SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

Approved by AICTE, Recognized by UGC & Affiliated to Anna University
Accredited by NBA-AICTE, NAAC-UGC with 'A+' Grade

Saravanampatti , Coimbatore -641035

CURRICULA AND SYLLABI

REGULATION 2016

CHOICE BASED CREDIT SYSTEM

DEPARTMENT OF MECHATRONICS

B.E. – MECHATRONICS

SNS COLLEGE OF TECHNOLOGY

COIMBATORE – 641035
(AN AUTONOMOUS INSTITUTION)
REGULATION – 2016

CHOICE BASED CREDIT SYSTEM

SUGGESTED CURRICULA & SYLLABI (I – VIII SEMESTERS)

B. E. MECHATRONICS

SEMESTER I

S.NO.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16EN101	Technical English – I	HS	3	3	0	0	3	-
2.	16MA101	Engineering Mathematics – I	BS	4	3	1	0	4	-
3.	16PY101	Engineering Physics	BS	3	3	0	0	3	-
4.	16CH101	Engineering Chemistry	BS	3	3	0	0	3	-
5.	16CS101	Fundamentals of Computing and Programming	ES	3	3	0	0	3	-
6.	16ME101	Engineering Drawing	ES	5	3	0	2	4	-
7.	16GE111	Career Development Program I	EEC	3	1	0	2	2*	-
PRACTICAL									
8.	16CS102	Fundamentals of Computing and Programming Laboratory	ES	4	0	0	4	2	-
9.	16CH103	Chemistry Laboratory	BS	2	0	0	2	1	-
10.	16EN103	Communication Skills Laboratory	HS	4	0	0	4	2	-
			TOTAL	**34**	**19**	**1**	**14**	**25+2***	

SEMESTER II

S.NO.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16EN102	Technical English – II	HS	3	3	0	0	3	16EN101
2.	16MA102	Engineering Mathematics – II	BS	4	3	1	0	4	16MA101
3.	16PY102	Physics of Materials	BS	3	3	0	0	3	16PY101
4.	16CH102	Environmental Science and Engineering	BS	3	3	0	0	3	-
5.	16EE101	Basic Electrical and Electronics Engineering	ES	3	3	0	0	3	-
6.	16ME102	Engineering Mechanics	ES	4	3	1	0	4	-
7.	16GE112	Career Development Program II	EEC	3	1	0	2	2*	

PRACTICAL									
8.	16PY103	Physics Laboratory	BS	2	0	0	2	1	-
9.	16GE102	Engineering Practices Laboratory	ES	4	0	0	4	2	-
10.	16ME103	Computer Aided Drafting Laboratory	ES	2	0	0	2	1	-
			TOTAL	**31**	**19**	**2**	**10**	**24+2***	

SEMESTER III

S.NO.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16MA201	Transforms and Partial Differential Equations	BS	4	3	1	0	4	16MA102
2.	16ME207	Strength of Materials	PC	3	3	0	0	3	16ME102
3.	16ME201	Engineering Thermodynamics	PC	5	3	2	0	4	16MA102
4.	16EC231	Digital Electronics	ES	3	3	0	0	3	16EE101
5.	16ME203	Engineering Materials and Metallurgy	ES	3	3	0	0	3	16PY102
6.	16MC201	Manufacturing Technology	PC	3	3	0	0	3	-
7.	16GE211	Career Development Programme III	EEC	3	1	0	2	2*	-
PRACTICAL									
8.	16MC202	Manufacturing Technology Laboratory	PC	2	0	0	2	1	-
9.	16MC203	Strength of Materials Laboratory	PC	2	0	0	2	1	-
10.	16MC204	Computer Aided Machine Drawing Laboratory	EEC	4	0	0	4	2	-
				31	**19**	**2**	**10**	**24+2***	

SEMESTER IV

S.NO.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16MA202	Statistics and Numerical Methods	BS	4	3	1	0	4	16MA201
2.	16AE213	Mechanics of Machines	ES	4	3	1	0	4	16ME102
3.	16EC233	Microprocessor and Microcontroller	PC	3	3	0	0	3	16EC231
4.	16MC210	Applied Instrumentation and Control System (Theory cum Practical Course)	PC	4	3	0	2	4	16EE101
5.	16MC205	Fluid Mechanics and Thermal Systems	PC	3	3	0	0	3	16ME102 16ME201
6.	16EE214	Electrical Machines and Drives	ES	3	3	0	0	3	16EE101
7.	16GE212	Career Development Program IV	EEC	3	1	0	2	2*	-

PRACTICAL									
8.	16EC234	Microprocessor and Microcontroller Laboratory	PC	2	0	0	2	1	-
9.	16MC206	Fluid Mechanics and Thermal Systems Laboratory	PC	4	0	0	4	2	-
10.	16EE215	Electrical Machines and Drives Laboratory	ES	4	0	0	4	2	-
				34	**19**	**3**	**12**	**26+2***	

SEMESTER V

S.NO.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16MC301	Mechanical Design	PC	4	3	1	0	4	16ME207
2.	16CS451	Object Oriented Programming using C++	PC	3	3	0	0	3	16CS101
3.	16MC302	Industrial Electronics and Applications	PC	3	3	0	0	3	16EE101
4.	16MC320	CNC Technology	PC	3	3	0	0	3	-
5.		Professional Elective - I	PE	3	3	0	0	3	-
6.		Open Electives - I**	OE	3	3	0	0	3	-
7.	16MC399	Career Development Programme V (Professional)	EEC	3	2	0	0	2*	-
PRACTICAL									
8.	16MC308	CNC Laboratory	PC	2	0	0	2	1	-
9.	16MC309	Industrial Electronics Laboratory	PC	2	0	0	2	1	-
10.	16CS452	Object Oriented Programming using C++ Laboratory	PC	2	0	0	2	1	16CS102
				27	**18**	**1**	**10**	**22+2***	

SEMESTER VI

S.NO.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16GE301	Professional Ethics	HS	3	3	0	0	3	-
2.	16MC310	Sensors and Signal Processing	PC	3	3	0	0	3	16EC233
3.	16MC311	Applied Hydraulics and Pneumatics	PC	3	3	0	0	3	16MC205
4.	16MC331	PLC, HMI & SCADA	EEC	3	3	0	0	3	-
5.		Professional Elective- II	PE	3	3	0	0	3	-
6.		Open Electives - II**	OE	3	3	0	0	3	-
7.	16GE312	Career Development Program VI	EEC	3	1	0	2	2*	-
PRACTICAL									
8.	16MC317	PLC, HMI & SCADA Laboratory	EEC	2	0	0	2	1	16MC233
9.	16MC318	Sensors and Signal Processing Laboratory	PC	2	0	0	2	1	-
10.	16MC319	Applied Hydraulics and Pneumatics Laboratory	PC	2	0	0	2	1	-
				29	**18**	**0**	**10**	**21+2***	

SEMESTER VII

S.NO.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.	16MC401	Robotics and Machine Vision System	PC	3	3	0	0	3	-
2.	16GE302	Engineering Economics and Cost Analysis	HS	3	3	0	0	3	-
3.	16MC430	Applied Mechatronics Engineering	PC	3	3	0	0	3	-
4.		Professional Elective- III	PE	3	3	0	0	3	-
5.		Professional Elective- IV	PE	3	3	0	0	3	-
6.		Open Electives - III**	OE	3	3	0	0	3	-
PRACTICAL									
7.	16MC405	Applied Mechatronics Engineering Laboratory	PC	2	0	0	2	1	-
8.	16MC406	Robotics Laboratory	PC	2	0	0	2	1	-
9.	16MC407	Project phase-I	EEC	4	0	0	4	2	-
				25	**17**	**0**	**10**	**22+2***	

SEMESTER VIII

S.NO.	COURSE CODE	COURSE TITLE	CAT	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
THEORY									
1.		Professional Elective – V	PE	3	3	0	0	3	-
2.		Professional Elective –VI	PE	3	3	0	0	3	-
3.		Professional Elective –VII	PE	3	3	0	0	3	-
PRACTICAL									
4.	16MC426	Project Phase – II	EEC	20	0	0	20	10	16MC407
				29	**9**	**0**	**20**	**19**	

TOTAL NO. OF CREDITS: 183

***Not included in the calculation of CGPA**
****Courses from the curriculum of other UG Programmes**

HUMANITIES AND SOCIAL SCIENCES (HS)

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16EN101	Technical English – I	3	3	0	0	3	-
2.	16EN103	Communication Skills Laboratory	4	0	0	4	2	-
3.	16EN102	Technical English – II	3	3	0	0	3	16EN101
4.	16GE301	Professional Ethics	3	3	0	0	3	-
5.	16GE302	Engineering Economics and Cost Analysis	3	3	0	0	3	-

BASIC SCIENCES (BS)

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16MA101	Engineering Mathematics – I	4	3	1	0	4	-
2.	16PY101	Engineering Physics	3	3	0	0	3	-
3.	16CH101	Engineering Chemistry	3	3	0	0	3	-
4.	16CH103	Chemistry Laboratory	2	0	0	2	1	-
5.	16MA102	Engineering Mathematics – II	4	3	1	0	4	16MA101
6.	16PY102	Physics of Materials	3	3	0	0	3	16PY101
7.	16CH102	Environmental science and Engineering	3	3	0	0	3	-
8.	16PY103	Physics Laboratory	2	0	0	2	1	-
9.	16MA201	Transforms and Partial Differential Equations	4	3	1	0	4	16MA102
10.	16MA202	Statistics and Numerical Methods	4	3	1	0	4	16MA201

ENGINEERING SCIENCES (ES)

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16CS101	Fundamentals of Computing and Programming	3	3	0	0	3	-
2.	16ME101	Engineering Drawing	5	3	0	2	4	-
3.	16CS102	Fundamentals of Computing and Programming Laboratory	4	0	0	4	2	-
4.	16EE101	Basic Electrical and Electronics Engineering	3	3	0	0	3	-
5.	16ME102	Engineering Mechanics	4	3	2	0	4	-
6.	16GE102	Engineering Practices Laboratory	4	0	0	4	2	-
7.	16ME103	Computer Aided Drafting Laboratory	2	0	0	2	1	-
8.	16EC231	Digital Electronics	3	3	0	0	3	16EE101
9.	16ME203	Engineering Materials and Metallurgy	3	3	0	0	3	16PY102
10.	16AE213	Mechanics of Machines	4	3	1	0	4	16ME102
11.	16EE214	Electrical Machines and Drives	3	3	0	0	3	16EE101
12.	16EE215	Electrical Machines and Drives Laboratory	4	0	0	4	2	-

PROFESSIONAL CORE (PC)

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16ME207	Strength of Materials	3	3	0	0	3	16ME102
2.	16ME201	Engineering Thermodynamics	4	3	2	0	4	16MA102
3.	16MC201	Manufacturing Technology	3	3	0	0	3	-
4.	16MC202	Manufacturing Technology Laboratory	2	0	0	2	1	-
5.	16MC203	Strength of Materials Laboratory	2	0	0	2	1	-
6.	16EC233	Microprocessor and Microcontroller	3	3	0	0	3	16EC231
7.	16MC210	Applied Instrumentation and Control System (Theory cum Practical Course)	4	3	1	0	4	16EE101
8.	16MC205	Fluid Mechanics and Thermal Systems	3	3	0	0	3	16ME102
9.	16EC234	Microprocessor and Microcontroller Laboratory	2	0	0	2	1	-
10.	16MC206	Fluid Mechanics and Thermal Systems Laboratory	4	0	0	4	2	-
11.	16MC301	Mechanical Design	5	3	2	0	4	16ME207
12.	16CS451	Object Oriented Programming using C++	3	3	0	0	3	16CS101
13.	16MC302	Industrial Electronics and Applications	3	3	0	0	3	16EE101
14.	16MC320	CNC Technology	3	3	0	0	3	-
15.	16MC308	CNC Laboratory	2	0	0	2	1	-
16.	16MC309	Industrial Electronics Laboratory	2	0	0	2	1	-
17.	16CS452	Object Oriented Programming using C++ Laboratory	2	0	0	2	1	16CS102
18.	16MC310	Sensors and Signal Processing	3	3	0	0	3	16EC233
19.	16MC311	Applied Hydraulics and Pneumatics	3	3	0	0	3	16MC205
20.	16MC318	Sensors and Signal Processing Laboratory	2	0	0	2	1	-
21.	16MC319	Applied Hydraulics and Pneumatics Laboratory	2	0	0	2	1	-
22.	16MC401	Robotics and Machine Vision System	3	3	0	0	3	-
23.	16MC430	Applied Mechatronics Engineering	3	3	0	0	3	-
24.	16MC405	Applied Mechatronics Engineering (Theory cum Practical Course)	2	0	0	2	1	-
25.	16MC406	Robotics Laboratory	2	0	0	2	1	-

PROFESSIONAL ELECTIVE (PE) I

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16MC303	Design of Mechatronics System	3	3	0	0	3	-
2.	16MC304	Industrial Automation	3	3	0	0	3	-
3.	16MC305	Composite Materials	3	3	0	0	3	16PY102
4.	16MC306	Industrial Networking	3	3	0	0	3	-
5.	16MC307	New and Renewable Energy Technologies	3	3	0	0	3	-

PROFESSIONAL ELECTIVE (PE) II

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16MC312	Automotive Engineering	3	3	0	0	3	-
2.	16MC313	Machine Interface Design	3	3	0	0	3	-
3.	16MC351	Internet of Things and Smart Manufacturing	3	3	0	0	3	-
4.	16MC315	Process Planning and Product Development	3	3	0	0	3	-
5.	16MC316	Basics of Digital Signal Processing	3	3	0	0	3	-

PROFESSIONAL ELECTIVE (PE) III

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16GE304	Principles of Management	3	3	0	0	3	-
2.	16GE307	Nano Technology	3	3	0	0	3	16PY102
3.	16MC402	Basics of Virtual Instrumentation	3	3	0	0	3	-
4.	16MC403	Emerging Smart Materials for Mechatronics Applications	3	3	0	0	3	16PY102 16ME306
5.	16MC404	Finite Element Method	3	3	0	0	3	16ME207

PROFESSIONAL ELECTIVE (PE) IV

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16MC408	MEMS & NEMS	3	3	0	0	3	-
2.	16MC409	Fuzzy Sets and Artificial Intelligence	3	3	0	0	3	-
3.	16MC410	Intelligent Visual Surveillance Systems	3	3	0	0	3	-
4.	16GE303	Total Quality Management	3	3	0	0	3	-
5.	16MC411	Materials Technology	3	3	0	0	3	16MC201

PROFESSIONAL ELECTIVE (PE) V

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16MC412	Medical Mechatronics	3	3	0	0	3	-
2.	16MC413	Design of Embedded Systems	3	3	0	0	3	16EC233
3.	16MC414	Textile Mechatronics	3	3	0	0	3	-
4.	16MC415	Building Automation	3	3	0	0	3	-
5.	16MC416	Underwater Robotics	3	3	0	0	3	-

PROFESSIONAL ELECTIVE (PE) VI

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16MC417	Autotronics	3	3	0	0	3	-
2.	16MC418	Rapid Prototyping	3	3	0	0	3	16ME317
3.	16MC419	Artificial Intelligence for Robotics	3	3	0	0	3	-
4.	16MC420	Computer Integrated Manufacturing	3	3	0	0	3	-

5.	16MC450	Virtual Reality and Haptics	3	3	0	0	3	-

PROFESSIONAL ELECTIVE (PE) VII

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16MC422	Intelligent Manufacturing Technology	3	3	0	0	3	16MC201
2.	16GE305	Intellectual Property Rights	3	3	0	0	3	-
3.	16MC423	Modelling and Simulation	3	3	0	0	3	-
4.	16MC424	Field and Service Robotics	3	3	0	0	3	16MC410
5.	16MC425	Diagnostic Techniques	3	3	0	0	3	-

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16GE111	Career Development Programme I	3	1	0	2	2*	-
2.	16GE112	Career Development Programme II	3	1	0	2	2*	-
3.	16GE211	Career Development Programme III	3	1	0	2	2*	-
4.	16GE212	Career Development Programme IV	3	1	0	2	2*	-
5.	16MC399	Career Development Programme V (Professional)	3	1	0	2	2*	-
6.	16GE312	Career Development Programme VI	3	1	0	2	2*	-
7.	16MC204	Computer Aided Machine Drawing Laboratory	4	0	0	4	2	-
8.	16MC331	PLC, HMI & SCADA	3	3	0	0	3	-
9.	16MC317	PLC, HMI & SCADA Laboratory	2	0	0	2	1	-
10.	16MC407	Project phase-I	4	0	0	4	2	-
11.	16MC426	Project Phase – II	20	0	0	20	10	16MC407

ONE CREDIT COURSE

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16MCOC1	Introduction to Computation Software (SCILAB)	2	1	0	1	1	-
2.	16MCOC2	Basics of Embedded Systems	2	1	0	1	1	-
3.	16MCOC3	Fundamentals of Simulink Software (MATLAB)	2	1	0	1	1	-
4.	16MCOC4	Basics of Programmable Boards (ARDUINO)	2	1	0	1	1	-
5.	16MCOC5	Technical and Scientific Documentation (LaTex)	2	1	0	1	1	-

OPEN ELECTIVE OFFERED TO OTHER UG PROGRAMMES

S.NO.	COURSE CODE	COURSE TITLE	CONTACT PERIODS	L	T	P	C	PRE-REQUISITES
1.	16MCOE1	Introduction to Robotics	3	3	0	0	3	-
2.	16MCOE2	Fundamentals of MEMS	3	3	0	0	3	-
3.	16MCOE3	Automation & Applications	3	3	0	0	3	-
4.	16MCOE4	Human Computer Interface	3	3	0	0	3	-

S.NO	SUBJECT AREA	Credits Per Semester								Total Credits
		I	II	III	IV	V	VI	VII	VIII	
1	**HS**	5	3	-		-	3	3	-	14
2	**BS**	11	11	4	4	-	-	-	-	30
3	**ES**	9	10	6	9	-	-	-	-	34
4	**PC**	-	-	12	13	16	8	8	-	57
5	**PE**	-	-	-	-	3	3	6	9	21
6	**OE**	-	-	-	-	3	3	3	-	9
7	**EEC**			2			4	2	10	18
	TOTAL	**25**	**24**	**24**	**26**	**22**	**21**	**22**	**19**	**183**
8.	**Non-Credit/ Mandatory**	2	2	2	2	2	2	-	-	-

16EN101	TECHNICAL ENGLISH I	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	3	0	0	3

UNIT I **9**

General Vocabulary (Word–formation - prefixes & suffixes, root words) – Tenses – Adjectives forms – Adverb forms - Compound nouns - Abbreviations and Acronyms –Techniques of reading – Autobiographical writing.

UNITII **9**

Active and Passive voice – Impersonal passive voice - Articles - Prepositions –Spelling and Punctuation –'WH' Question forms – Yes / No question form – Reading & note-making – Paragraph writing - comparison and contrast.

UNIT III **9**

Uses of Modal auxiliaries – Instructions– Definitions - Single line & Extended - Reading and understanding through Context –Transfer of information – bar chart, flowchart- Crafting advertisements.

UNIT IV **9**

Concord (subject & verb agreement) – Cause and effect expressions – One word substitution - Letter writing-letter to the editor & permission letter (for Industrial Visit & In-plant training) - Paragraph writing-descriptive.

UNIT V **9**

Empty verbs - 'If' conditionals – Gerund & Infinitive - Formal Letter writing – invitation, accepting & declining - Paragraph writing – analytical.

L :45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1 Dhanavel.S.P. English and Communication Skills for Students of Science and Engineering, Orient Blackswan, Chennai, 2011.

2. Gunasekaran.S , ' Technical English I' Third Edition, Vishnu Prints Media, Chennai, 2016.

REFERENCES

1 Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practice, Oxford University Press, New Delhi, 2011. .

2 Regional Institute of English. English for Engineers, Cambridge University Press, New Delhi, 2006.

3 Rizvi, Ashraf. M. Effective Technical Communication, Tata McGraw-Hill, New Delhi, 2005.

4 Department of English, Anna University, Mindscapes: English for Technologists and Engineers. Orient Blackswan, Chennai. 2012.

5 Mitra K. Barun, "Effective Technical Communication – A Guide for Scientists and Engineers", Oxford University Press, New Delhi, 2006.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Employ their active and passive vocabulary and construct basic sentence structures.

CO2 Become active readers who appreciate ambiguity and complexity, and who can articulate their own interpretations.

CO3 Write effectively and flawlessly avoiding grammatical errors for a variety of professional and social settings.

CO4 Demonstrate the usage of language effectively, creatively and successfully in both general and specific contexts.

CO5 Exhibit letter writing skills for effective communication both in formal and informal situations.

16MA101	ENGINEERING MATHEMATICS- I	L	T	P	C
	(Common to All B.E. / B. Tech. Courses)	3	1	0	4

UNIT I MATRICES 9+3

Characteristic equation – Eigen values and Eigen vectors of a real matrix –Properties–Orthogonal transformation of a symmetric matrix to diagonal form – Quadratic form –Reduction of quadratic form to canonical form by orthogonal transformation – Cayley– Hamilton theorem (excluding proof).

UNIT II THREE DIMENSIONAL ANALYTICAL GEOMETRY 9+3

Equation of a sphere – Plane section of a sphere – Tangent Plane – Equation of a cone – Right circular cone – Equation of a cylinder – Right circular cylinder.

UNIT III DIFFERENTIAL CALCULUS 9+3

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes.

UNIT IV FUNCTIONS OF SEVERAL VARIABLES 9+3

Partial derivatives – Euler's theorem for homogenous functions – Total derivatives – Jacobians – Taylor's expansion– Maxima and Minima – Method of Lagrangian multipliers.

UNIT V DIFFERENTIAL EQUATIONS OF HIGHER ORDER 9+3

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear differential equations.

L :45 T:15 P: 0 Total: 60 PERIODS

TEXT BOOKS

1 Bali, N. P. and Manish Goyal, "Text book of Engineering Mathematics", 4th Edition, University Science Press, 2014.

2. Grewal, B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, 2014.

REFERENCES

1 Ramana, B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2014.

2 Kandasamy, P., Thilagavathy, K. and Gunavathy, K., "Engineering Mathematics", Volume I., S. Chand & Co., New Delhi, 2012.

3 Veerarajan, T., "Engineering Mathematics for First Year", Tata McGraw Hill Pub. Co. Ltd., New Delhi, 2014.

4 Kreyszig, E., "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons, Inc, Singapore, 2008.

5 Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education Ltd., 2013.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Know Eigen values and Eigen vectors and its role in the system of equations.

CO2 Explore the knowledge to solving problems involving Sphere, Cone and Cylinder.

CO3 Discover the radius, centre and circle of curvature of any curves.

CO4 Identify the maximum and minimum values of surfaces.

CO5 Solve the ordinary differential equations of certain types.

16PY 101	ENGINEERING PHYSICS	L	T	P	C
	(Common to All B.E. / B. Tech. Courses)	3	0	0	3

UNIT I CRYSTAL PHYSICS 9

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures (qualitative treatment)

UNIT II PROPERTIES OF MATTER AND THERMAL PHYSICS 9

Elasticity- Hooke's law - Relationship between three moduli of elasticity– stress -strain diagram – Poisson's ratio –Factors affecting elasticity –Bending moment – Depression of a cantilever Young's modulus by uniform bending- I-shaped girders Modes of heat transfer- thermal conductivity- Newton's law of cooling - Linear heat flow -Lee's disc method – Radial heat flow – Rubber tube method – conduction through compound media (series and parallel).

UNIT III QUANTUM PHYSICS 9

Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jean's Law from Planck's theory – Compton effect. Theory and experimental verification – Properties of Matter waves – G.P Thomson experiment- Physical significance of wave function -Schrödinger's wave equation – Time independent and time dependent equations– Particle in a one dimensional box –Electron microscope- Scanning electron microscope

UNIT IV ACOUSTICS AND ULTRASONICS 9

Classification of Sound- decibel- Weber–Fechner law – Sabine's formula- derivation using growth and decay method – Absorption Coefficient and its determination –factors affecting acoustics of buildings and their remedies. Production of Ultrasonic's by magnetostriction and piezoelectric methods - acoustic grating - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C –scan displays, Medical applications – Sonogram.

UNIT V PHOTONICS AND FIBRE OPTICS 9

Spontaneous and stimulated emission- Population inversion -Einstein's A and B coefficients - derivation. Types of lasers – Nd:YAG, CO , Semiconductor lasers –applications. Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – Losses in optical fibre- attenuation, dispersion, bending - Fibre Optical Communication system (Block diagram)

L :45 T: 0 P: 0 T: 45 PERIODS

TEXT BOOKS

1 Naresh Kumar. P and Balasubramanian. V, Engineering Physics I, Gems Publishers,2015

2 Avadhanalu.M.N and Kshirsagar.P.G, A textbook of Engineering Physics,S.Chand & ompany Ltd, 2013.

REFERENCES

1 Searls and Zemansky, University Physics, 2009.

2 Gaur R.K. And Gupta S.L, Engineering Physics, Dhanpat Rai publishers, 2009.

3 Palanisamy P.K, Engineering Physics, SCITECH Publications, 2011.

4 Rajendran.V, Engineering Physics,Tata Mcgraw-Hill Publishing Company Limited, New Delhi.2009.

5 Dr.G.Senthil kumar, Engineering Physics-I, VRB Publishers Pvt.Ltd.Chennai.(2013).

COURSE OUTCOMES :

At the end of the course student should be able to

CO1 Understand the properties of the crystalline materials.

CO2 Analyze the elastic and thermal properties of the materials.

CO3 Understand the basics of quantum mechanics.

CO4 Identify the applications of acoustics and ultrasonic waves.

CO5 Understand the basics and applications of photonics and fibre optics technology.

16CH101	ENGINEERING CHEMISTRY	L	T	P	C
	(Common to All B.E. / B. Tech. Courses)	3	0	0	3

UNIT I ELECTRO CHEMISTRY 9

Electrochemical - EMF – Electrode potential – Nernst equation — problem – electrochemical series – significance– reference electrodes –Standard Hydrogen electrode - Calomel electrode – Ion selective electrode – glass electrode and measurement of pH and Fuel cells – hydrogen – oxygen fuel cell – batteries – Primary — Leclanche cell – secondary – Lead – acid battery – Lithium batteries (Li-TiS_2 and Li - S battery).

UNIT II CORROSION AND ITS CONTROL 9

Chemical corrosion – oxidation corrosion – mechanism – Pilling – Bed worth rule – electrochemical corrosion – different types – galvanic corrosion – differential aeration corrosion – corrosion control – sacrificial anode and impressed cathodic current methods – corrosion inhibitors – protective coatings – paints – constituents and functions – metallic coatings – electroplating (Gold plating).

UNIT III SPECTROSCOPY 9

Beer-Lambert's law – problem – UV-visible spectroscopy and IR spectroscopy (principle –instrumentation) (block diagram only) – estimation of iron by colorimetry – flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry – atomic absorption spectroscopy – principle – instrumentation (block diagram only) – estimation of nickel by atomic absorption spectroscopy

UNIT IV SURFACE CHEMISTRY & WATER TECHNOLOGY 9

Adsorption – types – adsorption of gases on solids – adsorption isotherms – Frendlich and Langmuir isotherms – – role of adsorbents in ion-exchange adsorption (Demineralization only). Water – hardness – problems – Domestic water treatment – disinfection methods (Chlorination, Ozonation, UV treatment) – break point chlorination – salinity – desalination by reverse osmosis

UNIT V ENGINEERING MATERIALS 9

Refractories – classification – acidic, basic and neutral refractories – properties (refractoriness, refractoriness under load, dimensional stability, porosity, thermal spalling) Abrasives – natural and synthetic abrasives – quartz, corundum, emery, garnet, diamond, silicon carbide and boron carbide. Lubricants – mechanism of lubrication - properties – viscosity index, flash and fire points, cloud and pour points, oiliness) – solid lubricants – graphite and molybdenum sulphide.

L :45 T: 0 P: 0 T:45 PERIODS

TEXT BOOKS

1 M.Manjuladevi, R.Anitha "Engineering Chemistry" Gem Pub. Coimbatore. 2013.
2. P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi 2008.

REFERENCES

1 B. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2009).
2 R. Sivakumar and N Sivakumar, "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd. New Delhi.2009.
3 Dr.Gourkrishna and Dasmohapatra, "Engineering Chemistry" Vikas Pub. House Pvt.Ltd. 2011.
4 O.Gpalanna, "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi.2009.
5 B.R.Puri,L.R.Sharma&M.S.Pathania,"Principles of Physical Chemistry" Vishalpublishing Co. Jalandhar, Punjab. 2013.

