KUMARAGURU COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University, Chennai)

COIMBATORE – 641049

B.E., MECHATRONICS ENGINEERING

REGULATIONS 2017

CURRICULUM AND SYLLABI

1 to 8 Semesters

DEPARTMENT OF MECHATRONICS ENGINEERING

VISION

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

MISSION

- Impart the right blend of knowledge and skills to students and enable them to apply it in real life situations.
- Motivate the students towards interdisciplinary research to cater to the local and global needs.
- Achieve innovation in developing industrial products with social responsibility.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The Program Educational Objectives of Mechatronics Engineering Undergraduate Program are to prepare the students:

I. To develop innovative and sustainable products with multidisciplinary Engineering expertise.

II. To solve complex engineering problems by applying mechanical, electrical and computer knowledge and engage in lifelong learning in their profession

III. To work or pursue higher education in multicultural, multilingual and multinational environment with competent oral and written communication.

IV. To lead and contribute in a team entrusted with professional, social and ethical responsibilities.

PROGRAM OUTCOMES (POs)

Graduates of the Aeronautical Engineering Undergraduate Program should have the ability to:

PO1: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: 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.

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PO6: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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

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

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

PROGRAM SPECIFIC OUTCOMES (PSOs)

Graduates of the Mechatronics Engineering Undergraduate Program will have the ability to:

PSO1. Design and develop Mechatronics systems to solve the complex engineering problem by integrating electronics, mechanical and control systems.

PSO2. Apply the engineering knowledge to conduct investigations of complex engineering problem related to instrumentation, control, automation, robotics and provide solutions

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B.E. MECHATRONICS ENGINEERING

CURRICULUM

SEMESTER-I								
Course Code	**Course Title**	**Course category**	**Course Mode**	**L**	**T**	**P**	**J**	**C**
U17MAT1101	Linear Algebra and Calculus	BS	Theory	3	1	0	0	4
U17MET1101	Engineering Graphics	ES	Theory	2	1	0	0	3
U17PHT1010	Physics for Mechatronics Engineering	BS	Theory	3	0	0	0	3
U17CHT1008	Chemistry for Mechatronics Engineering	BS	Theory	3	0	0	0	3
U17CSI1211	Structured Programming using C	ES	Embedded	3	0	2	0	4
U17ENI1201	English for Cognizance	HS	Embedded	1	0	2	0	2
U17MEP1501	Engineering Practices Laboratory	ES	Lab	0	0	2	0	1
U17PHP1501	Physics Laboratory	BS	Lab	0	0	2	0	1
U17VEP1501	Personal Values	HS	Lab	0	0	2	0	1
							Total Credits	**22**
							Total Periods per week	**27**

SEMESTER-II								
Course Code	**Course Title**	**Course category**	**Course Mode**	**L**	**T**	**P**	**J**	**C**
U17MCT2001	Manufacturing Technology	PC	Theory	3	0	0	0	3
U17MCT2002	Electronic Devices and Circuits	ES	Theory	3	0	0	0	3
U17MET2102	Engineering Mechanics	ES	Theory	3	1	0	0	4
U17PHT2008	Material Science for Mechatronics Engineering	BS	Theory	3	0	0	0	3
U17MAT2101	Advanced Calculus and Laplace Transforms	BS	Theory	3	1	0	0	4
U17ENP25--	Language Elective	HS	Lab	0	0	4	0	2
U17CHP2501	Chemistry Laboratory	ES	Lab	0	0	2	0	1
U17MCP2501	Electronic Devices and Circuits Laboratory	ES	Lab	0	0	2	0	1
U17ISP2701	Social Immersion Project	eRIDE	Project	0	0	0	4	2
U17VEP2502	Inter-Personal values	HS	Practical	0	0	2	0	1
							Total Credits	**24**
							Total Periods per week	**31**

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Semester III										Pre-requisite
S.No	Course code	Course Title	Course Mode	CT	L	T	P	J	C	
1	U17MAT3101	Partial Differential Equations and Transforms	Theory	BS	3	1	0	0	4	-
2	U17MCI3201	Electrical Machines	Embedded - Theory & Lab	PC	3	0	2	0	4	-
3	U17MCT3002	Mechanics of solids	Theory	ES	3	1	0	0	4	-
4	U17MCT3003	Fluid Mechanics and Thermal Sciences	Theory	ES	3	0	0	0	3	-
5	U17MCP3504	Manufacturing Technology Laboratory	Laboratory	PC	0	0	2	0	1	-
6	U17INI3600	Engineering Clinic I	Project based Course	ES	0	0	4	2	3	-
								Total Credits	19	
								Total Contact Hours/week	24	

Semester IV										Pre-requisite
S.No	Course code	Course Title	Course Mode	CT	L	T	P	J	C	
1	U17MAT4101	Numerical Methods and Probability	Theory	BS	3	1	0	0	4	-
2	U17MCI4201	Hydraulics and Pneumatics	Embedded - Theory & Lab	PC	3	0	2	0	4	U17MCT3003
3	U17MCI4202	Sensors and Instrumentation	Embedded - Theory & Lab	PC	3	0	2	0	4	-
4	U17MCT4103	Theory of Machines	Theory	PC	3	1	0	0	4	-
5	U17MCT4004	Digital Electronics and Microprocessor	Theory	PC	3	0	0	0	3	-
6	U17INI4600	Engineering Clinic II	Project based course	ES	0	0	4	2	3	-
								Total Credits	22	
								Total Contact Hours/week	27	

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Semester V										Pre-requisite
S.No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	
1	U17MCI5201	Industrial Electronics and Drives	Embedded - Theory & Lab	PC	3	0	2	0	4	U17MCI3201
2	U17MCI5202	Programmable logic controllers	Embedded - Theory & Lab	PC	3	0	2	0	4	-
3	U17MCT5003	Design of Machine Elements	Theory	PC	3	0	0	0	3	U17MCT3102
4	U17MCT5004	Control Engineering	Theory	PC	3	0	0	0	3	-
5	U17MCO0***	Open Elective I	Theory	OE	3	0	0	0	3	-
6	U17INI5600	Engineering Clinic III	Practical and Project	ES	0	0	4	2	3	-
Total Credits									20	
Total Contact Hours/week									25	

Semester VI										Pre-requisite
S.No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	
1	U17MCI6201	Robotics Engineering	Embedded - Theory & Lab	PC	3	0	2	0	4	U17MCT4004
2	U17MCI6202	Microcontroller and Embedded Systems	Embedded - Theory & Lab	PC	2	0	2	0	3	U17MCT3005
3	U17MCI6203	Computer aided Manufacturing	Embedded - Theory & Lab	PC	3	0	2	0	4	-
4	U17MCE00**	Professional Elective I	Theory	PE	3	0	0	0	3	-
5	U17MCO0***	Open Elective II	Theory	OE	3	0	0	0	3	-
6	U17MCE00**	Professional Elective - II	Theory	PE	3	0	0	0	3	-
7	U17INI6600	Engineering Clinic IV	Practical and Project	ES	0	0	4	2	3	-
Total Credits									23	
Total Contact Hours/week									30	

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Semester VII										
S.No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	U17MBT7001	Engineering Economics and Financial Management	Theory	HS	3	0	0	0	3	-
2	U17MCT7001	Autonomous Vehicle	Theory	PC	3	0	0	0	3	U17MCI6202
3	U17MCT7002	Image Processing and Computer Vision	Theory	PC	3	0	0	0	3	-
4	U17MCE00**	Professional Elective III	Theory	PE	3	0	0	0	3	-
5	U17MCE00**	Professional Elective IV	Theory	PE	3	0	0	0	3	-
6	U17MCP7701	Project – Phase I	Project based course	PW	0	0	0	6	3	
Total Credits									18	
Total Contact Hours/week									21	

Semester VIII										
S.No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**	**Pre-requisite**
1	U17MCP8701	Project – Phase II / Internship	Project based course	PW	0	0	0	24	12	-
Total Credits									12	
Total Contact Hours/week									24	
Total Credits (3rd to 8th Semester)									**114**	
Total Credits (1st to 8th Semester)									**160**	

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Mandatory courses					
No.	**Course code**	**Course Title**	**Course Mode**	**CT**	**Sem.**
1	U17VEP3503	Family Values	Workshop	MC	3
2	U17VEP4504	Professional Values	Workshop	MC	4
3	U17CHT4000	Environmental Science	Theory	MC	
4	U17VEP5505	Social Values	Workshop	MC	5
5	U17INT5000	Constitution of India	Theory	MC	
6	U17VEP6506	National Values	Workshop	MC	6
7	U17VEP7507	Global Values	Workshop	MC	7

Programme Electives									
S.No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**
Mechatronics Systems									
1.	U17MCE0001	Automotive Electronics	Theory	PE	3	0	0	0	3
2.	U17MCE0002	Condition Monitoring	Theory	PE	3	0	0	0	3
3.	U17MCE0003	Micro Electro Mechanical Systems	Theory	PE	3	0	0	0	3
Computational Intelligence									
4.	U17MCE0004	Artificial Intelligence and Machine Learning	Theory	PE	3	0	0	0	3
5.	U17MCE0005	Database Management System	Theory	PE	3	0	0	0	3
6.	U17MCE0006	Soft Computing	Theory	PE	3	0	0	0	3
7.	U17MCE0014	Underwater Robotics	Theory	PE	3	0	0	0	3
Design and Manufacturing									
8.	U17MCE0007	Smart Manufacturing	Theory	PE	3	0	0	0	3
9.	U17MCE0008	Statistical Quality Control	Theory	PE	3	0	0	0	3
10.	U17MCE0009	Composite and Smart Materials	Theory	PE	3	0	0	0	3
11.	U17MCE0010	Additive Manufacturing	Theory	PE	3	0	0	0	3
Automation									
12.	U17MCE0011	Design of material handling systems	Theory	PE	3	0	0	0	3
13.	U17MCE0012	Design for manufacturing and Assembly	Theory	PE	3	0	0	0	3
14.	U17MCE0013	Precision Manufacturing	Theory	PE	3	0	0	0	3
15.	U17MCE0015	Operation Research	Theory	PE	3	0	0	0	3

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SEMESTER I

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U17MAT1101	Linear Algebra and Calculus (Common to AE, AUE, CE, MCE, ME)	L	T	P	J	C
		3	1	0	0	4

Course Outcomes

After successful completion of this course, the students should be able to		
CO1:	Identify eigen values and eigen vectors , apply Cayley Hamilton theorem and convert quadratic form to canonical form	K3
CO2:	Determine the radius, centre, circle of curvature of functions	K4
CO3:	Discover the evolutes of curves and the envelope of a family of curves.	K4
CO4:	Solve first order ordinary differential equation and apply in some Physical situations	K4
CO5:	Solve higher order ordinary differential equations and apply the knowledge to physical situations	K4
CO6:	Evaluate the total derivative of a function, expand the given function as series and locate the maximum and minimum for multivariate functions.	K4

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	S	S							M	M		M
CO2	S	S							M	M		M
CO3	S	S							M	M		M
CO4	S	S							M	M		M
CO5	S	S							M	M		M
CO6	S	S							M	M		M

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination	1. Course -end survey

MATRICES	**9 + 3 Periods**
Rank of a matrix – Linearly dependent and independent vectors – Eigen values and eigen vectors of a real matrix – Properties of eigen values and eigen vectors – 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	**4 + 1 Periods**

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Curvature – Radius, Centre and Circle of curvature in Cartesian, Parametric and Polar form	
EVOLUTES AND ENVELOPES	**5 + 2 Periods**
Evolute – Envelope of family of curves with one and two parameters – Evolute as the envelope of normal – properties of evolute and envelope.	
FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS	**9 + 3 Periods**
Leibnitz's equation – Bernoulli's equation – Equations of first order and higher degree - Clairauts form – Applications: Orthogonal trajectories and Newton's law of cooling	
HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS	**9 +3 Periods**
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 - Mass-spring mechanical system. (Differential equations and associated conditions should be given).	
FUNCTIONS OF SEVERAL VARIABLES	**9 +3 Periods**
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.	
Theory: 45 Tutorial: 15 Practical: 0 Project: 0 Total : 60 Periods	

REFERENCES

1. Kreyzig E., "Advanced Engineering Mathematics", Eighth Edition, John Wiley and sons, 2010.
2. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition.
3. Veerarajan T., Engineering Mathematics (for First Year), Tata McGraw Hill Pub. Co. Ltd., New Delhi, Revised Edition, 2007.
4. Kandasamy P., Thilagavathy K., and Gunavathy K., "Engineering Mathematics",S. Chand & Co., New Delhi, (Reprint) 2008.
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).

E books and online learning materials

1. Advanced Engineering Mathematics, P. V. O'Neil, 5th Indian reprint, 2009, Cengage Learning India Pvt. Ltd.
2. Advanced Engineering Mathematics, Dennis Zill Warren S Wright Michael R. Cullen, 4th edition, 2011, Jones & Bartlett Learning.

Online Courses and Video Lectures:

www.mathworld.wolfram.com, http://nptel.ac.in

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U17MET1101	Engineering Graphics	L	T	P	J	C
		2	1	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to	
CO1:	Construct various plane curves.
CO2:	Construct projection of points and projection of 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	S	M										
CO2	S	S									W	
CO3	S	S									M	
CO4	S	S										
CO5	S											
CO6	S											

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I, II (Theory component) 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc (as applicable) (Theory component) 3. End Semester Examination (Theory component)	1. Course-end survey

PLANE CURVES, PROJECTION OF POINTS AND LINES	**6 + 3 Periods**

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	**6 + 3 Periods**

Projections of plane surfaces - polygonal lamina and circular lamina, located in first quadrant and inclined

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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	**6 + 3 Periods**

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	**6 + 3 Periods**

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	**6 + 3 Periods**

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.

Theory: 30 Tutorial: 15 Practical: 0 Project: 0 Total : 45 Periods

REFERENCES

1. Bhatt ND, Engineering Drawing, Charotar Publishing house, 54th edition, 2014.
2. Venugopal K. and Prabhu Raja V., Engineering Graphics, New Age International (P) Limited, New Delhi, 2016.
3. Nataraajan K.V., Engineering Drawing and Graphics, Dhanalakshmi Publisher, Chennai, 2006.
4. Basant Agrawal and Agrawal C.M, Engineering Drawing and Graphics,McGraw Hill Edition(India), 2013.
5. Gopalkrishna K.R., Engineering Drawing (Vol. I & II), Subhas Publications, 2014.

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U17PHT1010	Physics for Mechatronics Engineering	L	T	P	J	C
		3	0	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:	Comprehend the types of lasers, optical fibers and its applications.
CO3:	Understand the dual nature of light and its applications.
CO4:	Enumerate the principles and methods for the generation of ultrasonic waves.
CO5:	Apply the NDT techniques as modern engineering tools for measurements.
CO6:	Perceive the principles of electromagnetism.

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	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. Continuous Assessment Test I, II 2. Group Presentation, Project report, Poster preparation, End Semester Examination	1. Course-end survey

CRYSTAL PHYSICS	**9 Periods**

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

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HCP structures. Crystal imperfections: point defects – line defects – surface defects – volume defects – effect of crystal imperfections.

APPLIED OPTICS	**9 Periods**

Air wedge and its applications - Lasers – spontaneous and stimulated emissions – Einstein's coefficients – types of laser – Nd : YAG, CO2 and semiconductor laser – Homo junction (qualitative description) – applications – Holography (Qualitative only). **Optical fiber:** Principle and propagation of light in optical fibers – numerical aperture and acceptance angle –types of optical fibers – light sources and detectors – communication system.

QUANTUM PHYSICS	**9 Periods**

Introduction - Planck's quantum theory of black body radiation (derivation) - photo electric effect (qualitative description only) - Compton effect (derivation) and experimental verification of Compton effect - De-Broglie's concept - Schrodinger wave equation - time independent and time dependent equations (derivation) - physical significance of wave function - particle in a box (one dimensional case).

ULTRASONICS AND NDT	**9 Periods**

Ultrasonics: Production of ultrasonics - magnetostriction oscillator - piezo electric method – properties – detection – acoustic grating – applications - SONAR.

NDT: Liquid penetrant method – ultrasonic flaw detector: A scan, B scan and C scan – X- ray radiography and fluoroscopy – thermography.

ELECTROMAGNETISM	**9 Periods**

Magnetic effects of electric current - magnetic fields - definition of fundamental terms. permeability - forces due to currents - uniform and non-uniform magnetic fields - static and time-varying magnetic fields - electromagnetic induction - expression for induced emf - Gauss theorem - electromagnetic waves - propagation of electromagnetic waves through isotropic media - Maxwell's equations and interpretation of Maxwell's equations

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Periods**

REFERENCES

1. Richard Wolfson, ―Essential University Physics, Vols. 1 and 2. Pearson Education, Singapore, 2011.
2. Crawford Jr Waves, F.S. – Berkeley Physics Course, Vol. 3, 2008.
3. Purcell, E.M, ―Electricity and Magnetism – Berkeley Physics Course, Vol. 2, Tata McCraw-Hill ,2007.
4. Avadhanulu M.N. and Kshirsagar 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.
6. Palanisamy P.K., Engineering Physics I, Scitech Publications, Chennai, 2011.
7. Halliday, D., Resnick, R. & Walker, J. "Principles of Physics". Wiley, 2015.
8. Rajendran V, Applied Physics, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
9. Gopal S., Engineering Physics, Inder Publications, Coimbatore, 2006.
10. Bhattacharya, D.K. & Poonam, T. "Engineering Physics". Oxford University Press, 2015.

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U17CHT1008	Chemistry for Mechatronics Engineering	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to	
CO1:	Discuss Basic concepts of electrochemistry involved in corrosion
CO2:	Defend corrosion problems
CO3:	Apply the principle of electrochemistry and assemble a battery
CO4:	Select conducting polymers for a particular application.
CO5:	Outline about PCB and discuss the process of PCB fabrication
CO6:	Apply the concepts of etching and plating in developing printed circuit boards

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**											
CO3	**W**	**M**				**M**						
CO4	**S**		**M**			**M**						
CO5	**S**											
CO6	**M**											

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination	1. Course-end survey

ELECTROCHEMISTRY	**9 Hours**

Introduction - Electrode potential - Nernst equation and problems - Electrochemical series - Application of EMF measurements and problems - Kohlrausch law of independent migration of ions and its application

Electrodes: Standard and Reference electrode (Hydrogen and Calomel) - Types of electrodes (Metal -

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Metal ion; Metal – Metal insoluble salt, Redox electrode) - Ion selective (glass electrode) - Determination of pH, pO_2, pCO_2 - Classification of electrochemical cell

CORROSION SCIENCE	**6 Hours**

Corrosion: Principles and Mechanism of electrochemical corrosion - Factors influencing corrosion.
Types of corrosion: Galvanic corrosion - Differential aeration corrosion (pitting corrosion, water line corrosion) - Stress corrosion.
Corrosion control: Inhibitors - Dehumidifier gels - Cathodic protection (sacrificial anode)
- Plating Techniques: Plating - Need for plating - Electroforming -Electropolishing - Electrochemical machining - Electrophoretic painting

ENERGY STORING DEVICES	**12 Hours**

Batteries: Factors for selection of batteries - Rating calculation using datasheet.
Primary Battery (Alkaline battery) - Secondary Battery (Lead acid storage battery, Nickel - Cadmium battery, Lithium ion battery & Lithium polymer battery) - Nuclear battery-Nano battery.
Flow battery: Introduction - Construction of Types of fuel cell
Solar Cells: Silicon Solar cells - Hybrid Solar cells - Dye sensitized Solar cells - Tandem Solar cells.

CONDUCTING POLYMERS	**12 Hours**

Electron conducting polymers: Synthesis, Structure, Properties and Application of polyacetylene, polyphenylene, poly aniline, polypyrrole and polythiophine.Introduction - Polymer types - Conducting Polymers - Nature of doping process - Theory of conductivity.
Electron conducting polymers: Synthesis, Structure, Properties and Application of polyacetylene, poly aniline, polyphenylene, polythiophine, polypyrrole & indole carbazole.

BASICS OF PRINTED CIRCUIT BOARDS	**6 Hours**

Introduction- Components of PCB - Flexible printed circuit boards (an overview) Chemistry of Laminates in PCB: Properties and Types
Etching Techniques: Chemistry of Etching Solutions - electrochemical etching of Cu from PCBs.

