its impact on society.
- **CO3:** Apply and analyze the concept of safety and risk in the light of engineering ethics.
- **CO4:** Analyze and evaluate the rights & responsibilities of engineers.
- **CO5:** Analyze the ethical issues engineers are to consider while operating globally.
- **CO6:** Applying and analyzing the responsibilities of engineers in management and leadership roles.

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO1						M		S						
CO2						M		S				M		
CO3						M		S						
CO4						M		S						
CO5						M		S						
CO6						M		S						

Course Assessment methods:	
Direct	**Indirect**
Assignment Internal test Group Presentation End semester Examination	Course end survey

ENGINEERING ETHICS AND THEORIES **9 Hours**

Definition, Moral issues, Types of inquiry, Morality and issues of morality, Kohlberg and Gilligan's theories, consensus and controversy, Professional and professionalism, moral reasoning and ethical theories, virtues, professional responsibility, integrity, self respect, duty ethics, ethical rights, self interest, egos, moral obligations.

SOCIAL ETHICS AND ENGINEERING AS SOCIAL EXPERIMENTATION **9 Hours**

Engineering as social experimentation, codes of ethics, Legal aspects of social ethics, the challenger case study, Engineers duty to society and environment.

SAFETY **9 Hours**

Safety and risk – assessment of safety and risk – risk benefit analysis and reducing risk – the Three Mile Island and Chernobyl case studies. Bhopal gas tragedy.

RESPONSIBILITIES AND RIGHTS OF ENGINEERS **9 Hours**

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

GLOBAL ISSUES AND ENGINEERS AS MANAGERS, CONSULTANTS AND LEADERS **9 Hours**

Multinational Corporations – Environmental ethics – computer ethics – weapons development – engineers as managers – consulting engineers – engineers as expert witnesses and advisors – moral leadership – Engineers as trend setters for global values.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering". (2005) McGraw-Hill, New York.
2. John R. Boatright, "Ethics and the Conduct of Business", (2003) Pearson Education, New Delhi.
3. Bhaskar S. "Professional Ethics and Human Values", (2005) Anuradha Agencies, Chennai.
4. Charles D. Fleddermann, "Engineering Ethics", 2004 (Indian Reprint) Pearson Education / Prentice Hall, New Jersey.
5. Charles E. Harris, Michael S. Protchard and Michael J Rabins, "Engineering Ethics – Concepts and cases", 2000 (Indian Reprint now available) Wadsworth Thompson Learning, United States.

ELECTIVE VI

U15MC*E*601 RENEWABLE ENERGY SOURCES

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Discuss on the available solar energy and the current solar energy collectors and utilization processes.

CO2: Calculate the performance and testing of solar collectors for different applications.

CO3: Identify available wind energy resources and techniques to utilize them effectively.

CO4: Describe on bio energy, bio fuels, various resources and chemical conversion technologies and assess the competitiveness of these technologies under different scenarios.

CO5: Describe on biomass, waste preparation and utilization technologies and assess the competitiveness of these technologies under different scenarios.

CO6: Summarize the significance of hydrogen and fuel cells principles, storage and uses.

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O 1	PSO 2
CO1	M						M							
CO2				M									W	
CO3						W	M							
CO4	M					W	M							
CO5						W								
CO6	S													

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

SOLAR ENERGY 9 Hours

Sun as Source of Energy, Availability of Solar Energy, Nature of Solar Energy, Solar Energy & Environment. Various Methods of using solar energy – Photothermal, Photovoltaic, Photosynthesis, Present & Future Scope of Solar energy.

Solar collectors- types of collectors - characteristics and design principles of different type of collectors, performance and testing of collectors - Solar water and air heaters - performance and applications- solar cooling - solar drying - solar ponds - solar tower concept - solar furnace.

WIND ENERGY **9 Hours**

Basics & Power Analysis, Wind resource assessment, Power Conversion Technologies and applications, Wind Power estimation techniques, Principles of Aerodynamics of wind turbine blade, Various aspects of wind turbine design.

Wind Turbine Generators: Induction, Synchronous machine, constant V & F and variable V & F generations, Reactive power compensation. Site Selection, Concept of wind form & project cycle, Cost economics & viability of wind farm.