COURSE OUTCOMES :

At the end of the course student should be able to:

CO1 Assemble a battery and illustrate the phenomenon of production of electric current
CO2 Know the technical information about corrosion, corrosion control by galvanization and electroplating
CO3 Gain knowledge on the principles and instrumentation of spectroscopic techniques
CO4 Apply the theory of adsorption in real life situations
CO5 Acquire sound knowledge on different types of Engineering materials

16CS101	FUNDAMENTALS OF COMPUTING AND PROGRAMMING	L	T	P	C
	(Common to All B.E. / B. Tech.)	3	0	0	3

UNIT I INTRODUCTION TO COMPUTERS 8

Introduction – Characteristics of Computers –Computer Generations – Classification of Computers – Basic Computer organization – Number Systems- Algorithm –Pseudo code –Flow Chart- Computer Software –Types of Software– Internet Terminology

UNITII C PROGRAMMING BASICS 10

Introduction to 'C' programming –fundamental Rules–structure of a 'C' program –compilation and linking processes –Constants, Variables, keywords, Identifier, Delimiters –Declaring and Initializing variables–Data Types –Operators and Expressions–Managing Input and Output operations –Decision Making and Branching –Looping statements –solving simple scientific and statistical problems.

UNIT III ARRAYS AND STRINGS 10

Arrays – Characteristics, Initialization – Declaration – One dimensional and two dimensional arrays. String- String operations – String Arrays. Simple programs-sorting-searching –matrix operations (Addition, subtraction and Multiplication).

UNIT IV FUNCTIONS AND POINTERS 9

Function –definition of function – User-defined Functions - Declaration of function – Call by reference – Call by value –Recursion –Pointers -Definition –Initialization –Pointers arithmetic –Pointers and arrays-Example Problems.

UNIT V STRUCTURES AND UNIONS 8

Defining Structures and Unions–Structure declaration –need for structure data type - Structure within a structure- Union -Programs using structures and Unions- Pre-processor directives.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1 E.Balagurusamy, "Fundamentals of Computing and Computer Programming", Tata McGRaw-Hill Publishing Company Limited, (2011).

2. Ashok.N.Kamthane," Computer Programming", Pearson Education (India) (2010).

REFERENCES

1 Byron Gottfried, "Programming with C", 2nd Edition, (Indian Adapted Edition), TMH Publications, (2006).

2 Stephan G kochan, "Programming in C" Pearson Education (2010).

3 P.Sudharson, "Computer Programming", RBA Publications (2008).

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

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

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Distinguish the differences among the various generation and classification of computers and solve problems in number system

CO2 Understand the basic concepts of C programming and write programs using various control statements

CO3 Implement programs using arrays and apply the concepts to solve basic problems

CO4 Write C programs to solve problems using functions and pointers

CO5 Understand the concepts structures and unions and apply them

16ME101	ENGINEERING DRAWING	L	T	P	C
	(Common to Aero, Agri, Auto, Civil, Civil & Planning, Mech, MEA and MCT)	3	0	2	4

Concepts and conventions (Not for Examination)

Importance of graphics in engineering applications - Use of drafting instruments -BIS Conventions and specifications -Size, layout and folding of drawing sheets –Lettering and dimensioning.

UNIT I PROJECTION OF POINTS, LINES AND PLANE SURFACES 12+8

Projection of points - Projection of straight lines located in the first quadrant -Determination of true lengths and true inclinations - Projection of polygonal surface and circular lamina inclined to both reference planes.

UNIT II PROJECTION OF SOLIDS 9+6

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method

UNIT III SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES 9+6

Sectioning of above solids in simple vertical position by cutting planes inclined to one reference plane and perpendicular to the other -Obtaining true shape of section. Development of lateral surfaces of simple and truncated solids -Prisms, pyramids, cylinders and cones.

UNIT IV PICTORIAL PROJECTIONS AND FREE HAND SKETCHING 9+6

Principles of isometric projection -isometric scale -isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones. Perspective projection of prisms, pyramids and cylinders by visual ray method.

Free hand sketching:

Representation of Three Dimensional objects -Need for importance of multiple views and their placement -First angle projection -layout views -Developing visualization skills through free hand sketching of multiple views from pictorial drawing.

UNIT V BUILDING DRAWING 6+4

Drawing of a plan, Elevation and sectioning of security room and residential building (Two bed rooms, kitchen, hall,etc.)

L: 45 T:0 P: 30 TOTAL : 75 PERIODS

TEXT BOOKS

1. N.D. Bhatt and V.M. Panchal, "Engineering Drawing", Charotar Publishing House, 53rd Edition, (2016).
2. K. R. Gopalakrishnan, "Engineering Drawing" (Vol.I & II), Subhas Publications (2014).

REFERENCES

1. K. V. Natarajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai (2015).
2. M.S. Kumar, "Engineering Graphics", D.D. Publications, (2011),
3. K. Venugopal & V. Prabhu Raja, "Engineering Graphics", New Age International (P) Limited (2014).
4. M.B. Shah and B.C. Rana, "Engineering Drawing", Pearson Education (2011),
5. K.L. Narayanan and P. Kannaiah, "Engineering Drawing" SciTech Publications, 2nd edition, (2012).

COURSE OUTCOMES

CO1 Sketch the projections of a points, straight lines and plane surfaces.

CO2 Illustrate top view and front view of the solids.

CO3 Sketch sectioned views and develop area required.

CO4 Demonstrate knowledge about isometric, perspective and orthographic projections.

CO5 Design simple buildings with detailed plan and sectional elevation.

16GE111	CAREER DEVELOPMENT PROGRAMME - I	L	T	P	C
	(Common to All B.E. / B. Tech. Courses)	1	0	2	2*

UNIT I TRAINING FUNDAMENTALS **3+6**

Goal Settings – Insights into pre-placement requisites – SWOT Analysis – LSRW Skills.

UNIT II LINGUISTIC SKILLS I **3+6**

Parts of Speech – Noun, Verb, Participle, Articles, Pronoun, Preposition, Adverb, Conjunction – Logical sequence of words –Tense & Voice – Comparison – Comprehension – comprehend and understand a paragraph

UNIT III QUANTITATIVE ABILITY I **3+6**

Number theory – Percentage – Profit, loss and discount – Simple and compound interest.

UNIT IV QUANTITATIVE ABILITY II **3+6**

Ratio & Proportions – Partnership – Problems on Average & Ages – Clocks – Time sequence test.

UNIT V COMMUNICATION SKILLS **3+6**

Impromptu Speech – Group Discussion – Questioning Technique.

L:15 T:0 P:30 Total: 45 PERIODS

TEXT BOOKS

1 John Eastwood, "Oxford Practice Grammar", Oxford, 2006.
2. Rajesh Varma, "Fast Track Objective Arithmetic", Arihant Publications, 2010.

REFERENCES

1 Barun K. Mithra, 2016, "Personality Development & Soft Skills", Oxford.
2 R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication, 2012.
3 R.S.Agarwal, "Quantitative Aptitude for Competitive Examinations", S.Chand & Company Pvt Limited, 2016.
4 Kreyszig, E., "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons, Inc, Singapore, 2008.
5 Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education Ltd., 2013.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Set their career goals through SWOT analysis.
CO2 Form sentences through logical sequence of words and understand passage through Comprehension
CO3 Apply the shortcut methods in quantitative aptitude.
CO4 Solve application orientated concepts in quantitative aptitude.
CO5 Communicate well and familiarize with the questioning techniques.

16CS102	FUNDAMENTALS OF COMPUTING AND PROGRAMMINGLABORATORY (Common to All B.E. / B. Tech.)	L 0	T 0	P 4	C 2

LIST OF EXPERIMENTS

A) Word Processing

1. Document creation, Text manipulation with Scientific notations
2. Table creation, Table formatting and Conversion
3. Mail merge and Letter preparation
4. Drawing Flow Chart

B) Spread Sheet

1. Chart - Line, XY, Bar and Pie.
2. Formula - formula editor.
3. Spread sheet - inclusion of object, Picture and graphics, protecting the document and sheet.
4. Sorting and Import / Export features.

C) Simple C Programming

1. Data types, Expression Evaluation, Condition Statements.
2. Arrays , Looping Statement
3. Functions , Pointers
4. Structures and Unions

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

Hardware

- LAN System with 33 nodes (OR) Standalone PCs – 33 Nos.
- Printers – 3 Nos.

Software

- OS – Windows / UNIX Clone
- Application Package – Office suite
- Compiler – C

L : 0 T: 0 P: 60 Total: 60 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Create a document, insert formulas and pictures and prepare letters using MS office
CO2 Create tables and charts, use formula in calculations and protect worksheets in MS Excel
CO3 Write simple programs using basic C Concepts
CO4 Write C programs using concepts in control statements
CO5 Write C programs to solve problems using Arrays, Functions, Pointers, Unions, and Structures

16CH103	CHEMISTRY LABORATORY	L	T	P	C
	(Common to All B.E. / B. Tech. Courses)	0	0	2	1

LIST OF EXPERIMENTS

1. Estimation of hardness of Water by EDTA.
2. Determination of DO in water (Winkler's method)
3. Estimation of Chloride in Water sample (Argentometric).
4. Conductometric titration (Simple acid base).
5. Conductometric titration (Mixture of weak and strong acids vs strong base).
6. Potentiometric Titration (Fe^{2+} / $KMnO_4$ or $K_2Cr_2O_7$).
7. pH titration (acid & base).
8. Determination of inhibitor efficiency on the corrosion rate of steel in acid media by weight loss method.
9. Anodizing of aluminum and determination of thickness of anodic film.
10. Determination of cathode efficiency of nickel plating.

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

- Electronic balance
- pH meter
- Potentiometer
- Conductivity bridge
- Spectrophotometer
- Colorimeter
- IC regulated power supply
- Hot air oven

L : 30 T: 0 P: 0 Total:30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Gain the experimental knowledge of testing the water.

CO2 Carry out titration using conductivity meter, potentiometer and pH meter.

CO3 Estimate the metal ions in industrial effluents.

CO4 Set up mini electroplating unit.

CO5 Determine the inhibitor efficiency on the corrosion rate of steel.

16EN103 COMMUNICATION SKILLS LABORATORY L T P C

(Common to all B.E. / B. Tech. Courses) **0 0 4 2**

UNIT I LISTENING 15

Introduction to Business communication-Listening to Monologues-Listening for general content-Listening to dialogues-Listening to telephonic Conversation-Listening to conversation among three or more people-Listening to business conversations.

UNIT II SPEAKING 15

Greetings, Formal and in formal introduction of self and others – Establishing business relationships and negotiating- Tongue twisters/pronunciation drills – Describing an object or event-Describing a working mechanism- Phrases for positive feedback, agreeing/disagreeing Group Discussion-Conversation techniques – Presentation skills-Interview techniques.

UNIT III READING 10

Reading Techniques-Reading to understand –Facts, Inference, Main idea, Authors opinion and tone – Newspaper reading, Reading brochures- Reading and reviewing books, articles -Cloze exercises-Reading Comprehension- Reading a Technical Report-Critical Reading(Editorial):Creative and Critical Thinking.

UNIT IV WRITING 15

Business Itinerary – Business Letters – Calling for Quotation-Placing Orders-Letter Seeking clarification- Letter requesting Information, explaining a situation- Resume & cover letter, Short prepared compositions on current affairs – Leaflets, Instruction Manual- Picture Perception-Encoding and decoding advertisements-Perceiving Visual Information-E-mail Etiquette and Correspondence-Expression indicating frequency/responding to situations and Providing solutions.

UNIT V SOFT SKILLS 5

Emotional Intelligence- Inter & Intrapersonal skills-Teamwork/ Leadership skills -Decision making and Problem solving skills -Time & Stress management- Professional Ethics.

L: 0 T: 0 P:60 Total: 60 PERIODS

TEXT BOOKS

1. Norman Whitby, Business Benchmark, Cambridge English, Second Edition, South Asian Edition 2014
2. Guy Brook-Hart, Business Benchmark, Cambridge English, Second Edition, South Asian Edition 2014

REFERENCES

1. Adrian Doff, Craig Thaine, Herbert Puchta, Jeff Stranks, Peter Lewis-Jones, "Empower English", Cambridge University Press, NY, USA. Updated Edition, 2016.
2. Rizvi, Ashraf. M. "Effective Technical Communication". Tata McGraw-Hill, New Delhi. Updated Edition, 2015.
3. Department of English, Anna University,"Mindscapes: English for Technologists and Engineers",Chennai, Updated Edition, 2015.
4. Leo Jones, Richard Alexander, "New International Business English", Cambridge University Press, NY, USA. Updated Edition, 2009.
5. Jeff Butterfield, "Soft skills for everyone", Cengage Learning, New Delhi, 2011.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Face the challenges of the globalized world with confidence and with the best communicative skills.
CO2 Make learners imbibe listening and speaking skills in both formal and informal contexts.
CO3 Help them develop their reading skills by familiarizing them with different types of reading strategies.
CO4 Make them acquire language skills at their own pace by using e-materials and language lab components.
CO5 Enrich their creative and critical thinking and get through interviews successfully.

16EN102	TECHNICAL ENGLISH II	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	3	0	0	3

UNIT I **9**

Technical Vocabulary – meanings in context – Sentence pattern - Process description - Sequencing words - Uses of Pronouns - Paragraph writing – narrative.

UNITII **9**

Numerical adjective - Phrasal verbs - Phrases / Structures indicating use / purpose – Introduction to communication & Barriers to communication - Non-verbal communication – Different grammatical forms of the same word.

UNIT III **9**

Stress and Intonation – Word stress & Sentence stress – Formal Letter writing- quotations, clarification, placing orders, complaint letter – Writing – Using connectives (discourse makers) - Recommendations - Report writing – types of report, report format, recommendations/suggestions- (Fire Accident & Road Accident).

UNIT IV **9**

Direct & Indirect speech – Argumentative paragraphs – Letter of application – content, format (CV / Resume) –Checklist– E-mail communication – Blog writing.

UNIT V **9**

Auxiliary verbs - Preparing Agenda, Notices and Minutes – Proposal writing – project/business proposal- Technical essay – Conversational skills – four types of speeches – extempore, manuscript, impromptu, memorized.

L :45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1 Gunasekaran.S , ‘ Technical English II’ Third Edition, Vishnu Prints Media, Chennai, 2016.
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai. 2011.

REFERENCES

1 Muralikrishna & Sunita Mishra. Communication Skills for Engineers. Pearson, New Delhi. 2011.
2 Smith-Worthington, Darlene & Sue Jefferson. Technical Writing for Success. Cengage, Mason USA. 2007.
3 Rizvi, Ashraf. M, Effective Technical Communication, Tata McGraw-Hill, New Delhi, 2005.
4 Mitra K. Barun, “ Effective Technical Communication – A Guide for Scientists and Engineers”, Oxford University Press, New Delhi, 2006.
5 Anderson, Paul V. Technical Communication: A Reader-Centered Approach. Cengage. New Delhi. 2008

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Apply knowledge about the various principles of communication and its various stages.

CO2 Imply the importance of verbal and non-verbal communication in the professional world along with its uses.

CO3 Review the grammar – verbs and its different forms and application of the different forms of advanced grammar.

CO4 Apply grammatical knowledge which enhances speaking and writing skills to prepare reports and resume in a professional manner.

CO5 Speak clearly, confidently, comprehensively, and communicate with one or many listeners using appropriate communicative strategies.

16MA102	ENGINEERING MATHEMATICS II	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	3	1	0	4

UNIT I MULTIPLE INTEGRALS 9+3

Double integration in Cartesian co-ordinates – Change of order of integration – Triple Integrals – Simple problems – Area and volume by multiple integrals.

UNIT II VECTOR CALCULUS 9+3

Gradient Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs) – Simple problems involving cubes and rectangular parallelepipeds.

UNIT III COMPLEX DIFFERENTIATION 9+3

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy – Riemann equation and Sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions using Milne Thomson's method – Conformal mapping : w= z + c, cz, 1/z, and bilinear transformation.

UNIT IV COMPLEX INTEGRATION 9+3

Complex integration – Statement and Problems of Cauchy's integral theorem and Cauchy's integral formula – Taylor's and Laurent's expansion – Singular points – Residues – Residue theorem – Problems only.

UNIT V LAPLACE TRANSFORMS 9+3

Laplace transform – Conditions for existence (statement only) – Transforms of standard functions – Properties (statement only) – Transforms of derivatives and integrals – Initial and Final value theorems (statement only) – Periodic functions - Inverse transforms – Convolution theorems (statement only) – Applications of Laplace transforms for solving the ordinary differential equations up to second order with constant co-efficient.

L :45 T:15 P:0 Total: 60 PERIODS

TEXT BOOKS

1. Bali, N. P. and Manish Goyal, "Text book of Engineering Mathematics", 4th Edition, University Science Press, 2014.
2. Grewal, B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, 2014.

REFERENCES

1. Ramana, B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2014.
2. Kandasamy, P., Thilagavathy, K. and Gunavathy, K., "Engineering Mathematics", Volume I., S. Chand & Co., New Delhi, 2012.
3. Jain, R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", 4th Edition, Narosa Publishing House Pvt. Ltd., 2015.
4. Kreyszig, E., "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons, Inc, Singapore, 2008.
5. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education Ltd., 2013.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Evaluate double integral and triple integral to compute area, volume for two dimensional and three dimensional solid structure.

CO2 Know the gradient, divergence and curl, related theorems useful for engineering applications.

CO3 Test the analyticity and to construct the analytic function and transform complex functions from one plane to another plane graphically.

CO4 Evaluate real and complex integrals over suitable closed paths or contours.

CO5 Know the Applications of Laplace transform and its properties & to solve certain linear differential equations using Laplace transform technique.

16PY 102	PHYSICS OF MATERIALS	L	T	P	C
	(Common to All B.E. / B. Tech. Courses)	3	0	0	3

UNIT I CONDUCTING AND SUPERCONDUCTING MATERIALS 9

Classification of materials based on conductivity- Conductors –Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals. Superconductors – Type I and Type II superconductors – BCS theory of superconductivity (Qualitative) –High T_c superconductors – Application of superconductors –SQUID, Magnetic levitation.

UNIT II SEMICONDUCTING MATERIALS 9

Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination –direct and indirect band gap semiconductors- derivation of carrier concentration in n-type and p-type semiconductors – variation of Fermi level with temperature and impurity concentration — Hall effect –Determination of Hall coefficient – Applications.

UNIT III MAGNETIC MATERIALS 9

Basic concepts – magnetic moment, susceptibility, permeability. Origin of magnetic moment – Bohr magneton –Dia, Para and Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – antiferromagnetic materials – Ferrites and its applications. Magnetic storage devices- magnetic hard disc, bubble memory.

UNIT IV DIELECTRIC MATERIALS 9

Electrical susceptibility – dielectric constant – electronic, ionic, orientation and space charge polarization – frequency and temperature dependence of polarization – internal field – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – Applications of dielectric materials (capacitor and transformer) – ferroelectricity and applications.

UNIT V ADVANCED ENGINEERING MATERIALS 9

Metallic glasses: preparation, properties and applications. Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, applications – Nanomaterials: Properties –Top-down process: Ball milling method- Bottom –up process: Chemical vapour deposition method- Carbon Nanotubes- Preparation by pulsed laser deposition method, properties and applications.

L :45 T: 0 P: 0 T: 45 PERIODS

TEXT BOOKS

1 Charles Kittel, Introduction to Solid State Physics, Wiley Publications, 2006.
2 Ragavan V, "Materials Science and Engineering:, PHI Learning Private, 2012.

REFERENCES

1 Rajendran.V, Engineering Physics,Tata Mcgraw-Hill Publishing Company Limited,New Delhi.2009.
2 Neil W.Ashcroft, N.David Mermin, Solid state physics, Cengage Publication, 2011.
3 S.O.Pillai, Solid State Physics, New Age International, New Delhi, 2005.
4 William D.Callister, Material Science and Engineering, Wiley Publications, 2006.
5 Dr.G.Senthil kumar, Engineering Physics-II, VRB Publishers Pvt.Ltd. Chennai.(2013).

COURSE OUTCOMES :

At the end of the course student should be able to:

CO1 Understand the properties and applications of conducting, super conducting materials
CO2 Identify the electrical properties of semiconducting materials.
CO3 Classify the magnetic materials based on the properties and employ it to act as a memory storage device.
CO4 Understand the various types of polarization and applications of dielectric materials.
CO5 Comprehend the preparation and properties of advanced engineering materials for industrial applications.

16CH 102 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C

(Common to All B.E. / B. Tech. Courses) **3 0 0 3**

UNIT I ENVIRONMENT & BIODIVERSITY 9

Definition, scope and introduction –planet earth (atmosphere, lithosphere & hydrosphere) of environment. Introduction to biodiversity definition: genetic, species and ecosystem diversity –Values of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values–threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT II AIR &NOISE POLLUTION 9

Air pollution - Atmospheric chemistry - Chemical composition of the atmosphere-Definition- causes, effects and control measures. Control of particulate and gaseous emission - Electrostatic precipitator – automobile emission - catalytic convertor - Acid rain- Green house effect - Global warming- -Air (Prevention & control of pollution act) - Noise pollution – Definition, effects & control of noise pollution.

UNIT III WATER & SOIL POLLUTION 9

Water and their environment significance-Water quality parameters-Physical, chemical and biological parameters-Dissolved Oxygen-Biological Oxygen demand – Chemical Oxygen Demand (Definition only) - Water pollution- causes, effect & control measures-Sewage water treatment – Water (prevention & control of pollution act) - Soil pollution-Definition, causes, effects of soil pollution

UNIT IV CONVENTIONAL & NON CONVENTIONAL ENERGY RESOURCES 9

Conventional – Coal – Gross net calorific value (Definition only) – Coke – Manufacture of coke – Otto Hoffmann method **–** Petroleum- Fractional distillation - Natural gas - LPG and CNG-Need for alternative energy resources –Nuclear energy- Fission and fusion reactions- Light water nuclear reactor for power generation (block diagram only) – Solar energy – Wind energy-H_2O_2 fuel cell. Role of an individual in conservation of energy resources

UNIT V GREEN CHEMISTRY & ENVIRONMENTAL MANAGEMENT 9

Green chemistry- Principles of green chemistry – Water conservation – Rain water harvesting - Solid waste management: causes, effects and control measures of municipal solid wastes. Disaster management – Floods, Earthquake – Population growth – Population explosion and its consequences - Role of information technology in environment and human health.

L :45 T: 0 P: 0 T: 45 PERIODS

TEXT BOOKS

1 Dr.A.Ravikrishnan, "Environmental Science & Engineering"Sri Krishna Hitech Pub.Co.Pvt.Ltd.2013

2 Benny Joseph, "Environmental Science & Engineering" Tate McGraw-Hill Pub.Co.Ltd, New Delhi.2009.

REFERENCES

1 G.Tyler Miller, "Environmental Science" Cengage Learning India Pvt. Ltd.New Delhi.2011

2 Dr. Debang Solanki, "Principles of EnvironmentalChemistry" Prateeksha Pub.Jaipur.2011.

3 Gilbert M. Masters and Wendell. P.Ela, "Introduction to Environmental Engineering and Science" PHI Learning Pvt. Ltd. New Delhi.2010

4 Deeksha Dave and S.S. Katewa, "Environmental Science & Engineering" Learning India Pvt. Ltd.New Delhi.2011

5 Benny Joseph "Environmental Science & Engineering" Tata McGraw-Hill Pub.Co.Ltd, New Delhi. 2009 .

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Understand the importance of fossil fuels as energy sources, development of alternative sources of energy like solar, wind etc

CO2 Aware on green house effect, various types of pollutions and global warming.

CO3 Know about the effects of automobile emission and its control measures.

CO4 Gain knowledge about the protection of environment.

CO5 Conscious on water conservation, rapid growth of population and advantages of green chemistry

16EE101	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	L	T	P	C
	(Common to all Non circuit branches)	**3**	**0**	**0**	**3**

UNIT I ELECTRICAL CIRCUITS & MEASURMENTS 9

Ohm's Law – Kirchoff's Laws – Power and Power factor – Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters) and Energy meters.

UNIT II ELECTRICAL MACHINES 9

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, single phase induction Motor.

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS 9

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation. Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – ElementaryTreatment of Small Signal Amplifier.

UNIT IV DIGITAL ELECTRONICS 9

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – A/D and D/A Conversion (single concepts)

UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING 9

Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations. Communication Systems: Radio, TV, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

L:45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1 Muthusubramanian R, Salivahanan S, "Basic Electrical and Electronics Engineering", Tata McGraw Hill, New Delhi (2012)

2. Bhattacharya. S.K, "Basic Electrical and Electronics Engineering", Pearson Education , First Edition, (2011)

REFERENCES

1 N. Mittle "Basic Electrical Engineering", Second Edition, Tata McGraw Hill Edition, New Delhi, (2005)

2 Mehta V K, Mehta Rohit, "Principles of Electrical Engineering and Electronics", S.Chand & Company Ltd, (2010)

3 Mehta V K, Mehta Rohit, "Principles of Electronics", S.Chand & Company Ltd, (2005)

4 Anokh singh, Chhabra .A. K, "Principles of Communication Engineering", S.Chand & Company Ltd, (1999)

5 Vincent Deltoro, " Electrical Engineering Fundamentals", Second Edition, Pearson Education, (2015)

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Apply the elementary concept of electric sources, elements and their properties in the circuits
CO2 Familiarize in the concepts of measuring instruments
CO3 Understand the construction and operation of electrical machines
CO4 Gain knowledge on the theory and applications of analog and digital electronics
CO5 Acquire the knowledge on basics of communication engineering

16ME102	ENGINEERING MECHANICS	L	T	P	C
	(Common to Aero, Agri, Auto, Civil, CEP, MEA and MCT)	3	2	0	4

UNIT I BASICS & STATICS OF PARTICLES 9+6

Introduction - Units and Dimensions - Vectorial representation of forces and moments – Coplanar Forces - Laws of Mechanics - Lame's theorem, Parallelogram and triangular Law of forces -Resolution and Composition of forces -Equilibrium of a particle - Forces in space - Equilibrium of a particle in space - Equivalent systems of forces - Principle of transmissibility -Single equivalent force - Free body diagram.

UNITII EQUILIBRIUM OF RIGID BODIES 9+6

Types of supports and their reactions -requirements of stable equilibrium -Moments and Couples - Moment of a force about a point and about an axis -Vectorial representation of moments and couples - Scalar components of a moment -Varignon's theorem - Equilibrium of Rigid bodies in two dimensions –Equilibrium of Rigid bodies in three dimensions –Examples.

UNIT III PROPERTIES OF SURFACES AND SOLIDS 10+6

Determination of Areas and Volumes -First moment of area and the centroid of sections - Rectangle, circle, triangle from integration -T section, I section, - Angle section, Hollow section by using standard formula -second and product moments of plane area -Rectangle, triangle, circle from integration -T section, I section, Angle section, Hollow section by using standard formula -Parallel axis theorem and perpendicular axis theorem -Polar moment of inertia -Principal moments of inertia of plane areas - Principal axes of inertia -Mass moment of inertia -Derivation of mass moment of inertia for rectangular section, prism, sphere from first principle -Relation to area moments of inertia.

UNIT IV DYNAMICS OF PARTICLES 8+6

Displacements, Velocity and acceleration, their relationship - Relative motion -Curvilinear motion - Newton's law -Work Energy Equation of particles -Impulse and Momentum -Impact of elastic bodies.

UNIT V ELEMENTS OF RIGID BODY DYNAMICS 9+6

Translation and Rotation of Rigid Bodies -Velocity and acceleration -General Plane motion. Analysis of structures -Plane Trusses -simple trusses -Analysis by Method of joints - Method of sections -Frames - Analysis of a structure containing multi -force members.

L: 45 T: 30 P:0 TOTAL : 75 PERIODS

TEXT BOOKS

1. Arthur P.Boresi and Richard J.Schmidt, "Engineering Mechanics:Statics and Dynamics", Thomson Asia Private Limited, Singapore, 2010.
2. Beer, F.P and Johnston Jr. E.R. "Vector Mechanics for Engineers", McGraw-Hill Education 10th Edition (India) Pvt Ltd. (2013).

REFERENCES

1. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)
2. D.P.Sharma "Engineering Mechanics", Dorling Kindersley (India) Pvt. Ltd, New Delhi 2010.
3. Dr.I.S Gujral "Engineering Mechanical" second edition, 2011, Lakshmi Publication (P).Ltd.
4. J.L. MEriam & L.G. Karidge, Engineering Volume I) and engineering Mechanics: Dynamics, 7th edition, Wiley student edition, 2013.
5. Hibbeller, R.C., "Engineering Mechanics", 13th edition, Prentice hall (2013).

COURSE OUTCOMES

CO1 Recognize the basics of equilibrium of particles in 2D and 3D

CO2 Review the requirements of equilibrium of rigid bodies in 2D and 3D

CO3 Compute the center of mass and moment of inertia of surfaces and solids

CO4 Predict displacement, velocity and acceleration of dynamic particles

CO5 Solve for equilibrium and internal forces acting in a rigid body

16GE112	CAREER DEVELOPMENT PROGRAMME - II	L	T	P	C
	(Common to All B.E. / B. Tech. Courses)	1	0	2	2*

UNIT I LINGUISTIC SKILLS II **15**

Goal Settings, Insights into pre-placement requisites, SWOT Analysis, LSRW Skills

UNIT II QUANTITATIVE ABILITY III **8**

Time, speed and distance -Train problems-Boats and streams, Time and work – Pipes and cisterns, Calendars, Venn diagram.