Theory: 45	**Tutorial: 0**	**Practical: 0**	**Project: 0**	**Total: 45 Periods**

REFERENCES

1. Atkins, P. and de Paula, J., Atkins, Physical Chemistry, 9th ed., Oxford Univ. Press, 2009.
2. Glasstone S., An introduction to Electrochemistry, 10th Edition, Affiliated to East West Press Private Limited, 2007.
3. Derek Pletcher and Frank C Walsh., Industrial Electrochemistry, Blackie Academic and Professional, London, 1993.
4. Ahmed Z., Principles of Corrosion Engineering and Corrosion Control, Butterworth Heinemann, 2006.
5. David Linden & Thomas B. Reddy., Handbook of Batteries, 3rd edition, McGraw- Hill Companies, Inc. 2001
6. Revankar S.T., Majumdar P., Fuel Cell: Principles, Design and Analysis, CRC Press, 2014.
7. Syed Shabudeen, P.S. and Shoba U.S., Engineering Chemistry, Inder Publishers, Coimbatore, 2014
8. Jain P.C. and Jain. M., Engineering Chemistry, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, Reprint 2017.
9. Seymour R.B. and Carraher C.E. Jr, Polymer chemistry, 6th Edition, Plenum Pub. Corporation, New York, 2003.
10. Terje A. Skotheim and John R. Reynolds, The Handbook of Conducting Polymers in Conjugated polymers theory, synthesis, properties and characterization, 3rd Edition, CRC Press, 2006
11. Khandpur R.S., Printed Circuit Boards Design, Fabrication and Assembly, McGraw- Hill Publishing Company Limited., New Delhi, 2005

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U17CSI1211	Structured Programming using C	L	T	P	J	C
		3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to	
CO1:	Explain the basics of problem solving techniques
CO2:	Select appropriate data types and control structures for solving a given problem
CO3:	Illustrate the representation of arrays, strings and usage of string operations
CO4:	Illustrate the importance of pointers and functions
CO5:	Explain the fundamentals of structures and unions
CO6:	Explain the fundamentals of file handling

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	S	M										
CO2	S	M										
CO3	S	L			L				L	L		
CO4	M	L			L				L	L		M
CO5	M	L			L				L	L		M
CO6	L	L										

Course Assessment methods:

DIRECT	INDIRECT

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1. Continuous Assessment Test I, II (Theory Component) 2. Assignment (Theory Component) 3. Group Presentation (Theory Component) 4. Pre/Post - experiment Test/Viva; Experimental Report for each experiment (lab component) 5. Model examination (lab component) 6. End Semester Examination (Theory and lab component)	1. Course-end survey

FUNDAMENTALS OF PROBLEM SOLVING	**9 Periods**
Programs and Programming – Classification of Programming Languages based on Generations – Structured Programming Concept – Algorithm – Flowchart – Pseudo code	
STRUCTURED PROGRAMMING	**9 Periods**
Introduction to C Programming – Operators and Expressions – Data Input and Output – Control Statements	
ARRAYS AND STRINGS	**9 Periods**
Defining an array – Processing an array – Passing arrays to functions –Multidimensional Arrays Defining a string – NULL character – Initialization of Strings – Reading and Writing Strings – Processing Strings – Character Arithmetic – Searching and Sorting of Strings – Library functions for strings	
FUNCTIONS, STORAGE CLASSES AND POINTERS	**9 Periods**
Defining a function – Accessing a function – Function prototypes – Passing arguments to a function – Recursion – Storage classes – Pointer Fundamentals – Pointer Declaration – Passing Pointers to a Function – Pointers and one dimensional arrays – operations on pointers – Dynamic memory allocation	
STRUCTURES, UNIONS AND FILES	**9 Periods**
Structures and Unions: Defining a Structure – Processing a Structure – User defined data types (Typedef) – Unions Files: Opening and Closing a Data File – Reading and writing a data file – Processing a data file – Unformatted data files – Concept of binary files – Accessing a file randomly using fseek	
Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Periods	

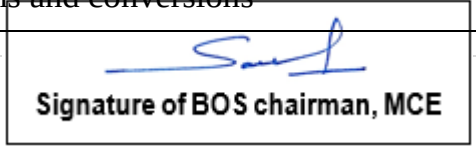
REFERENCES

1. Byron S Gottfried and Jitendar Kumar Chhabra, “Programming with C”, Tata McGraw Hill Publishing Company, Third Edition, New Delhi, 2011.
2. PradipDey and ManasGhosh, “Programming in C”, Second Edition, Oxford University Press, 2011.
3. Kernighan,B.W and Ritchie,D.M, “The C Programming language”, Second Edition, Pearson Education, 2006
4. Ashok N. Kamthane, “Computer programming”, Pearson Education, 2007.

Lab Component

List of Experiments	**30 Periods**

1. Writing algorithms, flowcharts and pseudo codes for simple problems.
2. Programs on expressions and conversions



3.	Programs using if, if-else, switch and nested if statements
4.	Programs using while, do-while, for loops
5.	Programs on one dimensional arrays, passing arrays to functions and array operations
6.	Programs using two dimensional arrays, passing 2D arrays to functions
7.	Programs using String functions
8.	Programs using function calls, recursion, call by value
9.	Programs on pointer operators, call by reference, pointers with arrays
10.	Programs using structures and unions.
11.	Programs on file operations and modes.
12.	Working with text files, random files and binary files

Theory: 0	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 30 Periods**

REFERENCES

1. Byron S Gottfried and Jitendar Kumar Chhabra, "Programming with C", Tata McGraw Hill Publishing Company, Third Edition, New Delhi, 2011.
2. PradipDey and ManasGhosh, "Programming in C", Second Edition, Oxford University Press, 2011.
3. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006
4. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007

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U17ENI1201	English for Cognizance (Common to all branches of Engineering and Technology)	L	T	P	J	C
		1	0	2	0	2

Course Outcomes

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

CO1:	Understand and appreciate vocabulary and syntax with accuracy and clarity.
CO2:	Communicate effectively by using appropriate grammar and technical parlance in a Range of academic scenarios
CO3:	Interpret and critically evaluate discourses related to functional English
CO4:	Comprehend critical text leading to academic articulation.
CO5:	Disseminate professional information through appropriate means of communication
CO6:	Demonstrate an understanding for innovative language learning strategies and write texts applying registers formats and language appropriate to the context.

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	W	M				W			M	S		M		
CO2		W	M		W	S		W	M	S		S		
CO3	W	S				W	W			S		M		
CO4		M								S		M		
CO5		S				W			M	S		S		
CO6		W				W			W	S		S		

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I 2. Open book test 3. Assignment 4. End Semester Examination	1. Course-end survey

INTRODUCTION TO LITERARY SKILLS	**09 Hours**

Parts of Speech – Word Formation – Homonyms - Homophones and Homographs, One Word Substitutes, Acronyms and Abbreviations, Reading Aloud, Quick Reading, Sequencing of jumbled sentences, Reading to Predict.

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TECHNICAL NUANCES	**9 Hours**
Tense, Voice, Kinds of Syntax, Gerund and Infinitives, Cause and effect expressions, Purpose and functional expressions, Conditional clauses, Reported speech, Diary Writing, Editing (Grammar – Concord, Articles, Parts of Speech, Modifiers – Dangling participles, Misplaced, Squinting and Punctuation).	
COMPREHENSION AND ANALYSIS	**9 Hours**
Sub Skills of Reading, Reading Comprehension, Text Visualization, Peer Reading, Cloze Test, Inferring Technical Texts, Reading a Travelogue, Reading for Interrogation, Reading to Respond, Note making – Linear and Non-linear.	
PRACTISING LITERARY SKILLS	**9 Hours**
Instructions and Recommendations, Discourse markers – Process description, Writing a Paragraph – Descriptive, Narrative, Compare and Contrast, Persuasive, Creative Writing, Critical Reading, Twirl Reading, Google Reading.	
TECHNICAL CORRESPONDENCE	**9 Hours**
Technical Discourse, Modules of a letter, Professional Letters, Industrial Visit/ In-plant Training, Basics of E-Mail writing and E-mail etiquette, Writing Notices, Circulars, Memo and Notes, Report writing.	
Theory: 15 **Tutorial: 0** **Practical: 30** **Total: 45 Periods**	
REFERENCES:	
1. English for Engineers—Regional Institute of English, South India, Bangalore, published by Foundation Books, Chennai.	
2. Effective Technical Communication—A Guide for Scientists and Engineers—BarunK.Mitra—Oxford University Press, New Delhi.	
3. Interchange, Fourth Edition—Jack.C.Richards et.al,--Cambridge University Press, Sri Maitrey Print Tech., Noida.	

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U17MEP1501	Engineering Practices Laboratory	L	T	P	J	C
		0	0	2	0	1

Course Outcomes

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

CO1:	Select the various tools and equipment's used in the fabrication workshop.
CO2:	Develop various models in carpentry and fitting
CO3:	Make components using sheet metal work.
CO4:	Select the various tools and joints for different applications in plumbing..
CO5:	Demonstrate and evaluate the parameters of basic electronic components (wires, resistors, capacitors, diodes etc.) and test the components.
CO6:	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	PSO 1	PSO2
CO1	S													
CO2					M									
CO3			M											
CO4						W								
CO5	M													
CO6	M													

Course Assessment methods:

DIRECT	INDIRECT
1. Pre-or Post-experiment Test/Viva; Experimental Report for each experiment; Comprehensive report / Model Examination 2. End Semester Examination	1. Course-end survey

List of Experiments **30 Periods**

GROUP – I

A. CIVIL ENGINEERING

1.Carpentry

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

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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
- Preparation of tray

GROUP - II (ELECTRICAL & ELECTRONICS ENGINEERING)

C. ELECTRICAL ENGINEERING PRACTICE

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair-case wiring.
4. Measurement of electrical quantities–voltage, current, power & Power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.

D. ELECTRONIC ENGINEERING PRACTICE

1. Testing of Electronic components and Measurements using a digital multimeter.
2. Study of CRO and Function generator.
3. PCB Design and Fabrication.
4. Soldering simple electronic circuits and checking continuity

Theory: 0 Tutorial: 0 Practical: 30 Total: 30 Periods

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U17PHP1501	Physics laboratory (Common to AE, AU, BT, CE, CS, IT, MC,TX)	L	T	P	J	C
		0	0	2	0	1

Course Outcomes

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

CO1:	Determine different physical properties of a material like thermal conductivity, thickness of the material.
CO2:	Perform experiments involving the physical phenomena like interference and diffraction
CO3:	Apply physical theories in real life situations by also taking into account its limitation.

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													
CO2		M	S											
CO3		S		M										
CO4														
CO5														
CO6														

Course Assessment methods:

DIRECT	INDIRECT
1. Pre-or Post-experiment Test/Viva; Experimental Report for each experiment; Model Examination 2. End Semester Examination	1. Course-end survey

List of Experiments **30 Periods**

1. Determine thermal conductivity of the given cardboard by Lee's disc method.
2. Determine the thickness of a thin sheet by air wedge method.
3. Determine the co-efficient of viscosity of the given liquid by Poiseuille's flow method.
4. Determine the value of acceleration due to gravity by compound pendulum.
5. Calculate the solar panel efficiency by using lux meter.
6. Determine the wavelengths of the violet, blue, green and yellow in mercury spectrum using spectrometer grating method (the green spectral line for which the wavelength is 5461 A^0).
7. Determine Young's modulus of the given bar using non-uniform bending method.
8. Calculate the frequency of the given tuning fork by longitudinal and transverse mode of vibrational methods.

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9. Determine the velocity of ultrasonic sound and compressibility of the given liquid by using ultrasonic interferometer.
10. By using semiconductor laser determine:
    i. Wavelength of LASER using grating
    ii. Acceptance angle & numerical aperture of optical fiber (grating element: N=5,00,000 lines/meter).

Theory: 0 Tutorial: 0 Practical: 30 Project: 0 Total: 30 Hours

REFERENCES

1. Laboratory Manual of Engineering Physics by Dr. Y. Aparna & Dr. K. Venkateswara Rao (V.G.S Publishers)
2. "Practical Physics", G.L. Squires, Cambridge University Press, Cambridge, 1985. 11. 12.
3. "Great Experiments in Physics", M.H. Shamos, Holt, Rinehart and Winston Inc., 1959.
4. "Experiments in Modern Physics", A.C. Melissinos, Academic Press, N.Y., 1966. Gupta S.C, and Kapur, J.N.

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U17VEP1501	Personal Values	L	T	P	J	C
		0	0	2	0	1

Course Outcomes

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

CO1:	Become an individual in knowing the self
CO2:	Acquire and express Gratitude, Truthfulness, Punctuality, Cleanliness & fitness.
CO3:	Practice simple physical exercise and breathing techniques
CO4:	Practice Yoga asana which will enhance the quality of life.
CO3:	Practice Meditation and get benefited.
CO3:	Procure Self Healing techniques for propagating healthy society

Pre-requisite

Nil

CO/PO Mapping

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

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

Course Assessment methods:

DIRECT	INDIRECT
1. Group Activity / Individual performance and assignment 2. Assessment on Value work sheet / Test	1. Course-end survey

Values through Practical activities: **30 Periods**

1.Knowing the self : Introduction to value education - Need & importance of Value education – Knowing the self – realization of human life – animal instinct vs sixth sense.

2. Mental Health : Evolution of senses – functioning steps of human mind – Body and Mind coordination - Analysis of thoughts – moralization of desires– autosuggestions – power of positive affirmations. – Meditation and its benefits.

3.Physical Health: Physical body constitution– Types of food - effects of food on body and mind – healthy eating habits – food as medicine– self healing techniques.

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4.Core value : Self love& Self care Gratitude - Happiness - Optimistic –Enthusiasm – Simplicity – Punctual - Self Control - Cleanliness & personal hygiene - Freedom from belief systems.

5.Fitness: Simplified physical exercises – Sun salutation - Lung strengthening practices: Naadi suddhi pranayama – Silent sitting and listening to nature – Meditation.

Theory: 0 Tutorial: 0 Practical: 30 Project: 0
Total:30 Periods

REFERENCES

1. KNOW YOURSELF — SOCRATES – PDF format at www.au.af.mil/au/awc/awcgate/army/rotc_ self-aware.pdf
2. STEPS TO KNOWLEDGE: The Book of Inner Knowing – PDF format at www.newmessage.org/wp-content/uploads/pdfs/books/STK_NKL_v1.5.pdf
3. PROMOTING MENTAL HEALTH - World Health Organization – PDF format at www.who.int/mental_health/evidence/MH_Promotion_Book.pdf
4. LEARNING TO BE: A HOLISTIC AND INTEGRATED APPROACH TO VALUES – UNESCO PDF format at www.unesdoc.unesco.org/images/0012/001279/127914e.pdf
5. PERSONALITY DEVELOPMENT By SWAMI VIVEKANANDA www.estudantedavedanta.net/Personality-Development.pdf

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SEMESTER II

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U17MCT2001	Manufacturing Technology	L	T	P	J	C
		3	0	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)											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M											
CO2	M											
CO3	M											
CO4	M											
CO5	M											
CO6	M											

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I, II 2. Assignment: Journal paper review, Group Presentation. 3. End Semester Examination	1. Course-end survey

FOUNDARY TECHNOLOGY	**9 Period**

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 Period**

Hot and Cold Working Rolling - Introduction – Rolling Mills – Rolling Operations – Forging -

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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 Periods**

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 Periods**

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	**9 Periods**

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 Tutorial: 0Practical: 0 Project: 0 Total: 45 Periods

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.
5. P N Rao,"Manufacturing Technology-Metal cutting and machine tools,4E(Volume II),Mc Graw Hill Education.

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U17MCT2002	Electronic Devices and Circuits	L	T	P	J	C
		3	0	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	PO10	PO11	PO12
CO1	M											
CO2	M											
CO3	M											
CO4	M											
CO5	M											

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I, II 2. Assignment: Journal paper review, Group Presentation Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc (as applicable) 3. End Semester Examination	1. Course-end survey

CIRCUIT THEORY	**9 Period**
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 Period**

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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.

APPLICATION OF DIODES	**9 Period**

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 Period**

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

OPERATIONAL AMPLIFIERS	**9 Period**

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

Theory: 45 Tutorial: 0Practical: 0 Project: 0 Total: 45 Periods

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 (Unit: 1).
6. Salivahanan S., Suresh kumar N. and Vallavaraj A., Electronic Devices and Circuits, Tata Mc Graw Hill publishing company, New Delhi, 2nd edition, 2008 (Units: 2,3,4).
7. Roy Chowdhury D. and Jain Shail B., Linear Integrated Circuits, New Age Int. Pub., 4th edition, 2010 (Unit: 5).

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U17MET2102	Engineering Mechanics	L	T	P	J	C
		3	1	0	0	4

Course Outcomes

After successful completion of this course, the students should be able to	
CO1:	Explain the concept of equilibrium of particles subjected to concurrent forces.
CO2:	Determine the reactions in different types of support and loading conditions.
CO3:	Estimate the moment of inertia for various shapes and sections.
CO4:	Make use of various concepts of friction.
CO5:	Solve problems using the concepts in kinematics
CO6:	Solve problems in kinetics.

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	**S**											
CO2		**S**										
CO3		**S**										
CO4		**M**										
CO5	**S**											
CO6	**S**											

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation,Prototype or Product Demonstration etc (as applicable) 3. End Semester Examination	1. Course-end survey

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BASICS& STATICS OF PARTICLES	12 Periods
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	**12 Periods**
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	**12 Periods**
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	**12 Periods**
Frictional force-Law of coulombfriction, simple contact friction, Rolling resistance and Belt friction, Ladder friction, Wedge friction.	
DYNAMICS OF PARTICLES	**12 Periods**
Kinematics: Rectilinear & Curvilinear motion of particles, Displacements Velocity and acceleration. **Kinetics:** Newton's law, Work Energy method, Impulse and Momentum, Impact of elastic bodies.	
Theory: 45 Tutorial: 15 Practical: Project: 0 Total: 60 Periods	

REFERENCES:

1. Beer F.P. and Johnson Jr. E.R., Vector Mechanics for Engineers, Vol. I S
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, PearsonEducation, Asia Pvt. Ltd., New Delhi, 2002.
4. Palanichamy M.S., and Nagan S., Engineering Mechanics (Statics & Dynamics) TataMcGraw Hill, 2001.
5. Irving H. Shames, Engineering Mechanics – Statics and Dynamics, IV Edition, Pearson Education, Asia Pvt. Ltd., 2003.
6. Sukumar T.R. and Sridhar S., Engineering Mechanics, Inder Publications, Coimbatore.

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U17PHT2008	Materials Science for Mechatronics Engineering	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to	
CO1:	Understand the core concepts of conductors.
CO2:	Explain the behavior of semiconductors and its applications
CO3:	Differentiate the structure and physical properties of magnetic materials.
CO4:	Understand the mechanism of dielectrics and its applications
CO5:	Elucidate the various process of heat treatment.
CO6:	Study of composite & new engineering materials, their properties with 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
CO1	M					M						
CO2	M											
CO3	W	M				M						
CO4	S		M			M						
CO5	S											
CO6	M											

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I, II 2. Cooperative learning report, Assignment; Group Presentation, Project report, Poster preparation 3. End Semester Examination	1. Course-end survey

CONDUCTING MATERIALS	**9 Period**
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.	
SEMICONDUCTING MATERIALS	**9 Period**
Origin of band gap in solids (Qualitative treatment only) - carrier concentration in an intrinsic semi	

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conductor (derivation) – Fermi level – variation of Fermi level with temperature - electrical conductivity – band gap –Extrinsic semiconductor(Qualitative only) – Variation of Fermi level with temperature and impurity concentration – Hall effect – Determination of Hall coefficient – experimental set up – applications

MAGNETIC AND DIELECTRIC MATERIALS	**9 Period**

Magnetic materials: Properties of dia, para, ferro, anti ferro and ferri magnetic materials – Domain theory of ferromagnetism - hysteresis – soft and hard magnetic materials – ferrites – applications.

Dielectric materials: Electronic, ionic, orientation and space charge polarization - frequency and temperature dependence of polarization – dielectric loss –internal field –Classius Mossotti relation– dielectric breakdown – different types of break down mechanism - ferro electric materials - properties and applications

HEAT TREATMENT	**9 Period**

Definition – annealing types – normalizing, hardening and tempering of steel - isothermal transformation diagrams – cooling curves superimposed on I.T. diagram CCR - hardenability, Jominy end quench test – austempering, martempering – case hardening - types

COMPOSITE AND NEW ENGINEERING MATERIALS	**9 Period**

Composite materials: Types - production techniques - properties and applications of composites - advanced structure ceramics - Al_2O_3 and diamond.

Shape memory alloys (SMA): Characteristics – applications - advantages and disadvantages of SMA - properties of NiTi alloy

Theory: 45 **Tutorial: 0** **Practical: 0** **Project: 0** **Total: 45 Periods**

REFERENCES:

1. Halliday D., Resnick R. & Walker, J. “Principles of Physics”. Wiley, 2015.
2. Calister, “Material Science and Engineering: An Introduction”, 7th Edition, John Wiley and Sons, 2006.
3. Gaur R.K. and Gupta S.L., Engineering Physics, 8th edition, DhanpatRai Publications (P) Ltd., New Delhi, 2003.
4. Palanisamy P.K., Materials Science, 2nd edition, Scitech Pub. India, (P) Ltd., Chennai, 2003.
5. Bhattacharya, D.K. & Poonam, T. “Engineering Physics”. Oxford University Press, 2015.
6. Rajendran V, Materials science, 5th edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
7. Avadhanulu M.N. and Kshirsagar P.G., A textbook of Engineering Physics, S.Chand & Company Ltd, New Delhi,2005.
8. Gopal S., Engineering Physics, Inder Publications, Coimbatore, 2006.
9. Van Vlack, ―Elements of Material Science and Engineering‖, Pearson Education India, 2008.

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U17MAT2101	Advanced Calculus and Laplace Transforms (Common to AE, AUE, CE, MCE, ME)	L	T	P	J	C
		3	1	0	0	4

Course Outcomes

After successful completion of this course, the students should be able to		
CO1:	Evaluate multiple integrals and apply them to find area, moment of inertia, centre of mass and volume	K3
CO2:	Apply various vector differential operators and integral theorems for solving Engineering problems involving cubes and rectangular parallelepipeds.	K4
CO3:	Construct analytic functions of complex variables and transform functions from z- Plane and w-plane and vice-versa, using conformal mappings	K4
CO4:	Use the fundamentals of residues, complex integration to evaluate real integrals	K3
CO5:	Transform functions in time domain to frequency domain using Laplace transform	K4
CO6:	Convert ordinary differential equations into algebraic equations using Laplace Transform and solve them using inverse Laplace transform	K4

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	S	S							M	M		M
CO2	S	S							M	M		M
CO3	S	S							M	M		M
CO4	S	S							M	M		M
CO5	S	S							M	M		M
CO6	S	S							M	M		M

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as	1. Course-end survey

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applicable) 3. End Semester Examination	

MULTIPLE INTEGRALS	**9 + 2 Periods**

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 –- Moment of inertia - Centre of mass - Volume as triple integral.