BIO-ENERGY **6 Hours**

Photosynthesis process, Bio-fuels, Biomass resources Bio based chemicals and materials Thermo-chemical Conversion: Pyrolysis, Combustion, Gasification, Liquification. Bio-Chemical Conversion: Aerobic and Anaerobic conversion, Fermentation etc.

BIOMASS **9 Hours**

Generation and utilization, Properties of biomass, Agriculture Crop & Forestry residues used as fuels. Biochemical and Thermo-chemical Conversion, Combustion, Gasification, Biomass gasifiers and types etc. Applications of Gasifiers to thermal power and Engines, Biomass as a decentralized power generation source for villages.

HYDROGEN ENERGY **9 Hours**

Hydrogen as a renewable energy source, Sources of Hydrogen, Fuel for Vehicles.

Hydrogen Production: Direct electrolysis of water, thermal decomposition of water, biological and biochemical methods of hydrogen production.

Storage of Hydrogen: Gaseous, Cryogenic and Metal hydride.

FUEL CELL **3 Hours**

Fuel cell – Principle of working, construction and applications.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Sukhatme S P., "Solar Energy, Principles of Thermal Collection and Storage", 3rd edition, Tata MCGraw Hill, 2008.
2. Khan B H., "Non Convention Energy Resources", 2nd edition, Tata McGraw Hill, 2009.
3. RAO S and Parulehar, "Energy Technology – Non conventional, Renewable and Conventional ", 3rd edition, Khanna Publishers, 2009.
4. Garg H P and Prakash J., "Solar Energy - Fundamentals and applications", 21st revised edition, Tata McGraw Hill, 2000.
5. Freris L L., "Wind energy Conversion Systems", Prentice Hall, 1990.
6. Rai G D, "Non conventional Energy sources" 4th edition, Khanna Publishers, New Delhi, 2009.
7. George W Sutton-(Editor), "Direct Energy Conversion", Lathur University, Electronic Series Vol 3, McGraw Hill, 2002.

U15MC*E*602 **COMPOSITE MATERIALS AND SUSTAINABLE DEVELOPMENT**

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Recognize the need and characteristics of the composite materials
CO2: Explain the manufacturing processes of composite materials
CO3: Explain the quality inspection methods involved in the manufacturing of composite materials
CO4: Calculate the Engineering constants for an angle lamina.
CO5: Characterize the laminates by finding static mechanical characteristics.
CO6: Explain the applications of composites and its sustainability

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS O 1	PSO 2
CO1	W													
CO2													W	
CO3		W											W	
CO4	W	W											W	
CO5	M			W										
CO6							M							

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

INTRODUCTION TO COMPOSITE MATERIALS **9 Hours**

Need and general characteristics of composite materials- mechanical advantages and limitations Characteristics of fibers and matrixes – classification of composites – Prepregs – Lamina, Laminate and sandwich construction.

MANUFACTURING AND QUALITY INSPECTION **9 Hours**

Fundamentals of curing – Bag molding process – compression and vacuum molding – filament winding – Quality inspection methods for raw materials – cure cycle monitoring – cured composite parts.

ANALYSIS OF LAMINA **10 Hours**

Fiber matrix interactions – Hook's law for different types of materials – relationship of compliance and stiffness matrix to engineering constants of a lamina – angle lamina: Engineering constants

ANALYSIS OF LAMINATES AND ITS PERFORMANCE **11 Hours**

Laminate code – stress – strain relations for a laminate – In-plane and flexural modulus of a laminate – lamination theory – Performance – static mechanical properties

APPLICATIONS OF COMPOSITES AND SUSTAINABILITY **6 Hours**

Applications of composites - Natural fibers needs and its significance - Recycling of composites

Topics of interest (Not for evaluation purpose)

Crack propagation in composites
De-lamination prediction in composites
NDT for composites
Joining of sandwich structures

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Mallick P K., "Fiber Reinforced Composites: Materials, Manufacturing and Design", 3rd Edition, Maneel Dekker Inc, 2008.
2. Kaw A K, "Mechanics of composite materials", 2nd Edition, CRC press, 2014.
3. Jones R M, "Mechanics of composite materials", Taylor and Francis, 1999.
4. Halpin J C, "Primer on Composite Materials, Analyis", 2nd edition, Techomic publishing Co., 2016.