UNIT III QUANTITATIVE ABILITY IV **7**

Probability, Permutation &Combination, Mixtures & Allegation, Mensuration, Data Interpretation.

UNIT IV PERSONALITY DEVELOPMENT **8**

Personality, Presentation Skills – stages, selection of topic, content & aids, Minutes of meeting, Public speaking.

UNIT V COMMUNICATION SKILLS **7**

Power point presentation, Speak for three minutes, Online typing, Passage reading.

L :15 T: 0 P: 30 T: 45 PERIODS

TEXT BOOKS

1. John Eastwood, "Oxford Practice Grammar", Oxford, 2006.
2. Rajesh Varma, "Fast Track Objective Arithmetic", Arihant Publications, 2010.
3. Barun K. Mithra, 2016, "Personality Development & Soft Skills", Oxford.

REFERENCES

1. R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication, 2012.
2. R.S.Agarwal, "Quantitative Aptitude for Competitive Examinations", S.Chand & Company Pvt Limited, 2016.

COURSE OUTCOMES

At the end of the course students should be able to

CO1 Understand the field Linguistic techniques.
CO2 Communicate at the basic level in public speaking and write reports.
CO3 Solve time related problems.
CO4 Get the critical concepts through the mixture & allegation & data interpretation sums.
CO5 Write minutes of meeting and versatile presentations.

16PY 103	PHYSICS LABORATORY	L	T	P	C
	(Common to All B.E. / B. Tech. Courses)	0	0	2	1

LIST OF EXPERIMENTS

1. Determination of wavelength of mercury spectrum – Spectrometer grating
2. Determination of Young's modulus of the material – uniform bending.
3. Determination of viscosity of liquid – Poiseuille's method.
   (a) Particle size determination using Diode Laser.
   (b) Determination of Laser parameters – Wavelength.
4. Determination of velocity of sound and compressibility of liquid – Ultrasonic Interferometer.
5. Determination of thickness of a thin wire – Air wedge method.
6. Determination of dispersive power of a prism using spectrometer.
7. Determination of Young's modulus of the material – non uniform bending.
8. Torsional Pendulum - determination of rigidity modulus of wire and moment of inertia of disc.
9. Determination of Band gap of semiconductor material.

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

- Spectrometer
- Young's modulus apparatus
- Poiseuille's method apparatus
- Diode Laser
- Ultrasonic Interferometer
- Air Wedge apparatus
- Torisional Pendulum Apparatus
- Band gap determination kit

L : 30 T: 0 P: 0 C: 0 Total:30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1	Experiment the concept of stress, strain for the given material.
CO2	Utilize the concept of interference and diffraction in optical measuring instruments.
CO3	Experiment the concept of diffraction in determining the wavelength, velocity of ultrasonic waves.
CO4	Grasp the knowledge of dependency of viscosity of a liquid on its density and velocity of liquid motion.
CO5	Apply the concept of temperature dependence of resistance of a semiconducting

16GE102	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS

GROUP A (CIVIL & MECHANICAL) (30)

CIVIL ENGINEERING (12)

1. Study of plumbing tools and Components
2. Preparation of threads in pipes
3. Preparation of single and multi tap connections for domestic
4. Study of carpentry tools and its applications
5. Preparation of Cross Lap and Dove Tail Joints.

MECHANICAL ENGINEERING (18)

1. Study of different types of Welding and its applications
2. Preparation of Butt, Lap and Tee joints
3. Study of sheet metal and its applications
4. Preparation of Rectangular, Square Trays and Funnel
5. Demonstration of Lathe and Drilling Operations
6. Demonstration of Smithy and Foundry tools.

GROUP B (ELECTRICAL AND ELECTRONICS) (30)

ELECTRICAL ENGINEERING PRACTICE (18)

1. Residential house wiring using switches, fuse, miniature circuit breaker, 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.
6. Measurement of insulation resistance to earth of electrical equipment.
7. Measurement of single and three phase voltages.
8. Study of Iron Box, Emergency Lamp and Fan.

ELECTRONICS ENGINEERING PRACTICE (18)

1. Study of Electronic components and equipments –Resistor, colour coding, measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.
2. Verification of logic gates: AND, OR, Ex-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice –Components Devices and Circuits Using general purpose PCB.
5. Characteristics of a PN Junction diode

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

CIVIL

1 Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.
2 Carpentry vice(fitted to workbench)
3 Standard wood working tools
4 Models of industrial trusses, door joints, furniture joints
5 Power Tools:
(a)Rotary Hammer
(b)Demolition Hammer
(c)Circular Saw
(d)Planer
(e)Hand Drilling Machine
(f)Jigsaw

MECHANICAL

1 Arc welding transformer with cables and holders
2 Welding booth with exhaust facility
3 Welding accessories like welding shield, chipping hammer, wire brush, etc.
4 Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.
5 Centre lathe
6 Hearth furnace, anvil and smithy tools
7 Moulding table, foundry tools
8 Power Tool: Angle Grinder
9 Study-purpose items: centrifugal pump, air-conditioner

ELECTRICAL

1 Assorted electrical components for house wiring
2 Electrical measuring instruments
3 Study purpose items: Iron box, fan and regulator, emergency lamp
4 Megger (250V/500V)
5 Power Tools:
(a) Range Finder
(b) Digital Live-wire detector

ELECTRONICS

1 Soldering guns
2 Assorted electronic components for making circuits
3 Small PCBs
4 Multi Meters
5 Study purpose items: Telephone, FM radio, low-voltage power supply
6 Bread Board
7 CRO

L : 0 T: 0 P: 60 Total:60 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Demonstrate plumbing system and Carpentry for the required applications.
CO2 Relate the basic machining operations with engineering problems.
CO3 Apply different types of Welding processes and Sheet metal processes for the Industrial applications
CO4 Illustrate Residential House wiring and simple wiring circuits.
CO5 Employ knowledge on measuring electrical quantities and usage of energy meters.

16ME103	COMPUTER AIDED DRAFTING LABORATORY	L	T	P	C
	(Common to Aero, Agri, Auto, Civil, CEP, Mech, MAE and MCT)	0	0	2	1

LIST OF EXPERIMENTS

1. Study of capabilities of software for Drafting and Modeling -Coordinate systems (Absolute, relative, polar, etc.) -Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like ellipse, parabola, Hyperbola, Cycloid and Involutes.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder cone, etc, and dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc
9. Creation of 3-D models of simple objects by using Revolve and Extrude option and also Convert 3D to 2D
10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from3-D model.

L: 0 T: 0 P:30 TOTAL: 30 PERIODS

LIST OF EQUIPMENTS REQUIRED

1. Pentium IV computer or better hardware, with suitable graphics facility -30 Nos.
2. Licensed software for Drafting and Modeling. -30 Licenses
3. Laser Printer or Plotter to print / plot drawings -1 Nos.

COURSE OUTCOMES

At the end of the course the student will be able to

CO1	Use the concept of drafting and modeling with help of software.
CO2	Display various views of engineering objects.
CO3	Develop an idea in drawing truss like structures
CO4	Create 3D drawings of simple models.
CO5	Convert 3D to 2D views

16MA201	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	3	1	0	4

UNIT I FOURIER SERIES 9+3

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

UNIT II FOURIER TRANSFORMS 9+3

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

UNIT III PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation of partial differential equations – Lagrange's linear equation –Solution of standard types of first order partial differential equations – Linear partial differential equations of second order with constant coefficients (Homogeneous Problems).

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3

Solutions of one dimensional wave equation – One dimensional equation of heat Conduction – Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

UNIT V Z -TRANSFORMS AND DIFFERENCE EQUATIONS 9+3

Z- Transforms – Elementary properties – Inverse Z - Transform – Convolution theorem – Formation of difference equation – Solution of difference equations using Z - Transform.

L:45 T:15 P: 0 Total: 60 PERIODS

TEXT BOOKS

1. Grewal, B.S., "Higher Engineering Mathematics", 43rd Edition, Khanna Publications, Delhi, 2014.
2. Ramana, B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2014.

REFERENCES

1. Bali, N.P. and Manish Goyal, "A Textbook of Engineering Mathematics", Fifth Edition, Laxmi Publications (P) Ltd., 2014.
2. Glyn James, "Advanced Modern Engineering Mathematics", Fourth Edition, Pearson Education, 2013.
3. Erwin Kreyszig, "Advanced Engineering Mathematics", Tenth Edition, Wiley India, 2015.
4. Ronald Bracewell, "The Fourier transforms & its Applications" 3rd Edition, 2012.
5. Zachmanoglou, E.C., "Introduction to partial differential Equations with Application", 2012.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Know how to find the Fourier Series and half range Fourier Series of a function given explicitly or to find Fourier Series of numerical data using harmonic analysis.

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

CO3 Form partial differential equations and solve certain types of partial differential equations.

CO4 Solve one dimensional wave equation, one dimensional heat equation and two dimensional heat equation in steady state using Fourier Series.

CO5 Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

16ME207	STRENGTH OF MATERIALS	L	T	P	C
	(Common to Mech, MAE, Auto & MCT)	3	0	0	3

UNIT I STRESS STRAIN DEFORMATION OF SOLIDS 9

Rigid and Deformable bodies -Strength, Stiffness and Stability - Stresses; Tensile, Compressive and Shear - Deformation of simple and compound bars under axial load - Elastic constants and their relationship - Stresses in Stepped shafts and varying sections.

UNIT II BEAMS -SHEAR FORCE, BENDING MOMENT AND THEORY OF BENDING 9

Types of beams: Supports and Loads - Shear force and Bending Moment in beams - Cantilever simply supported and Overhanging beams -Point of contra Flexure - Stresses in beams: Bending and shear stress.

UNIT III TORSION AND SPRINGS 9

Analysis of torsion of circular bars - Shear stress distribution - Bars of Solid and hollow circular section - Stepped shaft - Twist and torsion stiffness - Compound shafts - Fixed and simply supported shafts - Application to close - coiled helical springs - Maximum shear stress in spring section including Wahl Factor - Deflection of helical coil springs under axial loads - Design of helical coil springs - stresses in helical coil springs under torsion loads. Strain energy in Torsion.

UNIT IV DEFLECTION OF BEAMS AND BUCKLING OF COLUMNS 9

Elastic curve of Neutral axis of the beam under normal loads - Evaluation of beam deflection and slope: Double integration method, Macaulay Method - Columns- End conditions - Equivalent length of a column -Euler equation -Slenderness ratio -Rankine formula for columns.

UNIT V ANALYSIS OF STRESSES IN TWO DIMENSIONS 9

Biaxial state of stresses - Thin cylindrical and spherical shells - Deformation in thin cylindrical and spherical shells -Biaxial stresses at a point - Stresses on inclined plane -Principal Planes Hoop stress and stresses - Mohr's circle for biaxial stresses - Maximum shear stress.

L: 45 T: 0 P: 0 TOTAL: 45 PERIODS

TEXT BOOKS

1. Popov E.P, "Engineering Mechanics of Solids", Prentice - Hall of India, New Delhi, 2012.
2. R.K.Rajput, "Strength of Materials", S.Chand and Company Ltd., New Delhi 2015,

REFERENCES

1. R.S.Khurmi, "Strength of Materials", S.Chand and Company Ltd. New Delhi 2015.
2. Ray Hulse, Keith Sherwin & Jack Cain, "Solid Mechanics", Palgrave ANE Books, 2012.
3. Ryder G.H, "Strength of Materials, Macmillan India Ltd"., Third Edition, 2010
4. Kazimi S.M.A, "Solid Mechanics", Tata McGraw - Hill Publishing Co., New Delhi, 2006.
5. Singh D.K "Mechanics of Solids" Pearson Education 2014.

COURSE OUTCOMES

At the end of the course the student will be able to

CO1 Describe the fundamentals about the simple stresses, strains and deformation in components due to external loads.

CO2 Draw the shear force and bending moment diagrams for various beams.

CO3 Explain the effect of torsion on shaft and springs.

CO4 Determine the deflection of the beams and buckling of columns.

CO5 Evaluate the 2D stresses.

16ME201	ENGINEERING THERMODYNAMICS	L	T	P	C
	(Use of approved Steam tables is permitted)	3	2	0	4
	(Common to Mech, Auto , Agri & MCT)				

UNIT I BASIC CONCEPTS AND FIRST LAW 9+6

Basic concepts - concept of continuum - comparison of microscopic and macroscopic approach - Path and point functions - Intensive and extensive - total and specific quantities - System and their types - Thermodynamic Equilibrium State - path and process - Quasi - static- reversible and irreversible processes - Heat and work transfer - definition and comparison - sign convention - Displacement work and other modes of work - P - V diagram - Zeroth law of thermodynamics -concept of temperature and thermal equilibrium–relationship between temperature scales –new temperature scales - First law of thermodynamics –application to closed and open systems -steady flow processes.

UNITII PROPERTIES OF PURE SUBSTANCE 9+6

Formation of steam and its thermodynamic properties - P-V, P-T, T-V, T-s, h-s diagrams. P - V-T surface - Use of Steam Table and Mollier Chart - Determination of dryness fraction using Throttling, Separating and Throttling - Application of I law for pure substances.

UNIT III SECOND LAW 9+6

Second law of Thermodynamics - Statements of second law and its corollaries - Carnot cycle-Reversed Carnot cycle - Performance - Carnot theorem - Clausius equality - inequality- Concept of Entropy -T-s diagram - entropy change for pure substance - ideal gases - different processes - principle of increase in entropy - Applications of II Law.

UNIT IV STEAM POWER CYCLES 9+6

Ideal and actual Rankine cycles - Cycle Improvement Methods - Reheat and Regenerative cycles, Qualitative Treatment only: Economiser - preheater - Cogeneration Introduction - Binary and Combined cycles.

UNIT V IDEAL AND REAL GASES,GAS MIXTURE, THERMODYNAMIC RELATIONS 9+6

Mole and Mass fraction - Dalton's and Amagat's Law. Properties of gas mixture -Molar mass- gas constant - density - change in internal energy - enthalpy - entropy and Gibbs function.Properties of Ideal gas - Ideal and real gas comparison - Equations of state for ideal and real Gases - Reduced Properties - Compressibility Factor - Principle of Corresponding states - Generalized Compressibility Chart (Qualitative Treatment) and its use - Maxwell relations - Tds Equations - Difference and ratio of heat Capacities - Energy Equation - Joule – Thomson Coefficient - Clausius - Clapeyron equation.

L: 45 T:30 P:0 TOTAL : 75 PERIODS

TEXT BOOKS

1. Nag.P.K., "Engineering Thermodynamics", 5th Edition, Tata McGraw - Hill, New Delhi, 2013.
2. Cengel. Y and M.Boles, "Thermodynamics - An Engineering Approach", 8th Edition, Tata McGraw Hill, 2014.

REFERENCES

1. Natarajan E.,"Engineering Thermodynamics:Fundamentals and Applications", Anuragam Publications, 2012
2. Holman.J.P."Thermodynamics", 3rd Edition, McGraw - Hill, 1995.
3. Rathakrishnan.E.,"Fundamentals of Engineering Thermodynamics", 2nd Edition,e –Hall of India Pvt. Ltd, 2006
4. Arora C.P, "Thermodynamics", Tata McGraw - Hill, New Delhi, 2007.
5. Kau - Fui Vincent Wong, "Thermodynamics for Engineers", CRC Press, 2010 Indian Reprint.

COURSE OUTCOMES

At the end of the course students should be able to

CO1	Describe the laws of thermodynamics and their application to a wide range of systems.
CO2	Determine dryness fraction of pure substances undergoing processes using Mollier chart
CO3	Demonstrate Carnot, Clausius equality and Inequality theorems and apply the principles of entropy in real time applications
CO4	Illustrate the principles of various steam power cycles and to solve problems related to steam undergoing various processes.
CO5	Analyze the properties of ideal, real and its gas mixtures and apply the knowledge of mathematical relations in thermodynamic equations.

DIGITAL ELECTRONICS **L T P C**

16EC231

(Common to CSE,IT, MCT & MAE) **3 0 0 3**

UNIT I MINIMIZATION TECHNIQUES AND LOGIC GATES 9

Minimization Techniques: Boolean postulates and laws – De-Morgan‟s Theorem - Principle of Duality - Boolean expression - Minimization of Boolean expressions — Minterm – Maxterm - Sum of Products (SOP) – Product of Sums (POS) – Karnaugh map Minimization – Don't care conditions – Quine - Mc Cluskey method of minimization.

Logic Gates: AND, OR, NOT, NAND, NOR, Exclusive–OR and Exclusive–NOR Implementations of Logic Functions using gates, NAND–NOR implementations

UNIT II COMBINATIONAL CIRCUITS 9

Design procedure – Half adder – Full Adder – Half subtractor – Full subtractor – Parallel binary adder, parallel binary Subtractor – Fast Adder - Carry Look Ahead adder – Serial Adder/Subtractor - BCD adder – Binary Multiplier – Binary Divider - Multiplexer/ Demultiplexer – decoder - encoder – parity checker – parity generators – code converters - Magnitude Comparator.

UNIT III SEQUENTIAL CIRCUITS 9

Latches, Edge triggered Flip flops SR, JK, T, D and Master slave – Characteristic table and equation, Application table, Synchronous counters, Design of synchronous counters, up/down counter, Modulo–n counter, Decade counters.

UNIT IV DESIGN OF SEQUENTIAL CIRCUITS 9

Register, shift registers, Universal shift register, Ring counters, Classification of sequential circuits: Moore and Mealy, Design of synchronous sequential circuits, state diagram, State table, State minimization, State assignment, Introduction to Hazards: Static, Dynamic

UNIT V DIGITAL LOGIC FAMILIES AND PLD 9

Memories: ROM, PROM, EEPROM, RAM, Programmable Logic Devices: Programmable Logic Array (PLA), Programmable Array Logic (PAL), Implementation of combinational logic using PROM , PLA and PAL, Digital logic families: TTL, ECL and CMOS.

L:45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1 M. Morris Mano, "Digital Design", 4th Edition, Prentice Hall of India Pvt. Ltd., 2008 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.
2 John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.

REFERENCES

1 John F.Wakerly, "Digital Design", Fourth Edition, Pearson/PHI, 2008
2 Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
3 Donald P.Leach and Albert Paul Malvino, "Digital Principles and Applications", 6th Edition, TMH, 2006.
4 S.Salivahanan and S.Arivazhagan,―Digital Circuits and Design‖,Third Edition, Vikas Publishing House Pvt. Ltd, New Delhi,2007
5 Donald D.Givone, ―Digital Principles and Design‖, Tata Mc-Graw Hill Publishing company limited, New Delhi, 2002.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Understand the different methods used for simplification of Boolean expressions.
CO2 Analyze the Combinational circuits.
CO3 Describe the Sequential building blocks & Memory elements.
CO4 Design a sequential circuits
CO5 Classify the different memories and implement the digital circuits.

16ME203	ENGINEERING MATERIALS AND METALLURGY	L	T	P	C
	(Common to Mech , MAE & MCT)	3	0	0	3

UNIT I MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS 9

Mechanisms of plastic deformation - slip and Twinning- Types of Fracture - Testing of materials under tension - compression and shear loads - Hardness tests (Brinell, Vickers and Rockwell) - hardness tests -Impact test lzod and charpy -fatigue and creep failure mechanisms- procedure for Failure analysis - fail safe and safe life design.

UNIT II CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS 9

Constitution of alloys–Solid solutions - substitutional and interstitial - phase diagrams - Isomorphous -eutectoid -eutectic -peritectic - peritectoid reactions - Iron - Iron carbide equilibrium diagram - Classification of steel and cast Iron - microstructure - properties and applications.

UNIT III HEAT TREATMENT 9

Definition -Full annealing - stress relief - recrystallization - spheroidizing–normalizing - hardening and tempering of steel - Construction of TTT diagrams - CCT diagrams - Hardenability - Jominy end quench test - Austempering - martempering - case hardening –carburizing -nitriding - cyaniding - carbonitriding - flame and induction hardening.

UNIT IV FERROUS AND NON FERROUS METALS 9

Effect of alloying additions on steel - Ferrite and Austenite stabilisers-stainless and tool steels- HSLA -Maraging steels -Cu alloys -Aluminium and Al -Cu -precipitation strengthening treatment -Bearing alloys - Mg - alloys and Titanium alloys.

UNIT V NON - METALLIC MATERIALS 9

Polymers -types of polymer - commodity and engineering polymers–Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET, ABS, PPO, PEEK, PTFE, Polymers -Urea and Phenol formaldehydes) - Engineering Ceramics - Properties and applications of Al2O3 -SiC and SIALON -Composites - Classifications -MMC - CMC - PMC - Applications of Composites.

L: 45 T:0 P:0 TOTAL: 45 PERIODS

TEXT BOOKS

1. Kenneth G.Budinski and Michael K.Budinski “Engineering Materials” Prentice - Hall of India Private Limited, 9th Indian Reprint 2009.
2. Donald R. Askeland, Pradeep P. Fulay, Wendelin J. Wright The Science and Engineering of Materials 5th Edition 2010.

REFERENCES

1. William D Callister “Material Science and Engineering”, John Wiley and Sons, 9th Edition, 2014.
2. Raghavan.V “Materials Science and Engineering”, Prentice Hall of India Pvt., Ltd., 6th Edition 2015.
3. Sydney H.Avner “Introduction to Physical Metallurgy” McGraw Hill Book Company, 3rd Edition, 2010.
4. Dieter G.E.,” Mechanical Metallurgy”, McGraw Hill Book Company, 3rd Edition, 2013.
5. Vijendra Singh., “Heat Treatment of Metals”, Standard Publishers Distributors, 3rd Edition, 2012.

COURSE OUTCOMES

At the end of the course students should be able to

CO1 Describe the deformation mechanism and mechanical properties.
CO2 Explain the Constitution of Alloys, Microstructure and their Phase change.
CO3 Apply the Heat Treatment Concepts for various materials to meet the manufacturing requirements.
CO4 Choose the Ferrous and Non Ferrous Metals for various applications.
CO5 Select the Non Metallic Materials based on the properties to suit the applications.

16MC201	MANUFACTURING TECHNOLOGY	L	T	P	C
	(Common to Aero, MAE & Mechatronics)	3	0	0	3

UNIT I THEORY OF METAL CUTTING 9

Orthogonal and oblique cutting– Classification of cutting tools: Single, Multipoint – Tool signature for single point cutting tool – Mechanics of orthogonal cutting – Shear angle and its significance – Chip formation– Cutting tool materials– Tool wear and tool life – Machinability – Cutting Fluids– Simple problems.

UNIT II MACHINING 9

General principles (with schematic diagrams only) of working and commonly performed operations in the following machines: Lathe, Shaper, Planer, Horizontal Milling machine, Universal Drilling machine, Cylindrical grinding machine, Capstan and Turret lathe. Basics of CNC machines. General principles and applications of the following processes: Abrasive jet machining, Ultrasonic machining, Electric discharge machining, Electro chemical machining, Plasma arc machining, and Electron beam machining and Laser beam machining.

UNIT III CASTING AND WELDING 9

CASTING-Pattern and Core making – Moulding sand – Melting furnaces Cupola and Induction furnaces. Special casting processes – Shell, Investment, Die casting – Defects in casting. WELDING-Gas welding, Basic Arc Welding Processes, Thermit Welding, Electron – Beam Welding, Laser – Beam Welding- Plasma Arc. Solid State Welding: Ultrasonic Welding, Friction Welding.

UNIT IV METAL FORMING AND POWDER METALLURGY 9

Principles and applications of the following processes: Forging, Rolling, Extrusion, Wire drawing and Spinning. Powder metallurgy – Principal steps involved advantages, disadvantages and limitations of powder metallurgy-Case Studies.

UNIT V FORMING AND SHAPING OF PLASTICS 9

Types of plastics - Characteristics of the forming and shaping processes – Moulding of Thermoplastics – Working principles and typical applications of - Injection moulding – Plunger and screw machines – Blow moulding – Rotational moulding – Film blowing – Extrusion - Typical industrial applications – Thermoforming – Processing of Thermosets – Working principles and typical applications - Compression moulding – Transfer moulding – Bonding of Thermoplastics – Fusion and solvent methods – Induction and Ultrasonic methods.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Kalpakjian, S., "Manufacturing Engineering and Technology", Pearson education India, 4th edition, 2001(ISBN 81 78081 571)
2. Hajra Choudhury, "Elements of Workshop Technology", Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2005

REFERENCES

1. P. N. Rao, "Manufacturing Technology Vol I", Tata-McGraw-Hill Publishing Ltd, 2010.
2. Chua, C K., Leong, K F and Lim, C S., "Rapid Prototyping: Principles and Applications", John Wiley, New York, 2003
3. Rao P.N., "Manufacturing Technology, Metal cutting and Machine Tools", Tata McGraw Hill, 2000.
4. Sharma, P.C., "A textbook of Production Technology – Vol I and II", S. Chand & Company Ltd., New Delhi, 1996.
5. Jain. R. K., "Production Technology", Khanna Publishers, New Delhi, 2001.

COURSE OUTCOMES

At the end of the course student should be able to:

- **CO1** Understand the basics of cutting, cutting tools, and tool wear.
- **CO2** Gather knowledge about the conventional and unconventional machining processes.
- **CO3** Characterize the major machining operations of turning, milling and drilling.
- **CO4** Gather knowledge about the casting and welding.
- **CO5** Have an exposure to powder metallurgy and plastics

16GE211	CAREER DEVELOPMENT PROGRAMME - III	L	T	P	C
	(Common to All B.E. / B. Tech. Courses)	1	0	2	2*

UNIT I TRAINING FUNDAMENTALS **3+6**

Goal Settings – Insights into pre-placement requisites – SWOT Analysis – LSRW Skills.

UNIT II LINGUISTIC SKILLS I **3+6**

Parts of Speech – Noun, Verb, Participle, Articles, Pronoun, Preposition, Adverb, Conjunction – Logical sequence of words –Tense & Voice – Comparison – Comprehension – comprehend and understand a paragraph

UNIT III QUANTITATIVE ABILITY I **3+6**

Number theory – Percentage – Profit, loss and discount – Simple and compound interest.

UNIT IV QUANTITATIVE ABILITY II **3+6**

Ratio & Proportions – Partnership – Problems on Average & Ages – Clocks – Time sequence test.

UNIT V COMMUNICATION SKILLS **3+6**

Impromptu Speech – Group Discussion – Questioning Technique.

L:15 T: 0 P:30 Total: 45 PERIODS

TEXT BOOKS

1 John Eastwood, "Oxford Practice Grammar", Oxford, 2006.
2 Rajesh Varma, "Fast Track Objective Arithmetic", Arihant Publications, 2010.

REFERENCES

1 Barun K. Mithra, 2016, "Personality Development & Soft Skills", Oxford.
2 R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication, 2012.
3 R.S.Agarwal, "Quantitative Aptitude for Competitive Examinations", S.Chand & Company Pvt Limited, 2016.
4 Kreyszig, E., "Advanced Engineering Mathematics", 8th Edition, John Wiley & Sons, Inc, Singapore, 2008.
5 Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education Ltd., 2013.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Set their career goals through SWOT analysis.
CO2 Form sentences through logical sequence of words and understand passage through Comprehension
CO3 Apply the shortcut methods in quantitative aptitude.
CO4 Solve application orientated concepts in quantitative aptitude.
CO5 Communicate well and familiarize with the questioning techniques.