VECTOR CALCULUS	**9 + 3 Periods**

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 parallelepipeds

ANALYTIC FUNCTIONS	**9 + 3 Periods**

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 + 2 Periods**

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 TRANSFORMS	**5 + 3 Periods**

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	**4 + 2 Periods**

Inverse Laplace Transform – Simple system dynamic models – Transfer Functions – 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

Theory: 45	**Tutorial: 15**	**Practical: 0**	**Project: 0**	**Total: 60 Periods**

REFERENCES:

1. Kreyzig E., Advanced Engineering Mathematics, John Wiley & Sons (Asia), Pvt, Ltd., Sing
2. Grewal B.S., Higher Engineering Mathematics, Khanna Publishers, Delhi, 42nd Edition, 2012.
3. Philip D. Cha, James J. Rosenberg, Clive L. Dym, Fundamentals of Modelling and Analyzing Engineering Systems, Cambridge University Press, United Kingdom, 2000.
4. Veerarajan T., Engineering Mathematics (for First Year), Tata McGraw Hill, Pub. Co. Ltd., New Delhi, Revised Edition, 2007.

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5 Venkataraman M.K., Engineering Mathematics, Volume - II, The National Pub. Co., Chennai, 2003.
6 Kandasamy P., Thilagavathy K. and Gunavathy K., E
7 Arunachalam T. and Sumathi K., Engineering Mathematics II, Sri
8 Weir .MD, Hass J, Giordano FR: Thomas Calculus Pearson education 12th ED, 2015.
9 N.P.Bali., Dr. Manish Goyal., ―Transforms and partial Differential equations, University science Press, New Delhi, 2010.

E books and online learning materials

1. Advanced Engineering Mathematics, P. V. O'Neil, 5th Indian reprint 2009, Cengage Learning India Pvt. Ltd.
2. Advanced Engineering Mathematics, Dennis Zill Warren S Wright Michael R. Cullen, 4th edition, 2011, Jones & Bartlett Learning.

Online Courses and Video Lectures:

1. . http://nptel.ac.in/course.php?disciplineId=111
2. www.mathworld.wolfram.com

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U17CHP2501	Chemistry Laboratory (COMMON TO ECE, E&I, EEE, FT & ME)	L	T	P	J	C
		0	0	2	0	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 techniques and apply it in real life situations like corrosion, soil, water testing etc (S2)
CO4:	Analyse the solutions by spectroscopic techniques and apply it in real life situations like corrosion, soil, water testing etc (S2)

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	M											
CO3	M					M						
CO4	M					M						

Course Assessment methods:

DIRECT	INDIRECT
1. Post-experiment Test/Viva; Experimental Report for each experiment; Model Examination 2. End Semester Examination	1. Course-end survey

LIST OF EXPERIMENTS **30 Periods**

1. Preparation of normal solutions of the following substances -
   Sodium carbonate, Hydrochloricacid and Buffer solution

WATER TESTING

2. Determination of total, temporary and permanent hardness by EDTA method.
3. Estimation of DO by Winkler'smethod
4. Estimation of alkalinity by Indicatormethod.
5. Estimation of chloride by Argentometricmethod.

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ELECTRO CHEMICAL ANALYSIS

6. Estimation of hydrochloric acid by pHmetry.
7. Conductometric estimation of mixture of acids and strongbase
8. Estimation of corrosion of Iron byPotentiometry

PHOTOMETRY

9. Estimation of the extent of dissolution of Copper / Ferrous ions by Spectrophotmetry.
10. Estimation of sodium and potassium in water by Flamephotometry.

DEMONSTRATION

11. Determination of Fire point and Flash point
12. Determination of Cloud and Pour point
13. Microscopic usage in Metallurgy.
14. Determination of Molecular weight by Viscometer

Theory: 0 Tutorial: 0 Practical: 30 Project: 0 Total: 30 Periods

REFERENCES:

1. Jeffery G.H., Bassett J., Mendham J. and Denny R.C., Vogel's Text Book of Quantitative Chemical Analysis, Oxford, ELBS, London,2012.
2. Shoemaker D.P. and C.W. Garland., Experiments in Physical Chemistry, Tata McGraw-Hill Pub. Co., Ltd., London,2003.
3. Shoba U.S., Sivahari R. and Mayildurai R., Practical Chemistry, Inder Publications, Coimbatore, 2011.

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U17MCP2501	Electronic Devices and Circuits Laboratory	L	T	P	J	C
		0	0	2	0	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.
CO5:	Inspect the manufactured components using suitable measurement 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
CO1	M											
CO2	M											
CO3	M					M						
CO4	M					M						
CO5												

Course Assessment methods:

DIRECT	INDIRECT
1. Post-experiment Test/Viva; Experimental Report for each experiment; Model Examination 2. End Semester Examination	1. Course-end survey

LIST OF EXPERIMENTS	30 Periods

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

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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.

Theory: 0 Tutorial: 0 Practical: 30 Project: 0 Total: 30 Periods

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U17ISP2701	**Social Immersion Project** (Common to all branches of Engineering and Technology)	L	T	P	J	C
		0	0	0	4	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 and technical skills 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:	Explain how to make leadership decisions concerning organizational structure and the role of project resources on a project's team.
CO5:	Enhance technical knowledge in addressing the needs of a community problem.
CO6:	Identify tools and techniques for planning and working on a project.

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			S			S	S					
CO2			M	S		S	M	M	M			
CO3			S	W		S	S		S			M
CO4			S			S	S		W		M	
CO5	S		M			S	M					
CO6			S			S	S					

Course Assessment methods:

DIRECT	INDIRECT
1. Project Review 2. General report preparation 3. Team Presentation	1. Impact study 2. Field Visit & Observation Skill 3. Course end survey

SOCIAL BONDING AND ENGINEERING

Society and its impact on the individual – Responsibility of individuals towards community building – Essential requirement of the society – Role of an engineering graduate in approaching the requirements - Developing social consciousness.

ENGINEERING PREREQUISITE FOR ENHANCED SOCIAL LIVING

Theoretical reading (Based on the project / general – Books to be identified by the team) - Inculcating Social immersion and Leadership- Study on the society and identifying problems - Social immersion and Engineering implementation - Analysis of problems on issue based – Identification of causes and effects of the social issue identified.

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ESSENTIAL ENGINEERING INNOVATION
Essential Engineering Concepts - Multiple approaches towards the problem &Selection for addressing- Addressing a theoretical social problem -Providing multiple solutions for the problem
PROJECT PLANNING AND APPROACHES
Knowledge on budgeting and fund raising - Approaching agencies related to problems. Partnering with agencies- Presentation Skills - Report preparation
BROAD AREA OF PROJECTS **(Students can also identify their own social issue)**
Water / Sanitation and Hygiene - Waste Management -Women Empowerment- Community health - Child health/ Poverty/Education/others - Energy management -Environment Management - Adult Education - -Youth Empowerment - Green Industry - Given above are the broad areas of projects recommended. Projects may vary to individuals/ groups/ class/ branch.
TOTAL : 60 Hours
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. 3. Adedeji B. Badiru, STEP Project Management: Guide for Science, Technology, and Engineering Projects. Taylor and Francis Group., Florida 2009.

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U17VEP2502	Interpersonal Values	L	T	P	J	C
		0	0	2	0	1

Course Outcomes

After successful completion of this course, the students should be able to	
CO1:	Develop a healthy relationship & harmony with others
CO2:	Practice respecting every human being
CO3:	Practice to eradicate negative temperaments
CO4:	Acquire Respect, Honesty, Empathy, Forgiveness and Equality
CO5:	Practice Exercises and Meditation to lead a healthy life
CO6:	Manage the cognitive abilities of an Individual

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										S		
CO2									S			
CO3											M	S
CO4						M						
CO5												M
CO6											M	

Course Assessment methods:

DIRECT	INDIRECT
1.Group Activity / Individual performance and assignment 2.Assessment on Value work sheet / Test	1. Mini project on values / Goodwill Recognition

Values through Practical activities:	**30 hours**

1. **Introduction**: Introduction to interpersonal values – Developing harmony with others – Healthy relationship – Need & importance of interpersonal values for dealing with others and team - Effective communication with others.
2. **Maneuvering the temperaments:** From Greed To Contentment - Anger To Tolerance - Miserliness To Charity – Ego To Equality - Vengeance To Forgiveness.
3. **Core value** : **Truthfulness -**Honesty –Helping–Friendship – Brotherhood – Tolerance – Caring & Sharing – Forgiveness – Charity –Sympathy — Generosity – Brotherhood - Adaptability.
4. **Pathway to Blissful life :**

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Signs of anger – Root cause – Chain reaction – Evil effects on Body and Mind – Analyzing roots of worries – Techniques to eradicate worries.

5. **Therapeutic measures:** Spine strengthening exercises - Nero muscular breathing exercises - Laughing therapy - Mindfulness meditation.

Theory: 0	**Tutorial: 0**	**Practical: 30**	**Project: 0**	**Total: 30 hours**

REFERENCES:

1. INTERPERSONAL SKILLS Tutorial (PDF Version) – TutorialsPoint www.tutorialspoint.com/interpersonal_skills/interpersonal_skills_tutorial.pdf
2. INTERPERSONAL RELATIONSHIPS AT WORK - KI Open Archive - Karolinska www. publications.ki.se/xmlui/bitstream/handle/10616/39545/thesis.pdf?sequence=1
3. VALUES EDUCATION FOR PEACE, HUMAN RIGHTS, DEMOCRACY – UNESCO www.unesdoc.unesco.org/images/0011/001143/114357eo.pdf
4. MANEUVERING OF SIX TEMPERAMENTS - Vethathiri Maharishiwww.ijhssi.org/papers/v5(5)/F0505034036.pdf
5. THE BLISS OF INNER FIRE: HEART PRACTICE OF THE SIX ... - Wisdom Publicationswww.wisdompubs.org/sites/.../Bliss%20of%20Inner%20Fire%20Book%20Preview.pd...

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ENGLISH ELECTIVES

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U17ENE2501	Academic English (Common to all branches of Engineering and Technology)	L	T	P	J	C
		0	0	4	0	2

Course Outcomes

After successful completion of this course, the students should be able to	
CO1:	Maintain the standards of communal communication and acquire excellent listening skills with good Received Pronunciation.
CO2:	Accommodate with speaking skills, with fluency in communication obtaining levels of competency.
CO3:	Project desirable research oriented skills to interface the corporate and meet out the challenges of the modern trends.
CO4:	Familiarising with learner-centred strategies and improve writing activities through proper analysis.
CO5:	Develop the ability in procuring information and effectiveness in communication based on situations.
CO6:	Ability to present the individuals opinions, persuasion skills and academic curricular along with career profiles.

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		S	M		M	S	S	M	M		S	M	
CO2	M		S	M		M	S	S	M	M		S	M	
CO3	M		S	M		M	S	S	M	M		S	M	
CO4	M		S	M		M	S	M	M	M		S	M	
CO5	M		S	M		M	S	M	M	M		S	M	
CO6	M		S	M		M	S	M	M	M		S	M	

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment 2. Cooperative learning 3. Assignment 4. Presentation 5. End Semester Examination	1. Course-end survey

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AUDITORY PERCEPTION	12 Periods
Listening for understanding & information - short announcements, short conversations, telephonic conversation; Listening to British, American, Australian and Neutral Accent of Indian English; Listening and synthesizing information; Listening to TED/INK Talks (General); Critical review of short films, documentaries.	
ORAL FLUENCY	**12 Periods**
Informal introduction of self and others, conversation starters, articulating simple thoughts and ideas with clarity, Seeking Permission, Talking about People and Places. Describe an object or event. Retelling an incident, voicing opinions, persuasion skills, speaking from a single perspective (debate) - preparing and delivering an informal talk, Introduction to Presentation Skills – Formal tone – Impersonal style - Structuring and Presenting	
FOUNDATIONS OF ACADEMIC WRITING	**12 Periods**
Plan and write a library-based coursework assignment on an Engineering topic. Read academic textbooks and journal articles. Research and analyse scientific data and express understanding. Procuring information - Identifying research papers in a specific discipline, reading abstracts of research papers, reading the abstract of projects, reading articles from journals and publications and documenting/ archiving information.	
TRAITS OF RESEARCH WRITING	**12 Periods**
Reading research articles and summarizing. Review of Secondary sources - Writing an abstract - Writing an introduction to a paper in academic writing - Avoiding plagiarism – Bibliography – International Academic Styles of writing a research paper - Peer Evaluation.	
PROCESS OF PREPARING A RESEARCH ARTICLE	**12 Periods**
Research Projects - Converging areas of interest into field of research - Identifying the problem of research – Formulating hypothesis – Research Objectives – Literature Review – Identifying the research gap - Research methodology – Requirements Plan of work – Result and Discussion – Conclusion – References – Appendices.	
Theory: 0 **Tutorial: 0** **Practical: 60** **Project: 0** **Total: 60 Periods**	

REFERENCES:

1 English and Communication Skills—S.P.Dhanavel—Orient Blackswan Pvt Lted, Hyderabad.

2 Effective Technical Communication—Ashraf Rizvi—Tata McGraw Hill, New Delhi.

3 A Course in Communication Skils—Kiranmai Dutt, Geetha Rajeevan, C.L.N.Prakash—Foundation Books, New Delhi.

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U17ENE2502	Professional English (Common to all branches of Engineering and Technology)	L	T	P	J	C
		0	0	4	0	2

Course Outcomes

After successful completion of this course, the students should be able to	
CO1:	Formulate an understanding for effective use of short telephonic and oral conversations.
CO2:	Analyse and identify necessary interpersonal and persuasive skills for effective oral presentation.
CO3:	Employ appropriate strategies to articulate random thoughts and ideas in brainstorming sessions.
CO4:	Analyse and review technical and non-technical contents.
CO5:	Compose and compile effective written documents needed in a professional scenario.
CO6:	Recognize and establish dynamic corporate communication and relationship

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										S		M		
CO3										S		M		
CO4	M	S	M	S						S		M	M	S
CO5				M						S				
CO6						M	M	S	S			S		

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment 2. Review 3. Assignment 4. Report 5. End Semester Examination	1. Course-end survey

AUDITORY PERCEPTION	12 Periods

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Listening for understanding & information - short announcements, short conversations, telephonic conversation; Listening to British, American, Australian and Neutral Accent of Indian English; Listening and synthesizing information; Listening to TED/INK Talks (General); Critical review of short films, documentaries

ORAL FLUENCY	**12 Periods**

Informal introduction of self and others, conversation starters, articulating simple thoughts and ideas with clarity, Seeking Permission, Talking about People and Places, Describe an object or event. Retelling an incident, voicing opinions, persuasion skills, speaking from a single perspective (debate) - preparing and delivering an informal talk, Introduction to Presentation Skills – Formal tone – Impersonal style - Structuring and Presenting information. Transcode graphics orally

FOUNDATIONS OF PROFESSIONAL COMMUNICATION	**12 Periods**

Focused listening, Listening to lectures and talks on science and technology, Listening in international seminars, Video Documentary review, Receiving compliments and sharing information in a corporate scenario, Speaking in Formal Context. Business Vocabulary. Speaking practice in a variety of registers, Giving and Getting Product and Service Information. Product Review. Recording equipment and safety checklist. Business Itinerary, Presenting a Company Profile, Encoding and decoding advertisements

CORPORATE DYNAMICS	**12 Periods**

Corporate Social Responsibility, Crisis Management - handling issues and situations, Creating a powerful first impression, Goal Setting - Immediate goals, short term goals, long term goals, smart goals, strategies to achieve goals, Time Management - Types of time, Identifying time wasters, time management skills, Stress Management - Reasons, Strategies to cope up with stress, Stress-busters, Emotional Intelligence – Mental health, Job performance, Managing emotions

PROFESSIONAL WRITING	**12 Periods**

Writing Agenda and minutes of the meetings, Writing daily/periodic reports, Writing business / professional letters, Business E-mail - Writing an Email Announcing a Meeting -Writing an Email Announcing the modifications in a Meeting - Writing an Email Announcing the cancellation/ postponement of Meeting

Theory: 0	**Tutorial: 0**	**Practical: 60**	**Project: 0**	**Total: 60 Periods**

REFERENCES:

1. Soft Skills for Young Managers—Prof.M.S.Rao—Biztantra Publications, New Delhi.
2. Soft Skills—Dr.K.Alex—S.Chand and Co, New Delhi.
3. Professional Communication—Aruna Koneru—Oxford University Press, New Delhi.

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U17ENE2503	English for Competency (Common to all branches of Engineering and Technology)	L	T	P	J	C
		0	0	4	0	2

Course Outcomes

After successful completion of this course, the students should be able to	
CO1:	Recognize the inventory of listening strategies by various proposed listening activities.
CO2:	Construct learning situations and increase speaking skills based on strong educational and communication theories.
CO3:	Invent and practice effective reading strategy to enhance competent communication **CO4:** Honing the strengths of writing skills and set objectives for future development **CO5:**Showcase industry-ready attitude along with corporate communication
CO4:	Develop imaginative and critical thinking abilities, and improve the problem solving
CO5:	Recognize the inventory of listening strategies by various proposed listening activities.
CO6:	Construct learning situations and increase speaking skills based on strong educational and communication theories.

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		S	M		M	S	S	M		
CO2				M		S	M		M	S	S	M		
CO3				M		S	M		M	S	S	M		
CO4				M		S	M		M	S	M	M		
CO5				M		S	M		M	S	M	M		
CO6				M		S	M		M	S	M	M		

Course Assessment methods:

DIRECT	INDIRECT

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1. Continuous Assessment 2. Review 3. Assignment 4. Report 5. End Semester Examination	1. Course-end survey

AUDITORY PERCEPTION	**12 Periods**
Listening for understanding & information - short announcements, short conversations, telephonic conversation; Listening to British, American, Australian and Neutral Accent of Indian English; Listening and synthesizing information; Listening to TED/INK Talks (General); Critical review of short films, documentaries.	
ORAL FLUENCY	**12 Periods**
Informal introduction of self and others, conversation starters, articulating simple thoughts and ideas with clarity, Seeking Permission, Talking about People and Places. Describe an object or event. Retelling an incident, voicing opinions, persuasion skills, speaking from a single perspective (debate) - preparing and delivering an informal talk, Introduction to Presentation Skills – Formal tone – Impersonal style - Structuring and Presenting information. Transcode graphics orally.	
FOUNDATIONS OF ETS	**12 Periods**
Analogy, Synonyms and antonyms, Morphemes –Derivational and Inflectional, Affixes – Prefix and Suffix, strategies to improve high frequency vocabulary	
VERBAL BASED COMPETENCY	**12 Periods**
Verbal Reasoning - Critical Reasoning & Verbal Deduction - Statement and Assumptions, Statement and Arguments, Statement and Inference, Strong and Weak Arguments, Sentence Correction,; Sentence Equivalence, Text Completion, Word Groups, Integrated Reasoning – Graphics Interpretation, Two-part Analysis, Table Analysis, Multi-source Reasoning	
SKILL BASED COMPETENCY	**12 Periods**
Analytical writing – Argumentative writing, a 30-minute Analyse an argument, a 30-minute Analyse an issue, Listening and Speaking Tasks in ETS, Reading Comprehension – GRE, GMAT, TOEFL, IELTS, GATE	
Theory: 0 **Tutorial: 0** **Practical: 60** **Project: 0** **Total: 60 Periods**	

REFERENCES:

1 Personality Development and Soft Skill—Barun.K.Mitra—Oxford University Press, New Delhi.

2 A Modern Approach to Verbal and Non-verbal Reasoning—R.S.Agarwal—S.Chand & Co., New Delhi.

3 Soft Skills—Dr.K.Alex—S.Chand & Co., New Delhi.

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SEMESTER III

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U17MAT3101	PARTIAL DIFFERENTIAL EQUATIONS AND TRANSFORMS (Common to AE/AUE/CE/ME/MCE/EEE)	L	T	P	J	C
		3	1	0	0	4

Course Outcomes

After successful completion of this course, the students should be able to	
CO1:	Form partial differential equations and solve certain types of partial differential equations.
CO2:	know how to find the Fourier Series and half range Fourier Series of a function
CO3:	know how to solve one dimensional wave equation, one dimensional heat equationin steady state using Fourier series
CO4:	apply Fourier Series to solve the steady state equation of two-dimensional heat equation in Cartesian coordinates.
CO5:	Apply the Fourier Transform, Fourier sine and cosine transform to certain functions and use Parseval's identity to evaluate integrals.
CO6:	Evaluate Z – transform for certain functions. Estimate Inverse Z – Transform of certain functions and to solve difference equations using 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	PO10	PO11	PO12	PSO1	PSO2
CO1	S	M			M				M	M		S	M	M
CO2	S	M		M									W	W
CO3	S	S	S		S				M	M		S	W	W
CO4	S	M	M									M	W	W
CO5	S	M	M		S								W	W
CO6	S	S			S				M	M		S		

Course Assessment methods:

DIRECT	INDIRECT

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1. Continuous Assessment Test I,II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination	1. Course-end survey

PARTIALDIFFERENTIALEQUATIONS	**9+3 Hours**
Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions - Solution of PDE by variable separable method – Solution of standard types of first order partial differential equations(excludingreducibletostandardtypes)–Lagrange'slinearequation– LinearHomogeneouspartial differential equations of second and higher order with constant coefficients	
FOURIER SERIES	**9+3 Hours**
Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Parseval's identity – Harmonic Analysis.	
BOUNDARY VALUE PROBLEMS – ONE DIMENSIONAL EQUATIONS	**5+2 Hours**
Classification of second order quasi linear partial differential equations –Solution of one-dimensional wave equation – One dimensional heat equation (excluding insulated ends) – Fourier series solutions in Cartesian coordinates.	
BOUNDARY VALUE PROBLEMS – TWO DIMENSIONAL EQUATIONS	**4+1 Hours**
Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.	
FOURIER TRANSFORM	**9+3 Hours**
Statement of Fourier integral theorem – Infinite Fourier transforms – Sine and Cosine Transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.	
Z -TRANSFORM	**9+3 Hours**
Z-transform - Elementary properties – Convolution theorem- Inverse Z – transform (by using partial fractions, residues and convolution theorem) – Solution of difference equations using Z - transform.	