U15MC*E*603 ENGINEERING METROLOGY

L	T	P	C
3	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Summarize various linear measuring devices used to check dimensions.
CO2: Summarize various angular measuring devices used to check dimensions
CO3: Describe the methods and instruments used in gear parameters measurements
CO4: Describe the methods and instruments used in screw parameters measurements
CO5: Explain the automated systems used in Metrology.
CO6: Choose latest measuring tools for the modern Industrial environment.

Pre-requisite

Nil

CO/PO Mapping

(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	W													
CO2	M													
CO3	W													
CO4	M													
CO5					W									W
CO6	M				M									M

Course Assessment methods:	
Direct	**Indirect**
Internal test I Internal test II End semester Examination Assignment	Course end survey

LINEAR METROLOGY **9 Hours**

Definition of metrology – Linear measuring instrument : Vernier, micrometer measurement, dial indicator, Slip gauges and classification, interferometer, optical flats - limit gauges, Comparators - Mechanical, pneumatic, optical and electric types, applications

ANGULAR METROLOGY **5 Hours**

Sine bar, Vernier bevel protractor, optical bevel protractor, auto collimator, angle gauges, Clinometer, angle Decker – taper measurements.

SCREW THREAD AND GEAR METROLOGY **6 Hours**

Screw thread terminology – Measurement of various elements of Thread - Measurement of Major and minor diameter - Measurement of Thread angle by Two Ball Method - Pitch Measurement. Types of Gear-Gear Terminology-Spur gear measurement -Run out ,Pitch ,Concentricity ,profile ,lead ,alignment ,Back lash- Chordal thickness Method-Constant chord method-Parkinson gear tester.

SURFACE MEASUREMENT **3 Hours**

Surface evaluation, Stylus method, Numerical values for surface assessment, Surface texture specimens, straightness, flatness and roundness measurement.

ADVANCED TECHNIQUES IN METROLOGY **7 Hours**

Coordinate measuring machine – constructional features – types and application, digital devices – computer aided inspection — machine vision systems, Profile projector, Universal Measuring Machine, Laser principles – Laser interferometer – application in linear, angular measurement and machine tool metrology.

Theory: 45 Hrs **Total Hours: 45**

REFERENCES:

1. Jain R K "Engineering Metrology" Khanna Publishers, 2009.
2. Manohar Mahajan, "A textbook of Metrology", Dhanpat Rai and Co (P) LTD., 2008.
3. Alan S Morris "The Essence of Measurement" Prentice Hall of India, 1997.
4. Connie Dotson, Ronger Harlow and Richard L Thomson, "Fundamentals of Dimensional Metrology", 4th edition, Thompson – Delmar, 2006.
5. Gupta S C, "Engineering Metrology", Dhanpat Rai Publications, 2005.

U15MCINX CERTIFICATION PROGRAM

L	T	P	C
1	0	0	1

Course Outcomes

After successful completion of this course, the students should be able to

CO1: Program / design / analysis / control mechatronics systems using modern tools which are used in industry.

Pre-requisite

Nil

CO/PO Mapping (S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak														
COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1					S								S	S

Course Assessment methods:

Direct	Indirect
Authorized Certificate from the agency	

The following certification courses are considered for one credit course. The main objective of this course is to make the students employable, industry ready and to help them to pursue higher education. This course is optional, self study and self funded course. The student can choose any one of these courses (U15MCIN01) from the following list to earn one credit from 3rd to 8th semester. The students can opt only one certification course as additional course in any one of the semester mentioned above. It is restricted to maximum of three courses during their study. The program should be minimum of 15 hours and the certificate should be provided after conducting the examination by the concerned agency.

S.No.	Course code	Name of the course	Certification agency
1.	U15 MCIN01	Labview Associate Developer	National Instruments
2.	U15 MCIN02	Robot Certification	Fanuc Robotics, ABB Robotics, KUKA Robotics
3.	U15 MCIN03	CAD software Certification	Autodesk, Catia, Soldworks, ProE
4.	U15 MCIN04	PLC certification	Siemens, Allen-Bradley, Fanuc