16MC202	MANUFACTURING TECHNOLOGY LABORATORY	L	T	P	C
	(Common to Aero & Mechatronics)	0	0	2	1

LIST OF EXPERIMENTS

Study of Lathe

Exercise on Three-Jaw Chuck Lathe – Plain Turning
Exercise on Three-Jaw Chuck Lathe – Taper Turning
Exercise on Three-Jaw Chuck Lathe – Thread Cutting

Study of Drilling

Exercise on Drilling &Tapping
Exercise on Shallow hole Drilling &Reaming

Study of Milling Machine

Exercise on Surface Milling
Exercise on Gear Cutting
Exercise on Contour Milling

Study of Planning Machine

Exercise on Planning Machine – Cutting Key Ways

Study of Shaping Machine

Exercise on Shaping Machine – Cutting Key Ways

Study of Grinding Machines

Machining a work piece using a Surface Grinding
Machining a work piece using a Cylindrical Grinding

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

Lathe	-15
Drilling Machine	-1
Milling Machine	-2
Planning Machine	-1
Shaping Machine	-2
Grinding Machine	-1
Surface Grinding Machin e	-1
Cylindrical Grinding Machine	-1

L : 0 T: 0 P:30 C: 0 Total:30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1	gather the practical knowledge of the machines and various machining operations
CO2	have the exposure on hands-on training to the students on various conventional machines.
CO3	know the manufacturing of the components through machining process.
CO4	get ideas about various parameters of machining tools.
CO5	understand the working of special machines like Shaper, Planer, Milling, and Grinding Machines

16MC203 STRENGTH OF MATERIALS LABORATORY L T P C

(Common to Auto & Mechatronics) **0 0 2 1**

LIST OF EXPERIMENTS

1. Tension test on mild steel rod
2. Compression test on wood
3. Double shear test on metal
4. Torsion test on mild steel
5. Impact test on metal specimen – (IZOD &Charpy)
6. Study on Vickers Hardness test
7. Hardness test on metals (Rockwell &Brinell Hardness Tests)
8. Deflection test on beam
9. Compression test on helical spring

Test on cement

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

UTM of minimum 400 KN Capacity -1
Torsion Testing Machine for steel rods -1
IZOD and CHARPY Impact Testing Machine -1
Hardness Testing Machine Rockwell Brinell -1
Beam Deflection Test Apparatus -1
Extensometer -1
Compressometer -1
Dial Gauges -1
Le Chatelier"s Apparatus -1

L : 0 T: 0 P: 30 C: 0 Total: 30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 familiarize with tensile, compressive and shear test on UTM machine
CO2 know the operation of impact test machine on different materials.
CO3 able to found the twisting angle for various material.
CO4 analyze the deflection of beam for different load condition at various length.
CO5 evaluate the maximum stiffness of closed coiled spring

16MC204	COMPUTER AIDED MACHINE DRAWING LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS

1. **RAWING STANDARDS**

   Code of practice for Engineering Drawing, BIS specifications – Welding symbols, riveted joints, keys, fasteners – Reference to hand book for the selection of standard components like bolts, nuts, screws, keys etc.

2. **3D GEOMETRIC MODELLING**

   2.1 Introduction

   3D Modeling software such as SOLIDEDGE/AUTOCAD/PRO-E

   2.2 Real Components Drawing:

   Simple components are given, such as Bolts & Nut, Hacksaw frame, Brake shoe, etc… and made to draw their views and to draw assembly drawing

   2.3 Creation of 3D assembly model of following machine elements using 3D Modelling software

   - **a.** Flange Coupling
   - **b.** Plummer Block
   - **c.** Screw Jack
   - **d.** Lathe Tailstock
   - **e.** Universal Joint
   - **f.** Machine Vice
   - **g.** Stuffing box
   - **h.** Crosshead
   - **i.** Safety Valves
   - **j.** Non-return valves
   - **k.** Connecting rod
   - **l.** Piston

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

Pentium IV computer or better hardware, with suitable graphics facility -30
Software (SOLIDEDGE/AUTOCAD/PRO-E) for Drafting and Modeling
Laser Printer or Plotter to print / plot drawings - 2

L : 0 T: 0 P: 60 C: 0 Total: 60 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1	Define basic sketching commands and navigational commands.
CO2	Explain conversion of pictorial views into orthographic projections of simple machine parts with or without section.
CO3	Create solid models of objects; objects in basic shapes, composite bodies, custom built machine parts, building modules etc.
CO4	Develop engineering drawing for the industrial component using Indian Standard
CO5	Develop 2D and 3D models of the component using manual/software code of practice.

		L	T	P	C
16MA202	**STATISTICS AND NUMERICAL METHODS** (Common to AERO, AUTO, CIVIL, C&P, EEE, E&I, IT, MECH, MCT, MAE, BME)	**3**	**1**	**0**	**4**

UNIT I TESTING OF HYPOTHESIS **9+3**

Sampling distributions – Tests for single mean, proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit- Independence of attributes.

UNIT II DESIGNS OF EXPERIMENTS **9+3**

Completely Randomized Design – Randomized block design – Latin square Design – 2^2 factorial design.

UNIT III SOLUTIONS OF EQUATIONS AND EIGEN VALUE PROBLEMS **9+3**

Newton Raphson method – Gauss Elimination method – Pivoting Gauss Jordan methods – Iterative methods of Gauss - Jacobi and Gauss - Seidal – Matrix Inversion by Gauss - Jordan method – Eigen values of a matrix by power method.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION **9+3**

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 $1/3^{rd}$ rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS **9+3**

Taylor's series method – Euler's method – Modified Euler's Method – Fourth order Runge-Kutta method for solving first and second order equations – Milne's Predictor – corrector methods for solving first order equations.

L:45 T:15 P: 0 Total: 60 PERIODS

TEXT BOOKS

1. Johnson, R.A., and Gupta,C.B., Miller and Freund's, "Probability and statistics for Engineers", Pearson Education Asia,8th Edition, 2011.
2. Grewal, B.S and Grewal, J.S, "Numerical methods in Engineering and Science", 9th Edition, Khanna Publishers, New Delhi, 2012 .

REFERENCES

1. Spiegel,M.R., Schiller, J. and Srinivasan,R.A., "Schaum's Outlines Probabilty and Statistics", Tata McGraw Hill edition, 3rd Edition, 2011.
2. Chapra, S.C and Canale, R.P., "Numerical Methods for Engineers", 6th Edition, Tata McGraw Hill Edition, 2014 .
3. Gerald, C.F. and Wheatley, P.O. "Applied Numerical Analysis", 8th Edition, Pearson Education, Asia, New Delhi, 2014.
4. Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineers and Scientists", 8th Edition, Pearson Education, Asia, 2007.
5. Kandasamy, P., Thilagavathy. K and Gunavathy, K., "Numerical Methods", 3rd Edition, S.Chand & Company Pvt. Ltd, 2013.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Apply the statistical concepts and tools for engineering applications and to use different types of research methodology techniques for decision making under uncertainty.

CO2 Perform the ANOVA calculation which is needed for engineering research and project management.

CO3 Solve a set of algebraic equations representing steady state models formed in engineering problems

CO4 Find the trend information from discrete data set through numerical differentiation and summary information through numerical integration.

CO5 Predict the system dynamic behavior through solution of ODEs modeling the system.

16AE213	MECHANICS OF MACHINES	L	T	P	C
	(Common To Aero, Auto, MCT and MAE)	4	0	0	4

UNIT I KINEMATICS OF MECHANICS 12

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons (Velocity, Acceleration and Displacement diagram only graphical method)

UNIT II FORCE ANALYSIS 12

Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D-Alembert‟s principle – superposition principle – dynamic Force Analysis in simple machine members.

UNIT III GEARS AND GEAR TRAINS 12

Spur gear – law of toothed gearing – Involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclical gear trains – automotive transmission gear trains.

UNIT IV CAMS AND FOLLOWERS 12

Cams – Types of cams – Design of profiles – Knife edged, flat faced and roller followers with and without offsets for various types of follower motions.

UNIT V BALANCING 12

Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – Governors: Introduction – Types – Watt, Porter, Proell Governors.

L : 60 T: 0 P: 0 Total: 60 PERIODS

TEXT BOOKS

1 Rattan.S.S, “Theory of Machines”, Tata Mcgraw Hill Education Private Limited, 3rd Edition, 2009.

2. Thomas Bevan, “The Theory of Machines” 3rd Edition, CBS Publisher, 2005.

REFERENCES

1 Rao, J.S and Dukkipati, R.V, “Mechanism and Machine Theory”, Second Edition, New Age International (P) Ltd. Reprint, 2006.

2 Ballaney.P.L, “Theory of Machines”, Khanna Book Publishing Co. (P) Ltd, New Delhi, 2008.

3 Gosh, A. and Mallick, A.K., “Theory of Machines and Mechanisms”, East West Press, 3rd Edition, 2006.

4 R.S.Khurmi & J.K.Gupta, Theory of Machines - S.Chand and company Pvt Ltd, 14th Edition, 2005.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Describe different mechanisms and Linkages.

CO2 Analyze the contribution of force equilibrium in the machines.

CO3 Understand the gear and Cam profile with follower motion.

CO4 Describe the methods of balancing the moving parts of the machines.

CO5 Determine the phenomenon of direction of rotation, speed and torque systems for simple, compound and planetary gear

16EC233/16EC242 MICROPROCESSORS AND MICROCONTROLLERS **L T P C**

(Common to CSE,IT ,MCT and MAE) **3 0 0 3**

UNIT I ARCHITECTURE OF 8085 MICROPROCESSOR **9**

Functional Block Diagram - Registers, ALU, Bus systems - Timing and control signals - Machine cycles and timing diagrams - Interrupts -Programming of 8085 - Instruction formats - Addressing modes – Instruction set - Assembly language programs.

UNIT II ARCHITECTURE OF 8086 MICROPROCESSOR **9**

Intel 8086 Internal Architecture - 8086 addressing modes- Instruction set - Assembler Directives -8086 assembly language Programming - Interrupts.

UNIT III PERIPHERAL INTERFACING **9**

Interfacing requirements - Memory mapped I/O, I/O mapped I/O, 8255 PPI, 8279 keyboard and display controller, 8257 DMA controller, 8251 USART - Interrupt controller 8259 -Serial I/O standards RS232C, RS422A and IEEE 488.

UNIT IV MICROCONTROLLERS **9**

Functional block diagram of 8051 - Instruction format and addressing modes – Timer –I/O ports – Serial communication - Inter facing -keyboard, LCD,ADC & DAC.

UNIT V SYSTEM DESIGN USING MICROPROCESSOR & MICROCONTROLLER **9**

Case studies – Traffic light control, washing machine control, Standard- Motor Control- Relay, PWM, DC & Stepper Motor.

L:45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1 Soumitra Kumar Mandal, “Microprocessors and Microcontrollers”,Tata McGraw Hill Education Private Limited, Fourth reprint 2012.

2 Krishna Kant, “Microprocessors and Microcontrollers”, Prentice Hall of India, 2013.

REFERENCES

1 Ramesh S. Gaonkar ,”Microprocessor – Architecture, Programming and Applications with the 8085” , Penram International Publisher , 5th Ed.,2006

2 Douglas V.Hall, “ Microprocessors and Inter facing : Programming and Hardware”, Second Edition, Tata Mc Graw Hill ,2006

3 Kenneth J.Ayala, “The 8051 microcontroller Architecture, Programming and Applications”, Second Edition , Penram international.

4 Mohamed Ali Mazidi, Janice Gillispie Mazidi, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson Education / Prentice Hall of India, 2007.

5 A.K.Ray & K.M. Bhurchandi, “Advanced Microprocessor and Peripherals – Architecture, Programming and Inter facing”, Tata Mc Graw Hill, 2006.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Understand the different methods used for simplification of Boolean expressions.

CO2 Analyze the Combinational circuits.

CO3 Describe the Sequential building blocks & Memory elements.

CO4 Design a sequential circuits

CO5 Classify the different memories and implement the digital circuits.

16MC210 APPLIED INSTRUMENTATION AND CONTROL SYSTEM

L	T	P	C
3	0	1	3

UNIT I SIGNAL GENERATORS AND ANALYZERS 9+3

Function generators –RF signal generators – Sweep generators – Frequency synthesizer – wave analyzer – Harmonic distortion analyzer – spectrum analyzer :- digital spectrum analyzer, Vector Network Analyzer – Digital L,C,R measurements, Digital LCR meters.

Generation of square wave signal using Schmitt trigger

UNITII DIGITAL INSTRUMENTS 9+3

Comparison of analog and digital techniques –Types of digital voltmeter – Multimeter — Automation in digital instruments: Automatic polarity indication, automatic ranging, automatic zeroing, fully automatic digital instruments.

To measure and calculate the electrical quantities using multimeter

UNIT III CONTROL SYSTEMS REPRESENTATION 9+3

Basic elements in control systems – Transfer function - Open and closed loop systems – Transfer function analysis of Electrical and mechanical systems - Block diagram reduction techniques – Signal flow graphs

To Develop the transfer function for electrical system using MATLAB

UNIT IV TIME RESPONSE AND FREQUENCY RESPONSE ANALYSIS 9+3

Time response – Time domain specifications – Response of First order and Second order for unit step input - Frequency response –Bode plot-Polar plot – gain margin and phase margin.

To develop the bode plot to analyze the stability factor using MATLAB

UNIT V STABILITY ANALYSIS AND COMPENSATORS 9+3

Positive real functions- Routh Hurwitz stability criterion - Basics of Lag, lead and lag-lead compensation networks and its related responses.

Design basic compensators using MATLAB

L : 45 T: 0 P: 15 Total: 60 PERIODS

TEXT BOOKS

1. Albert D.Helfrick and William D.Cooper "Modern Electronic Instrumentation and Measurement Techniques", Pearson / Prentice Hall of India, 2007
2. J. Nagrath and M. Gopal, "Control Systems Engineering", New Age International Publishers, 2003

REFERENCES

1. Benjamin C. Kuo, "Automatic Control systems", Pearson Education, New Delhi, 2003
2. Joseph J.Carr, "Elements of Electronics Instrumentation and Measurement", Pearson Education, 2003
3. Alan. S. Morris, "Principles of Measurements and Instrumentation", 2nd Edition, Prentice Hall of India, 2003
4. David A. Bell, "Electronic Instrumentation and measurements", Prentice Hall of India Pvt Ltd, 2003
5. K. Ogata, "Modern Control Engineering", 4th edition, PHI, New Delhi, 2002

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Know the concepts of signal generators and various analyzers.
CO2 Understand the working principle of digital instrument.
CO3 Derive the transfer function for Electrical and mechanical system.
CO4 Determine the Stability of a system using time and frequency response
CO5 Design the various compensators for system.

16MC205 FLUID MECHANICS AND THERMAL SYSTEMS

L	T	P	C
3	0	0	3

UNIT I FLUIDCONCEPTS AND PROPERTIES 9

Fluid – Definition, real and ideal fluids - Distinction between solid and fluid - Units and dimensions - Properties of fluids - Density, Specific weight, Specific volume, Specific gravity, Viscosity, Capillary and Surface tension, Compressibility and Vapour pressure – Temperature influence on fluid properties.

UNIT II FLUIDSTATICS AND DYNAMICS 10

Fluid statics – Hydrostatic pressure concept and distribution on plane surfaces – Absolute and gauge pressures – Pressure measurements by manometers and pressure gauges.

Fluid dynamics – Euler's equation of motion – Euler's equation of motion along a streamline – Bernoulli equation and its application -Fluid flow - Flow through pipes - Darcy -Weisbach equation - Friction factor – Major and minor losses.

UNIT III HYDRAULICTURBINESANDPUMPS 10

Hydro turbines - Definition, types and classifications – Pelton and Francis turbines - Velocity triangles and simple applications - Work done - Specific speed – Efficiencies.

Pumps (Descriptive treatment only) - Definition and classifications – Positive Displacement -Dynamic Pumps–Classifications and working principle - Velocity triangles, Work done – Specific speed – Efficiency.

UNIT IV I.C. ENGINES AND AIR-STANDARD CYCLES 8

Classifications - Four stroke SI & CI engines, Two stroke SI & CI engines, Power developed by engines-Comparison of two stroke and four stroke engines, SI and CI engines. Application of SI & CI engines and simple problems in engine efficiency.

UNIT V AIRCOMPRESSORSAND APPLICATIONS 8

Reciprocating air compressors: calculation of volumetric, Isothermal and Isentropic efficiencies-Introduction to multistage compression and its advantages (Descriptive treatment only).

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Bansal, R.K., "Fluid Mechanics and Hydraulics Machines", 5th edition, Laxmi Publications (P) Ltd, New Delhi, 1995.
2. Rajput R K, "Thermal Engineering", Lakshmi Publications 2010.

REFERENCES

1. Kumar, K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd, New Delhi (7th edition), 1995.
2. Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", McGraw
3. White, F.M., "Fluid Mechanics", Tata McGraw
4. Som, S.K., and Biswas, G., "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw
5. Ballaney P L, "Thermal Engineering", Khanna Publishers, 2010.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Gather the basics of fluids and principles behind incompressible fluid.
CO2 Apply mathematical knowledge to predict the properties and characteristics of a fluid.
CO3 Critically analyze the performance of pumps and turbines
CO4 Understand the basics of engine performance and various efficiencies
CO5 Well understand the working & use of air Compressor and its functionalities

16EE214	ELECTRICAL MACHINES AND DRIVES (Common to Mechanical, MCT and MEA)	L	T	P	C
		3	0	0	3

UNIT-I OVERVIEW OF ELECTRICAL DRIVE 9

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and load variation factors

UNIT-II ELECTRICAL MOTORS 9

Constructional details, principle of operation and performance characteristics of D.C. motors, single phase induction motor, three phase induction motor, synchronous motor, universal motor, servo motor, stepper motor and reluctance motor

UNIT-III SPEED CONTROL AND STARTING 9

Speed control of D.C series and shunt motors- speed control of single and three phase induction motors –starting methods of D.C. motor and three phase induction motors –electrical braking –simple problems

UNIT-IV SOLID STATE SPEED CONTROL OF D.C DRIVES 9

Power electronic devices, Controlled rectifiers and choppers, Speed control of DC series and shunt motors using controlled rectifiers and DC choppers – ward leonard method-applications

UNIT-V SOLID STATE SPEED CONTROL OF A.C DRIVES 9

Inverters and voltage regulators, Speed control of three phase induction motor – Voltage control, voltage / frequency control and slip power recovery scheme using inverters and AC voltage regulators – applications

L:45 T: 0 P:0 Total: 45 PERIODS

TEXT BOOKS

1 D.P.Kothari and I.J.Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill publishing company ltd, second edition, 2007 (Reprint)

2. S.K.Pillai, “ A First Course on Electrical Drives” New age publishing Ltd, 1989.

REFERENCES

1 Metha. V.K. & Rohit Metha, "Principle of Electrical Engineering", S.Chand & Co, 2006.

2 Vedam Subramaniam. "Electric Drives", Tata McGraw Hill , New Delhi , 2007.

3 P.S Bimbhra, “Power Electronics”, Khanna Publishers, Pvt Ltd, 2004.

4 Dubey.G.K. “Fundamental Electrical Drives” 2nd Edition, Narosa Publications, 2002.

5 Bhattacharya S.K. & Brijinder Singh , "Control of Electrical Machines", New Age International Publishers, 2002.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Apply the concept of selection of different electrical motors for drives.

CO2 Understand the principle of operation of AC and DC motors.

CO3 Recognize the conventional method of speed control for DC and AC motors.

CO4 Employ the implementation of solid state speed control for DC motors.

CO5 Employ the implementation of solid state speed control for AC motors

16GE212	CAREER DEVELOPMENT PROGRAMME IV	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	1	0	2	2*

UNIT I COMMUNICATION & SOFT SKILLS 7

Group Discussion – Types, guidelines, roles, Do's and Don'ts during GD, Mock GD. Interview Etiquettes – Meaning, Purpose, Interview Process and Types, Checklist – Do's and Don'ts, Preparation of Self Introduction.

UNITII LINGUISTIC SKILLS IV 15

Cloze test, Direct & Indirect speech, Question Tags, Homonyms, HIGH LEVEL- Synonyms, Antonyms, Idioms and Phrases.

UNIT III VERBAL REASONING - III 7

Logical reasoning - Machine Input & Output, Coded Inequalities, Puzzles, Cubes, Data sufficiency, Analogy.

UNIT IV VERBAL &NON VERBAL REASONING - IV 8

Critical reasoning- Statement – Argument & Assumption, Courses of Action, Inferences.

Non Verbal reasoning- Insert the missing character, Figure series, Odd man out, Cubes & Dices, Logical Venn diagram.

UNIT V PRACTICALS 8

Group Discussion, Online typing, Mock Interview, Company website references.

L:15 T: 0 P: 30 Total: 45 PERIODS

TEXT BOOKS

1 Barun K. Mithra, "Personality Development & Soft Skills", Oxford, 2006.
2 S.P.Bakshi, "Objective English" Arihant Publications, 2014.
3 R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication, 2012.

REFERENCES

1 Dr. R.S.Agarwal, "A modern approach to Verbal & Non-verbal Reasoning", S.Chand & Company Pvt Limited, 2013.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Bring behavioral changes through interview etiquettes & communicate well.
CO2 Improve their thinking ability.
CO3 Solve the puzzles through their lateral thinking ability.
CO4 Think critically and attain solutions for the problems.
CO5 Speak better in GD and thorough with the company details.

16EC242	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
	(Common to CSE,IT ,MCT and MAE)	3	0	0	3

UNIT I ARCHITECTURE OF 8085 MICROPROCESSOR 9

Functional Block Diagram - Registers, ALU, Bus systems - Timing and control signals - Machine cycles and timing diagrams - Interrupts -Programming of 8085 - Instruction formats - Addressing modes – Instruction set - Assembly language programs.

UNIT II ARCHITECTURE OF 8086 MICROPROCESSOR 9

Intel 8086 Internal Architecture - 8086 addressing modes- Instruction set - Assembler Directives - 8086 assembly language Programming - Interrupts.

UNIT III PERIPHERAL INTERFACING 9

Interfacing requirements - Memory mapped I/O, I/O mapped I/O, 8255 PPI, 8279 keyboard and display controller, 8257 DMA controller, 8251 USART - Interrupt controller 8259 -Serial I/O standards RS232C, RS422A and IEEE 488.

UNIT IV MICROCONTROLLERS 9

Functional block diagram of 8051 - Instruction format and addressing modes – Timer –I/O ports – Serial communication - Inter facing -keyboard, LCD,ADC & DAC.

UNIT V SYSTEM DESIGN USING MICROPROCESSOR & MICROCONTROLLER 9

Case studies – Traffic light control, washing machine control, Standard- Motor Control- Relay, PWM, DC & Stepper Motor.

L:45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Soumitra Kumar Mandal, "Microprocessors and Microcontrollers",Tata McGraw Hill Education Private Limited, Fourth reprint 2012.
2. Krishna Kant, "Microprocessors and Microcontrollers", Prentice Hall of India, 2013.

REFERENCES

1. Ramesh S. Gaonkar ,"Microprocessor – Architecture, Programming and Applications with the 8085" , Penram International Publisher , 5th Ed.,2006
2. Douglas V.Hall, " Microprocessors and Inter facing : Programming and Hardware", Second Edition, Tata Mc Graw Hill ,2006
3. Kenneth J.Ayala, "The 8051 microcontroller Architecture, Programming and Applications", Second Edition , Penram international.
4. Mohamed Ali Mazidi, Janice Gillispie Mazidi, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson Education / Prentice Hall of India, 2007.
5. A.K.Ray & K.M. Bhurchandi, "Advanced Microprocessor and Peripherals – Architecture, Programming and Inter facing", Tata Mc Graw Hill, 2006.

COURSE OUTCOMES

At the end of the course student should be able to:

- **CO1** Understand the different methods used for simplification of Boolean expressions.
- **CO2** Analyze the Combinational circuits.
- **CO3** Describe the Sequential building blocks & Memory elements.
- **CO4** Design a sequential circuits
- **CO5** Classify the different memories and implement the digital circuits.

16MC206	FLUID MECHANICS AND THERMAL SYSTEMS LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS

1. Calibration of flow measuring instruments –Orifice meter.
2. Calibration of Flow Measuring instruments – Venturi meter.
3. Estimation of friction factor in flow through pipes
4. Performance studies on Centrifugal pump.
5. Performance studies on reciprocating pump.
6. Performance studies on Pelton turbine.
7. Performance studies on Francis turbine.
8. Load Test on Petrol and Diesel Engines.
9. Heat distribution analysis in I.C. Engines.
10. DeterminationoflossesofenergyduetofrictionbyretardationtestandMorsetest.
11. Valve timing and port timing diagram Test of engines and models.
12. Volumetric Efficiency Test on air compressor.

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

Orifice meter-1
Venturimeter-1
Flow through pipes-1
Centrifugal pump-1
Reciprocating pump-1
Francis Turbine-1
Pelton wheel-1
Engine cut section models-1
Single cylinder petrol engine with mechanical dynamometer-1
Single cylinder diesel engine with electrical dynamometer-1
Air compressor-1

L : 0 T: 0 P: 60 C: 0 Total: 60 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 familiarize with flow measuring instruments and friction in pipes
CO2 know the operation of pumps and turbines.
CO3 able to draw performance graphs for pump and turbine.
CO4 analyze the thermal characteristics of IC engines
CO5 evaluate efficiency Test on I.C. engines and air compressor.

16EE215	ELECTRICAL MACHINES AND DRIVES LABORATORY	L	T	P	C
	(Common to Mechanical, MCT & MEA)	0	0	4	2

LIST OF EXPERIMENTS

1. Load test on D.C. shunt motor.
2. Load test on D.C. series motor
3. Speed control of D.C. shunt motor.
4. Load test on three phase induction motor.
5. Load test on single phase induction motor.
6. Study and Starting of Synchronous motor.
7. Speed Control of 3 Phase Induction Motor using solid state v/f drive.
8. Speed Control of DC motor using solid state chopper drive.
9. Speed Control of DC motor using solid state controlled rectifier drive.
10. Speed Control of Reluctance motor using solid state controlled drive.

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

Hardware

- D.C. Shunt Motor
- D.C. Series Motor
- Three phase Induction Motor
- Single Phase Induction Motor
- Synchronous Motor
- Auto transformer (single and three phase)
- Three phase Rectifier - DC Drive Trainer with DC motor and loading arrangements
- Single phase Chopper- DC Drive trainer with DC motor and loading arrangements
- PWM based AC Drive Trainer with Induction Motor and loading arrangements
- DSP based Reluctance Motor Trainer with reluctance motor

L: 0 T: 0 P: 60 C: 0 Total:60 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Test the operation of DC motors.

CO2 Test the operation of AC Induction and Synchronous motors.

CO3 Recognize the conventional method of speed control for DC motors.

CO4 Employ the implementation of solid state speed control for DC motors

CO5 Employ the implementation of solid state speed control for AC motors

16MC301 **MECHANICAL DESIGN**

L	T	P	C
3	1	0	4

(Use of approved design data books are permitted)

UNIT I INTRODUCTION TO THE DESIGN PROCESS 9+3

Factor influencing machine design, selection of materials based on mechanical properties – Direct, bending and torsion stress equations – Impact and shock loading – Calculation of principle stresses for various load combinations, eccentric bending – Factor of safety – Theories of failure – Stress concentration – Fatigue strength and the S-N diagram – Soderberg, Goodman and Gerber relations.

UNIT II DESIGN OF SHAFTS AND COUPLINGS 9+3

Design of solid and hollow shafts based on strength and rigidity– Design of keys and key ways – Design of rigid and flexible couplings

UNIT III DESIGN OF GEARS 9+3

Review of gear fundamentals – Interference - Gear forces - Dimensions of a spur gear pair- Dimensions of helical gear pair- Design of spur and helical gears – Nomenclature of worm and bevel gears (Theoretical treatment only)

UNIT IV DESIGN OF SPRINGS AND PIN JOINTS 9+3

Design of helical and leaf springs under constant and varying loads – Design of knuckle and cotter joints.

UNIT V DESIGN OF BEARINGS 9+3

Selection of bearings – Sliding contact and rolling contact types – Cubic mean load – Design of journal bearing – McKee's equation – Lubrication in journal bearings – Calculation of bearing dimensions – Design of ball bearings.

L : 45 T: 15 P: 0 Total: 60 PERIODS

TEXT BOOKS

1. Bhandari V, "Design of Machine Elements", 4rd Edition, Tata McGraw-Hill Book Co, New Delhi, 2016
2. Prabhu T J, "Design of Transmission Systems", private publication, 1999

REFERENCES

1. Sundararajamoorthy T. V. Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003
2. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine Design", 7th Edition, Wiley, 2016
3. Alfred Hall, Halowenko, A and Laughlin, H., "Machine Design", 3rd Edition Tata McGraw-Hill BookCo.(Schaums Outline), New Delhi, 2010
4. Bernard Hamrock, Steven Schmid,Bo Jacobson, "Fundamentals of Machine Elements",2nd Edition, Tata McGraw-Hill Book Co, New Delhi, 2006
5. Orthwein W, "Machine Component Design", 3rd Edition Jaico Publishing Co, New Delhi, 2003

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Apply engineering analysis principles and methods to the proper analysis of a variety of common mechanical system components.

CO2 Select the proper dimensions for the Shafts, Keys and Coupling.

CO3 Analyse and design belt drives, knuckle and cotter joints with respect to static and dynamic loads

CO4 Interpret the different Parameter involved in the Energy absorbing Material

CO5 Design of Bearings based on different Load Combination

16CS451 OBJECT ORIENTED PROGRAMMING USING C++ **L T P C**

(Common to ECE,MCT, EEE & EIE) **3 0 0 3**

UNIT I INTRODUCTION **9**

Need for object oriented programming – Procedural Languages vs. Object oriented approach – Characteristics Object oriented programming – C++ Programming Basics: Basic Program Construction – Output Using cout – Input with cin – Data types – Variables and Constants – Operators – Control Statements-Manipulators-Type conversion.

UNIT II OBJECTS AND CLASSES **9**

Simple Class – C++ Objects as Physical Objects – C++ Object as Data types – Constructors and Destructors – Object as Function Arguments – Returning Objects from Functions – Structures and Classes – Arrays and Strings.