Theory : 45 Hours	**Total :60 Hours**	**Total :60 Hours**

REFERENCES:

1.	Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition. 2014.
2.	Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
3.	Kandasamy P., Thilagavathy K. and Gunavathy K., "Engineering Mathematics Volume III", S.Chand& Company ltd., New Delhi, 2006.
4.	Ian Sneddon., "Elements of partial differential equations", McGraw – Hill, New Delhi, 2003
5.	Arunachalam T., "Engineering Mathematics III", Sri Vignesh Publications, Coimbatore 2013.

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U17MCI3201	ELECTRICAL MACHINES	L	T	P	J	C
		3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to	
CO1:	Define the basic theorems in Magnetic circuits.
CO2:	Describe the principle of operation and performance of DC motors and Induction Machines
CO3:	Summarize the speed control methods of electrical machines
CO4:	Explain the principle of operation and performance of special machines and permanent magnet machines
CO5:	Select suitable motor for simple 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	PSO1	PSO2
CO1	S													
CO2	M												M	
CO3	M												M	
CO4	M												M	
CO5	M												M	

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I,II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as	1. Course-end survey

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applicable) 3. End Semester Examination	
DCMACHINES	**7 Hours**
DCmachines: Princileofworking-Construction,-TypesofDCmachinesbasedonconstruction-Backemf, voltage equations, torque equation-Characteristics of DC motors - Speed control of DC series and Shunt motors -Armature and Field control.	
ACMACHINES	**12 Hours**
Three phase induction motor: Principle of working -construction - Production of RMF - Torque-slip characteristics,torqueequation-cogging–crawling-Speedcontrolofthreephaseinductionmotor - Voltage Control-Voltage/frequency control-slip power recovery scheme.	
PERMANENT MAGNET MACHINES	**6 Hours**
PMDC motors: Construction, principle of operation Permanent magnet and variable reluctance type: Construction, principle ofoperation. BLDC motors: Construction, principle of operation.	
SPECIAL MACHINES	**6 Hours**
Stepper motors: Construction, principle of operation Servo motors: Types of servo motors -Servo Mechanism-Construction of AC and DC servo Motors	
SELECTION OFAMOTOR	**6Hours**
Factors influencing the selection of a motor - Motor Application Requirements – Velocity profiles – Current Density – Heat flow in a Motor - Fatigue and Lubrication tests – trends in test automation **CASE STUDY:** Selection of a motor for an industrial application.	
Theory:45 Tutorial:30 Total: 75 Hours	

REFERENCES:

1. TherajaB.L and Theraja A.K , “A Textbook of Electrical Technology”, Volume 2: AC and DC machines,s tudent edition, S.Chand Publications,2013.
2. Janardanan E G., “Special Electrical Machines” PHI Learning Private Limited, Delhi, 2014.
3. Nagrath I J and Kothari DP., “Electrical Machines”, 3rdEdition, Tata McGraw-Hill, New Delhi, 2006.
4. Pillai SK, “A first course on Electric drives”, Wiley Eastern Limited, 1998.
5. Stephen Chapman, “Electric Machinery Fundamentals”, McGraw-Hill Series in Electrical and Computer Engineering 4th edition, 2005
6. Univ.-Prof. Dr.-Ing., Dr. H.C. Gerhard Henneberger , “Electrical Machines I Basics, Design, Function, Operation” ,Aachen University, 2002.

LIST OF EXPERIMENTS	**30 Hours**

1. Load test on DC series motors
2. Load test on DC Shunt motor
3. Speed control of DC shunt motor (Armature and Field Control)
4. Load Test on Three Phase Squirrel Cage Induction
5. Speed control of BLDC motor
6. Speed control of Servo AC or DC motor
7. Speed control of Stepper motor.
8. Speed control of three phase slip ring induction mot
9. Voltage / Frequency control of three phase induction motor using inverter.

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U17MCT3002	MECHANICS OF SOLIDS	L	T	P	J	C
		3	1	0	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 calculate the stresses and deflection in simple and compound bars
CO2:	Calculate the thermal stresses and the material response due to temperature variations
CO3:	Find the stresses in bi-axial load system and strain energy for different loads
CO4:	Develop the shear force, bending moment diagram and locate maximum values of shear force and bending moments induced in various types of beams
CO5:	Estimate the slope and deflection of beams under various loading conditions and crippling load for a column with different end conditions
CO6:	Determine the power transmitting, torque carrying capacities of the circular shafts and required thickness of the pressure vessel for a given internal pressure

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		M										S	M
CO2	S		M										S	M
CO3	M		M										S	
CO4	M		M										S	W

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CO5	S		M										S	W
CO6	S		S										S	M

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination	1.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-Thermal stresses and creep.	
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	
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.	
DEFLECTION OF BEAMS	**12 Hours**
Elastic curve– Evaluation of beam: 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:45Hours Tutorials:15 Hours Total Hours:60	

REFERENCES:

1. Ramamrutham S, "Strength of materials", 14th 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.
5. RC hibbeler, "mechanics of materials", 9th edition, Pearson, 2014.

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U17MCT3003	FLUID MECHANICS AND THERMAL SCIENCES	L	T	P	J	C
		3	0	0	0	3

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:	Explain the concept of boundary layer and methods of preventing the boundary layer separation..
CO6:	Summarize the laws of thermodynamics and concept of heat transfer mechanisms in energy interactions.

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													M
CO2	S	M												M

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CO3	S													M
CO4	S													M
CO5	S	M												M
CO6	S													M

Course Assessment methods:

DIRECT	INDIRECT
1. Internal test I 2. Internal test II 3. End semester Examination Assignment	1.Course end survey

FLUIDPROPERTIES	**6Hours**

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.

FLIUD STATICS AND BUOYANCY	**10 Hours**

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	**10 Hours**

Fluid Kinematics – Types of flow - velocity and acceleration - continuity equation.
Fluid dynamics - equations of motion - Euler's equation along streamline - Bernoulli's equation – Applications - Venturi meter, Orifice meter, Pitot tube.

FLUID FLOW AND BOUNDARY LAYER CONCEPTS	**10 Hours**

Hagen Poiseuille Equation - Darcy Welsbach equation - Friction factor – Major and minor energy losses - Flow through pipes in series and in parallel.
TypesofBoundarylayerthickness–Boundarylayerseparation–Methodsofpreventingtheboundary layer separation

THERMAL ENERGY INTERACTION	**9 Hours**

Zeroth law of thermodynamics – Measuring temperature, Thermal expansion, absorption of heat by solidsandliquids.Firstlawofthermodynamics–Firstlawappliedtoflowandnon-flowprocess.Heat transfer mechanisms: Conduction–Fourier'sLaw,thermalresistance.Convection–Newton'slawof cooling. Radiation – Wien's law, Kirchhoff's law, Stefan-Boltzmannlaw.

Theory:45 Hours Total Hours:45

REFERENCES:

1. White FM., "Fluid Mechanics", 7th Edition, Tata McGraw-Hill, New Delhi, 2011.
2. Cengel YA., Cimbala J M., "Fluid Mechanics – Fundamentals and applications", 2nd Edition, McGraw Hill higher education, 2010.
3. Bansal RK., "Fluid Mechanics and Hydraulics Machines", 9th edition, Laxmi publications (P) Ltd., New Delhi, 2011.
4. Ramamirtham S., "Fluid Mechanics and Hydraulics and Fluid Machines", Dhanpat Rai and Sons, Delhi, 2006.
5. Nag P.K., "Engineering thermodynamics", Tata McGraw hill, 2005.
6. Rajput R.K., "Heat and Mass transfer", S.Chand and Co Publishing, 2008.

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U17MCP3504	MANUFACTURING TECHNOLOGY LABORATORY	L	T	P	J	C
		0	0	2	0	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. U17MCT201 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	PSO1	PSO2
CO1	W									M				W
CO2	M									M				W
CO3	W									M				W
CO4	W									M				W
CO5	W									M				W
CO6	W									M				W

Course Assessment methods:

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DIRECT	INDIRECT
1. Lab Exercises 2. Model Practical Examination 3. End Semester Practical Examination Assignment	1. Course Exit 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

U17INI3600	ENGINEERING CLINIC - I	L	T	P	J	C
		0	0	4	2	3

Course objectives

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and teamwork
- To create an engaging and challenging environment in the engineering lab

Course Outcomes	
After successful completion of this course, the students should be able to	
CO1:	Identify a practical problem and find a solution
CO2:	Understand the project management techniques
CO3:	Demonstrate their technical report writing and presentation skills

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	S	S	S	M	W		S			S	S	M
CO2											S		S	M
CO3										S			S	M

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Course Assessment methods:

DIRECT	INDIRECT
1. Project reviews50% 2. Workbook report10% 3. Demonstration & Viva-voce40%	1. Course Exit Survey

Content:

Thecoursewillofferthestudentswithanopportunitytogainabasicunderstandingofcomputer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the third semester, students will focus primarily on IOT with C programming using Arduino

GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hours: 90

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U17VEP3503	FAMILY VALUES (Mandatory)	L	T	P	J	C
		0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to	
CO1:	Develop skills in maintaining the harmony in the family.
CO2:	Create impulsive activities for healthy family
CO3:	Be receptive to troubled Individuals
CO4:	Gain healthy life by practicing Kundalini Yoga &Kayakalpa
CO5:	Possess Empathy among family members.
CO6:	Reason the life and its significance

Pre-requisite

1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES

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

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CO1									S					
CO2							M							
CO3										M				
CO4												S		
CO5						S								
CO6								M						

Course Assessment methods:

DIRECT	INDIRECT
1. Group Activity / Individual performance and assignment 2. Assessment on Value work sheet /Test	1. Mini project on values / Goodwill Recognition

Values through Practical activities:

1. **Family system:** Introduction to Family Values – elements of family values -Adju
2. **Peace in Family :**Family members and their responsibility - Roles of parents, children, grant parents -. Respectable women hood
3. **Core value: Empathy:** Unconditional love - Respect - Compassion - sacrifice–Care &share -helping – emotional support- hospitality – cleanliness
4. **Blessing:** Blessing - methods - Vibration effect - Benefits - Reason for misunderstanding in the Family and resolution through blessings.
5. **Healthy Family:** Good relationship with neighbors - Counseling - Simplified Kundalini Yoga -Kaya Kalpa Yoga

Workshop mode

REFERENCES

1. FAMILY - www.download.nos.org/331courseE/L-13%20FAMILY.pdf
2. FRAMEWORK FOR ACTION ON VALUES EDUCATIONI EARLY CHILDHOOD – UNESCO – PDF – www.unesdoc.unesco.org/images/0012/001287/128712e.pdf
3. TRUE FAMILY VALUES Third Edition – Tparents Home
4. www.tparents.org/Library/Unification/Books/TFV3/_TFV3.pdf
5. FAMILY VALUES IN A HISTORICAL PERSPECTIVE - The Tanner Lectures on www.tannerlectures.utah.edu/_documents/a-to-z/s/Stone95.pdf
6. PROBLEMS OF INDIA'S CHANGING FAMILY AND STATE ... - the United Nations - www.un.org/esa/socdev/family/docs/egm09/Singh.pdf

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SEMESTER IV

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U17MAT4101	NUMERICAL METHODS AND PROBABILITY (Common to AE/AUE/CE/ME/MCE/EEE)	L	T	P	J	C
		3	1	0	0	4

Course Outcomes

After successful completion of this course, the students should be able to	
CO1:	Apply various numerical techniques for solving non-linear equations and systems of linear equations.
CO2:	Analyze and apply the knowledge of interpolation and determine the integration and differentiation of the functions by using the numerical data.
CO3:	Predict the dynamic behaviour of the system through solution of ordinary differential equations by using numerical methods.
CO4:	Solve PDE models representing spatial and temporal variations in physical systems through numerical methods.
CO5:	Apply the concepts of probability to random variables.
CO6:	Construct probabilistic models for observed phenomena through distributions which play an important role in many engineering applications.

Pre-requisite

Nil

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

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	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	S	S												
CO2	S	S												
CO3	S	S							M					
CO4	S	S											M	M
CO5	S	S							M				M	M
CO6	S	S												

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I,II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination	1. Course-end survey

SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS	**9+3 Hours**
Linear interpolation method – Iteration method – Newton's method – Solution of linear system by Gaussian elimination and Gauss-Jordan methods - Iterative methods: Gauss Jacobi and Gauss - Seidel methods – Inverse of matrix by Gauss – Jordan method – Eigen values of a matrix by Power method.	
INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION	**9+3 Hours**
Lagrange's and Newton's divided difference interpolation – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal and Simpson's rules.	
NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS	**9+3 Hours**
Single step methods: Taylor'sseries method–Euler and Improved Euler methods for solving a first order equations – Fourth order Runge-Kutta method for solving first and second order equations – Multistep method: Milne's predictor and correct or method.	
BOUNDARY VALUE PROBLEMS IN PARTIALDIFFERENTIALEQUATIONS	**9+3 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.	
PROBABILITY AND RANDOM VARIABLES	**9+3 Hours**
Axioms of probability - Conditional probability – Total probability – Bayes' theorem – Random variable – Distribution function – properties – Probability mass function- Probability density function – moments - Binomial, Poisson and Normal distributions – Properties.	
Theory:45 Hours Tutorials: 15 Hours Total: 60 Hours	
REFERENCES:	

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1. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", 9th Edition, Khanna Publishers, New Delhi,2007.
2. Gerald, C. F. and Wheatley, P. O., "Applied Numerical Analysis", 7th Edition, Pearson Education Asia, New Delhi,2007.
3. Chapra,S.CandCanale,R.P."NumericalMethodsforEngineers",7th Edition,TataMcGraw- Hill, New Delhi, 2016.
4. R.A. Johnson and C.B. Gupta, "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition,2016.
5. R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 9th edition,2017.
6. Gupta S.C, and Kapur V.K "Fundamentals of Applied Statistics", Sultan Chand, NewDelhi, 4th Edition,2014.

U17MCI4201	HYDRAULICS AND PNEUMATICS	L	T	P	J	C
		3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to	
CO1:	Describe the concept of fluid power and different types of fluid power systems.
CO2:	Explain the working principles of different types of hydraulic pumps.
CO3:	Discuss the working principles of different types of hydraulic actuators
CO4:	Summarize the working principles of compressors and pneumatic components.
CO5:	Design hydraulic and pneumatic circuits for simple applications.
CO6:	Explain the concept of fluid logic control systems, maintenance of fluid power systems

Pre-requisite

Nil

CO/PO Mapping

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

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

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination	1. Course end survey

FUNDAMENTALS OFFLUIDPOWER	**6 Hours**
Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids. Fluid power symbols. Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids. Fluid power symbols.	
HYDRAULIC SYSTEM AND COMPONENTS	**10 Hours**
Pumping theory – Pump classification – Gear pump, Vane Pump, piston pump, construction and working of pumps – pump performance – Variable displacement pumps. Linear hydraulic actuators – Types of hydraulic cylinders–Singleacting,Doubleactingspecialcylindersliketandem,Rodless,Telescopic-Constructionand application. Cushioning mechanism, Rotary actuators - Gear, Vane and Piston motors - Selection of Pumps andactuators.	
HYDRAULIC VALVES, ACCUMULATORS AND CIRCUITS	**10 Hours**
Directional control valve – 3/2 way valve – 4/2, 4/3 way valve – Shuttle valve – check valve. Pressure control valves, Flow control valve – Fixed and adjustable, electrical control solenoid valves. Types of accumulators, Accumulators circuits, Intensifier – Circuit and Application, Speed control circuits, synchronizing circuit and industrial application circuits – copying circuit and press circuit.	
PNEUMATIC SYSTEMS, COMPONENTS AND CIRCUITS	**10 Hours**
Properties of air – Compressors – Filter, Regulator, and Lubricator Unit – Air control valves, Quick exhaust valves and pneumatic actuators. Pneumo hydraulic circuit, Sequential circuit design for simple applications using cascade method, Karnaugh – Veitch Mapping method.	
FLUID LOGIC CONTROL SYSTEMS AND MAINTENANCE	**9 Hours**
Hydro Mechanical servo systems, Electro-hydraulic and Electro-pneumatic systems and proportional valves. Fluidic Logic and switching controls - PLC applications in fluid power control, Maintenance - Failure and trouble shooting in fluid power systems.	
Theory:45 Hours Tutorials: 30 Hours Total: 75 Hours	

REFERENCES:

1. Anthony Esposito, “Fluid Power with Applications”, Pearson Education Inc., 7th Edition2014.
2. MajumdarS.R.,“Pneumaticsystems–Principlesandmaintenance”,TataMcGraw-Hill,2009.
3. James A. Sullivan, “Fluid Power: Theory and Applications”, C.H.I.P.S, 4th edition,2007.
4. Andrew Parr, “Hydraulics and Pneumatics ", Jaico Publishing House,2005.
5. Srinivasan R, “Hydraulic and Pneumatic Controls”, McGraw Hill Education,2008.

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LIST OF EXPERIMENTS
1. Design and testing of the following hydraulic circuits: i. Pressure control ii. Flow control iii. Sequential circuit using an Electro hydraulic Trainer kit. 2. Design and testing of the following pneumatic circuits: i. Pressure control ii. Flow control iii. Circuits with logic controls iv. Circuits for multiple cylinder sequencing in Pneumatic, Electro pneumatic Trainer kits. 3. Simulation of basic hydraulic, pneumatic and electrical circuits using Automation Studio software.

U17MCI4202	SENSORS AND INSTRUMENTATION	L	T	P	J	C
		3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to	
CO1:	Classify the transducers and instruments base don their working principles, characteristics and order of the system.
CO2:	Describe the working principle and characteristics of non-electrical transducers.
CO3:	Discuss about the construction, working principles and characteristics of bio medical sensors
CO4:	Generate appropriate design procedure, suitable for signal conversion to interface with computer.
CO5:	Design appropriate circuits by using conventional formulas used in signal conditioning and conversion.
CO6:	Use sensors and transducers to create simple Mechatronics applications using data logging software

Pre-requisite

Nil

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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			W									W	
CO2	S			M	M								M	
CO3	S			M	M								M	
CO4	S	M	S	S	M								S	M
CO5	M	M	S	S	M								S	M
CO6	M	M		S	S								S	

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I,II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination	1.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, Tacho generators 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.

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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:45Hours Practical:30Hours Total Hours:75

REFERENCES:

1. ErnestODoebelin,"MeasurementSystems–ApplicationsandDesign",TataMcGraw-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, 2009
4. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12thedition, Dhanpat Rai & Co, New Delhi, 2013.

LIST OF EXPERIMENTS

1. Design and testing of Voltage to frequency converter and frequency to voltage converter
2. Design and testing of sample and hold circuit.
3. Displacement measurement using potentiometer and LVDT and plotting the characteristic curves.
4. Study of Characteristics and calibration of strain gauge and Load Cell
5. Measurement of strain using resistive type strain gauges with temperature compensation and various ridge configurations
6. Temperature measurement using Thermocouple, Thermistor and RTD and comparing the characteristics.
7. Comparison of capacitive and resistive type transducer for humidity measurement with their characteristics
8. Measurement of sound using microphones and sound level meter.
9. Measurement of temperature, strain, displacement, acceleration using NI DAQ and RIO cards.
10. Signal conditioning the physical signals using LABVIEW..

U17MCT4103	THEORY OF MACHINES	L	T	P	J	C
		3	1	0	0	4

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:	Explain the significance of balancing and solve balancing problems related to rotating and reciprocating masses.
CO5:	Choose appropriate gear train for a given application

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

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												S	
CO2	M													
CO3	M		M										M	
CO4	M		W										M	
CO5	M		W										M	
CO6	M		M										M	

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I,II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination	1. Course end survey

INTRODCUTION	**6 Hours**
Basic Elements of Mechanisms – Introduction to kinematic links, pairs, chain, machine and structure,degreesoffreedom.Grashoff'slaw,Kutzbackcriterion.Kinematicinversionsoffour- bar and slider crank chain.	
KINEMATICS	**10 Hours**
Velocity and acceleration analysis for simple mechanism, Classification of CAM and follower, displacement diagram. Construction of cam profile for uniform velocity, uniform acceleration of follower. Construction of cam profile for Simple Harmonic Motion (SHM) and cycloidal motion of follower.	
GEAR AND FRICTION DRIVES	**9 Hours**
Gear and Friction drives - Fundamentals of toothed gearing, spur gear terminology. Involute gear tooth profile. Gear meshing, contact ratio. Gear trains, simple compound gear trains and epicyclic gear train. Belt, Clutch (Including Problems) – Screw and Brake (Concept only).	
BALANCING	**12 Hours**
Introduction, static and dynamic. Balancing of single mass rotating in single plane. Balancing of several masses rotating in single plane. Balancing of several masses rotating in different planes. Balancing of reciprocating masses. Balancing of single cylinder engine. Balancing of multi cylinder inline engine. Hammer blow, swaying couple, tractive force. Turning moment diagram of multi cylinder engine. Energy stored in flywheel.	
GYROSCOPE	**8 Hours**

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Forces and couples, effect of gyroscopic couple in aero planes and ships, stability of two-wheel and four- wheel vehicle. Types of vibration, longitudinal, transverse and torsional, transverse vibration: Dunkerley's method. Critical speed of shafts, frequency of undamped system

Theory:45 Hours Tutorials:15 Hours Total Hours:60

REFERENCES:

1. Rattan S S., "Theory of Machines", 2nd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007.
2. R.L. Norton, "Kinematics and Dynamicsof Machinery", Tata McGraw Hill Publishing CompanyLtd.,2014.
3. R.K. Bansal, "Theory of Machines", Lakshmi publications pvt.ltd.,2011.
4. SingiresuS.Rao, "Mechanical Vibrations", Nem Chand and Bros, 1998.
5. Thomas Beven, "Theory of Machines", CBS Publishers and Distributors, 3rd edition, 2013.

U17MCT4004	DIGITAL ELECTRONICS AND MICROPROCESSOR	L	T	P	J	C
		3	0	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 various combinational and sequential circuits
CO4:	Explain the architecture of 8085 microprocessor
CO5:	Write assembly language program for 8085 for the given application.
CO6:	Explain the memory Mapping and I/O devices.

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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	S	W	M										W	
CO3	M	S	S										M	M
CO4	M													M
CO5	M				S									S
CO6	M		S		S								M	S

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I,II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination	1.Course end survey

NUMBER SYSTEMS, DIGITAL LOGIC FAMILIES ANDBOOLEAN 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, Parallel adder and Subtractor- Carry look ahead adder- BCD adder, Magnitude Comparator, parity checker Encoder, decoder,Multiplexer/Demultiplexer,codeconverters,Functionrealizationusinggatesandmultiplexers. 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, Counters, Ring counter and Johnson counter.	
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- Peripheral ICs*: 8255, 8279 and 8251 A. * Emphasis to be given on architecture with simple applications.	
Theory:45Hours Total Hours:45	
REFERENCES:	

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1. Morris Mano M. and CilettiM 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”, 5th edition, oxford university press, 2018.

4. Ramesh Gaonkar, “Microprocessor Architecture, Programming and Applications with the 8085”, 6th edition, Penram International (India), 2013.

5. Aditya P Mathur, “Introduction to Microprocessor”, 3rdedition,Tata McGraw Hill, New Delhi, 2003.

U17INI4600	ENGINEERING CLINIC - II	L	T	P	J	C
		0	0	4	2	3

Course objectives

- To help the students look into the functioning of simple to complex devices and systems
- To enable the students to design and build simple systems on their own
- To help experiment with innovative ideas in design and teamwork
- To create an engaging and challenging environment in the engineering lab

Course Outcomes	
After successful completion of this course, the students should be able to	
CO1:	Identify a practical problem and find a solution
CO2:	Understand the project management techniques

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CO3:	Demonstrate their technical report writing and presentation skills

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	S	S	S	M	W		S			S	S	M
CO2											S		S	M
CO3										S			S	M

Course Assessment methods:

DIRECT	INDIRECT
1. Project reviews 50% 2. Workbook report10% 3. Demonstration & Viva-voce 40%	1. Course Exit Survey

Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flyingmachines.

In the fourth semester, students will focus primarily on Raspberry pi-based controllers with Python programming

GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the ‘Engineering Clinics Expo’ at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hours: 90

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U17VEP4504	PROFESSIONAL VALUES	L	T	P	J	C
		0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to	
CO1:	Develop the ethical values in both professional and personal life
CO2:	Develop ability to take decision to reinforce professional life
CO3:	Rational in professional skills required for diverse society
CO4:	Excel in ingenious attitude to congregate professional life
CO5:	Research into the professional stand
CO6:	Spruce an Individual with decorum to achieve professional life

Pre-requisite

Nil

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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				M										
CO3			S											
CO4												S		
CO5								M						
CO6										M				

Course Assessment methods:

DIRECT	INDIRECT
1. Group Activity / Individual performance and assignment 2. Assessment on Value work sheet /Test	1. Mini project on values / Goodwill Recognition

VALUES THROUGH PRACTICAL ACTIVITIES:	**30 Hours**

1. **ProfessionalskillsWithValues:**PositiveAttitude,Adaptability,Responsibility,Honesty and Integrity, Self Esteem, & Self Confidence
2. **Building Innovative work cultures:** Creative thinking, Critical thinking, Conflict Resolution, Problem Solving, & Decisionmaking
3. **Professional Work Ethics:** Types of Ethics, Etiquette, personality Grooming,

   Emotional quotient, Human Dignity, Safety & Role of Professional in Social Responsibility
4. **Engineering Ethics:** Engineering Council of India - Objectives - Code of Ethics - Social responsibility -Professional Quality - Ethical issues - Effects - Strategy – Corruption, Consequences, Cures
5. **Case studies in engineering ethics:** Discussion of case studies relating to Public safety, health, welfare, Quality of product, Improper conduct by management, Product responsibility, Intellectual property

Theory:0 Tutorial:0 Practical:30 Project:0 Total: 30hours

Workshop mode

REFERENCES:

1. LEARNING TO DO SOURCEBOOK 3 - UNESCO-UNEVOC - PDF
   www.unevoc.unesco.org/fileadmin/user_upload/pubs/LearningToDo.pdf
2. DECLARATION OF PROFESSIONAL VALUES AND ETHICAL STANDARDS
   www.garda.ie/Documents/User/declarationvalues.pdf
3. KARMA YOGA - SWAMI VIVEKANANDA
   www.vivekananda.net/PDFBooks/KarmaYoga.pdf
4. PROFESSIONAL ETHICS IN ENGINEERING - Sasurie College of Engineering www.sasurieengg.com/.../GE2025%20Professional%20Ethics%20in%20Engineering
5. ENGINEERING ETHICS CASE STUDY; Challenger
   www.ucc.ie/en/processeng/staff/academic/ebyrne/.../PE1006PptNotesLect7.pdf

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U17CHT4000	Environmental Science and Engineering (Common to All branches)	L	T	P	J	C
		3	0	0	0	0

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:	Consider issues of environment and sustainable development in his/her 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

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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					S		M					
CO2						M				M			M	
CO3							M							
CO4						M	S						M	
CO5							S							
CO6			W				S					M		

Course Assessment methods:

DIRECT	INDIRECT
1. Internal TestI 2. Internal TestII 3. Assignment 4. Group presentation	1.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 nonrenewable 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 ECOSYSTEM:	**9 Hours**

Concept of an ecosystem – Structure and function of an ecosystem: Producers, consumers and decomposers, Food chain, Food web, Energy flow in the ecosystem and Ecological pyramids – Ecological succession – 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 – Bio geographical classification of India – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic values – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts

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– Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

ENVIRONMENTAL POLLUTION	**8 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	**7 Hours**

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

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

REFERENCES:

1. G. Tyler Miller and Scott Spoolman, 'Environmental Science', Fourteenth Edition, Brooks Cole, 2012.
2. Gilbert M. Masters and Wendell P. Ela, 'Introduction to Environmental Engineering and Science', Third Edition, Pearson Education, 2013.
3. Bharucha Erach, 'The Biodiversity of India', Mapin Publishing Pvt. Ltd., Ahmedabad, 2002.
4. Trivedi R.K and P.K.Goel, '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, W.P. Cooper and T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publication House, Mumbai, 2001.
7. Wager K.D., 'Environmental Management', W.B. Saunders Co., Philadelphia, USA, 1998.
8. Colin R. Townsend, Michael Begon and John L. Harper, 'Essentials of Ecology', Third Edition, Blackwell Publishing, 2008.

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SEMESTER V

U17MCI5201	INDUSTRIAL ELECTRONICS AND DRIVES	L	T	P	J	C
		3	0	2	0	4

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	**K2**
CO2:	Describe the concept of operation of AC-DC converters	**K2**
CO3:	Identify the operating the single phase and three phase inverter circuits	**K3**
CO4:	Describe the various PWM techniques.	**K2**

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CO5:	Identify DC equipment with changing DC voltage and choppers for simple electrical application	**K3**

Pre-requisite

U17MCI3201- Electrical Machines

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				M					M			S	
CO2	S												M	
CO3	S				M								M	
CO4	S	S	S										W	
CO5		M	S		M						M		S	
CO6	S				M					M			S	

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) **3.** End Semester Examination	1. Course end survey

POWER SEMICONDUCTOR DEVICES	**9 Hours**
Thyristors – Volt-Ampere Characteristics – Switching Characteristics-Power MOSFET – Volt-Ampere Characteristics – Switching Characteristics - Power IGBT – Volt-Ampere Characteristics – Switching Characteristics	
AC to DC CONVERTERS	**9 Hours**
Diode Rectifiers – Single phase Bridge – R, RL – Thyristor Converter – Single phase bridge – RL – schemes of DC motor speed control - Single phase separately excited drive.	
INVERTERS	**9 Hours**
Single-phase VSI – Half-bridge – Centre tapped inverter – Full bridge inverter -Three-phase VSI – Square-wave–Control of induction motor by voltage source inverter.	
PWM TECHNIQUES	**9 Hours**
PWM Inverter – fundamental concepts of PWM – naturally sampled PWM - PWM analysis by duty cycle variation	
DC- DC CONVERTER	**9 Hours**
DC Chopper - Step Down Converter – Step Up Converter -Buck Boost Converter – Introduction - Fly Back converter-speed control of PMDC motor.	
Theory: 45 Tutorial: 0 Practical:30 Project: 0 Total: 75 Hours	
REFERENCES:	

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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. D. Grahame Holmes, Thomas A. Lipo “Pulse Width Modulation for Power Converters: Principles and Practice”, John Wiley & Sons, 2003.

LIST OF EXPERIMENTS	**30 Hours**

Voltage-Current characteristics of SCR
Voltage-Current characteristics of IGBT/MOSFET
AC-DC uncontrolled converter
AC-DC converter for half wave controlled using phase control method
Speed control of PMDC motor using three phase fully controlled converter
DC Voltage control using DC – DC Converter
Buck – boost converters
Single phase IGBT based PWM inverter
Speed control of three phase induction motor using AC to AC voltage control
Speed control of BLDC motor

Theory: 45 Tutorial: 0 Practical: 30 Project: 0 Total: 75 Hours

U17MCI5202	**PROGRAMMABLE LOGIC CONTROLLERS**	**L**	**T**	**P**	**J**	**C**
		3	**0**	**2**	**0**	**4**

Course Outcomes

After successful completion of this course, the students should be able to		
CO1:	Outline the importance of PLC, DCS, SCADA in industrial automation	**K2**
CO2:	Describe the architecture of PLCs with the analogy of relay logic components	**K2**

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CO3:	Develop ladder logic program for applications	**K3**
CO4:	Integrate PLCs with electro-mechanical systems	**K3**
CO5:	Classify the communication protocols	**K2**
CO1:	Design SCADA system for industrial applications	**K3**

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													
CO2:	M													
CO3:	M	M		M	S					S			S	M
CO4:	M	M	M		S								M	
CO5;	M												M	
CO6:	M	M	M	M	S					S			S	S

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I, II 2. Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination	1. Course end survey

INTRODUCTION	**6 Hours**
Role of automation in industries, Benefits of automation –Introduction to automation tools: Low cost automation, PLC, DCS, SCADA - Automation strategy evolution.	
PLC HARWARE MODULES AND PROGRAMMING	**6 Hours**
CPU – processor function – processor operating modes – PLC system memory and application memory – input modules – output modules – module selection – PLC internal operation and signal processing – input and output processing	
PROGRAMMING OF PLC SYSTEM	**11 Hours**
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.	
INDUSTRIAL COMMUNICATION PROTOCOLS	**11 Hours**
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), Foundation Fieldbus (H1&HSC). Comparison of Foundation Fieldbus, Modbus, Devicenet, Profibus, Industrial Ethernet.	
SCADA SYSTEMS	**11 Hours**
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	

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PLC based automation systems, Application Development using SCADA system
Theory: 45 Tutorial: 0 Practical: 30 Project: 0 Total: 75 Hours
REFERENCES:
1. John W Webb and Ronald A Reis, "Programmable logic controllers: Principles and Applications", 5th Edition, Prentice Hall India, 2002. 2. Michael P Lukas, "Distributed Control systems", Van Nostrand Reinfold Company, 1995. 3. Frank D Petruzella, "Programmable Logic Controllers", 5th edition, McGraw-Hill Companies, March 2017. 4. Ian G Warnock, "Programmable Controllers Operation and Application", Prentice Hall International, UK, 1992 5. Krishna kant, "Computer Based Industrial Control", 2nd revised edition, Prentice Hall of India, 2011.

LIST OF EXPERIMENTS	**30 Hours**

1. Construct a circuit to control a simple process using Relay and Timer module.
2. Design a T-junction traffic light controller using PLC
3. Design a PLC Program for automating bottle filling systems
4. Develop a PLC system to control a simple conveyor system
5. Study of industrial process automation and communication network architecture
6. Develop an HMI design for a simple pump tank system.
7. Develop a simple SCADA application using Dynamos.
8. Develop a SCADA panel to control a PLC based system.
9. Design a PLC ladder logic program to control the Speed of a motor
10. Design a PLC ladder logic program to control the Position of a servomotor

Theory: 45 Tutorial: 0 Practical: 30 Project: 0 Total: 75 Hours

U17MCT5003	DESIGN OF MACHINE ELEMENTS	L	T	P	J	C
		3	0	0	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	**K3**

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CO2:	Apply the basic concepts of design to Estimate the life of the components subjected to varying loads	**K3**
CO3:	Design the circular shafts based on strength and rigidity, keys and couplings for power transmission	**K3**
CO4:	Apply the basics of power transmission to select the belts	**K3**
CO5;	Design the welded joints, threaded joints and springs subjected to static and dynamic loads	**K3**
CO6:	Select the rolling contact bearings for static and cyclic loads	**K3**

Pre-requisite

1. U17MCT3102 Mechanics of solids
2. U17MCT4103 Theory of Machines

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								M	W
CO2	S				M								M	
CO3	S												M	
CO4	M												W	
CO5	S												M	
CO6	M												W	

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination	1. 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.

IGN 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 POWER TRANSMITTING ELEMENTS	**8 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 – Belt drives: Selection of Flat belts, V-belts and ribbed belts.

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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	10 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.

Theory: 45 Tutorial: 0 Practical: 0 Project: 0 Total: 45 Hours

REFERENCES:

1. Bhandari V B., "Design of Machine Elements", 4th edition, Tata McGraw Hill Publication Co. Ltd., 2016.Principles and Applications", 5th Edition, Prentice Hall India, 2002.
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.
5. Krishna kant, "Computer Based Industrial Control", 2nd revised edition, Prentice Hall of India, 2011..

U17MCT5004	CONTROL ENGINEERING	L	T	P	J	C
		3	0	0	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	K2

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CO2:	Develop mathematical equations for model mechanical, electrical systemsand canable to compute transfer function using block diagram and signal flow graph methods	**K3**
CO3:	Analyze the 1st and 2nd order systems in time domain for various test signals and Calculate steady state errors and derive generalized error series in the time domain analysis	**K3**
CO4:	Analyze the 1st and 2nd order systems in frequency domain using Bode and Polar plots.	**K3**
CO5;	Calculate the stability of the system using Routh Hurwitz, Nyquist and Root Locus techniques.	**K3**
CO6:	Explain about PID control and tuning, time delay responses and also discuss sequence control in process industry	**K2**

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													
CO2	S													M
CO3	S		M											M
CO4	S			M										
CO5			M	M										
CO6	S				M									

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I, II 2. Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc.(as applicable). 3. End Semester Examination	1. Course end survey

INTRODUCTION	**12 Hours**

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

TIME DOMAIN ANALYSIS	**12 Hours**

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	**12 Hours**

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. **Tutorials**: Bode plot and polar plot using MATLAB.

STABILITY OF CONTROL SYSTEMS	**12 Hours**

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

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AUTOMATIC CONTROL	12 Hours
Introduction to Automatic Control -P-I-D Control - PID Control Tuning - Feed forward Control Ratio Control - Time Delay Systems and Inverse Response Systems - Special Control Structures - Introduction to Sequence Control, PLC, RLL.	
Theory: 60 Tutorial: 0 Practical: 0 Project: 0 Total: 60 Hours	

REFERENCES:

1. Nagrath I J. and Gopal M., "Control Systems Engineering", 5th edition, Prentice Hall of India, New Delhi, 2009.Co. Ltd., 2016.
2. Principles and Applications", 5th Edition, Prentice Hall India, 2002.
3. Katsuhiko Ogata, "Modern Control Engineering", 5th edition, Prentice Hall India, 2011Hill International, 2008.
4. R.C Dorf and R.H. Bishop, "Modern Control systems", 12th edition, Pearson India, 2014
5. Curtis D Johnson, "Process control Instrumentation technology", Prentice Hall India, 2013.

U17INI5600	ENGINEERING CLINIC - III	L	T	P	J	C
		0	0	4	2	3

Course Outcomes

Course objectives
To help the students look into the functioning of simple to complex devices and systems
To enable the students to design and build simple systems on their own

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To help experiment with innovative ideas in design and team work	
To create an engaging and challenging environment in the engineering lab	
To help the students look into the functioning of simple to complex devices and systems	
After successful completion of this course, the students should be able to	
CO1:	Identify a practical problem and find a solution
CO2:	Understand the project management techniques
CO3:	Demonstrate their technical report writing and presentation skills

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	S	S	S	M	W		S			S	S	M
CO2											S		S	M
CO3	S									S			S	M

Course Assessment methods:

DIRECT	INDIRECT
1. Project reviews 50% 2. Workbook report 10% **3.** Demonstration & Viva- voce 40%	1. Course Exit Survey

Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the fifth semester students will focus primarily on design project combining concepts learnt in engineering Clinic I and II

GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total: 90 Hours

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U17VEP5505	SOCIAL VALUES (Mandatory)	L	T	P	J	C
		0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to	
CO1:	Understand the transformation from self to society

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CO2:	Acquire knowledge about disparity among Human Beings
CO3:	Realize the new ethics in creating a more sustainable Society
CO4:	Develop skills to manage challenges in social issues.
CO5;	Acquire the skills for Management of Social work & Holistic Society
CO6:	Validate the social liabilities at dissimilar situations

Pre-requisite

1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES
3. U17VEP3503 / FAMILY VALUES
4. U17VEP4504 / PROFESSIONAL VALUES

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								M						
CO4											S			
CO5												S		
CO6									M					

Course Assessment methods:

DIRECT	INDIRECT
1. Group Activity / Individual performance and assignment **2.** Assessment on Value work sheet / Test	Mini project on values / Goodwill Recognition

Values through Practical activities:

1. **Self and Society:** Relation between self and society – Different forms of society - Elements of Social structures – Realization of Duties and Responsibilities of Individual in the Society
2. **Social Values:** Tolerance – Responsibility – Sacrifice – Sympathy - Service – peace- nonviolence - right conduct- Unity – forgive – dedication – Honest
3. **Social issues :**Disparity among Human beings- Poverty-Sanitation -corruption- un employment- superstition – religious intolerance & castes – terrorism.
4. **Emerging Ethics for Sustainable Society:** Unison of Men in Society - Positive Social Ethics - Cause and Effect - Ensuring an Equitable Society- Effect of Social Media in society - development of Education and Science in the Society
5. **Social Welfare**: Social welfare Organization - Programme by Government and NGO's - Benefits of Social Service - Balancing the Family and Social Life – Development of

Holistic Society systems - Electrical networks - Block diagram – Signal flow graph - Mason's gain formula. Transfer function - Transfer function of DC servomotor, AC servomotor

Workshop mode

REFERENCES:

1. SOCIAL PROBLEMS IN INDIA - ForumIAS.com – PDF discuss.forumias.com/uploads/File upload/.../711b18f321d406be9c79980b179932.pd...
2. INVESTING IN CULTURAL DIVERSITY AND INTERCULTURAL DIALOGUE: UNESCO ...