UNIT III OPERATOR OVERLOADING AND INHERITANCE **9**

Need of operator overloading – Overloading Unary Operators – Overloading binary Operators – Overloading Special Operators – Data Conversion – Inheritance: Derived Class and Base Class – Derived Class Constructors – Overriding Member Functions-Class Hierarchies – Public and Private Inheritance – Levels of Inheritance – Multiple Inheritance.

UNIT IV POLYMORPHISM AND FILE STREAMS **9**

Virtual Function – Friend Function – Static Function-Assignment and Copy Initialization – Streams – String I/O – Character I/O – Object I/O – I/O with Multiple Objects – File Pointers – Disk I/O with Member Functions – Error Handling in File I/O.

UNIT V TEMPLATES AND EXCEPTION HANDLING **9**

Templates: Introduction – Function Templates – Overloading Function Templates – Class Templates – Exception Handling – Syntax, multiple exceptions, exceptions with arguments.

L : 45 T: 0 P: 0 J: 0 Total: 45 PERIODS

TEXT BOOKS

1 Robert Lafore, Object Oriented Programming in-C++, Galgotia Publication, 2009.

2. Deitel & Deitel, "C++ How to program", Prentice Hall,2005.

REFERENCES

1 D.S.Malik, "C++ Programming", Thomson, 2007.

2 K.R. Venugopal, Rajkumar and T.Ravishankar, "Mastering C++", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2006.

3 Balagurusamy, "Object Oriented Programming with C++", Sixth Edition,McGraw Hill Education ,2013.

4 Joyce Farrell ,"Object-Oriented Programming Using C++", Fourth Edition,2008.

5 Subhash K U, "Object Oriented Programming With C++", First Edition, Pearson Education,2010.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Determine the needs of object oriented programming.

CO2 Differentiate the functionalities of object oriented approach and procedural languages.

CO3 Demonstrate the concept of operator overloading and inheritance.

CO4 Demonstrate the concepts of polymorphism and file streams.

CO5 Develop create templates and handle exceptions.

16MC302	INDUSTRIAL ELECTRONICS AND APPLICATIONS	L	T	P	C
		3	0	0	3

UNIT-I POWER SEMICONDUCTOR DEVICES 9

Classification of Power Semiconductor devices, Construction and working principle of SCR,TRIAC, BJT, MOSFET, IGBT- Triggering and commutation circuit for SCR- Driver and snubber circuits

UNIT-II PHASE-CONTROLLED CONVERTERS 9

Single phase half & fully controlled converters, Three phase half & fully controlled converters, Inversion mode of converter -performance parameters-Effect of source inductance-Dual converters-Battery charging circuit

UNIT-III DC TO DC CONVERTER 8

Classifications of DC to DC converters- step-down and step-up DC to DC Converter -control strategies-Switched mode regulators- Buck, boost, buck- boost converter, Introduction to SMPS

UNIT IV INVERTERS & AC TO AC CONVERTERS 10

Single phase and three phase voltage source inverters (both1200mode and1800mode) -Voltage control methods -PWM techniques-Current source inverters, Single phase AC voltage controllers- Multistage sequence control - Single phase and three phase cyclo converters.

UNIT V INDUSTRIAL APPLICATION FOR MECHATRONICS 9

Introduction to UPS, Solid state Relays, Electronic Timer, Motor Drive. Application: AC Motor Control, DC Motor Control, Servo Motor Control, Stepper Motor Control; Induction heating.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. P.S.Bimbra "Power Electronics" Khanna Publishers, third Edition, 2003.
2. M.H.Rashid, 'Power Electronics: Circuits, Devices and Applications', Pearson Education, PHI , Third Edition, New Delhi, 2004.

REFERENCES

1. M.D. Singh and K.B. Khanchandani, "Power Electronics," McGraw Hill India, 2013.
2. Joseph Vithayathil, " Power Electronics, Principles and Applications" McGraw Hill Series, 6th Reprint, 2013.
3. Ned Mohan, Undeland, Robbins, "Power Electronics: Converters, Design and Applications", WILEY India Edition
4. Muhammad H. Rashid, Power Electronics - Circuits, Devices and Applications, Prentice Hall of India Learning. Ltd., New Delhi, 2013
5. M. D. Singh and K. B. Khanchandani, Power Electronics, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Understand the characteristics of power electronics devices.
CO2 Know the concept of AC-DC conversion systems
CO3 Design various DC-DC converters
CO4 Understand the working of DC-AC converters & AC-AC converters
CO5 Understand the concept of Industrial Application

16MC303	DESIGN OF MECHATRONICS SYSTEMS	L	T	P	C
		3	0	0	3

UNIT I FUNDAMENTALS **9**

Key elements – Mechatronics Design process –Design Parameters – Traditional and Mechatronics designs – Advanced approaches in Mechatronics - Industrial design and ergonomics, safety.

UNIT II SYSTEM MODELLING **9**

Introduction-model categories-fields of application-model development-model verification- model validation-model simulation-design of mixed systems-electro mechanics design-model transformation- domain-independent description forms-simulator coupling.

UNIT III SYSTEM INTERFACING **9**

Introduction - Elements of data acquisition and control - Overview of I/O process, Analog signals, discrete signals, Data conversion process and Frequency signals, over framing.

UNIT IV CASE STUDIES ON MECHATRONIC SYSTEM **9**

Thermal cycle fatigue of a ceramic plate - pH control system - De-Icing Temperature Control System - Skip control of a CD player - Autofocus Camera, exposure control.

UNIT V ADVANCED APPLICATION IN MECHATRONICS **9**

Sensors for condition Monitoring – Mechatronic Control in Automated Manufacturing – Artificial intelligence, Fuzzy Logic Applications, Micro actuation – Micro robot – Micro pump – Applications of micro Mechatronics components

L:45 T:0 P:0 TOTAL : 45 PERIODS

TEXT BOOKS

1. Smaili and F. Mrad, “Applied Mechatronics”, Oxford University Press, 2007.
2. Georg pelz, "Mechatronic Systems: Modelling and simulation" with HDLs, John wiley and sons Ltd, 2003

REFERENCES

1. Bishop, Robert H, "Mechatronics Hand book", CRC Press, 2002.2. Bradley, Dawson
2. N.C. Burd and A.J. Loader, "Mechatronics: Electronics in Products and Processes", CRC Press 1991, First Indian print 2010.
3. De Silva, “Mechatronics: A Foundation Course", Taylor & Francis, Indian Reprint, 2013
4. Bolton, -Mechatronics - Electronic Control systems in Mechanical and Electrical Engineering-, 2nd Edition, Addison Wesley Longman Ltd., 1999.
5. Devdasshetty, Richard A. Kolk, “Mechatronics System Design”, 2nd Edition, Cengage Learning 2011.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Design simple mechatronics system.
CO2 Demonstrate the mechatronics design process
CO3 Understand the data acquisition system with application
CO4 Get exposure to the applications of mechatronics system.
CO5 To Realize the advanced application in mechatronics system.

16MC304	INDUSTRIAL AUTOMATION	L	T	P	C
		3	0	0	3

UNIT I PRODUCTION OPERATIONS AND AUTOMATION STRATEGIES 9

Automation – Definition, levels, need, strategies principles. Types of production, functions in manufacturing, plant layout – types, organization and information processing in manufacturing, Types of flow lines, methods of transport, transfer mechanisms, ASRS system

UNIT II GROUP TECHNOLOGY 9

Automated manufacturing systems: Components, classification, overview, group technology and cellular manufacturing, parts classification and coding– OPITZ and MI CLASS system, product flow analysis, cellular manufacturing, advantages, disadvantages and application considerations in GT

UNIT III INTEGRATED MANUFACTURING SYSTEMS 9

Definition - application - features - types of manufacturing systems-machine tools-materials handling system computer control system - DNC systems manufacturing cell. Flexible manufacturing systems (FMS) - the FMS concept-transfer systems - head changing FMS-variable mission manufacturing system - CAD/CAM system-Rapid prototyping - Artificial Intelligence and Expert system in CIM.

UNIT IV MATERIAL HANDLING AND STORAGE SYSTEMS 9

Material handling: Introduction, material handling systems, principles and design, material transport system: transfer mechanisms automated feed cut of components, performance analysis, uses of various types of handling systems including AGV and its various guiding technologies. Storage system: Performance, location strategies, conventional storage methods and equipments, automated storage systems.

UNIT V MANUFACTURING SUPPORT & APPLICATIONS 9

Process planning and concurrent engineering- process planning, CAPP, CE and design for manufacturing, advanced manufacturing planning, production planning and control system, master production schedule, MRP. Capacity planning, shop floor control, inventory control, MRP-II, J.I.T production systems, Kanban System, Business Process Re-engineering (BPR), 5S, lean and agile manufacturing..

L:45 T:0 P:0 TOTAL : 45 PERIODS

TEXT BOOKS

1. Groover, M.P. "Automation, Production Systems and Computer Integrated Manufacturing", 4th edition Prentice Hall of India, New Delhi, 2015.
2. David Bedworth, "Computer Integrated Design and Manufacturing", TMH, New Delhi,1998.

REFERENCES

1. Rao .P.N., Computer Aided Manufacturing, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2001.
2. Kant Vajpayee .S, Principles of Computer Integrated Manufacturing, Prentice Hall of India Pvt. Ltd., 1995.
3. Radhakrishnan .P, Subramaniyan .S, CAD/CAM/CIM, New Age International Limited, 1994.
4. Viswanathan .N, Navahari .Y "Performance Modeling of Automated Manufacturing Systems", Prentice Hall of India Pvt. Ltd., 1998.
5. Jha, Nand K. "Handbook of Flexible Manufacturing Systems", Academic Press, Orlando, 2006.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Understand the various automations followed now a day.
CO2 Able to learn various techniques importance of group technology.
CO3 Understand the various cellular manufacturing systems.
CO4 Familiar with fundamentals components of FMS.
CO5 Understood the methodologies to be followed in material handling systems.

16MC320 **CNC TECHNOLOGY**

L	T	P	C
3	0	0	3

UNIT-I INTRODUCTION TO CNC MACHINE TOOLS 9

Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines– turning center ,machining center-5 Axis and 6 Axis machining centre-grinding machine ,EDM, types of control systems, CNC controllers, characteristics, interpolators– Computer Aided Inspection.

UNIT-II STRUCTURE OF CNC MACHINE TOOL 9

CNC Machine building ,structural details, configuration and design, guide ways –Friction, Anti friction and other types of guide ways ,elements used to convert the rotary motion to a linear motion–Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller screw, rack and pinion, spindle assembly, torque transmission elements–gears, timing belts, flexible couplings, Bearings.

UNIT-III DRIVES AND CONTROLS 9

Spindle drives–DC shunt motor, 3-phaseAC induction motor, feed drives–stepper motor, servo principle, DC and AC servomotors, Open loop and closed loop control ,Axis measuring system– synchro , synchro-resolver ,gratings, moiré fringe gratings, encoders, inductosysn, laser interferometer.

UNIT IV CNC PROGRAMMING 9

Coordinate system, structure of a part program, G&M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, APT Language-machining cycles, programming for machining center and turning center for well-known controllers such as Fanuc, Heidenhain, Sinumeriketc., generation of CNC codes from CAM packages.

UNIT V MAINTENANCE AND DIAGNOSTICS 9

Economics of CNC, maintenance of CNC Factors influencing selection of CNC Machines – Cost of operation of CNC Machines –Practical aspects of introducing CNC machines in industries – Maintenance features of CNC Machines – Preventive Maintenance, other maintenance requirements -Diagnostic techniques-ATC-Turret Mechanism.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1 YoreurKoren, “Computer Control of Manufacturing Systems”, Pitman, London, 1987.
2 Mike Mattson, “CNC Programming Thomson Learning, 2003.

REFERENCES

1 HMT, "Mechatronics”, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005
2 Warren S.Seamers, “Computer Numeric Control”, Fourth Edition – Thomson Delmar, 2002.
3 James Madison, “CNC Machining Hand Book”, Industrial Press Inc., 1996.
4 Ken Evans, John Polywka& Stanley Gabrel, “Programming of CNC Machines”, Second Edition – Industrial Press Inc, New York, 2002
5 Peter Smid, “CNC Programming Hand book”, Industrial Press Inc., 2000

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Provide knowledge on principle, constructional features, programming, tooling and work holding devices in CNC machine tool.
CO2 Generate CNC programs for popular CNC controllers.
CO3 Explain drives and positional transducers used in CNC machine tools.
CO4 Generate the codes for various CNC machines
CO5 Understand the tooling and maintenance in tools used in CNC

16MC305 COMPOSITE MATERIALS

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION 9

Limitations of conventional materials - Definition of composite material, Classification based on matrix and topology, Constituents of composites, Interfaces and Interphases, Distribution of constituents, Characteristics - Applications, - Composites in Electrical, Superconducting and Magnetic Applications, Nano-composite devices - Nano-composites.

UNIT II MATERIALS 9

Fiber – Materials – Fiber reinforced plastics – thermoset polymers – Coupling agents, fillers and additives Metal Matrix and Ceramic composites.

UNIT III FABRICATION 9

Fabrication of Metal Matrix Composites: Commonly used Matrices, Basic Requirements in Selection of constituents, solidification processing of composites - XD process, Spray processes - Osprey Process, Rapid solidification processing, Dispersion Processes - Stir-casting & Compo casting, Fabrication of Polymer Matrix Composites - Commonly used Matrices Basic Requirements in selection of Constituents, Moulding method, Low pressure closed moulding, pultrusion, Filament winding, Fabrication of ceramic matrix composites - Various techniques of vapour deposition, Liquid phase method and Hot pressing etc., Fabrication of nano-composites.

UNIT IV MECHANICS AND PERFORMANCE 9

Introduction to micro-mechanics – unidirectional lamina – laminates – intervlaminar stresses – static mechanical properties – fatigue properties – impact properties – environmental effects – fracture mechanics and toughening mechanisms, damage prediction, failure modes

UNIT V DESIGN AND OPTIMIZATION 9

Failure predictions – design considerations – joint design – codes – design examples. Optimization of laminated composites – Application of FEM for design and analysis of laminated composites.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. P.K.Mallicak, “Fiber-reinforced composite: Materials, Manufacturing and Design”, 3rd Edition, CRC press , Nov 2007, ISBN : 0849342058
2. Ronald F Gibson, “Principles of Composite Material Mechanics”, second edition, CRC press, Taylor & Francis group, 2007

REFERENCES

1. Michael W Hyer, “Stress Analysis of Fiber – Reinforced Composite Materials”, DEStech Publications, Inc. 2008, ISBN: 193207886X
2. Bhagwan.D. Agarwal, Lawrence.J.Broutman and K.Chandrasekara , “Analysis and Performance of Fiber Composites”, John Wiley and Sons,3rd Edition, 2006, ISBN:0471268917
3. K.K. Chawala “Composite materials”, , 2nd ed., (1987) Springer-Verlag, New York.
4. George.E.Dieter,”MechanicalMetallurgy”,Tata-McGraw Hill,2013
5. F.Matthews & R.Rawlings, “Composite Materials, Engineering and Science”, Woodhead Publishing, New edition,1999, ISBN:1855734737

COURSE OUTCOMES

At the end of the course student should be able to:

- **CO1** Describe and comment on the basic mechanical behaviour of composite materials.
- **CO2** Make sound judgments on the likely behaviour of new combinations of materials
- **CO3** Support the choices made for using certain types of composites in certain applications with reference to composite properties.
- **CO4** Understand the concept of various methods in fabrication
- **CO5** Know the various applications of composite material.

16MC306	INDUSTRIAL NETWORKING	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION **9**

Modern instrumentation and control systems – OSI model – Protocols – Standards – Common problems and solutions – Grounding/shielding and noise - EIA-232 interface standard – EIA-485 interface standard – Current loop and EIA-485 converters.

UNIT II MODBUS **9**

Overview – Protocol structure – Function codes – Modbus plus protocol –Data Highway – AS interface (AS-i) –**Device Net**: Physical layer – Topology – Device taps – **Profibus PA/DP/FMS**: Protocol stack – System operation.

UNIT III ETHERNET SYSTEMS **9**

IEEE/ISO standards – Medium access control – frames – Reducing collisions – Auto negotiation – LAN system components – Structured cabling – Industrial Ethernet – Troubleshooting Ethernet.

CAN BUS: Concepts of bus access and arbitration – CAN: Protocol-Errors: Properties – detection – processing – Introduction to CAN 2.0B

UNIT IV WIRELESS COMMUNICATIONS **9**

Radio spectrum – Frequency allocation – Radio modem – Intermodulation – Implementing a radio link – RFID: Basic principles of radio frequency identification – Transponders - Interrogators

UNIT V APPLICATIONS **9**

Automotive communication technologies – Design of automotive X-by-Wire systems, - The LIN standard – The IEC/IEEE Train communication network: Applying train communication network for data communications in electrical substations.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Steve Mackay, Edwin Wright, Deon Reynders and John Park, "Practical Industrial Data Networks: Design, Installation and Troubleshooting", Newnes (Elsevier), 2004 .
2. "Practical Filebus, DeviceNet and Ethernet for Industry", IDC Technology, 2006

REFERENCES

1. James F. Kurose, Keith W. Ross, "Computer Networking - A Top-Down Approach Featuring the Internet", Fifth Edition, Pearson Education, 2009.
2. Nader. F. Mir, "Computer and Communication Networks", Pearson Prentice Hall Publishers, 2010.
3. Richard Zurawski, "The Industrial Communication Technology Handbook", Taylor and Francis, 2005
4. Dominique Paret, "Multiplexed Networks for Embedded Systems", John Wiley & Sons, 2007.
5. Wayne Tomasi, "Introduction to Data Communication and Networking", 1/e, Pearson Education.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Apply the concepts of data communications.
CO2 Design computer networks using sub-netting and routing concepts.
CO3 Compare the various medium access control techniques.
CO4 Analyze the different protocols.
CO5 Compare and contrast the different network components

16MC307	NEW AND RENEWABLE ENERGY TECHNOLOGIES	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION 9

Fossil fuels - past, present & future - Remedies & alternatives for fossil fuels – Renewable Energy Sources – Global and Indian power scenario - Energy Policy – Renewable Energy Scenario in Tamilnadu, India

UNITII SOLAR POWER 9

Solar PV Power system – PV Cell: Technologies, Module, Array, - IV and PV curves – Design of Array – system components – Overview of solar thermal systems – Operation and maintenance of grid connected solar system – case study.

UNIT III WIND POWER 9

Wind power scenario – Speed and power relations – wind resource map - system components –control requirements – Environmental aspects

UNIT IV OTHER TECHNOLOGIES 9

Biomass plant – Cogeneration plant - Hydrogen Energy - Fuel Cells - Alternative Fuels for Surface Transportation - Geo Thermal Energy - Tidal Energy – Biofuels

UNIT V APPLICATIONS 9

Introduction to micro grid and smart grid systems. Smart grid usage to rural area development- other commercial applications of smart grid.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1 Rai. G.D., "Non-Conventional Energy Sources", 5th Edition, Khanna Publishers, New Delhi, 2011.

2 Volker Quasching, " Understanding Renewable Energy systems" Jan 2005

REFERENCES

1 Sukhatme. S.P., "Solar Energy", 3rd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2008.

2 Twidell, J.W. and Weir, A., "Renewable Energy Sources", 3rd Edition, EFNSpon Ltd., UK, 2006.

3 David M. Mousdale – "Introduction to Biofuels", 1st Edition, CRC Press, Taylor and Francis Group, USA 2010

4 Chetan Singh Solanki - Solar Photovoltaics - "Fundamentals, Technologies and Applications", 3 rd Edition, PHI Learning Private Limited, New Delhi, 2015

5 Mukund R. Patel, "Wind and Solar Power Systems – Design, Analysis and Operation", CRC Press, 2006.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Gain expertise in Renewable Energy Technologies.

CO2 Discuss the various applications of solar energy.

CO3 Describe concepts of wind energy and able to design wind mills.

CO4 Discriminate the different types of Bio mass energy conversion.

CO5 Understand about Microgrid and Smartgrid.

16MCOE1	INTRODUCTION TO ROBOTICS	L	T	P	C
	(Open Elective offered by MCT to other UG Programmes)	3	0	0	3

UNIT I ROBOTICS BASICS 9

Robot-Basic concepts, Need, Law, History, Anatomy, specification. Robot configurations-cartesian, cylinder, polar and articulate. Robot wrist mechanism, Precision and accuracy of robot.

UNITII SENSORS FOR ROBOTICS 9

Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors – Robotic vision sensor-Force sensor-Light sensors, Pressure sensors.

UNIT III ACTUATORS FOR ROBOTICS 9

End effectors-Classification, Types of Mechanical actuation, Robot drive system-Types, Position and velocity feedback devices-Robot joints and links-Types, Motion interpolation.

UNIT IV INDUSTRIAL ROBOTS AND APPLICATIONS 9

Robot work cell design and control – Safety measures in Robot – Robot cell layouts – Multiple robots and machine interference – Robot cycle time analysis – Industrial applications of robots.

UNIT V HUMANOID ROBOTS 9

Introduction – Need of Humanoid robots – Sensors: Proprioceptive sensors - Exteroceptive sensors – Actuators for Humanoid Robots - planning and control – DoF – ZMP – Applications.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Deb.S.R, "Robotics Technology and Flexible Automation", Tata McGraw - Hill Publishing Company Limited, 2010.
2. Mikell. P. Groover, 'Industrial Robotics Technology', Programming and Applications, McGraw Hill Co, 2008..

REFERENCES

1. Klafter.R.D, Chmielewski.T.A, and Noggin's., "Robot Engineering : An Integrated Approac"', Prentice Hall of India Pvt. Ltd.,1994
2. Fu.K.S, Gonzalez.R.C & Lee.C.S.G, "Robotics control, sensing, vision and intelligence", McGraw Hill Book co, 1987.
3. Craig.J.J, "Introduction to Robotics mechanics and control", Addison- Wesley, 1999.
4. Ray Asfahl.C, "Robots and Manufacturing Automation", John Wiley & Sons Inc., 1985
5. Kozyrey, Yu. "Industrial Robotics", MIR Publishers Moscow, 1985.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Understand the Robot fundamentals
CO2 Identify Robots various components parts and the robotic internal and external sensors
CO3 Know robot transformation system and its application to a robots Kinematic structure.
CO4 Apply the Robot programming for applications
CO5 Need and working of Humanoid robots.

16MCOE2	FUNDAMENTALS OF MEMS	L	T	P	C
	(Open Elective offered by MCT to other UG Programmes)	3	0	0	3

UNIT I INTRODUCTION TO MEMS AND MICROFABRICATION 9

MEMS Roadmap - MEMS markets - MEMS foundries - Benefits of Miniaturization - Benefits of Scaling. Microfabrication: Basic Fabrication Processes – oxidation - film deposition – lithography – etching - ion implantation – diffusion

UNITII SURFACE MICROMACHINING AND BULK MICROMACHINING 9

Surface Micromachining: Basic process flow – release – stiction – material choices - residual stress - Electroplating. Bulk Micromachining: wet etch-based - dissolved wafer process - SOI MEMS – Scream – MEMS – RIE – DRIE.

UNIT III MEMS DEVICES 9

Pressure sensors- Accelerometers - Gyroscopes- RF MEMS Switch- Temperature sensors - Humidity sensors. Microactuators: Electrostatic – piezoelectric – SMA – Thermoelectric – electromagnetic actuators.

UNIT IV POLYMER AND OPTICAL MEMS 9

Polymers in MEMS– Polimide – SU-8 – Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon – Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

UNIT V SMART MATERIALS SYSTEMS 9

Introduction - Optimization schemes forms and smart system modeling - Shape memory alloys (SMAs) - magnetostrictive material - TERFENOL-D - metallo-organic chemical vapor deposition (MOCVD) - Barium strontium titanate (BST) - UV radiation polymer curing - microwave CVD - smart system sensors: conductometric sensors - carbon nanotubes (CNTs) sensors.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Tai - Rai Hsu, "*MEMS and Microsystems: Design and Manufacturing*", Tata MC Graw Hill, Edition 2002.
2. Stephen D.Senturia, "*Microsystems Design*", Springer, 2001

REFERENCES

1. Gregory Kovacs, "Micro machined Transducers", Tata Mc Graw Hill,1998
2. Mark Madou, "Fundamentals of Microfabrication", CRC Press, 2002.
3. Julian W. Gardner, Microsensors – Principles and Applications, Wiley, 1994
4. James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.
5. Thomas M.Adams and Richard A.Layton, “Introduction MEMS, Fabrication and Application,” Springer, 2010.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Understand the concepts of MEMS systems.
CO2 Know the steps in designing and manufacturing of an MEMS device.
CO3 Acquire an adequate knowledge about various fabrication techniques and MEMS systems.
CO4 Recall the manufacturing and packaging of basic MEMS sensors
CO5 Apply the knowledge in using MEMS based actuators.

16MC399	CAREER DEVELOPMENT PROGRAMME V	L	T	P	C
		3	0	0	3

UNIT I MECHATRONICS 7

Introduction, Systems, Measurement systems, Control systems, Microprocessor based controllers, Applications

UNIT II MECHANICAL ACTUATION SYSTEMS 7

Mechanical systems, types of motion, Kinetin chains, cams, gear trains, belt and chain drives, bearings, mechanical aspects of motor selection.

UNIT III INTRODUCTION TO CNC MACHINES & ROBOTICS 7

NC-CNC-DNC machines, structure, sideways, guide ways etc. Components of robots, classification, application

UNIT IV ELECTRICAL ACTUATION SYSTEMS 6

Electrical systems, mechanical switches, solid state switches, solenoids, D.C. motors, A.C. motors, Stepper motors

UNIT V CONTROL OF ELECTRICAL MOTORS 6

Electrical relays, representation of output devices, control of D.C. motor, A.C.motor, stepper motor, induction motor.

UNIT VI MICROPROCESSORS 6

Microprocessor systems, microcontroller, applications, programming

UNIT VII DESIGN OF MECHATRONICS SYSTEMS 6

Introduction, Mechanical approach to design, examples, Future Trends

L : 15 T: 0 P: 30 Total: 45 PERIODS

REFERENCES

1. Mechatronics- Integrated Mechanical Electronics Systems
2. K.P. Ramachandran, G.K. Vijayaraghavan, M.S. Balasundaram Wiley India Pvt Ltd, New Delhi
3. Mechatronics-3rd edition W.bolton, Pearson education Publication
4. Mechatronics ,N.P.Mahalik, TataMcgraw Hill
5. Mechatronics ,Dan Necsulescu, Pearson Education
6. Mechatronics, HMT Ltd., TataMcgraw Hill
7. A Text Book of Mechatronics ,R.K.Rajput, S.Chand

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Provide knowledge on Mechatronics system

CO2 Understand the different actuation systems in mechanical and electrical systems

CO3 Understand and work with CNC machines and Robotics

CO4 Analyze various electrical actuation system and drives

CO5 Understand the various design process in Mechatronics system

16MC308	CNC LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS

Manual part programming using G and M codes for Turning, step turning, Taper turning, thread cutting and radius turning on cylindrical components.

Programming and Simulation of machining using the following features.

(i) Linear and Circular interpolation.

(ii) Pocket milling, slotting, peck drilling and other fixed canned cycles.

Given a component drawing to write the manual part programming and execute on CNC Lathe and Milling Machine.

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

- CNC Lathe with Fanuc control-1
- Computer nodes=1
- NX CAM Express=10
- CNC Milling Machine with Fanuc control=36

L : 0 T: 0 P: 30 C: 0 Total: 30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1	Write manual part programming using G code and M code for simple components.
CO2	Write manual part programming using canned cycle for turning operations
CO3	Write manual part programming for milling operations
CO4	Operate CNC controlled machine tools
CO5	Generate parts with NX CAM Express software

16MC309 INDUSTRIAL ELECTRONICS LABORATORY L T P C

0 0 2 1

LIST OF EXPERIMENTS

- Characteristics of SCR and TRAIC
- Characteristics of MOSFET and IGBT
- Single phase AC to DC half controlled converter
- Single phase AC to DC fully controlled Converter
- Step down and step up MOSFET based choppers
- IGBT based single & three phase PWM inverter
- Single phase AC Voltage controller
- Resonant DC-DC Converter
- Rectifier based speed control of DC Motor
- Step angle and speed control of stepper motor.
- Study of Uninterrupted Power Supply(UPS)

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

- SCR Trainer kit-2
- TRIAC Trainer kit-2
- IGBT Trainer kit-2
- MOSFET Trainer kit-2
- Single phase AC to DC half & full controlled converter Trainer kit-1
- MOSFET based choppers Trainer kit-1
- IGBT based single phase PWM inverter Trainer kit-1
- IGBT based Three phase PWM inverter Trainer kit-1
- Single phase AC Voltage controller Trainer Kit-1
- Resonant DC-DC Converter Trainer kit-1
- Rectifier based speed control of DC Drive-1
- Speed control of stepper motor Trainer Kit-1

L : 0 T: 0 P: 30 C: 0 Total: 30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Understand the characteristics of power electronic devices through experimentation

CO2 Differentiate the operation of converters, inverters and choppers

CO3 Understand the industrial motor drive controls

CO4 Understand the speed control of various devices

CO5 work with hardware, software, and measurement techniques used in power electronic systems

16CS452	OBJECT ORIENTED PROGRAMMING USING C++LABORATORY	L	T	P	C
	(Common to ECE,MCT, EEE & EIE)	0	0	4	2

LIST OF EXPERIMENTS

1. Define a class to represent a bank account to include the following members.
   Data Members: Name of the depositors, Account number, Type of account, Balance amount in the account.
   Member functions:
   - To initialize values to data members
   - To deposit an amount
   - To withdraw an account after checking the balance
   - To display the name and the balance

   Note: Try to use all types of constructors
2. Apply function overloading and operator overloading to the given problems.
3. Implement the concept of default argument function.
4. Implement the concept of array of objects.
5. Apprehend a class with dynamic objects and use constructors and destructors.
6. Execute the concept of Inheritance.
7. Illustrate the use of static data member and static member functions by keeping track of number of instances of object that are created and alive.
8. Implement friend functions and friend classes to add the private data member of two different classes.
9. Exercise the file handling concepts Copy the content of one file to another file by removing unnecessary spaces between words.
10. Realize the following concepts:
    (i) Class templates and Function templates
    (ii) Exception Handling
11. Design Experiments.
12. Application Oriented Experiments: Mini Project.