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www.un.org/en/events/culturaldiversityday/pdf/Investing_in_cultural_diversity.pdf
3. INDIAN SOCIETY AND SOCIAL CHANGE - University of Calicut www.universityofcalicut.info/SDE/BA_sociology_indian_society.pdf
4. CULTURE, SOCIETY AND THE MEDIA - E- class www.eclass.uoa.gr/.../MEDIA164/.../%5BTony_Bennett,_James_Curran,_Michael_G
5. SOCIAL WELFARE ADMINISTRATION - IGNOU www.ignou.ac.in/upload/Bswe-003%20Block-2-UNIT-6-small%20size.pdf

U17INT5000	CONSTITUTION OF INDIA (Mandatory course)	L	T	P	J	C
		2	0	0	0	2

Course Outcomes

After successful completion of this course, the students should be able to	
CO1:	Gain Knowledge about the Constitutional Law of India
CO2:	Understand the Fundamental Rights and Duties of a citizen
CO3:	Apply the concept of Federal structure of Indian Government

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CO4:	Analyze the Amendments and Emergency provisions in the Constitution.
CO5;	Develop a holistic approach in their life as a Citizen of 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	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1						M			W			S		
CO2						S		S				M		
CO3									M	S		W		
CO4								W	M			M		
CO5						M		M				S		
CO6									M					

Course Assessment methods:

DIRECT	INDIRECT
1. Group Activity / Quiz/ Debate / Case studies **2.** Class test / Assignment	Surveys

THEORY COMPONENT:

Module.1: Introduction to Indian Constitution :	**4Hours**
Meaning of the constitution law and constitutionalism - Historical perspective of the Constitution - Salient features and characteristics of the Constitution of India	
Module.2: Fundamental Rights	**8 Hours**
Scheme of the fundamental rights - Right to Equality - Fundamental Right under Article 19 - Scope of the Right to Life and Liberty - Fundamental Duties and its legal status - Directive Principles of State Policy – Its importance and implementation	
Module.3: Federal Structure	**8 Hours**
Federal structure and distribution of legislative and financial powers between the Union and the State - Parliamentary Form of Government in India - The constitutional powers and status of the President of India	
Module.4: Amendment to Constitution	**6 hours**
Amendment of the Constitutional Powers and Procedure - The historical perspectives of the constitutional amendments in India	
Module.5: Emergency Provisions	**4 hours**
National Emergency, President Rule, Financial Emergency Local Self Government – Constitutional Scheme in India	
Theory: 30 Tutorial: 0 Practical: 0 Project: 0 Total: 30 Hours	
REFERENCES:	

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1. Constitution of India - Ministry of Law & ustice – PDF format awmin.nic.in/coi/coiason29july08.pdf
2. Introduction to the Constitution of India by Durgadas Basu
3. The Constitution of India – Google free material –
4. Parliament of India – PDF format *download.nos.org/srsec317newE/317EL11.pdf*
5. The Role of the President of India – By Prof. Balkrishna .
6. Local Government in India – E Book - Pradeep Sachdeva

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SEMESTER VI

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U17MCI6201	ROBOTICS ENGINEERING	L	T	P	J	C
		3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to		
CO1:	Explain the robotic terminologies for various configurations	**K2**
CO2:	Select an appropriate gripper for a given application and use a gripper for pick and place application	**K3**
CO3:	Calculate the forward kinematics, inverse kinematics and Jacobian for a serial robot	K3
CO4:	Apply Lagrangian and Newton-Euler methods to analyze dynamic characteristics of a robot .	K3
CO5;	Describe various control strategies and software interfaces used in robot	**K3**
CO6:	Explain and practice various programming techniques used in industrial robots	**K2,K3**

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													
CO2	S			W					M	M				
CO3	S	M	M		M				M	M				
CO4	S	M	M											
CO5	M													
CO6					S				M	M				

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I, II 2. Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) **3.** End Semester Examination	1. 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- Hardenberg Representation of forward kinematics equations of robots- Degeneracy and Dexterity	

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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 Tutorial: 0 Practical: 30 Project: 0 Total: 75 Hours	

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

LIST OF EXPERIMENTS	30 Hours

1. Study of different types of robots based on configuration and application.
2. Study of different type of robotics simulation software.
3. Modeling Forward and inverse kinematics for robotic arm using Mathematical Software
4. Offline programming of an Industrial robot using a Robotics simulation Software
5. Setup and program a robot with object profile tracking using a Robotics simulation Software
6. Develop a trajectory planning for a robot using a simulation software.
7. Setup and program an Industrial Robot with a pneumatic vacuum gripper for a simple pick and place operation
8. Writing and verifying a Program for point to point operations
9. Obstacle Avoidance of a robot using proximity Sensor
10. Speech recognition and object recognition algorithm in a robot.

Theory: 45 Tutorial: 0 Practical: 30 Project: 0 Total: 75 Hours

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U17MCI6202	MICROCONTROLLER AND EMBEDDED SYSTEMS	L	T	P	J	C
		2	0	2	0	3

Course Outcomes

After successful completion of this course, the students should be able to		
CO1:	Compare various cores of embedded systems	**K2**
CO2:	Develop applications on 8051 micro controller	**K3**
CO3:	Describe the features of ARM Cortex-M4 controller	**K2**
CO4:	Interface the peripherals of ARM Cortex-M4 controller	**K3**
CO5;	Develop embedded systems through hardware and software integration	**K3**
CO6:	Explain the concepts of real time operating systems	**K2**

Pre-requisite

U17MCT4004 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	PSO1	PSO2
CO1	M		M										M	M
CO2	M		S	M	S								S	S
CO3	W		M										M	M
CO4	M		S		S								S	S
CO5	W	M	S		S								S	S
CO6	S	S	M	M									M	M

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination	1. Course end survey

INTRODUCTION	**3 Hours**
Embedded system overview and applications, features - Brief introduction to embedded microcontroller cores: CISC, RISC, ARM and DSP .	
THE MICROCONTROLLER ARCHITECTURE	**9 Hours**
Introduction to 8051 Microcontroller: Architecture, Pin configuration, Memory organization, Input /Output Ports, Counter and Timers, Serial communication and Interrupts, Instruction set, Addressing modes, Simple programming	
INTRODUCTION TO TIVA ARM Cortex M4	**9 Hours**
Key Features – Functional Block Diagram - Pin Configuration –I/O pin multiplexing, pull up/down registers, GPIO control, Memory Mapped Peripherals, programming System registers, Watchdog Timer, need of low power for embedded systems, System Clocks and control, Hibernation Module on	

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Tiva, Active vs Standby current consumption. Introduction to Interrupts, Interrupt vector table, interrupt programming.

PERIPHERALS OF TIVA ARM Cortex	**9 Hours**

Timer, Basic Timer, Real Time Clock (RTC), Timing generation and measurements, Analog interfacing and data acquisition: ADC, Analog Comparators, DMA, Motion Control Peripherals: PWM Module & Quadrature Encoder Interface (QEI).

HARDWARE/SOFTWARE INTEGRATION	**6 Hours**

Host and Target Machines. Getting Embedded Software into Target System: Programmers, Display, Keyboard, Relay, Stepper and DC Motor Interfacing

REAL TIME OPERATING SYSTEMS	**9 Hours**

Survey of Software Architectures, Tasks and Task States, Tasks and Data, Semaphores and Shared Data, Message Queues, Mailboxes and Pipes, Timer functions, Events, Memory Management and Interrupt Routines in RTOS Environment. Study of embedded product design with real time concepts using RTOS

Theory: 45 Tutorial: 0 Practical: 30 Project: 0 Total: 75 Hours

REFERENCES:

1. Kenneth J Ayala and Dhananjay V Gadre, "The 8051 Microcontroller & Embedded Systems using Assembly and C" Cengage Learning (India edition), 2010Applications", 5th Edition, Prentice Hall India, 2002.
2. Jonathan W Valvano, "Introduction to Arm Cortex -M Microcontrollers", 2012
3. Steve Furber, "ARM System-on-Chip Architecture", Pearson Education, 2009..
4. David E Simon, "An Embedded Software Primer", Pearson Education Asia, New Delhi, 2009
5. Rajkamal, "Embedded Systems: Architecture, Programming and Design", Tata McGraw- Hill, New Delhi, 2008
6. Mazidi M A, Mazidi J G. and McKinlay R D., "The 8051 Microcontroller & Embedded systems", 2nd Edition, Pearson, 2008
7. Shibu K V., "Introduction to Embedded Systems" McGraw Hill, 2009.
8. Andrew N Sloss, Dominic Symes and Chris Wright, "ARM system developer's guide", Elsevier, 2010.

LIST OF EXPERIMENTS	**30 Hours**
8051 Assembly language program & interfacing	

1. Basic programming using 8051 ALP (addition, subtraction, multiplication, ascending, descending etc.)
2. 8051 peripheral programming (ADC, counter, timer, interrupts etc.)
3. Motor control using 8051(DC motor and stepper motor)
4. Build and test circuits with switches, LEDs, resistors, potentiometers, and liquid crystal displays
5. Synchronizing hardware and software input/output with switches, lights, sound, sensors, motors, and liquid crystal displays
6. Implementation of combination lock with Capsense
7. Motor control using PWM
8. Development of hypothetical Switch Protocol using GPIO and timer using ARM7and PSoC
9. Utilization of capacitive sensing (CapSense) module of PSoC board for simple applications
10. Study of E yantra board

Theory: 45 Tutorial: 0 Practical: 30 Project: 0 Total: 75 Hours

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U17MCI6203	COMPUTER AIDED MANUFACTURING	L	T	P	J	C
		3	0	2	0	4

Course Outcomes

After successful completion of this course, the students should be able to		
CO1:	Describe the fundamentals of Computer Aided Design.	**K2**
CO2:	Describe the basic and constructional features of CNC machines	**K2**
CO3:	Develop a CNC Part programming for the basic turning and milling operations	**K3**
CO4:	Explain the importance of group technology and Computer Aided process plan	**K2**
CO5;	Generate CNC programs for a given components to work in CNC machines	**K3**
CO6:	Draft, Model and assemble a given dimensional engineering components	**K3**

Pre-requisite

U17MCT2001 – 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	PSO1	PSO2
CO1	S									W				
CO2	M												W	
CO3	M	M	M		M								M	
CO4	M		W											
CO5	M				S									
CO6	S				S					M			S	

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I, II 2. Open book test; Cooperative learning report, Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination	1. Course end survey

FUNDAMENTALS OF COMPUTER GRAPHICS	**9 Hours**
Product Cycle- Design Process- Sequential And Concurrent Engineering- Computer Aided Design	

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– CAD System Architecture- Computer Graphics – Co-Ordinate Systems- 2D And 3D Transformations- Homogeneous Coordinates – Line Drawing -Clipping- Viewing Transformation

INTRODUCTION TO CNC	**8 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.

Group Technology and CAPP	**7 Hours**

Introduction, part families, part classification and coding systems: OPITZ, PFA, FFA, Cell design, rank order clustering, composite part concepts, Benefits of group technology. Approaches to Process Planning, Different CAPP system, application and benefits

Theory: 45 Tutorial: 0 Practical: 30 Project: 0 Total: 75 Hours

REFERENCES:

1. Radhakrishnan P., "Computer Numerical Control Machines", New Central Book Agency, 2011.Ltd., 2016.Principles and Applications", 5th Edition, Prentice Hall India, 2002.
2. Groover M P., "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall, 2007International, 2008.
3. YoremKoren, "Computer Control of Manufacturing Systems", Pitman, London, 1987
4. Chris McMahon and Jimmie Browne "CAD/CAM Principles", "Practice and Manufacturing management " Second Edition, Pearson Education, 1999
5. Ibrahim Zeid, Sivasubramanian R, "CAD/CAM: Theory & Practice" 2nd edition, McGraw Hill, Singapore, 2009.

LIST OF EXPERIMENTS	**30 Hours**

1. Drafting
2. Modeling
3. Assembly
4. Part Programming - CNC Machining Centre (Turning)
5. Part Programming - CNC Machining Centre (Milling)

Theory: 45 Tutorial: 0 Practical: 30 Project: 0 Total: 75 Hours

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U17INI6600	ENGINEERING CLINIC - IV	L	T	P	J	C
		0	0	4	2	3

Course objectives

To help the students look into the functioning of simple to complex devices and systems
To enable the students to design and build simple systems on their own
To help experiment with innovative ideas in design and team work
To create an engaging and challenging environment in the engineering lab.

Course Outcomes

After successful completion of this course, the students should be able to	
CO1:	Identify a practical problem and find a solution
CO2:	Understand the project management techniques
CO3:	Demonstrate their technical report writing and presentation skills

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	S	S	S	M	W		S			S		
CO2											S			
CO3										S				

Course Assessment methods:

DIRECT	INDIRECT
1. Project reviews 50% 2. Workbook report 10% 3. Demonstration & Viva-voce 40%	1. Course end survey

Content:

The course will offer the students with an opportunity to gain a basic understanding of computer controlled electronic devices and apply the concepts to design and build simple to complex devices. As a practical project based embedded course, the students will be taught the concepts using a variety of

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reference material available in the public domain. While the course will start with formal instruction on hardware, programming and applications, the major portion of the course will provide the students with ample opportunity to be innovative in designing and building a range of products from toys to robots and flying machines.

In the sixthh semester, students will focus primarily on reverse engineering project to improve performance of a product

GUIDELINES:

1. Practical based learning carrying credits.
2. Multi-disciplinary/ Multi-focus group of 5-6 students.
3. Groups can select to work on a specific tasks, or projects related to real world problems.
4. Each group has a faculty coordinator/Instructor who will guide/evaluate the overall group as well as individual students.
5. The students have to display their model in the 'Engineering Clinics Expo' at the end of semester.
6. The progress of the course is evaluated based on reviews and final demonstration of prototype.

Total Hours: 90

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U17VEP6506	NATIONAL VALUES (Mandatory)	L	T	P	J	C
		0	0	2	0	0

Course Outcomes

After successful completion of this course, the students should be able to	
CO1:	Acquire knowledge on the Essence of Indian Knowledge Tradition
CO2:	Know the great Indian personalities and follow their trail
CO3:	Understand the specialty of democracy
CO4:	Disseminate our Nation and its values to propagate peace
CO5:	Contribute with their energy and effort for a prosperous India
CO6:	Propagate the youth and the contribution for development of our Nation

Pre-requisite

1. U17VEP1501 / PERSONAL VALUES
2. U17VEP2502 / INTERPERSONAL VALUES
3. U17VEP3503 / FAMILY VALUES
4. U17VEP4504 / PROFESSIONAL VALUES
5. U17VEP5505 / SOCIAL VALUES

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									M					
CO3							M							
CO4								S						
CO5											S			
CO6												M		

Course Assessment methods:

DIRECT	INDIRECT

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1. Group Activity / Individual performance and assignment **2.** Assessment on Value work sheet / Test	1. Mini project on values / Goodwill Recognition

Values through Practical activities:

Essence of Indian Knowledge Tradition

Basic structure of Indian Knowledge System - Modern Science and Indian Knowledge System - Yoga and Holistic Health care - Case studies - Philosophical Tradition - Indian Linguistic Tradition - Indian Artistic Tradition

Great Indian Leaders

Ancient rulers - Freedom fighters - Social reformers -Religious and Spiritual leaders - Noble laureates - Scientists – Statesman

Largest Democracy

Socialist -Secular - Democratic and Republic – special features of Indian constitution – Three pillar of Indian democracy - Fundamental rights – Duties of a citizen – centre state relationship.

India's Contribution to World peace

Nonaligned Nation – Principle of PanchaSheela– Mutual respect, non-aggression, non-interference, Equality and cooperation – Role of India in UNO -Yoga India's gift to the world.

Emerging India

World's largest young work force - Stable Economic development - Labor market & Achievement in space technology – Value based Social structure. Emerging economic superpower.

Workshop mode

REFERENCES:

1. KNOWLEDGE TRADITIONS AND PRACTICES OF INDIA, CBSE Publication _cbseacademic.nic.in/web_material/Circulars/2012/68_KTPI/Module_6_2.pdf
2. CULTURAL HERITAGE OF INDIA - SCERT Kerala www.scert.kerala.gov.in/images/2014/HSC.../35_Gandhian_Stud ies_unit-01.pdf
3. LEARNING TO DO: VALUES FOR LEARNING AND WORKING TOGETHER - UNESCO www.unesdoc.unesco.org/images/0014/001480/148021e.pdf
4. INDIA AFTER GANDHI.pdf - Ramachandra Guha - University of Warwick www2.warwick.ac.uk/fac/arts/history/students/modules/hi297 /.../week1.pdf
5. INDIA'S CONTRIBUTION TO THE REST OF THE WORLD - You Sigma www.yousigma.com/interesting facts/indiasgifttotheworld.pdf
6. INDIA AS AN EMERGING POWER - International Studies Association web.isanet.org/Web/Conferences/.../11353cac-9e9b- 434f-a25b-a2b51dc4af78.pdf

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SEMESTER VII

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U17MBT7001	ENGINEERING ECONOMICS AND FINANCIAL MANAGEMENT	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to		
CO1:	Evaluate the economic theories, Cost concepts and pricing policies	**K2**
CO2:	Analyze the market structures and integration concepts	**K2**
CO3:	Apply the concepts of national income and understand the functions of banks and concepts of globalization	**K2**
CO4:	Apply the concepts of financial management for project appraisal and working capital management	**K2**
CO5:	Understand accounting systems	**K2**
CO6:	Analyze financial statements using ratio analysis	**K2**

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		L	
CO2											M		L	
CO3				M		M					M			
CO4											S			
CO5						M					S			
CO6			M		M						S			

Course Assessment methods:

DIRECT	INDIRECT
• Internal Tests	• Course End Survey

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• Assignments • Presentation • End Semester Exam	

ECONOMICS, COST AND PRICING CONCEPTS	**9 Hours**

Economic theories – Demand analysis – Determinants of demand – Demand forecasting – Supply

– Actual Cost and opportunity Cost – Incremental Cost and sunk Cost – Fixed and variable Cost – Marginal Costing – Total Cost – Elements of Cost – Cost curves – Breakeven point and breakeven chart – Limitations of break even chart – Interpretation of break evenchart – Contribution – P/V-ratio, profit-volume ratio or relationship – Price fixation – Pricing policies – Pricing methods.

CONCEPTS ON FIRMS AND MANUFACTURING PRACTICES	**9 Hours**

Firm – Industry – Market – Market structure – Diversification – Vertical integration – Merger

– Horizontal integration.

NATIONAL INCOME, MONEY AND BANKING, ECONOMIC ENVIRONMENT	**9 Hours**

National income concepts – GNP – NNP – Methods of measuring national income – Inflation

– Deflation – Kinds of money – Value of money – Functions of bank – Types of bank – Economic liberalization – Privatization – Globalization

CONCEPTS OF FINANCIAL MANAGEMENT	**9 Hours**

Financial management – Scope – Objectives – Time value of money – Methods of appraising project profitability – Sources of finance – Working capital and management of working capital

ACCOUNTING SYSTEM, STATEMENT AND FINANCIAL ANALYSIS	**9 Hours**

Accounting system – Systems of book-keeping – Journal – Ledger – Trail balance – Financial statements – Ratio analysis – Types of ratios – Significance – Limitations

Theory: 45 Tutorial: 0 Total: 45 Periods

REFERENCES:

1. Prasanna Chandra, “Financial Management (Theory & Practice), “TMH
2. Weston & Brigham, “Essentials of Managerial Finance”
3. Pandey, I. M., “Financial Management”
4. Fundamentals of Financial Management- James C. Van Horne.
5. Bhaskar S. “Engineering Economics and Financial Accounting”, (2003) Anuradha Agencies, Chennai
6. Financial Management & Policy -James C. Van Horne
7. Management Accounting & Financial Management- M. Y. Khan & P. K. Jain
8. Management Accounting Principles & Practice - P.Saravanavel
9. Ramachandra Aryasri. A., and Ramana Murthy V.V.,”Engineering Economics & Financial Accounting”-Tata McGraw Hill, New Delhi, 2006.
10. Varshney R.L., and Maheswari K.L., ”Managerial Economics” – Sultan Chand & Sons, New Delhi, 2001
11. Samvelson and Nordhaus,” Economics”-Tata McGraw Hill, New Delhi, 2002

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U17MCT7001	AUTONOMOUS VEHICLE	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to		
CO1:	Explain different types of mobile robot locomotion	**K2**
CO2:	Apply mobile robot kinematics and constraints	**K2**
CO3:	Choose sensors for the perception of mobile robots.	**K2**
CO4:	Implement robot localization techniques	**K3**
CO5:	Explain planning and navigation in robotics	**K2**
CO6:	Apply obstacle avoidance techniques in mobile robots	**K3**

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													M
CO2	S	M	M		M									S
CO3	S				M								M	S
CO4	S				M									S
CO5	S												M	S
CO6	S													M

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I, II 2. Assignment: Group Presentation 3. End Semester Examination	1. Course end survey

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LOCOMOTION	**9 Hours**
Introduction to Robotics – key issues in robot locomotion – Types of Locomotion -legged robots – wheeled mobile robots – aerial mobile robots – stability - robot maneuverability – controllability	
MOBILE ROBOT KINEMATICS	**9 Hours**
Forward and inverse kinematics, holonomic and nonholonomic constraints, kinematic models of simple car and legged robots, simulation of mobile robots	
ROBOT PERCEPTION	**9 Hours**
Proprioceptive/Exteroceptive and passive/active sensors, performance measures of sensors, sensors for mobile robots like global positioning system (GPS), Doppler effect-based sensors, vision-based sensors, uncertainty in sensing, filtering;	
MOBILE ROBOT LOCALIZATION	**9 Hours**
Introduction to localization – challenges in localization – localization and navigation – belief representation – map representation – probabilistic map-based localization – Markov localization, Kalman localization.	
PATH PLANNING AND NAVIGATION	**9 Hours**
Introduction to planning and navigation – planning and reacting – path planning algorithms based on A-star, Dijkstra, Voronoi diagrams – obstacle avoidance techniques	
Theory: 45	**Total: 45 Periods**

REFERENCES:

1. Roland Seigwart, Illah Reza Nourbakhsh, and Davide Scaramuzza, “Introduction to autonomous mobile robots”, Second Edition, MIT Press, 2011.
2. 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.
3. Gregory Dudek and Michael Jenkin, “Computational Principles of Mobile Robotics”, Second Edition, Cambridge University Press, 2010.
4. Peter Corke , Robotics, Vision and Control: Fundamental Algorithms in MATLAB, Springer Tracts in Advanced Robotics, 2011.
5. S. M. LaValle, “Planning Algorithms”, Cambridge University Press, 2006.