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

Hardware

PC – 30 nos.

- Processor – 2.0 GHz or higher
- RAM – 256 MB or higher
- Hard disk – 20 GB or higher
- OS- Windows 2000/ Windows XP/ NT

Software

Turbo C (freeware) – to be installed in all PC's.

L : 0 T: 0 P: 60 Total:60 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1	Strengthen the problem solving ability by applying the characteristics of an object- oriented approach
CO2	Implements fundamental constructs of OOP- classes, objects friend function, inline functions and dynamic programming.
CO3	Apply critical thinking skills and creativity to solve the problems.
CO4	To design and implement object oriented software to solve moderately complex problems.
CO5	Develop application using OOP concepts

16GE301	PROFESSIONAL ETHICS	L	T	P	C

(Common to all B.E. / B. Tech. Courses) **3 0 0 3**

UNIT I ENGINEERING ETHICS 9

Senses of Engineering ethics – Variety of moral issues – Types of inquiry- Moral dilemmas. Moral autonomy – Kolberg's theory – Gilligan's theory – consensus and controversy – professions and professionalism – professional ideals and virtues – theories about right action – self-interest – customs and religion – use of ethical theories.

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as social experimentation – engineers as responsible experimenters – codes of ethics – a balanced outlook on law – Case studies.

UNIT III ENGINEERS RESPONSIBILITY FOR SAFETY 9

Safety and risk – assessment of safety and risk – risk benefit analysis – reducing risk – Case studies.

UNIT IV RESPONSIBILITIES AND RIGHTS 9

Collegiality and loyalty – respect for authority – collective bargaining – confidentiality – conflicts of interest –occupational crime – professional rights –employee right – discrimination – intellectual property rights, Case studies.

UNIT V GLOBAL ISSUE 9

Multinational corporations – environmental ethics – computer ethics – weapons development – engineers as managers – consulting engineers – engineers as expert witnesses and advisors – moral leadership – sample code of conduct, Case studies.

L:45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1 Mike Martin and Roland Schinzinger, "Ethics in Engineering" McGraw hill, NewYork, 2004.

2 Govindarajan. M, Natarajan. S,Senthilkumar. V.S, "Engineering Ethics" Prentice Hall, New Delhi, 2004.

REFERENCES

1 Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics– Concepts and Cases", Cengage Learning, 2009 .

2 Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" McGraw Hill education, India Pvt.Ltd., New Delhi 2013 .

3 Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.

4 Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, (2004).

5 David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, 2003.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Understand the basic perception of profession, professional ethics, various moral issues and uses of ethical theories.

CO2 Identify various social issues, industrial standards, code of ethics and role of professional ethics in engineering field.

CO3 Realize the responsibilities of an engineer for safety and risk benefit analysis.

CO4 Recognize the professional rights and responsibilities of an engineer.

CO5 Acquire knowledge about various roles of engineers in variety of global issues and able to apply ethical principles to resolve situations that arise in their professional career.

16MC310 SENSORS & SIGNAL PROCESSING

L	T	P	C
3	0	0	3

UNIT I SCIENCE OF MEASUREMENT 9

Units and Standards– Calibration techniques –Errors in Measurements– Generalized Measurement System–Static and dynamic characteristics of transducers– Generalized Performance of Zero Order and First Order Systems - Response of transducers to different time varying inputs – Classification of transducers-Introduction to second order systems.

UNITII MECHANICAL MEASUREMENTS 9

Temperature: Filled thermometer–Bimetallic thermometer–monometers–elastic transducers – bourdon gauge – bellows – diaphragm. Vacuum: McLeod gauge, thermal conductivity gauge – Ionization gauge, flow measurement, hotwire anemometer.

UNIT III ELECTRICAL MEASUREMENTS 9

Resistive transducers– Potentiometer–RTD– Thermistor – Thermocouple–Strain gauges–use in displacement, temperature, force measurement–Inductive transducer–LVDT– RVDT–use in displacement– Capacitive transducer –Piezoelectric transducer –Digital displacement transducers.

UNIT IV SMART SENSORS 9

Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors – applications - Automobile, Aerospace, Home appliances, Manufacturing, Medical diagnostics, Environmental monitoring.

UNIT V SIGNAL CONDITIONING & DATA ACQUISITION 9

Amplification–Quantization -Filtering– Sample and Hold circuits–Data Acquisition: Single channel and multi-channel data acquisition–Data logging- Computer based DAQ-Applications of DAQs

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. A.K. Sawney and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 14th edition, Dhanpat Rai & Co, New Delhi, 2017.
2. E. O. Doebelin, 'Measurement Systems – Applications and Design ', Tata McGraw Hill, edition 1992

REFERENCES

1. Patranabis. D, "Sensors and Transducers", PHI, New Delhi, 2ndEdition , 2003.
2. David G. Alciatore and Michael B. Histand, "Introduction to Mechatronics and Measurement systems", Tata McGraw-Hill, 2nd Edition, 2008.
3. Thomas G. Bekwith and Lewis Buck.N, "Mechanical Measurements, Oxford and IBH publishing Co. Pvt. Ltd.
4. Gupta.I.C, "A Text book of Engineering Metrology", Dhanpat Rai and Sons, 2006.
5. D. Roy Choudry, Sheil Jain, ' Linear Integrated Circuits', New Age International Pvt. Ltd., 2000.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Understanding the basic knowledge in Measurements
CO2 Summarize the working and construction of sensors measuring various physical Parameters.
CO3 Design suitable signal conditioning and filter circuits for sensors.
CO4 Outline operations of various data acquisition and transmission systems.
CO5 Distinguish smart sensors from normal sensors by their operation and construction

16MC311 APPLIED HYDRAULICS AND PNEUMATICS

L	T	P	C
3	0	0	3

UNIT I FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS 9

Introduction to Fluid power-Advantages and Applications-Fluid power systems– Types of fluids-Properties of fluids–Basics of Hydraulics–Pascal's Law-Principles of flow– Friction loss- Work, Power and Torque. Problems Sources of Hydraulic power: Pumping Theory–Pump Classification Construction, working, Design, Advantages, Disadvantages, Performance, Selection criterion of Linear, Rotary-Fixed and Variable displacement pumps- Problems based on Fluid Power System.

UNITII HYDRAULIC ACTUATORS AND VALVES 9

Hydraulic Actuators: Cylinders– Types and construction, Application, Hydraulic cushioning- Hydraulic motors Control Components: Direction control, Flow control and Pressure control valves-Types, Construction and Operation-Servo and Proportional valves -Applications–Types of actuation. Accessories: Reservoirs, Pressure Switches- Applications-Fluid Power ANSI Symbols– Problems

UNIT III HYDRAULIC SYSTEMS 9

Accumulators, Intensifiers, Industrial hydraulic circuits-Regenerative, Pump Unloading, Double- pump, Pressure Intensifier, Reciprocation, Synchronization, Fail-safe, Speed control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical Hydraulic servo systems.- Hydro-Pneumo Circuits

UNIT IV PNEUMATIC SYSTEMS 9

Properties of air– Perfect Gas Laws-Compressors-Filter, Regulator ,Lubricator, Muffler, Air control Valves, Quick Exhaust valves, Pneumatic actuators, Design of pneumatic circuit cascade method- Electro pneumatic circuits, Introduction to Fluidics Pneumatic logic circuits

UNIT V TROUBLESHOOTING ANDAPPLICATIONS 9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems. Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Fork lift applications. Design of Pneumatic circuits for a Pick and Place application and tool handling in a CNC machine. –

Applications in Assembly, Feeding, Metalworking, materials handling and plastics working.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1 Anthony Esposito, "Fluid Power with Application", Prentice-hall of India Pvt. Ltd., 2006.
2 R.Srinivasan, "Hydraulic and Pneumatic controls", Mc-Graw-Hill Education Pvt. Ltd., 2006.

REFERENCES

1 Andrew Parr, "Hydraulics and Pneumatics", Jaico Publishing House, 2005.
2 Majumdar S R, "Pneumatic Systems – Principle and Maintenance", Tata Mc-Graw Hill, 2006.
3 Majumdar,S.R.,"Oil Hydraulics Systems, Principles and Maintenance", Tata McGraw Hill, 2001.
4 Dudelyt,APeaseandJohnJPippenger, "BasicFluidPower", Prentice Hall,1987.
5 Joji.P, "Pneumatic Controls",WileyIndia,2008

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Explain basic working principle and constructional features of hydraulics and pneumatics system.
CO2 Understanding the actuating Techniques
CO3 Design of hydraulics circuits.
CO4 Design of pneumatics circuits
CO5 Understanding problem solving in the hydraulics and pneumatics circuits

16MC331 **PLC, HMI & SCADA**

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION TO PLC 9

Programmable Logic Controllers: Introduction – Evolution of PLC's – Parts of PLC – Brick Style – Rack Style – Principles of operation – Advantages over relay logic – PLC sizes – PLC hardware components – I/O section – Discrete and Analog Module – CPU processor and memory module – Program Scan – Programming devices – PLC Programming Languages – Ladder diagram – Function Block Diagram – Latching relays PLC ladder diagram, Converting simple relay ladder diagram in to PLC relay ladder diagram

UNITII PLC PROGRAMMING LANGUAGES & I/O DEVICES 9

Basic Of PLC Programming And Systems: Instructions In Plc, Timer Instructions On Delay, Off Delay And Retentive Timers, Up Counter, Down Counter And Up Down Counters, Relay – Type Instructions, Data Manipulating Program, Data Handling Instructions - Control Instruction, Math Instructions - Sequencer And Shift Register Instructions, Electromagnetic Control Relays, Motor Starters – Latching Relays - Manually Operated Switches – Mechanically Operated And Proximity Switches – Output Control Devices

UNIT III APPLICATIONS OF PLC 9

Applications of PLC: Incremental Encoder – Counter Applications – Networking of PLC, PLC installation, Trouble shooting and Maintenance – Simple materials handling applications, Automatic control of warehouse door, Automatic lubrication of oil supplier – Conveyor belt motor control, Automatic car washing machine, Bottle label detection, PLC in process control – case study on bottle filling systems.

UNIT IV INTRODUCTION TO HMI AND SCADA 9

Human Machine Interface – Interfacing PLC with HMI – HMI Components – Online process variable monitoring and control. Supervisory Control and Data Acquisition Systems: Introduction – Evolution of SCADA – features of SCADA – SCADA Architecture – Components of SCADA – Master Terminal Unit–Remote terminal Unit - SCADA Communications

UNIT V SCADA APPLICATIONS 9

SCADA controls and its Applications: SCADA Tools – tag database, recipe database – log, trace – alarm logging –Trend – on line, off line – Security and user access management, Management Information System – report function – SCADA Functions – Supervisory computer control – Interfacing PLC with SCADA – SCADA applications – Case studies, implementation, Simulation exercise.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2010
2. Stuart A Boyer, "SCADA supervisory control and data acquisition"

REFERENCES

1. K. L.S. Sharma, Overview of Industrial Process Automation, Elsevier, 2011 Batten G. L., "Programmable Controllers", McGraw Hill Inc., Second Edition
2. Pradeep Kumar&Srivashtava , Programmable Logic Controller- BPB Publications.
3. Hughes .T, "Programmable Logic Controllers", ISA Press, 1989.
4. Gordan Clark, Deem Reynders, "Practical Modem SCADA Protocols"
5. MdhuchhandaMitra, SamarjitSen Gupta, "Programmable Logic Controllers and Industrial Automation, An Introduction" Penram International Publishing Limited.

COURSE OUTCOMES

At the end of the course student should be able to:

- **CO1** Acquire an adequate knowledge about various functions of PLC and its interfacing
- **CO2** Understanding the concepts of various instructions in PLC programming language
- **CO3** Write the PLC programs for the various sequential control applications
- **CO4** Understand the basic of Supervisory Control and Data Acquisition (SCADA)
- **CO5** Interface and program HMI with PLC

16MC312 **AUTOMOTIVE ENGINEERING**

L	T	P	C
3	0	0	3

UNIT-I VEHICLE STRUCTURE AND ENGINES 9

Types of automobiles, vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines–components- functions and materials, lean burn engines.

UNIT-II ENGINE AUXILIARY SYSTEMS 9

Emission norms, Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system),Electronic ignition system(Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, 42 volt technology.

UNIT-III TRANSMISSION & ELECTRONICS SYSTEMS 9

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Overdrive, fluid flywheel ,torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle ,Hotchkiss Drive and Torque Tube Drive. CVT, Hydrostatic Transmission. Application of Basic Electronics Components.

UNIT-IV STEERING, BRAKESAND SUSPENSION SYSTEMS 9

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control-Exhaust Braking.

UNIT-V ALTERNATIVE ENERGY SOURCES 9

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance ,Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Kirpal Singh, “Automobile Engineering”, Vol 1 & 2, Standard Publishers, Seventh Edition, New Delhi, 1997.
2. Newton, Steeds and Garet, “Motor Vehicles”, Butterworth Publishers,1989.

REFERENCES

1. Joseph Heitner, “Automotive Mechanics,” Second Edition, East-West Press, 1999.
2. Martin W, Stockel and Martin T Stockle , “Automotive Mechanics Fundamentals,” The Good heart – Will Cox Company Inc, USA ,1978.
3. Heinz Heisler, "Advanced Engine Technology,” SAE International Publications USA, 1998.
4. Ganesan V. “Internal Combustion Engines ”,Third Edition, TataMcgraw-Hill,2007
5. JainK.K.andAsthana.R.B,“AutomobileEngineering”TataMcGrawHillPublishers,NewDelhi,2002.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Identify the different components in Vehicle Structure.
CO2 Know the concept about Engine System
CO3 Understand the working of various components of automobile systems.
CO4 Have clear understanding on major and auxiliary automobile systems.
CO5 Understand the concept of Alternative Energy Source

16MC313 MACHINE INTERFACE DESIGN

L	T	P	C
3	0	0	3

UNIT-I INTRODUCTION 9

Introduction to Human Machine Interface, Hardware, software and operating environment to use HMI in various fields. The psychopathology of everyday things – complexity of modern devices; human-centered design; fundamental principles of interaction; Psychology of everyday actions- how people do things; the seven stages of action and three levels of processing; human error.

UNIT-II GRAPHICAL USER INTERFACE 9

Benefits of a good UI; popularity of graphics; concept of direct manipulation; advantages and disadvantages; characteristics of GUI; characteristics of Web UI; General design principles. User Interface Design Process: Steps in UI design

UNIT-III GRAPHICAL SCREEN DESIGN 9

Graphical design concepts, components of visible language, graphical design by grids- Beyond screen design: characteristics of good representations, information visualization, Tufte's guidelines, visual variables, metaphors, direct manipulation

UNIT-IV DESIGN PRINCIPLES AND USABILITY HEURISTICS 9

Design principles, principles to support usability, golden rules and heuristics, Human Computer Inetraction (HCI) patterns - HCI design standards: process-oriented standards, product-oriented standards, strengths and limitations of HCI Standards

UNIT-V CASE STUDIES 9

Designing and evaluating Human-Machine Interface (HMI) for Process control application - Flight control system - Robotics Welding - Air-conditioning system - Smart phones - Medical Devices

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1 Donald A. Normann, "Design of everyday things", Basic Books; Reprint edition 2002.

2 Wilbert O. Galitz, "The Essential Guide to User Interface Design", Wiley publication

REFERENCES

1 Ben Shneiderman and Catherine Plaisant, Designing the user Interface, Pearson, Addison Wesley.

2 Alan Cooper, Robert Reimann, David Cronin, "About Face3: Essentials of Interaction design", Wiley publication.

3 Jeff Johnson, "Designing with the mind in mind", Morgan Kaufmann Publication.

4 Dix A. et al., Human-Computer Interaction. Harlow, England: Prentice Hall, 2004, ISBN-10: 0130461091

5 Yvonne Rogers, Helen Sharp, Jenny Preece, Interaction Design: Beyond Human Computer Interaction, 3rd Edition, Wiley, 2011, ISBN-10: 0470665769.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Design innovative and user friendly interfaces for industrial application.

CO2 Criticize existing interface designs, and improve them.

CO3 Design application for social and technical task with safety concern.

CO4 Indulge into research in Machine Interface Design.

CO5 Apply HMI in industrial application.

16MC351	INTERNET OF THINGS AND SMART MANUFACTURING	L	T	P	C
		3	0	0	3

UNIT-I INTRODUCTION **9**

Concept of Internet of Things (IoT), common definitions, IoT applications, and functional view. Cloud Computing, Semantic Technologies, Networking and Communication Technologies.

UNIT-II CONTEMPORARY Vs IOT ENABLED MANUFACTURING SYSTEM **9**

Architecture of IoT-MS, Integration framework of Real-time manufacturing information, Work logic of IoT-MS. Architecture of IoT-MS, Integration framework of Real-time manufacturing information, Work logic of IoT-MS.

UNIT-III CLOUD BASED MANUFACTURING RESOURCE CONFIGURATION **9**

Concept of cloud manufacturing, Real-time production information perception and capturing, Cloud service selection, Cloud Machine model.

UNIT-IV SMART FACTORY AND SMART MANUFACTURING **9**

Concepts of Industry 4.0 standard, Real-time information based scheduling, capacity planning, material planning, Real-time production monitoring techniques with smart sensors, Configuration of smart shop floor, traceability and call back of defective products

UNIT-V CASE STUDIES **9**

Case studies on applications of IoT in different industrial progressions like virtual visibility maturity model etc.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. S. Jeschke, C. Brecher, H. Song, and D. B. Rawat, Industrial Internet of Things: Cyber manufacturing Systems, Springer, 1st edition, 2017, ISBN: 978-3319425580.
2. A. Bahga and V. Madisetti, Internet of Things, A hands-on approach, Create Space Independent Publishing Platform, 1st edition, 2014, ISBN: 978-0996025515.

REFERENCES

1. T. Erl, Z. Mahmood, and R. Puttini, Cloud Computing: Concepts, Technology & Architecture, Prentice Hall, 1st edition, 2013, ISBN: 978-0133387520
2. M. P. Groover, Automation, Production Systems and Computer-Integrated Manufacturing, 4th edition, Pearson Education, 2016, ISBN: 9789332572492.
3. C. Tong and D. Sriram, Artificial Intelligence in Engineering Design: Knowledge acquisition, commercial systems, and integrated environments, 1992, ISBN:9780080926025.
4. P. C. Pandey and H. S. Shan, Modern Machining Processes, 1st edition, McGraw- Hill, 2013, ISBN: 9780070965539
5. S. Kalpakjian, S. R. Schmidt, Manufacturing Engineering and Technology, 7th edition, Pearson India, 2009. ISBN: 978-0133128741

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 To work and contribute on digital transformation.
CO2 Understand the existing IoT and Cloud architectures
CO3 Design an IoT system with cloud infrastructure
CO4 To outline the various systems used in a manufacturing plant and their role in an Industry 4.0 worlds.
CO5 Understand the opportunities, challenges brought about by Industry 4.0 and how organizations and individuals should prepare to reap the benefits.

16MC315	PROCESS PLANNING AND PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

UNIT-I INTRODUCTION TO PROCESS PLANNING 9

Introduction- methods of process planning-Drawing interpretation-Material evaluation – steps in process selection-.Production equipment and tooling selection

UNIT-II PROCESS PLANNING ACTIVITIES 9

Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies

UNIT-III PRODUCT DEVELOPMENT 9

Product Development process, product development versus design, product cost analysis, cost models, reverse engineering and redesign product development process, new product development, tear down method.

UNIT-IV PRODUCT SPECIFICATIONS 9

Establishing the product specifications– Target specifications – Refining specifications, concept generation-Clarify the problem – Search internally – Search externally – Explore systematically - Reflect on the Results and the Process.

UNIT-V PRODUCT IMPROVEMENT 9

Reliability, failure identification techniques, Poka-Yoke, Design for the environment, design for maintainability, product safety, liability and design, design for packaging, factorial analysis-ANOVA, factorial experiments, examples

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Peter Scalon, “Process planning, Design/Manufacture interface”, Elsevier science technology Books, 2002.
2. Alexis Leon, “Enterprise Resource Planning”, Tata McGraw Hill, New Delhi, 2008.

REFERENCES

1. Ostwalal P.F. and Munez J., “Manufacturing Processes and systems”, John Wiley, 9th Edition, 1998.
2. Concurrent Engg. /Integrated Product Development. Kemnneth Crow, DRM Associates, 26/3, ViaOlivera, Palos Verdes, CA 90274 (310) 377 569, Workshop Book
3. “Effective Product Design and Development”, Stephen Rosenthal, Business One Orwin Homewood, 1992, ISBN, 1-55623-603-434
4. David S Linthicum, “B2B Application Integration”, Addison Wesley,2001
5. Chitale A.V. and Gupta R.C., “Product Design and Manufacturing”, 2nd Edition, PHI, 2002

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Apply knowledge on the concepts of product specification.
CO2 Know the concept of product architecture.
CO3 Describe the principles of industrial design and prototyping.
CO4 Examine the concept of product development and customer needs.
CO5 Understand the concept of product improvement, safety, and packing.

16MC316 BASICS OF DIGITAL SIGNAL PROCESSING

L	T	P	C
3	0	0	3

UNIT-I DISCRETE FOURIER TRANSFORM 9

Discrete Signals and Systems- A Review – Introduction to DFT – Properties of DFT – Circular Convolution - Filtering methods based on DFT – FFT Algorithms –Decimation in Time Algorithms, Decimation in frequency Algorithms – Use of FFT in Linear Filtering.

UNIT-II IIR FILTER DESIGN 9

Structures of IIR – Analog filter design – Discrete time IIR filter from analog filter – IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives – LPF, HPF, BPF, BRF filters design using frequency translation.

UNIT-III FIR FILTER DESIGN 9

Structures of FIR – Linear phase FIR filter – Fourier Series method- Filter design using Rectangular Window, Hamming Window, Hanning Window, Blackman window.

UNIT-IV FINITE WORDLENGTH EFFECTS 9

Fixed point and floating point number representations – ADC –Quantization- Truncation and Rounding errors - Quantization noise – coefficient quantization error – Product quantization error - Overflow error – Round off noise power - limit cycle oscillations due to product round off and overflow errors – Principle of scaling.

UNIT-V DSP APPLICATIONS 9

Multirate signal processing: Decimation, Interpolation, Sampling rate conversion by a rational factor. Adaptive Filters: Introduction, Types of adaptive filters, Applications of adaptive filtering to equalization.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. John G Proakis and Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", Pearson, Fourth Edition, 2007
2. S.K.Mitra, Digital Signal Processing, A Computer Based approach, Tata McGraw Hill, 1998

REFERENCES

1. H. P. Hsu, Rakesh Ranjan"Signals and Systems", Schaum's Outlines, Tata McGraw Hill, Indian Reprint, 2007
2. S.Salivahanan, A.Vallavaraj, C.Gnanapriya, "Digital Signal Processing", McGraw Hill International / TMH, 2007
3. Simon Haykins and Barry Van Veen, "Signals and Systems", John Wiley & Sons, Inc, 2004
4. Rodger E. Ziemer, William H. Tranter, D. Ronald Fannin "Signals & systems", Pearson Education, 2007
5. B.P Lathi,"Principles of Linear Systems and Signals", Second Edition, Oxford, 2009

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Understand the Discrete Fourier transform (DFT)
CO2 Design digital IIR filters.
CO3 Know the structure of FIR filters
CO4 Analyze the finite word length effects
CO5 Understand the various application of DSP

16MCOE3	AUTOMATION & ITS APPLICATIONS (Open Elective offered by MCT to other UG Programmes)	L	T	P	C
		3	0	0	3

UNIT I BASICS OF INDUSTRIAL AUTOMATION 9

Programmable Logic Controllers, Parts of a PLC, Principles of Operation,

PLC Hardware Components - The I/O Section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules, I/O Specifications: Typical Discrete I/O Module Specifications, Typical Analog I/O Module Specifications, Central Processing Unit (CPU).

UNITII HMI AND SCADA 9

Human machine Interface – Need – Advantages – HMI real time application for industry process Evolution – SCADA architectures –MTU – RTU – Operator Interface – Displays – Engineering Interface.

UNIT III ADVANCED INDUSTRIAL AUTOMATION & ITS APPLICATIONS 9

Evolution of process control operations - Remote transmission, logging and data historian - Mobile interfaces and controls.

APPLICATION OF DCS - DCS Applications in power plants, Iron and steel plants, Chemical plants, Cement plants, paper and pulp industries.

UNIT IV HOME AND OFFICE AUTOMATION 9

Introduction – Fingerprint based door opening system –PIR sensors based lighting systems– WIFI based office automation – Global Positioning System for tracking devices – GSM based home and office equipments control.

UNIT V STREET AUTOMATION 9

Introduction – basic street automation components - Human detection based lighting system – Density based traffic control system – street water automation using PLC – Parking automation system – Automatic gate control Mechanism.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Frank D. Petruzella, "Programmable Logic Controllers", Glencoe McGraw Hill Second Edition, 2013
2. Michael Lucas, "Distributed Control Systems", Van Nostrand Reinhold Co.,1986

REFERENCES

1. McMillan.G.K, "Process/ Industrial instrument and handbook", McGraw-Hill, New York, 1999
2. Popovic D. and Bhatkar.V.P, "Distributed Computer Control for industrial automation", Marcel Dekkar Inc., 1990
3. Kant, Krishna "Computer - Based Industrial Control", PHI Learning. 2004
4. Stenerson Jon Stenerson, "Industrial Automation and Process Control", PHI Learning. 2008.
5. Z. Binder and R. Perret "Components and Instruments for Distributed Control , Systems", Elsevier Ltd. 2009

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Acquire an adequate knowledge about basic functions of PLC.
CO2 Understanding the concepts of HMI and SCADA.
CO3 Know the function and advantages of DCS.
CO4 Automate office with simple components.
CO5 Know the need of street automation.

16MCOE4	HUMAN COMPUTER INTERFACE (Open Elective offered by MCT to other UG Programmes)	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION 9

Introduction : Importance of user Interface – definition, importance of good design. Benefits of good design. A brief history of Screen design.

UNITII GUI 9

The graphical user interface – popularity of graphics, the concept of direct manipulation, graphical system, Characteristics, Web user – Interface popularity, characteristics- Principles of user interface.

UNIT III HCI DESIGN 9

Design process – Human interaction with computers, importance of human characteristics human consideration, Human interaction speeds, and understanding business junctions.

UNIT IV CORE METHOLOGIES OF HCI 9

Screen Designing : Design goals – Screen planning and purpose, organizing screen elements, ordering of screen data and content – screen navigation and flow – Visually pleasing composition – amount of information – focus and emphasis – presentation information simply and meaningfully – information retrieval on web – statistical graphics – Technological consideration in interface design.

UNIT V SOFTWARE TOOLS AND OTHER DEVICES 9

Windows – New and Navigation schemes selection of window, selection of devices based and screen based controls. Components – text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors. Software tools – Specification methods, interface – Building Tools. Interaction Devices – Keyboard and function keys – pointing devices – speech recognition digitization and generation – image and video displays – drivers.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. The essential guide to user "Interface design", Wilbert O Galitz, Wiley DreamaTech, 2007.
2. "Designing the user interface", 3rd Edition Ben Shneidermann, Pearson Education Asia. 2005.