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U17MCT7002	IMAGE PROCESSING AND COMPUTER VISION	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to		
CO1:	Summarize the fundamentals of digital image processing	**K2**
CO2:	Apply image enhancement techniques in spatial and frequency domain.	**K3**
CO3:	Apply image segmentation and clustering techniques	**K3**
CO4:	Describe 3D vision concepts	**K2**
CO5:	Choose appropriate techniques for different applications	**K4**

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	W											S	
CO2	M	M	S		S								W	M
CO3	M	M	S		S								W	M
CO4	M	M		S									M	S
CO5	S	S	S	S	S								S	S

Course Assessment methods:

DIRECT	INDIRECT
Internal test I Internal test II End semester Examination Assignment	Course end survey

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FUNDAMENTALS OF IMAGE PROCESSING	7 Hours
Introduction to Image processing and Computer Vision; Digital image representation; elements of digital image processing systems; Structure of the human eye; a simple image model; brightness adaptation and discrimination; Electromagnetic Spectrum. Image Sensing and Acquisition. Some Basic Relationships Between Pixels.	
IMAGE ENHANCEMENT	**10 Hours**
Basic gray level transformations-histogram equalization- Arithmetic/logic Operations-Basics of spatial filtering-comparison between smoothing and sharpening spatial filters.2D Fourier transform - Smoothing & sharpening Frequency domain filters (Ideal, Butterworth, Gaussian)	
SEGMENTATION AND CLUSTERING	**10 Hours**
Segmentation – Thresholding, Edge detection and Region growing, watershed, Binary Morphology and grey morphology operations. boundary descriptors–chain codes –Fourier descriptors –region descriptors, moments Clustering: K-means Clustering. Pattern recognition.	
3D VISION GEOMETRY	**9 Hours**
3D vision tasks, Basics of projective geometry, A single perspective camera, Scene reconstruction from multiple views, Two cameras stereopsis, Three cameras and trifocal tensor, 3D model-based vision, 2D view based representations of a 3D scene	
APPLICATIONS	**9 Hours**
Industrial automation and quality inspection, Object detection; Gesture Recognition; Finger print recognition, Vision for robot control	
Theory: 45 Total: 45 Periods	

REFERENCES:

1. Rafael C Gonzalez and Richard E Woods, “Digital Image Processing”, 6th Indian Reprint, Pearson Education Asia/Addison Wesley publishing company, 2017.
2. William K Pratt, “Digital Image Processing”, 2nd edition, Wiley-Inter Science Publication, 1991.
3. Milan Sonka, Vaclav Hlavac and Roger Boyle, “Image Processing, Analysis, and Machine Vision”, Brooks/Cole, Singapore,2008.
4. Davies E. R., “Computer & Machine Vision”, Academic Press, 2012.
5. Szeliski R., “Computer Vision: Algorithms and Applications”, Springer, 2011.
6. Simon J. D. Prince, “Computer Vision: Models, Learning, and Inference”, Cambridge University Press, 2012
7. 7. Rafael C. Gonzalez, Richard Eugene Woods, Steven L. Eddins “Digital Image Processing Using MATLAB” Pearson Education India, 2004

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U17VEP7507	GLOBAL VALUES (Common to all branches of Engineering and Technology)	L	T	P	J	C
		1	1	0	1	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	PO10	PO11	PO12	PSO 1	PSO 2
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

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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**
Globalization Vs Localization – an economic and Spiritual Perspective	**3 Hours**
Global Issues & Solutions	**3 Hours**
Advanced Contemplative Practices	**4 Hours**
	Total Hours: 15

Theory: 45 Tutorial: 0Practical: 0 Project: 0 Total: 45 Periods

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

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U17MCP7701	PROJECT PHASE I	L	T	P	J	C
		0	0	0	6	3

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	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 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:

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DIRECT	INDIRECT
Interdisciplinary work Publication Working model/ simulation result Innovation Report with good referencing End Semester Viva Voice	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 interdisciplinary projects will carry more weightage.	

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SEMESTER VIII

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U17MCP8701	PROJECT PHASE II / INTERNSHIP	L	T	P	J	C
		0	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	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
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
1. Inter disciplinary work 2. Innovation 3. Working model/ simulation result 4. Report with good referencing 5. End Semester Viva Voice	1.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.

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PROGRAMME ELECTIVES

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U17MCE0001	AUTOMOTIVE ELECTRONICS	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to		
CO1:	Explain the basics concepts of automobile engines	K2
CO2:	Describe the components of Engine Control system	K2
CO3:	State the working principle of automotive sensors.	K2
CO4:	Describe the principle of vehicle network protocols	K3
CO5:	Explain the working of various comfort system embedded in automobile	K2
CO6:	Describe the working principle of automobile safety systems	K2

Pre-requisite

U17MCI4202 - 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	PO10	PO11	PO12	PSO1	PSO2
CO1	S						M					W		
CO2	S					W	W	M					M	M
CO3	S	M											W	M
CO4	S	M	M	W		W		W					S	M
CO5	S		M		M	W	M					W		M
CO6	S		M		M	M	M	W				W	S	S

Course Assessment methods:

DIRECT	INDIRECT
1. Internal test I 2. Internal test II 3. End semester Examination 4. Assignment	1.Course end survey

INTRODUCTION	**9 Hours**

Automobile physical configuration - Evolution of electronics in automobiles - Operating principles of IC engine – Two stroke – Four stroke - Major engine arrangements –working of simple carburetor- Ignition system – terms

ENGINE CONTROL SYSTEM	**9 Hours**

Motivation For Electronic Engine Control - Electronic Engine Control System - Engine Functions And Control - Electronic Fuel Control System- Engine Mapping- Effect of Air/Fuel Ratio, Spark Timing on Performance, Exhaust Gas Recirculation on Performance- Electronic Ignition. Digital Engine Control System - Engine Crank (Start) - Engine Warm-Up - Open-Loop Control - Closed-Loop Control - Hard Acceleration - Deceleration and Idle

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AUTOMOTIVE SENSORS AND COCK PIT ELECTRONICS	9 Hours
Role of sensors and actuators in automotive control- construction and working principle of Mass air flow (MAF) rate sensor - Exhaust gas oxygen sensor - Throttle plate angular position sensor - Crankshaft angular position/RPM sensor - Coolant temperature - Intake air temperature sensor - Manifold absolute pressure (MAP) sensor - Differential exhaust gas pressure sensor - Vehicle speed sensors- Introduction to Cockpit Electronics – Visual displays.	
VEHICLE NETWORKS	**9 Hours**
Vehicle Tracking System GPS, Vehicle networks CAN, CAN FD, LIN, Flex Ray- I/O Modules – Features- Advantages- Protocol formats – on board diagnostics systems.	
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- Maintenance and charging of batteries.	
Theory: 45 Hrs Total Hours: 45	

REFERENCES:

1. David Crolla, “Encyclopedia of Automotive Engineering”, 6th edition, wiley, 2015
2. Tom Denton, “Automobile Electrical and Electronics Systems”, 2nd edition Edward Arnold Publishers, 2013.
3. William B Ribbens, “Understanding Automotive Electronics”, 5th edition, Newnes Publishing, 2003
4. Robert Bosch GmbH, “BOSCH Automotive Handbook”, 9th edition, Bentley publishers, 2014.
5. Barry Hollembeak, “Automotive Electricity, Electronics and Computer Controls”, 3rd edition, Delmar Publishers, 2001.
6. Warren M Farnell, “Fuel System and Emission controls”, 1st edition Check Chart Publication, 2000.
7. H.H. Braess, “Handbook of Automotive Engineering”, Ulrich Seiffert, 1st edition, SAE International, 2005

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U17MCE0002	CONDITION MONITORING	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to		
CO1:	Recognize the types of failures and maintenance strategies	K2
CO2:	Illustrate the fundamental principles of machinery vibration	K2
CO3:	Explain signal analysis, fundamentals of FFT and signal conditioning	K2
CO4:	Explain the vibration and noise based condition monitoring techniques	K3
CO5:	Explain the thermography and wear analysis for condition monitoring	K2
CO6:	Identify and explain the appropriate condition monitoring technique for a given application	K3

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												W	
CO2	W												W	
CO3	M				S								M	
CO4	M												M	
CO5	M												M	
CO6	S	S							W		W	W	S	

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I, II 2. Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination	1.Course end survey

FAILURES AND PRINCIPLES OF MAINTENANCE	**07 Hours**

System failure and component failure, Types of failure, Causes of failure, Failure investigation principles, Human factors in failure incidents, Maintenance strategies: Preventive Maintenance,

Predictive Maintenance, Bath Tub Curve, Failure Modes Effects and Criticality Analysis

FUNDAMENTALS OF MACHINERY VIBRATION	**10 Hours**

Simple harmonic motion and vibration, Vibration and Spring Mass system, Degrees of freedom, Free vibration and Natural frequency, Forced vibration and Vibration isolation, Single Degree-of- Freedom Motion, Forced Vibration Response, Base Excitation, Force Transmissibility and Vibration Isolation,

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Tuned Vibration Absorber, Unbalanced Response, Characteristics of Vibrating Systems, Vibration of Continuous Systems, Mode Shapes and Operational Deflection Shapes	
DIGITAL SIGNAL PROCESSING	**10 Hours**
Classification of Signals, Signal Analysis, Frequency Domain Signal Analysis, Fundamentals of Fast Fourier Transform, Computer-Aided Data Acquisition, Signal Conditioning, Signal Demodulation, Cepstrum Analysis, Illustrative examples: Representation of signals in the frequency domain, Compressor Vibration and Engine Vibration	
VIBRATION AND NOISE MONITORING	**06 Hours**
Principles of Vibration Monitoring, Misalignment Detection, Eccentricity Detection, Cracked Shaft, Bowed and Bent Shaft, Unbalanced Shaft, Looseness, Rub, Bearing Defects, Faults in Fluid Machines, Acoustical Terminology, Noise Sources, Sound Fields, Noise Measurements, Noise Source Identification	
THERMOGRAPHY	**06 Hours**
Thermal Imaging Devices, Use of IR Camera, Industrial Applications of Thermography in Condition Monitoring	
WEAR DEBRIS ANALYSIS	**06 Hours**
Mechanisms of Wear, Detection of Wear Particles, Oil Sampling Technique, Oil Analysis, Limits of Oil Analysis	
Theory:45Hours Total Hours:45	

REFERENCES:

1. Amiya R. Mohanty, "Machinery Condition Monitoring: Principles and Practices", CRC Press, 2015
2. R.A. Collacott, "Mechanical Fault Diagnosis and Condition Monitoring", Springer, 2012.
3. W.T.Becker, R.J.Shipley, "ASM Handbook: Volume 11: Failure Analysis and Prevention", ASM International, 2002.
4. V.P. Singh, "Mechanical Vibrations", Dhanpat Rai & Co., 2014.

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U17MCE0003	MICRO ELECTRO MECHANICAL SYSTEMS	L	T	P	J	C
		3	0	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.	K2
CO2:	Illustrate about various sensors and actuating system.	K2
CO3:	Classify the Micro machining techniques in MEMS.	K2
CO4:	Evaluate a proper scaling method.	K2
CO5:	Determine packaging techniques in MEMS and smart system.	K2
CO6:	Discuss various applications of MEMS.	K2

Pre-requisite

U17MCI4202 - 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	PO10	PO11	PO12	PSO1	PSO2
CO1	S													
CO2	M													
CO3	S													
CO4		S											S	
CO5	S												S	
CO6	S	M	M										S	M

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I, II 2. Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc (as applicable) 3. End Semester Examination	1. 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

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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 Hours Total Hours:45	

REFERENCES:

1. Tai-Ran Hsu, “MEMS & Microsystems Design and Manufacture”, Tata McGraw-Hill, 2017.
2. Mohamed Gad-el-Hak, “The MEMS Hand book”, CRC press, 2005.
3. Julian W Gardner, Vijay K Varadan, Osama O Awadel Karim, “Micro sensors MEMS and Smart Devices”, John Wily and sons Ltd., 2001.
4. Fatikow S,Rembold U, “Micro system Technology and Micro robotics”, Springer-Verlag Berlin Heidelberg , 1997.
5. Francis E H Tay and W O Choong, “Micro fludics and Bio MEMS Applications”, Springer, 2002

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U17MCE0004	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

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

CO1	Express the basic concepts of Artificial Intelligence	K2
CO2	Demonstrate the usage of planning and decision making.	K3
CO3	Interpret the ideas of machine learning by supervised and unsupervised learning methods	K3
CO4	Apply Linear Regression and Logistic Regression machine learning methods.	K3
CO5	Summarize the concepts of Artificial Neural Networks	K2
CO6	Describe various Artificial Neural Networks methodology	K2

Pre-requisite

Data Warehousing and Data Mining

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		S	S			S	M		M	M	M
CO2	S	M	M							M		M	W	M
CO3	S	S	M		M					M		M	W	M
CO4	S	S	M		M					M		M	W	M
CO5	S	S	M		S	S			S	M		M	S	M
CO6	S	S	M		S	S		W	S	M		M	S	S

Course Assessment methods:

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

INTRODUCTION TO ARTIFICIAL INTELLIGENCE — 9 Hours

Defining Artificial Intelligence, Intelligent Agents, Solving Problems by searching-Problem-solving agents- Example problems – Searching for Solutions-Uninformed search strategies – Informed search strategies – Heuristic functions.

KNOWLEDGE REPRESENTATION AND PREDICATE LOGIC — 10 Hours

Knowledge Representation and Mappings, Approaches to knowledge representation

Representing simple facts in logic, Computable functions and predicates, Procedural vs Declarative knowledge, Logic Programming, Forward vs backward reasoning.Classical Planning, Making simple Decisions

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IDEA OF MACHINE LEARNING	9 Hours
Idea of Machine learning from data, Supervised Learning : Learning a Class from Examples–Noise–Learning Multiple Classes– Regression–Model Selection and Generalization, Unsupervised learning-Introduction, k-Means Algorithm, Optimization objective, Random Initialization, Choosing number of clusters.	
LINEAR REGRESSION AND LOGISTIC REGRESSION	**9 Hours**
Linear Regression -Model representation for single variable, Single variable Cost Function, Multivariable cost function, Gradient Decent for Linear Regression, Multivariable model representation, Logistic Regression - Classification, Hypothesis Representation, Decision Boundary, Cost function, Advanced Optimization, Multi-classification (One vs All), Problem of Over fitting, Regularization	
APPLICATIONS	**9 Hours**
Applications of AI- Natural Language Processing – Machine Translation – Robot – Gaming. Introduction to Artificial Neural Networks and Convolution Neural networks – Applications Use of Tensor flow.	
Theory: 45 Total Hours: 45Hours	

REFERENCES:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", 3rd Edition, Pearson Education / Prentice Hall of India,2015.
2. Elaine Rich, Kevin Knight, Shivashankar. B.Nair, "Artificial Intelligence", Tata McGraw Hill,Third Edition , 2009
3. Nils J. Nilsson, "Artificial Intelligence: A new Synthesis", Harcourt Asia Pvt. Ltd.,2000.
4. George F. Luger, "Artificial Intelligence-Structures and Strategies for Complex ProblemSolving", Pearson Education / PHI,2002
5. David L. Poole, Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", Cambridge University Press, 2010.
6. EthemAlpaydin, "Introduction to Machine Learning", Second Edition, MIT Press,2013
7. Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013
8. Stephen Marsland, ―Machine Learning: An Algorithmic Perspective, CRC Press, 2009.
9. Y. S. Abu-Mostafa, M. Magdon-Ismail, and H.-T. Lin, "Learning from Data", AML Book Publishers, 2012
10. K. P. Murphy, "Machine Learning: A probabilistic perspective", MIT Press, 2012.
11. M. Mohri, A. Rostamizadeh, and A. Talwalkar, "Foundations of Machine Learning", MIT Press,2012.

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U17MCE0005	DATABASE MANAGEMENT SYSTEMS	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to		
CO1:	Understand the functional components of DBMS and Relational Model.	K2
CO2:	Devise queries using SQL to develop database application	K2
CO3:	Describe the database design approaches.	K2
CO4:	Understand data storage and retrieval techniques.	K2
CO5:	Explore concepts for transaction processing, concurrency control and NOSQL.	K2
CO6:	Illustrate the concepts of NOSQL	K2

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	M					S		M					M
CO2				M	S			M		M	S	M		M
CO3			M				M						M	
CO4			M				S							
CO5	S						S			M				
CO6	S	M	M							M			M	M

Course Assessment methods:

DIRECT	INDIRECT
1. Internal Test I 2. Internal Test II 3. Assignment: Group Presentation 4. End semester exam	1.Course end survey

INTRODUCTION TO DATABASE AND RELATIONAL MODEL	**9 Hours**

Introduction: Database applications, Purpose, Accessing and modifying databases, Architecture of DBMS. Relational Databases: Relational model, Database schema, Keys, Formal Relational Query Languages

DATABASE APPLICATION DEVELOPMENT	**9 Hours**

Guidelines for Database Design. SQL: Data definition, Basic SQL query structure, Specifying integrity constraints in SQL, Set operations, Nested subqueries, Aggregation, Join expressions, Views. Functions, Procedures and Triggers. Accessing Databases from Programs using JDBC, Building Web Applications using PHP &MySQL. Case Study: Open Source Relational DBMS

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DATABASE DESIGN	9 Hours
Database Design: E-R model, E-R diagram, Reduction to relational schema, E-R design issues, Relational Database Design: features of good design, Functional Dependency theory, decomposition using functional dependency, Normal forms. (Optional: multi-valued dependency and 4th normal form).	
STORAGE AND INDEXING	**7 Hours**
Storage and File structure: File Organization, RAID. Indexing: Concepts, Clustered and Non-clustered Indices, B- tree and B+-tree. Basics of Hashing (Static, Dynamic).Overview of Query processing.	
TRANSACTION MANAGEMENT	**11 Hours**
Transactions: Concept and purpose, ACID properties and their necessity, transactions in SQL .Transaction Schedules: Conflicts and Aborts, Serializability, Recoverability. Concurrency Control: lock-based protocols, 2-phase locking, Timestamp based protocols. Deadlock handling. Case Study: NoSQL: CAP Theorem and BASE Properties, Types of NoSQL Systems.	
Theory: 45 Hrs Total Hours: 45	

REFERENCES:

1. Abraham Silberschatz, Henry Korth, and S. Sudarshan, "Database System Concepts", Sixth Edition, McGraw- Hill.2016.
2. R. Elmasri and S. Navathe, "Fundamentals of Database Systems", Sixth Edition, Pearson Education,2011
3. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, 3nd Edition, McGraw Hill,2003.
4. Thomas M. Connolly and Carolyn E. Begg, "Database Systems - A Practical Approach toDesign, Implementation and Management", Fifth edition, Pearson Education, 2010
5. C.J.Date, A.Kannan and S.Swamynathan, "An Introduction to Database Systems", Eighth Edition,Pearson Education, 2006.

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U17MCE0006	SOFT COMPUTING	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to		
CO1:	Identify and describe soft computing techniques and their roles in building intelligent Machines	K2
CO2:	Recognize the feasibility of applying a soft computing methodology for a particular problem	K2
CO3:	Identify and select a suitable classification/clustering algorithm to solve the problem	K2
CO4:	Apply evolutionary algorithms and Fuzzy logic to solve the problem	K2
CO5:	Discuss the soft computing systems by hybrid soft computing techniques	K2
CO6:	Describe the various optimization techniques used in soft computing	K2

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	M	S										S	S
CO2	S	M											M	
CO3	S		S	S				S	S				M	S
CO4	S		S		S	M		S	S				M	S
CO5	S				S			S						
CO6	S	S						S					W	W

Course Assessment methods:

DIRECT	INDIRECT
1. Internal Test I 2. Internal Test II 3. Assignment: Group Presentation 4. End semester exam	1.Course end survey

INTRODUCTION TO FUZZY SETS AND FUZZY LOGIC SYSTEMS	**9 Hours**

Fuzzy sets and Fuzzy logic systems- Classical Sets and Fuzzy Sets and Fuzzy relations- Operations on Classical sets, properties of classical sets, Fuzzy set operations, properties of fuzzy sets, cardinality, operations, and properties of fuzzy relations. Membership functions: Features of membership functions, standard forms and boundaries, different fuzzification methods Fuzzy to Crisp conversions: Lambda Cuts for fuzzy sets, fuzzy Relations, Defuzzification methods.

FUZZY RULE BASED SYSTEMS	**9 Hours**

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Classical predicate logic, Fuzzy Logic, Approximate reasoning and Fuzzy Implication- Linguistic Hedges, Fuzzy Rule based system – Aggregation of fuzzy Rules, Fuzzy Inference System- Mamdani Fuzzy Models – Sugeno Fuzzy Models. Applications of Fuzzy Logic: How Fuzzy Logic is applied in Home Appliances, General Fuzzy Logic controllers, Basic Medical Diagnostic systems and Weather forecasting

INTRODUCTION TO NEURAL NETWORKS	**9 Hours**

Advent of Modern Neuroscience, Classical AI and Neural Networks, Biological Neurons and Artificial neural network; model of artificial neuron. Learning Methods: Hebbian, competitive, Boltzman etc., Neural Network models: Perceptron, Adaline and Madaline networks; single layer network; Backpropagation and multi-layer networks. Competitive learning networks: Kohonen self-organizing networks, Hebbian learning; Hopfield Networks.

GENETIC ALGORITHMS	**9 Hours**

Simple GA, crossover and mutation, Multi-objective Genetic Algorithm (MOGA) Applications of Genetic Algorithm: genetic algorithms in search and optimization, GA based clustering Algorithm, Image processing and pattern Recognition.

HYBRID SOFT COMPUTING TECHNIQUES	**9 Hours**

Introduction - Neuro-Fuzzy Modelling-Applications of Neural Networks- Pattern Recognition and classification Genetic-Neuro Hybrid System, Genetic-Fuzzy Hybrid System, Fuzzy-Genetic Hybrid System, Simplified Fuzzy ARTMAP, Application of Soft Computing, CASE Study.
Other Soft Computing techniques: Simulated Annealing, Tabu search, Ant colony optimization (ACO), Particle Swarm Optimization (PSO).

Theory: 45 Hrs Total Hours: 45

REFERENCES:

1. Samir Roy, Udit Chakroborthy, ―Introduction to soft computing - neuro-fuzzy and genetic algorithm‖, Person Education, 2013
2. Timothy J.Ross, ―Fuzzy Logic with Engineering applications‖, Tata McGraw Hill New York, Third edition, 2010
3. David E. Goldberg,―GeneticAlgorithmsinSearchOptimizationandMachineLearning‖,PearsonEducation, 2007.
4. J.-S.R Jang., C.-T Sun., & E. Mizutani, ―Neuro-Fuzzy and Soft Computing, A Computational Approach to Learning and Machine Intelligence‖, Prentice-Hall of India Pvt. Ltd., 2005.