REFERENCES

1. ALAN DIX, JANET FINCAY, GRE GORYD, ABOWD, RUSSELL BEALG, "Human – Computer Interaction", PEARSON, Prentice Hall (2004).
2. PRECE, ROGERS, SHARPS, "Interaction Design" Wiley Dreamtech. 2005
3. Soren Lauesen, "User Interface Design", Pearson Education. 2009.
4. Marting G. Helander, Thomas K. Landauer and Prasad V. Prabhu **"**Handbook of Human-Computer Interaction", Elsevier BV publications. 2008.
5. Serengul Smith-Atakan "Human-Computer Interaction: Basics and Practice" Cengage Learning. 2004.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Know the needs of Human computer Interaction.
CO2 Understand the concept of Graphical user interface.
CO3 Know the basic design of HCI.
CO4 Acquire the knowledge about core methodologies and its uses in HCI
CO5 Use the software tools and other devices.

16GE312	CAREER DEVELOPMENT PROGRAMME VI	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	1	0	2	2*

UNIT I LINGUISTIC SKILLS 10

Parts of Speech, Sentences - Simple, Compound & Complex sentences, Logical sequence of words, Reading Comprehension, Paragraph writing, Jumbled words, Jumbled sentences, Error Spotting, Idioms & Phrases, Word Substitution, Synonyms & Antonyms.

UNITII QUANTITATIVE ABILITY 10

Number theory, Percentage, Profit loss and discount, Simple and compound interest, Problems on Average & Ages, Ratio & Proportions, Partnership, Mixtures and allegation, Time speed and distance, Time and work, Probability, Permutation and combination, Mensuration, Clocks, Calendars.

UNIT III VERBAL & NON-VERBAL REASONING 10

Analytical reasoning - Linear, Circular & Complex arrangement, Blood relation, Direction Problems, Decision making.

Logical reasoning - Number and Alpha series, Odd man out, Element series, Logical series, Coding and decoding, Syllogisms, Alphabets Machine Input & Output Coded Inequalities, Puzzles, Cubes, Data sufficiency, Analogy.

Critical reasoning - Statement – Argument & Assumption, Causes & effects, Courses of Action, Inferences.

Non-Verbal reasoning - Insert the missing character, Figure series, Cubes & Dices, Logical Venn diagram.

UNIT IV PERSONALITY DEVELOPMENT & SOFT SKILLS 8

Body Language – Introduction, Grooming, Body Language - Postures and Gestures, Dressing Etiquettes, Hygiene & Cleanliness, Time Management

Interview Etiquettes – Meaning, Purpose, Interview process and types, checklist – do's and don'ts, Dress code, Self-Introduction.

Resume Building – Introduction, transformation between Resume and CV, Strategy of Resume Writing, Body of the resume, clarity and crispness, format and content.

Group Discussion – Types, Key steps to succeed in Group Discussion, Guidelines – Do's and Don'ts during Group Discussion, the technique of summing up.

UNIT V COMPANY SPECIFIC TRAINING 7

Company specific training.

L:15 T: 0 P: 30 Total: 45 PERIODS

TEXT BOOKS

1. John Eastwood, "Oxford Practice Grammar", Oxford.
2. Rajesh Varma, "Fast Track Objective Arithmetic", Arihant Publications.
3. M.K.Panday, "Analytical Reasoning", Magical Series.

REFERENCES

1. R.V.Praveen, "Quantitative Aptitude and Reasoning" PHI Publication.
2. R.S.Agarwal, "Quantitative Aptitude for Competitive Examinations", S.Chand & Company Pvt Limited.
3. S.P.Bakshi, "Objective English" Arihant Publications.
4. Edgar Thorpe & Showick Thorpe, "Winning Interviews", Pearson Publications.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Communicate well both in oral and written English.
CO2 Solve the complicated problems with the thorough knowledge on the basics.
CO3 Think both critical and logical to solve the problems.
CO4 Be a better personality in their professional and social life.
CO5 Face the recruitment challenges.

16MC317	PLC, HMI & SCADA LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS

1. Study of Programmer Logic Controller.-2
2. Construction of Ladder programming for Boolean operations & Math operations using PLC.-1
3. Linear actuation of hydraulic cylinder with timer and counter using PLC.-1
4. Hydraulic rotation with timer and speed control using PLC.-1
5. Sequential operation of pneumatic cylinders using PLC.-1
6. Traffic light controller using PLC.
7. Speed control of DC motor using PLC.
8. Testing of Relays using PLC.
9. Interfacing of PLC with HMI.
10. Real time process monitoring and control using HMI.
11. Study on Supervisory Control and Data Acquisition.
12. Interfacing PLC real time tag with SCADA.
13. Develop a SCADA screen program for process plant operation.

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

PLC Trainer Kit (VPLCT-01)-2
PLC based Real Time application Trainer (VPAT - 12A) Hydraulic systems-1
Sequential operation of Pneumatic cylinders basic electro pneumatic with PLC (VMPT 303LC)-1
Traffic Light controller PLC Real time application trainer (VPAT -03A)-1
Relay Testing Module Trainer (VPAT - 13)-1
DC Motor speed Control Module (VPAT - 02)-1
SCADA software-5
HMI Interface Module-1
Freeware

L : 0 T: 0 P: 30 C: 0 Total: 30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1	Acquire an adequate knowledge about various functions of PLC and its interfacing.
CO2	Understand the basic of Supervisory Control and Data Acquisition (SCADA) & Human Machine Interface (HMI).
CO3	Learn the PLC programming concepts, programming methods, fundamentals, process logic and human machine interface.
CO4	Understand the SCADA Schematic Representation, architecture and communication protocols.
CO5	Design and simulation of Automation process using SCADA & HMI.

16MC318	SENSORS AND SIGNAL PROCESSING LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS

Measurement of temperature using thermocouple and thermistor
Measurement of temperature using RTD
Measurement of displacement using Potentiometer.
Measurement of displacement using LVDT
Measurement of displacement using capacitive transducer
Torque measurement using torque measuring devices
Strain Measurement using strain gauge
Wave Shaping circuit
Analog to Digital Converters
Digital Comparator
Voltage to frequency converter
Frequency to Voltage Converter
Study on the application of data acquisition system for industrial purposes

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

RTD module-1
Thermocouple module-1
Thermistor module-1
Potentiometer Kit-1
LVDT & Capacitive transducer trainer kit-1
Strain Measurement trainer kit-1
Torque measurement kit-1
Wave Shaping trainer kit-1
Cathode Ray Oscilloscope-5
Function Generator-5
Regulated power supply-7
Voltage to frequency and Frequency to Voltage Converter-1
Digital Comparator-1

L : 0 T: 0 P: 30 C: 0 Total: 30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1	Students will be able know about the working and construction of sensors measuring various physical parameters.
CO2	Design suitable signal conditioning and filter circuits for sensors
CO3	Outline operations of various data acquisition and transmission systems
CO4	Distinguish the Electrical and Mechanical Measurements.
CO5	Classify various sensing methods used in condition monitoring

16MC319	APPLIED HYDRAULICS AND PNEUMATICS LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS

Design and testing of the following hydraulic circuits:

i. Pressure control
ii. Flow control
iii. Sequential circuit using an Electro hydraulic Trainer kit.

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.

Simulation of basic hydraulic, pneumatic and electrical circuits using Automation Studio software

Design and testing of the following hydraulic circuits:

i. Pressure control
ii. Flow control

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

Pressure relief valve-2
Flow control valves-2
Limit switches-2
Linear actuator-4
Rotary actuator-2
Double solenoid actuated DCV-2
Single solenoid actuated DCV-2
Hydraulic power pack with pump and pressure relief valve-2
Pneumatic trainer kit with FRL Unit, Single acting cylinder, push button actuated-1 DCV and manually actuated DCV-1
Pneumatic training kit with FRL unit, Double acting cylinder, pilot actuated DCV-1
Pneumatic trainer kit with FRL unit, Double acting cylinder, Double solenoid-1 actuated DCV with sensors/ magnetic reed switches-1
Pneumatic trainer kit with FRL unit with PLC with Interface card-10
FLUIDSIM software

L : 0 T: 0 P: 30 C: 0 Total: 30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1	Select the actuators and valves for the design of fluid power circuits.
CO2	Design and simulate the fluid power circuits using software tool
CO3	Test the simulated output by constructing the fluid power circuits using suitable actuators and valves
CO4	Analyze and present the findings of experimental observations in both written and oral format
CO5	Able to know the Applications of Fluid Power System in automation of Machine Tools and others Equipments

16MC401	ROBOTICS AND MACHINE VISION SYSTEM	L	T	P	C
		3	0	0	3

UNIT I BASICS OF ROBOTICS 9

Introduction - Basic components of robot wrist configurations, motion - roll - Pitch - Yaw, sensors - Laws of robotics - classification of robot - work space – accuracy -resolution – repeatability of robot. Power transmission system: Rotary to rotary motion, Rotary to linear motion, Harmonics drives

UNIT II ROBOT END EFFECTORS 9

Robot End effectors: Introduction – types of End effectors – Mechanical gripper – types of gripper mechanism - gripper force analysis - other types of gripper- special purpose grippers.

UNIT III ROBOT MECHANICS 9

Robot kinematics: Introduction- Matrix representation - rigid motion & homogeneous transformation - forward & inverse kinematics - trajectory planning. Robot Dynamics: Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton-Euler formulation.

UNIT IV MACHINE VISION & ITS APPLICATION 9

Machine vision: Basic Components - image acquisition, digital images - sampling and quantization - levels of computation - Feature extraction - windowing technique – segmentation – Thresholding - edge detection - binary morphology - grey morphology – Application : Vision and Tracking - Introduction to NI-IMAQ and IMAQ Vision

UNIT V ROBOT PROGRAMMING & ROBOT ASSEMBLING 9

Robot programming: Robot Languages - Classification of robot language - Computer control and robot software - Basic introduction to VAL Programming & Robotic operating System (ROS) - Programming of robots using Robot C and Labview programming – Assembly of robots using Lego, Vex and Tetrix Kits - Five minute bot, Line follower, Obstacle avoidance robot, Wall following robot and other simple applications.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. M.P.Groover, M.Weiss, R.N.Nagal, N.G.Odrey, "Industrial Robotics - Technology, Programming and Applications" Tata McGraw-Hill Education Pvt Limited, 2008
2. K.S.Fu, R.C.Gonzalez, CSG. Lee, ―Robotics control, sensing, vision and Intelligence, McGraw Hill Education Pvt. Ltd., 2013.

REFERENCES

1. John J Craig, ―Introduction to Robotics, Pearson, 2009.
2. Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer, Indian Reprint, 2010
3. Carsten Steger, Markus Ulrich, Christian Wiedemann, - Machine Vision Algorithms and Application, WILEY-VCH, Weinheim, 2008.
4. Aaron Martinez and Enrique Fernandez, ―Learning ROS for Robotics Programming, PACKT Publishing, 2013.
5. Bruno Siciliano, Oussama Khatib, Springer Hand book of Robotics, Springer, 2008.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1	Know the fundamentals of Robot.
CO2	Recognize various robot components, parts and the End-effectors
CO3	Comprehend Robot transformation system and its application to a robots Kinematic and Dynamic structure
CO4	Understand Image Processing and its application in Machine Vision System
CO5	Understand the basics of robot programming and Robot Assembling

16GE302 ENGINEERING ECONOMICS AND COST ANALYSIS L T P C

(Common to all B.E. / B. Tech. Courses) **3 0 0 3**

UNIT I BASIC ECONOMICS 9

Definition of economics - nature and scope of economic science - nature and scope of managerial economics - basic terms and concepts - goods - utility - value - wealth - factors of production - land - its peculiarities - labour - economies of large and small scale - consumption -wants - its characteristics and classification - law of diminishing marginal utility – relation between economic decision and technical decision.

UNIT II DEMAND AND SCHEDULE 9

Demand - demand schedule - demand curve - law of demand - elasticity of demand - types of elasticity - factors determining elasticity - measurement – its significance - supply – supply schedule - supply curve - law of supply - elasticity of supply - time element in the determination of value - market price and normal price - perfect competition - monopoly – monopolistic competition.

UNIT III ORGANISATION 9

Forms of business - proprietorship - partnership - joint stock company - cooperative organization - state enterprise - mixed economy - money and banking - banking - kinds - commercial banks - central banking functions - control of credit - monetary policy - credit instrument.

UNIT IV FINANCING 9

Types of financing - Short term borrowing - Long term borrowing – Internal generation of funds - External commercial borrowings - Assistance from government budgeting support and international finance corporations - analysis of financial statement – Balance Sheet - Profit and Loss account - Funds flow statement.

UNIT V COST AND BREAK EVEN ANALYSES 9

Types of costing – traditional costing approach - activity base costing - Fixed Cost – variable cost – marginal cost – cost output relationship in the short run and in long run – pricing practice– full cost pricing – marginal cost pricing – going rate pricing – bid pricing – pricing for a rate of return – appraising project profitability –internal rate of return – pay back period – net present value – cost benefit analysis – feasibility reports – appraisal process – technical feasibility economic feasibility – financial feasibility. Break even analysis - basic assumptions – break even chart – managerial uses of break even analysis.

L:45 T: 0 P:0 Total: 45 PERIODS

TEXT BOOKS

1 Dewett K.K. & Varma J.D., Elementary Economic Theory, S Chand & Co., 2006.
2 Sharma JC “Construction Management and Accounts” Satya Prakashan, New Delhi, 2006.

REFERENCES

1 Barthwal R.R., Industrial Economics - An Introductory Text Book, New Age, 2007.
2 Jhingan M.L., Micro Economic Theory, Konark,1989.
3 Samuelson P.A., Economics - An Introductory Analysis, McGraw Hill.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Know the basic terms and concepts of economic.
CO2 Understand the major capability and limitations of cash flow analysis for proposed capital investment.
CO3 Recognize, formulate, analyze and solve cash flow models in practical situations.
CO4 Develop the ability to account for time value of money using engineering economy factors and formulas, as well as implication and importance of considering taxes, depreciation and inflation.
CO5 Evaluate engineering alternatives by economic analysis techniques and models.

16MC430 APPLIED MECHATRONICS ENGINEERING

L	T	P	C
3	0	0	3

UNIT I INFOTRONICS 9

Driver assistance system: Introduction, driver support systems – driver information, Vehicle support systems – general vehicle control, collision avoidance, vehicle status monitoring - seat belt tightening system, collision warning systems, child lock - Adaptive cruise control, adaptive noise control, active roll control system, cylinder cut- off technology

UNIT II AUTOTRONICS 9

Sensors: Knock sensor, Crash sensor, Speed sensor, Acceleration sensor and Micro sensor – X-by-wire systems - Electronic ignition system – fuel cell Electric vehicle - CNG Electric hybrid vehicle Vision based autonomous road vehicles – Aerodynamic drag detection system - An application of mobile robot vision to a vehicle information system - Objective detection, collision warning and avoidance system.

UNIT III AVIONICS 9

Need for Avionics in civil and military aircraft and space systems - Avionics sub-systems and design - Avionics system architecture– Salient features and applications of Data buses MIL–STD1553 B–ARINC 429–ARINC 629 - Navigation systems - Flight control systems - Radar electronic warfare

UNIT IV HOME AUTOMATION 9

Introduction – Fingerprint system – retinal scanning system – PIR sensors – Night Vision system – Zigbee technology – advanced wireless technology - Radio telemetry – Global Positioning System – Global System for Mobile Communication

UNIT V BIOTRONICS 9

Introduction to bioelectronics – Biosensors and Transducers - Measurement and recording: Cardiovascular systems, electrical activities in muscles and brain - Respiratory mechanism - Measurement of pH value of blood, ESR measurements, hemoglobin measurement, oxygen and carbon dioxide concentration in blood, GSR measurement – Biotelemetry.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. LjuboVlacic, Michel Parent and Fumio Harashima, “Intelligent Vehicle Technologies”, Butterworth-Heinemann publications, Oxford, 2011
2. Robert Bosch, “Automotive Hand Book”, 5th Edition, SAE, 2000
3. Middleton, D.H., Ed., “Avionics Systems, Longman Scientific and Technical”, Longman Group UK Ltd., England, 1989.
4. Jigisha D. Pardesi, "Emerging Trends in Information Technology ", 1st Edition, Nirali Prakashan publication, 2007.
5. Khandpur R.S, “Hand-book of Biomedical Instrumentation”, Tata McGraw Hill, 2nd Edition, 2003.

REFERENCES

1. William B Riddens, “Understanding Automotive Electronics”, 5th edition, Butter worth Heinemann Woburn, 1998.
2. Automotive Technology”, Jack Erjavec, Robert Scharff, -Delmar Publications Inc 1992.
3. Spitzer, C.R., “Digital Avionic Systems”, Prentice Hall, Englewood Cliffs, N.J., USA.,1987.
4. Electric and Hybrid-electric vehicles, Ronald K. Jurgen, SAE 2002. [Unit-IV]
5. Joseph DuBovy, “Introduction to biomedical electronics”, McGraw-Hill Ryerson, Limited, 1978.

COURSE OUTCOMES

At the end of the course student should be able to:

- **CO1** Gain knowledge on advanced technology in applied mechatronics system.
- **CO2** Able to design and analyses a real time mechatronics system with suitable controlling techniques.
- **CO3** Understand the basic concepts of Mechatronics in various fields
- **CO4** Work in various Mechatronics system
- **CO5** Design and analyses a real time Mechatronics system with suitable controlling techniques

16GE304	PRINCIPLES OF MANAGEMENT	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	3	0	0	3

UNIT I INTRODUCTION TO MANAGEMENT 9

Management: Definition - Evolution of Management Studies –Nature, Functions, Levels and role of management - Basic Principles and Process of Management - Management vs. Administration – Taylor & Fayol's contribution to Management - Role of Managers.

UNIT II PLANNING 9

Planning: Basic types of planning – Characteristics of a good plan- Features - Planning process- Obstacles in planning - MBO, Policy - Policy formulation - Types of policies - Forecasting, Process, Importance – Decision making process.

UNIT III ORGANISING 9

Organization: Need - forms of organization - features of a good organization. Departmentation –- manuals - span of management, factors affecting span of management – delegation of authority and responsibility - centralization and decentralization.

UNIT IV STAFFING & DIRECTING 9

Staffing: Meaning, Nature, Need, and Process. Directing - Characteristics, Importance and Techniques of directing. Event & Time Management - Scope, Importance - Coordination - Need for coordination.

UNIT V CONTROLING 9

Concept of Control – Importance of control- Essentials of control system - Process of control – Communication - Process of Communication - Types - Barriers - Management Information Systems.

L:45 T:0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1 Harold Koontz, and Weihrich, 'Essential of Management' 8th Edition, Tata Mc Graw Hill Education, Delhi, (2010) .

2 Tripathy.P.C and Reddy.P.N., 'Higher Principles of Management' Tata Mc-Graw Hill Publishing Company limited, New Delhi (2011).

REFERENCES

1 Stephen.P.Robbins, Mary coulter, NeharikaVohra 'Management', 10th Edition, Tata Mc-Graw Hill Publishing Company limited, New Delhi (2010).

2 Glyn James, 'Advanced Modern Engineering Mathematics', Third edition-Pearson Education (2011).

3 VSP Rao, V.Hari Krishna, 'Management, Excel Books (2010).

4 Dr.Kumkum Mukherjee, 'Principles of Management, 2nd Edition, Tata Mc Graw Hill, (2009).

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Discuss and communicate the management evolution and how it will affect future managers.

CO2 Explain how organizations adapt to an uncertain environment and identify techniques managers use to influence and control the internal environment.

CO3 Practice the process of management's four functions: planning, organizing, leading, and controlling.

CO4 Use appropriate methods of communication in the Business Environment.

CO5 Gather and analyze both qualitative and quantitative information to isolate issues and formulate best control methods.

16GE307	NANO TECHNOLOGY	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	3	0	0	3

UNIT I NANO SCALE MATERIALS 9

Introduction – Classification of nanostructures, nano scale architecture – effects of the nanometre length scale – Nano composites- Nano Tubes and Nano wires- effect of nanoscale dimensions on various properties – structural, thermal, chemical, mechanical,magnetic, optical and electronic properties.

UNITII NANO MATERIALS SYNTHESIS METHODS 9

Fabrication methods – top down processes –Ball milling- synthesis using solvents and plant extracts litho graphics, machining process –bottom up process – vapour phase deposition methods, plasma assisted deposition process, colloidal and solgel methods – methods of templating the growth of nano materials –ordering of nano systems.

UNIT III NANO CHARECTERIZATION TECHNIQUES 9

General classification of characterization methods – analytical techniques – microscopy techniques – Principles of Fourier Transform Infra-red spectroscopy- Scanning electron microscopy- Transmission Electron Microscopy- atomic force microscopy – diffraction techniques –X-Ray diffraction spectroscopy

UNIT IV NANO DEVICES AND INORGANIC SEMICONDUCTORS 9

Quantum confinement in semiconductor nanostructures – quantum wells, quantum wires, quantum dots, super lattices –Organic FET – principle, description, requirements, integrated circuits – organic LEDs – basic processes, organic photovoltaic cells – carbon nano tubes – structure, synthesis and electronic properties.

UNIT V APPLICATIONS OF NANOMATERIALS 9

Applications – fuel cells –as fuel in IC engines- nano motors – Solar Photovoltaic cells-aerospace-defence-bio medicines- Textile Technology- Electronic applications.

L: 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, Nanoscale Science and Technology, John Wiley and Sons Ltd, 2005.
2. T. Pradeep, NANO: The Essentials Understanding Nanoscience and Nanotechnology, McGraw – Hill Education (India) Ltd, 2007.

REFERENCES

1. Michael Kohler, Wolfgang Fritzsche, Nanotechnology: An Introduction to Nano structuring Techniques, Wiley-VCH Verlag GmbH & Co.2004.
2. William Goddard, Donald .W.Brenner, Handbook of Nano Science Engineering and Technology, CRC Press, 2004.
3. Bharat Bhushan, Springer Handbook of Nanotechnology, 2004.
4. Charles P Poole, Frank J Owens, Introduction to Nanotechnology, John Wiley and Sons, 2003.
5. Mark Ratner, Daniel Ratner, Nanotechnology: A Gentle Introduction to the Next Big Idea, Prentice Hall, 2003.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Apply principles of basic science concepts in understanding, analysis and prediction of matter at Nano scale.

CO2 Analyze interdisciplinary subjects/concepts/ideas for interdisciplinary application of Science and engineering concepts.

CO3 Know advanced ideas and techniques required in emergent area of nanotechnology.

CO4 Develop human resource with specialization in theoretical and experimental techniques required for career in academia and Nano technology driven industry.

16MC402	BASICS OF VIRTUAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION **9**

Historical perspective of traditional benchtop instruments, Architecture of Virtual Instrumentation - Advantages of Virtual Instrumentation over conventional instruments -Sequencing - data flow- Graphical programming concept.

UNIT II SOFTWARE ENVIRONMENT **9**

Introduction to VI software - Front panel - Block diagram - Icon and Connector – Palettes -Creating, editing, wiring, debugging and saving VIs - sub-VIs - creating sub-VIs - simple examples - Looping: For loop, while loop - Shift registers.

UNIT III PROGRAMMING TECHNIQUES **9**

Case and sequence structures, formula nodes, Arrays-clusters, charts and graphs, local and global variables - property node, string and file I/O.

UNIT IV DATA ACQUISITION AND INSTRUMENT CONTROL **9**

DAQ - Components - Buffers: Buffered and non-buffered I/O – Triggering - Analog I/O, Digital I/O- Counters and timers-Instrument control: VISA, GPIB, PXI.

UNIT V APPLICATIONS OF VIRTUAL INSTRUMENTATION **9**

Process control- Physical- Biomedical- Image acquisition and processing.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Sanjay Gupta and Joseph John., "Virtual Instrumentation using LabVIEW", Tata McGraw Hill Publishing Company Ltd., 2nd Edition, New Delhi, 2010.
2. Garry W Johnson, "LabVIEW Graphical Programming", Tata McGraw Hill book Co, 4th Edition, New Delhi, 2006.

REFERENCES

1. Gupta S. and Gupta J.P., "PC Interfacing for Data Acquisition and Process Control", Instrument Society of America, 2nd Edition, 1994.
2. Dr. Sumathi. S and Prof. Surekha. P, "LabVIEW Based Advanced Instrumentation Systems", 2nd Edition, 2007.
3. Johnson Gary W. and Jennings Richard, "LabVIEW Graphical Programming", McGraw- Hill Professional, 3rd Edition, New York, 2006.
4. Jovitha Jerome,"Virtual Instumentation using LABVIEW", PHI Publishers, 2nd Edition, New Delhi, 2010.
5. N.Mathivanan,"PC Based Instrumentation-Concept and practice," PHI Publishers, 1st Edition, New Delhi,2007

COURSE OUTCOMES

At the end of the course student should be able to:

CO1	Acquire Knowledge in basics of graphical programming.
CO2	Apply structured programming concepts in developing VI programs and employ various debugging techniques
CO3	Familiarize with various interfacing standards
CO4	Ability to identify elements of data acquisition for hardware and software installation.
CO5	Develop virtual instruments for practical applications.

16MC403	EMERGING SMART MATERIALS FOR MECHATRONICS APPLICATIONS	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION AND HISTORICAL PERSPECTIVE 9

Classes of materials and their usage – Intelligent /Smart materials – Evaluation of materials Science – Structural material – Functional materials – Poly functional materials – Generation of smart materials – Diverse areas of intelligent materials – Primitive functions of intelligent materials – Intelligent inherent in materials – Examples of intelligent materials, structural materials, Electrical materials

UNIT II SMART MATERIALS AND STRUCTURAL SYSTEMS 9

The principal ingredients of smart materials – Thermal materials – Sensing technologies – Micro sensors – Intelligent systems – Hybrid smart materials – An algorithm for synthesizing a smart material – Passive sensory smart structures– Reactive actuator based smart structures – Active sensing and reactive smart structures – Smart skins – Aero elastic tailoring of airfoils – Synthesis of future smart systems

UNIT III ELECTRO-RHEOLOGICAL (FLUIDS) SMART MATERIALS 9

Suspensions and electro-rheological fluids – Bingham-body model – Newtonian viscosity and non-Newtonian viscosity – Principal characteristics of electro rheological fluids – The electro-rheological phenomenon – Charge migration mechanism for the dispersed phase

UNIT IV PIEZOELECTRIC SMART MATERIALS 9

Background – Electrostriction – Pyro electricity – Piezoelectricity – Industrial piezoelectric materials – PZT – PVDF – PVDF film – Properties of commercial piezoelectric materials – Properties of piezoelectric film (explanation) – Smart materials featuring piezoelectric elements – smart composite laminate with embedded piezoelectric actuators – SAW filters

UNIT V SHAPE – MEMORY (ALLOYS) SMART MATERIALS 9

Background on shape – memory alloys (SMA) Nickel – Titanium alloy (Nitinol) – Materials characteristics of Nitinol – Martensitic transformations – Austenitic transformations – Thermo elastic martensitic transformations – Cu based SMA, chiral materials – Applications of SMA – Continuum applications of SMA fasteners – SMA fibres – reaction vessels, nuclear reactors, chemical plants – Micro robot actuated by SMA – SMA memorisation process (Satellite antenna applications) SMA blood clot filter – Impediments to applications of SMA

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. M.V.Gandhi and B.S. Thompson, Smart Materials and Structures Chapman and Hall, London, First Edition, 1992
2. T.W. Deurig, K.N.Melton, D.Stockel and C.M.Wayman, Engineering aspects of Shape Memory alloys, Butterworth –Heinemann, 1990

REFERENCES

1. C.A.Rogers, Smart Materials, Structures and Mathematical issues, Technomic Publising Co., USA, 1989
2. Srinivasan A V and Michael McFarland, "Smart Structures: Analysis and Design", Cambridge University Press, UK, 2001
3. Smith, C.: Smart material systems, Ralph, SIAM, 2005
4. Vijay, K., Varadan K., Vinoy J. Gopalakrisham S.: Smart Material Systems and MEMS: Design and Development Methodologies , Willey 2006
5. Addington, M. , Schodek, Daniel L.: Smart materials and new technologies, Architectural Press, 2005

COURSE OUTCOMES

At the end of the course student should be able to:

CO1	Knowledge and understanding of the physical principles underlying the behaviour of smart materials.
CO2	understanding of the engineering principles in smart sensors and its structure
CO3	gain the knowledge of electro-rheological (fluids) smart materials behaviours
CO4	understand the engineering principles in smart sensor, actuator and transducer technologies
CO5	improvement on the design, analysis, manufacturing and application of shape memory alloy in smart materials

16MC404	FINITE ELEMENT METHOD	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION 9

Basics, historical background, FEM applications, General field problems in engineering, Modeling– discrete and continuous models. Boundary and initial value problems.

UNIT II CALCULUS OF VARIATIONS 9

Variational formulation in finite elements, Weighted residual methods- Galerkin method, sub domain method, method of least square and collocation method.

UNIT III ONE DIMENSIONAL ANALYSIS 9

Finite element modelling –coordinates and shape functions–Applications to axial loadings of rods, springs– extension to plane trusses–problems solid mechanics.

UNIT IV TWO DIMENSIONAL ANALYSIS 9

Finite element modelling–CST elements–Element equations, load vectors and boundary conditions– assembly–applications to scalar variable problems such as torsion.