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U17MCE00014	UNDER WATER ROBOTICS	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to		
CO1:	Express the basic concepts of underwater vehicle and Manipulator Systems	K2
CO2:	Describe the rigid body kinematics of Autonomous Underwater vehicle and Manipulators	K2
CO3:	Summarize the dynamics of Autonomous Underwater vehicle and manipulators.	K2
CO4:	Apply controllers for dynamic control of Autonomous Underwater vehicles.	K2
CO5:	Discuss the concepts of kinematic control of Underwater manipulator systems.	K2
CO6:	Describe various dynamic control theories of Underwater manipulator systems.	K2

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											W		
CO2	S	M												
CO3	S	M				M							M	S
CO4	S	W		W	M								S	S
CO5	S	M		W	M								W	W
CO6	S	M		W	M								M	M

Course Assessment methods:

DIRECT	INDIRECT
1. Internal Test I 2. Internal Test II 3. Assignment 4. Group Presentation 5. End semester exam	1.Course end survey

MODELLING OF UNDER WATER ROBOTS	**9 Hours**
Introduction to Underwater Vehicles -Sensorial Systems, Actuation, Localization, Autonomous Underwater Vehicles (AUV) Control Fault Detection/Tolerance for UUVs, Underwater Vehicle Manipulator Systems (UVMS) Coordinated Control, Future Perspectives.	
MODELLING OF UNDER WATER ROBOTS	**10 Hours**
Rigid Body's Kinematics-Attitude Representation by Euler Angles, Attitude Representation by Quaternion,AttitudeErrorRepresentation,6-DOFsKinematics,RigidBody'sDynamics-Rigid Body's Dynamics in Matrix Form.	

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DYNAMIC CONTROL OF AUVS	9 Hours
Earth Fixed Frame Based, Model Based Controller, Earth Fixed Frame Based, Non model Based Controller , Vehicle Fixed Frame-Based, Model-Based Controller, Mixed Earth/Vehicle Fixed Frame Based Controller..	
KINEMATIC CONTROL OF UVMS	
Kinematic Control, The Drag Minimization Algorithm, The Joint Limits Constraints, Singularity-Robust Task Priority, Fuzzy Inverse Kinematics.	
DYNAMIC CONTROL OF UVMS	
Feed forward Decoupling Control, Feedback Linearization, Non-regressor-Based Adaptive Control, Sliding Mode Control, Adaptive Control, Output Feedback Control.	
Total Hours: 45	

REFERENCES:

1. Gianluca Antonelli, Underwater Robots: Motion and Force Control of Vehicle-Manipulator Systems, Springer Berlin Heidelberg, Second Edition 2010
2. C. Vasudevan, K. Ganesan, Underwater Robots, Springer , Third Edition, 2015.
3. Frank Kirchner, Sirko Straube, Daniel Kühn , AI Technology for Underwater Robots, First Edition 2019.
4. Steven W. Moore, Harry Bohm, Vickie Jensen, Underwater Robotics: Science, Design & Fabrication, Marine Advanced Technology Education (MATE) Center, 2010.
5. Daniel R. Faust, Underwater Robots, The Rosen Publishing Group, Inc , First Edition, 2016.

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U17MCE0007	SMART MANUFACTURING	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to		
CO1:	Explain the basic principles of smart manufacturing.	K2
CO2:	Illustrate the importance of IoT in smart manufacturing	K2
CO3:	Describe the functions of internet of things (IoT).	K2
CO4:	Explain the key elements of Industrial internet of things (IIoT).	K2
CO5:	Explain the functions of big data analytics.	K2
CO6:	Discuss various applications of Industrial IoT.	K2

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													
CO2	M													
CO3	S													
CO4		S											S	
CO5	S												S	
CO6	S	M	M										S	M

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I,II 2. Assignment: Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc (as applicable) 3. End Semester Examination	1. Course end survey

INTRODUCTION	**9 Hours**
Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories	

IoT COMPONENTS	**9 Hours**
Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product LifecycleManagement,AugmentedRealityandVirtualReality,ArtificialIntelligence,BigData And Advanced Analysis, Cyber security inIndustry4.0,BasicsofIndustrialIoT,IndustrialSensing & Actuation, Industrial Internet Systems	

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INDUSTRIAL IoT	9 Hours
Introduction, Industrial IoT: Business Model and Reference Architecture: IIoT-Business Models, IIoT Reference Architecture, Industrial IoT- Layers: IIoT Sensing, IIoT Processing, IIoT Communication, IIoT Communication, IIoT Networking.	
INDUSTRIAL IoT: BIG DATA ANALYTICS	**9 Hours**
IIoT Analytics - Introduction, Machine Learning and Data Science, IoT Platforms, Data Management tool, Software-Defined Networking, Data Center Networks, Cloud Computing	
INDUSTRIAL IoT- APPLICATION	**9 Hours**
Power Plants, Oil, chemical and pharmaceutical industry, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.	
Theory:45Hours	**Total Hours: 45**
REFERENCES:	
1. Alasdair Gilchrist, "Industry 4.0: The Industrial Internet of Things", Apress, 2016.	
2. Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat, "Industrial Internet of Things: Cybermanufacturing Systems", Springer, 2017.	
3. Andrew Minteer, "Analytics for the Internet of Things (IoT): Intelligent analytics for your intelligent devices", Packt Publishing, 2017.	
4. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", Willy Publications, 2013.	
5. Dieter Uckelmann, Mark Harrison, Florian Michahelles, "Architecting the Internet of Things", Springer, 2011.	

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U17MCE0008	STATISTICAL QUALITY CONTROL	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to		
CO1:	Define the concept of probability and quality control	K2
CO2:	Explain various sampling method to measure quality and the attributes of quality.	K2
CO3:	Summarize the process behavior based on various control charts for variables.	K2
CO4:	Summarize the process behavior based on various control charts for attributes	K2
CO5:	Select the appropriate samples for the study.	K2
CO6:	Apply various techniques to improve the overall quality.	K2

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					S					
CO2	S			M					S					
CO3	S	M		S										
CO4	S				S	M				S				
CO5														
CO6														

Course Assessment methods:

DIRECT	INDIRECT
1. Internal Test I 2. Internal Test II 3. Assignment: Group Presentation 4. End semester exam	1.Course end survey

INTRODUCTION	**9 Hours**
Probability concepts, Review of distribution: Normal, Poison's, and Binomial, Problems, Measuring of quality and control, Value and quality, Quality costs, Quality assurance	
CONTROL CHARTS FOR VARIABLES	**9 Hours**
Chance and assignable causes of quality variation, Control charts for variables, X-bar, R, and s-charts, Warning and modified control limits, Process capability study, Ranges, Moving Averages, and Six s- limits, multivariate charts.	
CONTROL CHARTS FOR ATTRIBUTES	**9 Hours**
Limitation of variable chart, p-chart, problems with variable sample size, np-chart, c- chart, u-chart, and	

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ku-chart, Demerits per unit control chart.	
ACCEPTANCE SAMPLING	**9 Hours**
Economics of sampling, Lot formation, OC-Curve-Producer's and Consumer's risk, Single and double sampling plans, AOQ, AOQL, ATI, ASN, Sequential sampling plan, MIL – STD – 1050 tables, MIL – STD – 414 tables, IS 2500 Standard.	
QUALITY IMPROVEMENT	**9 Hours**
Zero defects program, Quality circle, Fishbone diagram, scatter diagram, Pareto Analysis, Deming cycle, Introduction to Reliability function, System reliability of series, parallel, and combined configurations, Reliability improvement techniques.	
Theory: 45Hours	**Total Hours:45**
REFERENCES:	
1. Grant E.L. and Leavenworth, "Statistical Quality Control", Tata McGraw-Hill Publishing Company, 5th edition 2002.	
2. Douglas C. Montgomery, "Statistical Quality Control", John Wiley and Sons, 2001.	
3. Fiegenbaum, A.V., "Total Quality Control", McGraw-Hill Inc., 1991.	
4. Sharma S.C., "Inspection Quality Control and Reliability", Khanna Publishers, New Delhi, 1998	
5. Srinath L.S "Reliability Engineering", Affiliated East west Press, 1998.	

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U17MCE0009	COMPOSITE AND SMART MATERIALS	L	T	P	J	C
		3	0	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	K2
CO2:	Explain the manufacturing processes of composite materials	K2
CO3:	Explain the applications of composites and its sustainability	K2
CO4:	Give the classifications on the various smart materials	K2
CO5:	Explain the various smart actuators along with their working principle	K2
CO6:	Understand the concept behind smart composites	K2

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													
CO2													M	
CO3							M							
CO4	S												M	
CO5													M	
CO6	M													

Course Assessment methods:

DIRECT	INDIRECT
1. Internal test I 2. Internal test II 3. End Semester Examination 4. Assignment	1.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**

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Fundamentals of curing – Bag molding process – compression and vacuum molding – filament winding – Quality inspection methods for raw materials – cure cycle monitoring – cured composite parts.	
APPLICATIONS OF COMPOSITES AND SUSTAINABILITY	**9 Hours**
Applications of composites - Natural fibers needs and its significance - Recycling of composites	
PIEZOELECTRIC AND MAGNETOSTRICTIVE MATERIALS	**9 Hours**
Introduction to Smart Materials, Principles of Piezoelectricty, Perovskyte Piezoceramic Materials, Single Crystals vs Polycrystalline Systems, Piezoelectric Polymers, Modelling Piezoelectric Actuators, Amplified Piezo Actuation – Internal and External Amplifications. Principles of Magnetostriction, Rare earth Magnetostrictive materials, Giant Magnetostriction and Magneto-resistance effect. Magnetostrictive Actuation, Joule Effect, Wiedemann Effect, Magneto volume Effect, Magnetostrictive Mini Actuators.	
ELECTRO ACTIVE MATERIALS AND SHAPE MEMORY ALLOYS	**9 Hours**
Introduction to Electro-active Materials, Electronic Materials, Electro-active Polymers, Ionic Polymer Matrix Composite (IPMC), Shape Memory Effect, Shape Memory Alloys, Shape Memory Polymers, Electro-rheological Fluids, Magneto Rhelological Fluids. IPMC and Polymeric Actuators, Shape Memory Actuators. .	
Theory:45Hours	**Total: 45 Hours**

REFERENCES:

1. Mallick P K., “Fiber Reinforced Composites: Materials, Manufacturing and Design”, 3rdEdition, Maneel Dekker Inc, 2008.
2. Brian Culshaw, Smart Structures and Materials, Artech House,2000
3. Gauenzi, P., Smart Structures, Wiley,2009
4. Cady, W. G., Piezoelectricity, Dover Publication

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U17MCE0010	ADDITIVE MANUFACTURING	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to		
CO1:	Recognize the development of AM technology and how AM technology propagated into various businesses and developing opportunities.	K2
CO2:	Acquire knowledge on process of transforming a concept into the final product in AM Technology.	K2
CO3:	Elaborate the vat polymerization and material extrusion processes and its applications.	K2
CO4:	Acquire knowledge on powder bed fusion processes and its applications.	K2
CO5:	Acquire knowledge on direct energy deposition processes and its applications.	K2
CO6:	Evaluate the advantages, limitations, applications of binder jetting, material jetting and laminated object manufacturing processes.	K3

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													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. Continuous Assessment Test I, II 2. Assignment; Journal paper review, Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable) 3. End Semester Examination	1.Course end survey

INTRODUCTION	**9 Hours**
Overview – Need - Development of Additive Manufacturing (AM) Technology: Rapid Prototyping- Rapid Tooling – Rapid Manufacturing – Additive Manufacturing. AM Process Chain- Classification –	

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Benefits. Applications: Building Printing-Bio Printing- Food Printing-Printing Electronics. Business Opportunities and Future Directions - Intellectual Property.	
DESIGN FOR ADDITIVE MANUFACTURING (DFAM)	**9 Hours**
Concepts and Objectives- AM Unique Capabilities: Part Consolidation-Topology Optimization-Lightweight Structure - DFAM for Part Quality Improvement. Data Processing - CAD Model Preparation –Part Orientation and Support Structure Generation -Model Slicing - Tool Path Generation-Customized Design and Fabrication for Medical Applications- Case Studies.	
VAT POLYMERIZATION AND MATERIAL EXTRUSION	**9 Hours**
Photo polymerization: Stereolithography Apparatus (SLA) - Materials -Process -Advantages-Limitations-Applications. Digital Light Processing (DLP) - Materials – Process - Advantages - Applications. Extrusion Based System: Fused Deposition Modeling (FDM) - Process-Materials - Applications and Limitations.	
POWDER BED FUSION AND DIRECT ENERGY DEPOSITION	**9 Hours**
Powder Bed Fusion: Selective Laser Sintering (SLS): Process – Powder Fusion Mechanism – Process Parameters – Typical Materials and Application. Selective Laser Melting (SLM) and Electron Beam Melting (EBM): Materials – Process - Advantages and Applications. Beam Deposition Process: Laser Engineered Net Shaping (LENS) - Process -Material Delivery - Process Parameters -Materials - Benefits -Applications.	
OTHER ADDITIVE MANUFACTURING PROCESSES	**9 Hours**
Binder Jetting: Three Dimensional Printing - Materials -Process - Benefits and Limitations. Material Jetting: Multijet Modeling- Materials- Process- Benefits. SheetLamination Process:Laminated Object Manufacturing (LOM)- Basic Principle- Mechanism: Gluing or Adhesive Bonding – Thermal Bonding- Materials-Application and Limitation.	
Theory:45Hours	**Total Hours: 45**
REFERENCES:	
1. Andreas Gebhardt and Jan-Steffen Hötter “Additive Manufacturing: 3D Printing for Prototyping and Manufacturing”, Hanser publications, United States,2015,	
2. Ian Gibson, David W. Rosen and Brent Stucker “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, 2nd edition, Springer., United States, 2015,	
3. Amit Bandyopadhyay and Susmita Bose, “Additive Manufacturing”, 1st Edition, CRC Press., United States, 2015,	
4. Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Manufacturing”, Hanser Gardner Publication, Cincinnati., Ohio, 2011,.	
5. Kamrani A.K. and Nasr E.A., “Rapid Prototyping: Theory and practice”, Springer., United States, 2011,	
6. Liou, L.W. and Liou, F.W., “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press., United States, 2011,	
7. Milan Brandt, “Laser Additive Manufacturing: Materials, Design, Technologies, and Applications”, Wood head Publishing., United Kingdom,2016,	

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U17MCE0011	DESIGN OF MATERIAL HANDLING SYSTEMS	L	T	P	J	C
		3	0	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 Equipments	K2
CO2:	Calculate the power requirements for a given belt conveyor	K3
CO3:	Select the components for the belt conveyors	K3
CO4:	Select and design the conveyors for the particular application	K3
CO5:	Differentiate the conveyors and elevators and design the bucket and cage elevators	K3
CO6:	Explain the various elements of the hoists	K2

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		M										M	
CO4	M	W	S			W							M	W
CO5	M	W	M										M	
CO6	M		M										M	

Course Assessment methods:

DIRECT	INDIRECT
1. Internal test I 2. Internal test II 3. End semester Examination 4. Assignment	1.Course end survey

MATERIAL HANDLING EQUIPMENTS (MHE)	**4 Hours**
Materials and Bulk materials – Types of material handling equipments – selection and applications of MHE. Automation in material handling system.	
BELT CONVEYORS	**10 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**

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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:45Hours	**Total Hours: 45**
REFERENCES:	
1. Rudenko N., "Materials handling equipment", ELnvee Publishers,1970.	
2. Fenner & Dunlop, "Conveyor Handbook"	
3. DavidVHutton"FundamentalsofFiniteElementAnalysis",McGraw-HillInternationalEdition, 2004.	
4. Alexandrov M, Materials Handling Equipments, MIR Publishers,1981.	
5. Conveyors and Related Equipment, A. Spivakovsky(Author), V. Dyachkov (Author),D. Danemanis (Translator) 1966.	

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U17MCE0012	DESIGN FOR MANUFACTURE AND ASSEMBLY	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to		
CO1:	Explain the design principles for manufacturability and factors influencing it	K2
CO2:	List and explain the factors influencing form design.	K2
CO3:	Explain the design considerations for cast steel and casting process	K2
CO4:	Explain the design considerations various machining process.	K2
CO5:	Explain the use of computer in DFMA.	K2
CO6:	Describe the Design considerations and Guidelines for assembly.	K3

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		M										M	
CO4	M	W	S										M	W
CO5	M	W	M		W								M	
CO6	M		M										M	

Course Assessment methods:

DIRECT	INDIRECT
1. Internal test I 2. Internal test II 3. End semester Examination 4. Assignment	1.Course end survey

INTRODUCTION	**9 Hours**

General design principles for manufacturability –Factors influencing design-Types of problems to be solved-evaluation of customer's requirements-Systematic working plan for the designer-Types of problems to be solved-Possible Solutions-Evaluation method- Process capability - Feature tolerances -Geometric tolerances - Assembly limits -Datum features - Tolerance stacks-Interchangeable part manufacture and selective assembly.

FACTORS INFLUENCING FORM DESIGN	**9 Hours**

Materials choice - Influence of basic design, mechanical loading, material, production method, size and weight on form design- form design of welded members and forgings-case studies

COMPONENT DESIGN – CASTING CONSIDERATION	**9 Hours**

Form design of grey iron, steel, malleable iron and aluminium castings. Redesign of castings based on parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores-case studies

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COMPONENT DESIGN - MACHINING CONSIDERATION	9 Hours
Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clampability - Design for accessibility - Design for assembly. Identification of uneconomical design - Modifying the design - Computer Applications for DFMA- case studies	
DESIGN FOR ASSEMBLY	**9 Hours**
Design for assembly (DFA) - The assembly process - Economic production quantities - Design considerations - Guidelines for assembly Improvement- Rivets - Screw fasteners - Metal stitching – Fits - press-fits - snap-fits. Weldments - Characteristics and applications of arc weldments - Economic Production Quantities - Design Recommendations.	
Theory:45Hours	**Total Hours: 45**
REFERENCES:	
1. Geoffrey Boothroyd, G, , Assembly Automation and Product Design.NewYork, Marcel Dekker,2011	
2. Bralla, Design for Manufacture handbook, McGraw hill,1999.	
3. Kevien Otto and Kristin Wood, Product Design. Pearson Publication,2004.	

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U17MCE0013	PRECISION MANUFACTURING	L	T	P	J	C
		3	0	0	0	3

Course Outcomes

After successful completion of this course, the students should be able to		
CO1:	Describe different types of Unconventional Machining processes and principle of mechanical energy based unconventional machining processes.	K2
CO2:	Explain the working principle of electrical energy based unconventional machining processes.	K2
CO3:	Explain the working principle of chemical energy based unconventional machining processes.	K2
CO4:	Explain the working principle of electro chemical energy based unconventional machining processes.	K2
CO5:	Explain the working principle of thermal energy based unconventional machining processes.	K2
CO6:	Describe the working principle of super finishing process.	K2

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	W												
CO2	M	M												
CO3	M	M											M	
CO4	M	M				W							M	W
CO5	M	M											M	
CO6	M	M											M	

Course Assessment methods:

DIRECT	INDIRECT
1. Continuous Assessment Test I, II 2. Assignment: Group Presentation, Project report, Poster preparation, Prototype or Product Demonstration etc. (as applicable). 3. End Semester Examination	1.Course end survey

MECHANICAL ENERGY BASED PROCESSES	**9 Hours**

Introduction Unconventional Machining Process, Need, Classification, Brief overview of all techniques, Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining- Ultrasonic Machining (AJM, WJM, AWJM, USM). Working Principles – equipment used – Process parameters – MRR – Applications.

ELECTRICAL ENERGY BASED PROCESSES	**9 Hours**

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Electric Discharge Machining (EDM) - working Principles-equipment-Process Parameters-MRR-electrodes Used – Power Circuits – Dielectric – Flushing – Applications, Wire Cut EDM Applications.	
CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES	**9 Hours**
Chemical machining and Electro-Chemical machining (CHM and ECM)-Etchants – Maskant-techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications. Principles of ECM- equipments – MRR -Process Parameters- ECG and ECH - Applications.	
THERMAL ENERGY BASED PROCESSES	**9 Hours**
Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining (EBM),Principles-Equipment – MRR - Process Parameters - Applications.	
SUPER FINISHING PROCESS	**9 Hours**
Super finishing process – Honing - honing machines, Process parameter, MRR – Lapping – characteristics, Types of lapping, lapping machines, and Super finishing – Burnishing, Magnetic float polishing, Magnetic field assisted polishing, Electro polishing	
Theory:45Hours	**Total Hours: 45**
REFERENCES:	
1. Vijay K Jain “Advanced Machining Processes”, first edition, Allied Publishers Pvt. Ltd., New Delhi, 2007.	
2. Benedict G F. “Nontraditional Manufacturing Processes”, Marcel Dekker Inc., New York, 1987	
3. Pandey P C and Shan H S. “Modern Machining Processes”, Tata McGraw-Hill, New Delhi, 1980.	
4. Hassan Abdel-Gawad El-Hofy “Advanced Machining Processes: Nontraditional and Hybrid Machining Processes” Tata McGraw-Hill, New Delhi, 2005	

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U17MCE0015	OPERATION RESEARCH	L	T	P	J	C
		3	0	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.	K2
CO2:	Analyze the various methods under transportation model and apply the model for testing the closeness of their results to optimal results	K2
CO3:	Apply the concepts of PERT and CPM for decision making and optimally managing projects	K2
CO4:	Analyze the various replacement and sequencing models and apply them for arriving at optimal decisions.	K2
CO5:	Analyze and apply appropriate inventory techniques in domain specific situations.	K2
CO6:	Analyze and apply appropriate queuing theories in domain specific situations.	K2

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		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
1. Internal Test I 2. Internal Test II 3. Assignment 4. End semester Examination	1.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.	

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Optimality test – MODI method and stepping stone method. Assignment model – formulation – balanced and unbalanced assignment problems. Traveling salesman problem	
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

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