UNIT V ISOPARAMETRIC ELEMENT FORMULATION 9

Natural coordinates–4 node rectangular elements–element shapes functions–Element equations–Gaussian quadrature –Examples.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Chandrupatla T R and Belegundu A D, "Introduction to Finite Elements in Engineering", Pearson Education, Third Edition–2006.
2. Logan D L,"A First Course in the Finite Element Method", Fifth Edition, Thompson Learning, 2012.

REFERENCES

1. David V Hutton, "Fundamentals of Finite Element Analysis", McGraw Hill Int. Ed., New Delhi, 2004.
2. Rao S S,"The Finite element Method in Engineering", Pergammon Press, 2005
3. Rogers.D.F. and Adams.J.A., Mathematical Elements in Computer Graphics, 2nd Edition, Tata McGraw-Hill, New Delhi, 2003.
4. S Bhavikatti," Finite Element Analysis", New Age International,2010
5. P Seshu," Finite Element Analysis", Phi Learning, 2009.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Understand the fundamental theory of the FEA method
CO2 Develop the governing equations for a continuum
CO3 Model and assemble the stiffness matrices for 1D elements
CO4 Generate the stiffness matrices for 2D elements
CO5 Choose the appropriate element type for a particular application

16MC408 **MEMS & NEMS**

L	T	P	C
3	0	0	3

UNIT I OVERVIEW AND INTRODUCTION 9

New trends in Engineering and Science: Micro and Nano scale systems Introduction to Design of MEMS and NEMS, Overview of Nano and Micro electromechanical Systems, Applications of Micro and Nano electro mechanical systems, Micro electromechanical systems, devices and structures Definitions, Materials for MEMS: Silicon, silicon compounds, polymers, metals

UNIT II MEMS FABRICATION TECHNOLOGIES 9

Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation.Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect-Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials

UNIT III MICRO SENSORS 9

MEMS Sensors: Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors. Case study: Piezo-resistive pressure sensor

UNIT IV MICRO ACTUATORS 9

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps. Case study: Comb drive actuators

UNIT V NANOSYSTEMS AND QUANTUM MECHANICS 9

NanoAtomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Shrodinger Equation and Wavefunction Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their quantization, Molecular Wires and Molecular Circuits

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Marc Madou, “Fundamentals of Micro fabrication”, CRC press 1997,
2. Stephen D. Senturia,” Micro system Design”, Kluwer Academic Publishers,2001.

REFERENCES

1. Tai Ran Hsu ,”MEMS and Microsystems Design and Manufacture” ,Tata Mcraw Hill, 2002.
2. Chang Liu, “Foundations of MEMS”, Pearson education India limited, 2006
3. Julian w. Gardner, Vijay K. Varadan, Osama O. Awadelkarim, “Micro Sensors MEMS and Smart Devices”, John Wiley & Son LTD,2002.
4. James J.Allen, “Micro Electro Mechanical System Design”, CRC Press Publisher, 2010.
5. Thomas M.Adams and Richard A.Layton, “Introduction MEMS, Fabrication and Application,” Springer 2012.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Understand the operation of micro devices, micro systems and their applications
CO2 Gain a knowledge of basic approaches for various sensor design
CO3 Gain a knowledge of basic approaches for various actuator design
CO4 Develop experience on micro/nano systems for photonics
CO5 Gain the technical knowledge required for computer-aided design, fabrication, analysis and characterization of nano-structured materials, micro- and nano-scale devices.

16MC409 FUZZY SETS AND ARTIFICIAL INTELLIGENCE

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION TO AI 9

Introduction to AI - Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics -Specialized productions system- Matching, Indexing and Heuristic functions -Hill Climbing - Depth first and Breath first, Constraints satisfaction – Related algorithms, Measure of performance and analysis of search algorithms.

UNIT II FUZZY LOGIC SYSTEMS 9

Basic of fuzzy logic theory - crisp and fuzzy sets, Basic set operation like union - interaction - complement - T-norm - T-conorm - composition of fuzzy relations - fuzzy if-then rules - fuzzy reasoning - Neuro-Fuzzy Modeling: Adaptive Neuro-Fuzzy Inference System (ANFIS) - ANFIS architecture - Hybrid Learning Algorithm.

UNIT III NEURAL NETWORKS 9

Back Propagation Network - generalized delta rule - Radial Basis Function Network - interpolation and approximation RBFNS - comparison between RBFN and BPN - Support Vector Machines : Optimal hyperplane for linearly separable patterns - optimal hyperplane for non-linearly separable patterns - Inverse Modeling.

UNIT IV PLANNING AND MACHINE LEARNING 9

Basic plan generation systems – Strips -Advanced plan generation systems – K strips -Strategic explanations -Why, Why not and how explanations. Learning- Machine learning, adaptive Learning.

UNIT V EXPERT SYSTEMS 9

Expert systems – Architecture of expert systems, Roles of expert systems – Knowledge Acquisition – Meta knowledge, Heuristics. Typical expert systems – MYCIN, DART, XOON, Expert systems shells.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1 Kevin Night and Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, Mc Graw Hill- 2008.

2 H.J. Zimmermann, “Fuzzy Set Theory and its Applications”, Springer.

REFERENCES

1 Peter Jackson, “Introduction to Expert Systems”, 3rd Edition, Pearson Education, 2007.

2 Stuart Russel and Peter Norvig “AI – A Modern Approach”, 2nd Edition, Pearson Education 2007.

3 Deepak Khemani “Artificial Intelligence”, Tata Mc Graw Hill Education 2013.

4 Christopher M. Bishop, “Neural Networks for Pattern Recognition”, Oxford University Press.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Understanding the basics of AI algorithms.

CO2 Understanding the fundamentals of Computational Intelligence models.

CO3 Understanding the concepts of neural networks and fuzzy neural networks.

CO4 Design and carry out an empirical evaluation of different algorithms on a problem formalisation.

CO5 State the conclusions that the evaluation supports Artificial Intelligence.

16MC410 INTELLIGENT VISUAL SURVEILLANCE SYSTEMS

L	T	P	C
3	0	0	3

UNIT I BASICS OF IMAGE PROCESSING 9

Introduction to Image Processing methods, Image Transforms, Wavelet Transform, JPEG Image Compression, Image Formats, Color Spaces- RGB, CMY, HSI.

Video Compression Standards: H. 261, H. 263, H.264, MPEG-1, MPEG-2, MPEG-4, MPEG-7, and MPEG-21, Video shot boundary detection, motion modeling and segmentation techniques.

UNITII OBJECT DETECTION AND CLASSIFICATION 9

Shape based object classification, motion based object classification, Silhouette-Based Method for Object Classification, Viola Jones object detection framework, Multiclass classifier boosting.

UNIT III MULTI-OBJECT TRACKING 9

Classification of multiple interacting objects from video, Region-based Tracking, Contour-based Tracking, Feature-based Tracking, Model-based Tracking, Hybrid Tracking, Particle filter based object tracking, Mean Shift based tracking, Tracking of multiple interacting objects

UNIT IV HUMAN ACTIVITY RECOGNITION 9

Template based activity recognition, Sequential recognition approaches using state models (Hidden Markov Models), Human Recognition Using Gait, HMM Framework for Gait Recognition, Description based approaches, Human interactions, group activities, Applications and challenges.

UNIT V CAMERA NETWORK CALIBRATION 9

Types of CCTV (closed circuit television) camera- PTZ (pan-tilt zoom) camera, IR (Infrared) camera, IP (Internet Protocol) camera, wireless security camera, Multiple view geometry, camera network calibration, PTZ camera calibration, camera placement, smart imagers and smart cameras

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Murat A. Tekalp, "Digital Video Processing", Prentice Hall, 1995. (1986).
2. Y. Ma and G. Qian (Ed.), "Intelligent Video Surveillance: Systems and Technology", CRC Press, 2009.

REFERENCES

1. J.K. Petersen, Introduction to Surveillance Studies, CRC Press, 2013.
2. Herman Kruegle, CCTV Surveillance: Analog and Digital Video Practices and Technology, Elsevier Butterworth-Heinemann, 2007
3. Fredrik Nilsson and Axis Communications, Intelligent Network Video: Understanding Modern Video Surveillance Systems, CRC Press, 2009.
4. Daniel Neyland, Privacy, Surveillance and Public Trust, Palgrave Macmillan, 2006.
5. Fredrika Bjorklund and Ola Svenonius, Video Surveillance and Social Control in a Comparative Perspective, Routledge, 2013

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Understand the basics of image processing
CO2 Acquire knowledge of object detection and tracking
CO3 Understand the multi object tracking technique
CO4 Acquire Knowledge of human activity recognition
CO5 Do camera calibration for detection of objects

16GE303	TOTAL QUALITY MANAGEMENT	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	3	0	0	3

UNIT I INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, and Customer retention - Costs of quality.

UNITII TQM PRINCIPLES **9**

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III STATISTICAL PROCESS CONTROL (SPC) **9**

Statistical fundamentals – Measures of central Tendency and Dispersion - Population and Sample, Control Charts for variables and attributes, Industrial Examples. Process capability. Concept of six sigma – New seven Management tools.

UNIT IV TQM TOOLS **9**

Bench marking -Reason to bench mark, Bench marking process - FMEA - Stages, Types. Quality Function Deployment (QFD) - House of Quality - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY SYSTEMS **9**

Need for ISO 9000 and Other Quality Systems - ISO 9001-2015 Quality System - Elements, Implementation of Quality System Documentation, Quality Auditing - QS 9000 – BS-OHSAS 18001: 2007, ISO 20000, ISO 22000 IATF 16949: 2016, ISO 14001:2015, AS9100– Concept, Requirements and Benefits- Case studies.

L:45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Dale H. Besterfiled, "Total Quality Management", Third Edition, Pearson Education Asia, Indian Reprint, 2016.
2. SubburajRamasamy“ Total Quality Management” Tata Mcg raw hill edition, 2015.

REFERENCES

1. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2010.
2. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012. .
3. Dr S. Kumar, “Total Quality Management”, Laxmi Publications Ltd., New Delhi 2006.
4. P. N. Muherjee, “Total Quality Management”, Prentice Hall of India, New Delhi, 2015.
5. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2010.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 State about the recent techniques followed in quality approach.
CO2 Improve Leadership Skills.
CO3 Implement the Concepts of SPC Tools in Industrial Activity.
CO4 Examine the TQM Tools in Several Engineering fields.
CO5 Explain about the ISO and QS certification process and its need for the industries.

16MC411 MATERIALS TECHNOLOGY

L	T	P	C
3	0	0	3

UNIT I MECHANICAL PROPERTIES AND BEHAVIOUR OF MATERIALS 9

Elastic and plastic Behaviour of metals and polymers- Imperfections in crystals Mechanism of plastic deformation- Deformation of single crystal by slip, Stress strain curve – Yield point phenomenon – Mechanical properties of materials.

UNITII MATERIAL TESTING AND FRACTURE BEHAVIOUR 9

Fracture- Types of fracture and Griffth theory- Fatigue and fatigue testing- Impact testing, Creep ,Creep mechanism and creep testing – Hardness testing – Brinell and Rockwell hardness testing- Failure analysis

UNIT III PHASE DIAGRAMS 9

Constitution of alloys – Solid solutions, substituional and interstitial – Phase diagrams- Isomorphous, eutectoid, eutectic, peritectic and peritectoid reactions- Iron-carbide diagram- Classification of steel and cast iron- Microstructure, properties and applications

UNIT IV NON METALLIC MATERIALS AND MODERN MATERIALS 9

Polymeric materials – Formation of polymer structure – Production techniques, Composites –types, applications and production techniques, Ceramics – Types and applications. Dual phase alloys, Micro alloyed steels, High Strength Low alloy (HSLA) steel, Transformation Induced Plasticity
(TRIP) and nano crystalline materials.

UNIT V STRENGTHENING MECHANISMS AND NON-DESTRUCTIVE TESTING 9

Refinement of grain size, Work hardening, Solid solution –Strengthening, dispersion strengthening, Precipitation hardening.

Magnetic particle inspection, dye penetrant inspection, ultrasonic inspection, radiography, eddy-current testing, acoustic emission inspection.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Kenneth GBudinski and Michael K.Budinski, “Engineering Materials” Prentice-Hall of India Private Limited, 4th Indian Reprint, 2002.
2. William D Callister, “Material Science and Engineering”, John Wiley and Sons, 2007

REFERENCES

1. Raghavan.V, “Materials Science and Engineering”, Prentice Hall of India Pvt., Ltd.,2007.
2. Sydney HAvner, “Introduction to Physical Metallurgy”, McGraw Hill Book Company, 2007
3. Dieter.G.E, “Mechanical Metallurgy”, Mc Graw Hill Book Company, 1988
4. Khanna.O.P, “A text book ofMaterials Science and Metallurgy”, Khanna Publishers, 2003.
5. Vijaya.M.S and Rangarajan.G, “Material Science”, Tata McGraw-Hill, 2007.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Explore the different materials with their properties
CO2 Understand various production techniques and applications
CO3 Describe the Fracture analysis for different metals
CO4 Explore the strengthening mechanisms and Non-destructive Testing
CO5 Categorize the various materials according to their properties

16MC405	APPLIED MECHATRONICS ENGINEERING LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS

Fault diagnosis of ignition, starting and charging system
Calibration of fuel injection pump
Fault diagnosis of petrol and diesel fuel system and filters & air cleaners
Interfacing Sensors like RTD, LVDT, and Load Cell etc.
Study of Different Avionics Data Buses.
MIL-Std – 1553 Data Buses Configuration with Message transfer.
DC Motor control using GSM.
Biometric based security systems.
Glucose sensor
BP measuring techniques

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

MIL-Std – 1553 Data Buses -1
Sensors like RTD, Load cell, LVDT-1
Vernier Biomedical Sensor Kit-1
Distributor, ignition coil, spark plug-1
GSM Modem-1
Biometric system-1
SI & CI Engine-1

L : 0 T: 0 P: 30 C: 0 Total: 30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1	Gain knowledge on advanced technology in Mechatronics system.
CO2	Understand the basic of all automation techniques l
CO3	Works in various Mechatronics system.
CO4	Design and analyses a real time Mechatronics system with suitable controlling techniques.
CO5	Design a mechatronics system.

16MC406	ROBOTICS LABORATORY	L	T	P	C
		0	0	2	1

LIST OF EXPERIMENTS

1. Study of different types of robots based on configuration and application.
2. Study of different type of links and joints used in robots.
3. Study of components of robots with drive system and end effectors.
4. Study of selection of grippers.
5. Determination of maximum and minimum position of links.
6. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system.
7. Estimation of accuracy, repeatability and resolution.
8. Point to Point Path Programming
9. Continuous Path Programming
10. Assembling and Dismantling of Line Follower Robot

MAJOR EQUIPMENTS / SOFTWARE REQUIRED

5 axis Robot -1
Computers -36
Line Follower Kit-1
Robotics simulated software -

L : 0 T: 0 P: 30 C: 0 Total: 30 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Identify configuration, links, joints, and components of a robot.
CO2 Understand the Selection of Grippers
CO3 Calculate position, accuracy and transformation.
CO4 Write robot programming to do various tasks
CO5 Build a line follower robot kit and Quad copter from scratch.

16MC407	PROJECT WORK PHASE I	L	T	P	C
		0	0	4	2

PROJECT WORK GUIDELINES

- The students in convenient groups of members on a project involving theoretical and experimental studies related to automobile engineering. Every project work shall have a guide who is the member of the faculty of the institution.
- Four periods per week shall be allotted in the time table and this time shall be utilized by the students for carrying out the project work.

GENERAL GUIDELINES

1. Selection of a topic or project title in consultation with a staff member.
2. Develop a project planning strategy.
3. If it is an industry – sponsored project, a concurrent letter from industry is required.
4. A maximum of 4 students per group will do the project.
5. The project may be done in one of the labs under the supervision of a guide or in the selected industry.
6. At the end of the project, a report will be written and a technical presentation along with demonstration will be made by the students.

The report, project demonstration and technical presentation will be evaluated by the internal and external examiners. Selection of a topic or project title in consultation with a staff member.

L: 0 T: 0 P: 60 Total: 60 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Apply the relevant knowledge and skills, which are acquired within the technical area, to a given problem.

CO2 Apply the knowledge and demonstrate a project work

CO3 Reflect on, evaluate, and critically assess one's own and others' scientific results

CO4 Discriminate the research journals/Technical Papers.

CO5 Publish their project work in a reputed journal / Conference Proceedings.

16MC412 MEDICAL MECHATRONICS

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION 9

Brief review of Human physiology and anatomy – Cell and its structure – Action and Resting Potential- propagation of action potential – Sodium pump- electrodes for their measurement -ECG, EEG, EMG – machine description.

UNIT II TRANSDUCERS FOR BIO-MEDICAL INSTRUMENTATION 9

Input isolation, DC amplifier, power amplifier, and differential amplifier, carrier Amplifier. Oscillography – galvanometric - X-Y, magnetic recorder, storage oscilloscopes – electron microscope – PMMC writing systems – Telemetry principles – Bio telemetry.

UNIT III SIGNAL CONDITIONING, RECORDING AND DISPLAY 9

Piezo resistive sensors – Piezo resistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

UNIT IV MEDICAL IMAGING SYSTEMS AND THERAPEUTIC EQUIPMENTS 9

Electro cardio graph measurements–blood pressure measurement: by ultrasonic method– plethysonography –blood flow measurement by electromagnetic flow meter cardiac output measurement by dilution method–phonocardiography –vector cardiography. Heart lung machine– artificial ventilator– Anesthetic machine–Basic ideas of CT scanner–MRI and ultrasonic scanner– Bio-telemetry– laser equipment and application–cardiac pacemaker–DC–defibrillator patient safety - electrical shock hazards.

UNIT V RECENT TRENDS IN MEDICAL INSTRUMENTATION 9

Radiation therapy and planning – Telemedicine – virtual Hospitals - Smart Medical Homes – Personalized e-health services – Biometrics - GRID and Cloud Computing in Medicine.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Khandpur, R.S., “Handbook of Biomedical Instrumentation”, Third edition, TMH, 2014
2. SiamakNajarian “ Mechatronics in Medicine – A Bio medical engg approach" , McGraw – Hill Education , 2011

REFERENCES

1. Cromwell, Weibell and Pfeiffer, “Biomedical Instrumentation and Measurements”, 2 Edition, Prentice Hall of india , 1999
2. Geddes L.A., and Baker, L.E., “Principles of Applied Bio-medical Instrumentation”, 3 Edition, John Wiley and Sons, 1995.
3. Tompkins W.J., “Biomedical Digital Signal Processing”, Prentice Hall of India, 1998.
4. Arumugam M., “Bio Medical Instrumentation”, Anuradha agencies Pub., 2002
5. Josef Zezulka, “Biotronics” ,Dimenze 2+2 Praha - Tomáš Pfeiffer, 2006.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Understand the basic ideas of mechatronics system in medical field.
CO2 Describe the sensors and signal conditioning circuits used in biomedical engineering.
CO3 Able to demonstrate the major functions of mechatronics equipments in medical field.
CO4 Get exposed to the applications of mechatronics in medical field.
CO5 Differentiate the working of recorders and explain the advanced systems used in medicine.

16MC413 DESIGN OF EMBEDDED SYSTEMS

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Embedded system, Functional building block of embedded system, Characteristics of embedded system applications, Challenges in embedded system design, Embedded system design processes.

UNIT II ARCHITECTURE OF EMBEDDED SYSTEM 9

Computer architecture taxonomy, CPUs – Programming input and output, Supervisor mode, Exceptions & Traps, Co - processors, Memory system mechanisms - CPU bus - Memory devices - I/O devices - Component interfacing - Assembly and linking - Basic compilation techniques – Program optimization.

UNIT III OS FOR EMBEDDED SYSTEMS 9

Introduction to RTOS, Multiple tasks and multiple processes, Context switching, Operating system, Scheduling policies, Interprocess communication mechanisms. Introduction to μC/ OS II.

UNIT IV PERFORMANCE ISSUSES OF EMBEDDED SYSTEMS 9

CPU Performance, CPU power consumption, Program level performance analysis, Analysis and optimization of program size, energy and power, Evaluating operating system performance, Power management and optimization strategies for processes, Multiprocessors – CPUs and accelerators, Multiprocessor performance analysis.

UNIT V IMPLEMENTATION AND APPLICATIONS 9

Development and debugging, Manufacturing Testing, Program validation and Testing, Distributed embedded architecture, Networks for Embedded Systems - I2 C Bus, CAN Bus, Design examples: Cell phones, Digital Still Cameras, Elevator Controller.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Wayne Wolf, "Computers as Components: Principles of Embedded Computer Systems Design", The Morgan Kaufmann Series in Computer Architecture and Design, Elsevier Publications, 2008.
2. Rajkamal, 'Embedded System-Architecture, Programming, Design', Mc Graw Hill, 2013.

REFERENCES

1. Shibu. K.V, "Introduction to Embedded Systems", Tata Mcgraw Hill,2009.
2. Lyla B Das," Embedded Systems-An Integrated Approach", Pearson, 2013
3. Peckol, "Embedded system Design", John Wiley & Sons,2010
4. Han-Way Huang, "Embedded system Design Using C8051", Cengage Learning,2009.
5. Rajib Mall "Real-Time systems: Theory and Practice" Pearson Education, 2007.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Outline the concepts of embedded systems.
CO2 Explain the basic concepts of real time Operating system design.
CO3 Use the system design techniques to develop software for embedded systems
CO4 Differentiate between the general purpose operating system and the real time operating system.
CO5 Model real-time applications using embedded-system concepts.

16MC414 **TEXTILE MECHATRONICS**

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION TO TEXTILE TECHNOLOGY & BASICS OF SPINNING **9**

History of textile technology and its advancements, introduction to textile fibers, overview of textile manufacturing, Introduction to automation in textile industries. Spinning process flow chart – Objectives and process variables of textile spinning machineries: Mixing, Blow room, Carding, Draw frame, Combing, Speed frame, Ring frame, rotor spinning.

UNIT II BASICS OF WEAVING & PROCESSING **9**

Weaving process flowchart – Objectives and process variables in weaving preparatory: Winding, Warping, Sizing and beaming. Objectives and process variables in weaving: drawing in, knotting, denting and weaving. Objectives and process variables in processing machines: Singeing, Desizing, Scouring, Bleaching, Mercerizing, Dyeing, Printing, Finishing.

UNIT III AUTOMATION IN SPINNING MACHINERY **9**

Machinery material flow and its variation controls – Feeders & Stop motions – Auto levelers – Safety switches – Production and quality monitors – Full doff and pre-set length monitors. Data acquisition system for spinning preparatory, ring spinning – rotor spinning.

UNIT IV AUTOMATION IN WEAVING MACHINERY **9**

Yarn cleaner controls – Knotter / splicer carriage controls – Warping machine monitors and controls – sizing machine monitors and controls – Auto reaching / drawing in and knotting machine monitors and controls – Data acquisition system in weaving preparatory and weaving –humidification systems .

UNIT V MECHATRONICS APPLICATIONS **9**

CAD / CAM / CIM in spinning, Weaving, Dyeing, Printing, Apparel production – Electronicsdata interchange - Robotics in textile industries

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Venkatachalam. A and Ashok Kumar L, "Monograph on — Instrumentation & Textile Control Engineering" – 2005.
2. Ormerod A, "Modern Development in spinning and Weaving Machinery", Butterworth‟s,1993.

REFERENCES

1. Chattopadhyay R. (Ed), "Advances in Technology of Yarn Production", NCUTE, IIT Delhi, 2002
2. Krishna Kant, "Computer – Based Industrial Control", PHI Learning Pvt Ltd, 2nd edition, New Delhi, 2011
3. Oxtoby E "Spun Yarn Technology" butter worth‟s, London, New Edition 2002.
4. Berkstresser G A, Buchanan D R and Grady P, "Automation in the Textile Industry from Fibers to Apparel", The Textile Institute, UK, 1995
5. Lord P.R. and Mohammed M.H., "Weaving – Conversion of Yarn to Fabric", Merrow Publication, 2001

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Explain the evolution of textile technology and manufacturing with textile fibers
CO2 Describe various process and machines involved in spinning.
CO3 Explain various process and machines involved in weaving
CO4 Explain various stages of automation scopes in spinning and weaving.
CO5 Explain role of computers in automated textile manufacturing.

16MC415 **BUILDING AUTOMATION**

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION 12

Concept and application of Building Management System (BMS) and Automation, requirements and design considerations and its effect on functional efficiency of building automation system, architecture and components of BMS

UNITII FIRE ALARM SYSTEM 8

Fundamentals: What is Fire? Fire modes, History, Components, and Principles of Operation. **FAS Components**: Different fire sensors, smoke detectors and their types, Fire control panels, design considerations for the FA system. **FAS Architectures**: Types of Architectures, Examples. **FAS loops**: Classification of loops, Examples.

UNIT III ACCESS CONTROL SYSTEM 9

Access Components, Access control system Design. **CCTV**: Camera: Operation & types, Camera Selection Criteria, Camera Applications, DVR Based system, DVM, Network design, Storage design. Components of CCTV system like cameras, types of lenses, typical types of cables, controlling system-CCTV Applications.

UNIT IV SECURITY SYSTEMS 8

Fundamentals: Introduction to Security Systems -Perimeter Intrusion: Concept, Components, Technology, Advanced Applications. Security Design: Security system design for verticals. Concept of automation in access control system for safety, Physical security system with components, RFID enabled access control with components, Computer system access control – DAC, MAC, RBAC.

UNIT V HVAC system 7

Fundamentals: Introduction to HVAC, HVAC Fundamentals, Basic Processes (Heating , Cooling etc) Basic Science: Air Properties, Psychometric Chart, Heat Transfer mechanisms, Examples. Human Comfort: Human comfort zones, Effect of Heat, Humidity, Heat loss. Processes: Heating Process & Applications (I.e. Boiler, Heater), Cooling Process & Applications (I.e. Chiller), Ventilation Process & Applications (I.e. Central Fan System, AHU, Exhaust Fans), Unitary Systems (VAV, FCU etc).

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Smart Buildings by Jim Sinopoli, Butterworth-Heinemann imprint of Elsevier,2nd ed., 2010.
2. Understanding Building Automation Systems (Direct Digital Control, Energy Management, Life Safety, Security, Access Control, Lighting, Building Management Programs) by Reinhold A. Carlson, Robert A. Di Giandomenico, pub. by R.S. Means Company, 1991.

REFERENCES

1. Intelligent Building Systems by Albert Ting-Pat So, WaiLok Chan, Kluwer Academic publisher,3rd ed., 2012.
2. Design of Special Hazards and Fire Alarm Systems by Robert Gagnon, Thomson Delmar Learning; 2nd edition, 2007.
3. HVAC Controls and Systems by Levenhagen, John I.Spethmann, Donald H., McGraw-Hill Pub.
4. HVAC Control in the New Millennium by Hordeski, Michael F, Fairmont press, 2001.
5. Process Control- Instrument Engineers Handbook by Bela G. Liptak, Chilton book co., 2013

COURSE OUTCOMES

At the end of the course student should be able to:

- **CO1** Analyse current philosophy, technology, terminology, and practices used in building automation
- **CO2** Evaluate different fire standards, FAS Components, FAS loops, Architectures
- **CO3** Apply automation concepts in building appliances
- **CO4** Select hardware and software for HVAC system
- **CO5** Evaluate energy management system

16MC416 UNDER WATER ROBOTICS

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION TO UNDERWATER ROBOTICS 9

Robotics in Water - Basics Representation of Underwater Robot - Types and Classification of Underwater Robotics - Differentiating Aerial and Underwater Robotics - why it is called an perfect engineering product - Overview about Environmental Factors affecting object in water.

UNITII CONTROL OF THE UNDERWATER ROBOTICS 9

Control System and Types of Control Systems in Underwater Robotics - Sensors Connected with the Underwater Robotics - Introduction to Underwater Manipulators - Applications of Underwater Vehicles

UNIT III ENGINEERING CONCEPTS IN UNDERWATER ROBOTICS 9

Introduction to Fluid Dynamics - Studying of FD Model - Computation Fluid Dynamics on Water Bodies Introduction to Hydraulics - Hydraulics Acting on an Object - Hydraulics as Underwater Pressure Compensator Introduction to Pressure Dynamics - Buoyancy Concept - Studying various Polymers in Buoyancy and Pressure Calculations Introduction to Electrical Power Driven Systems - Studying Different Types - PLC and HMI Interface Systems an Overlook

UNIT IV AUTONOMOUS UNDERWATER SYSTEM 9

Introduction to AUVS - Development of AUV / ROV in Market - Case Study on AUV Control System Basics - Case Study on Subsea Manipulator - Case Study on Technologies Used.

UNIT V APPLICATIONS OF UNDERWATER ROBOTICS 9

Case Studies and procedure for design of underwater robots- Applications

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Gianluca Antonelli "Underwater Robots (Springer Tracts in Advanced Robotics)", Springer; 3rd ed. 2014 edition.
2. Steven W. Moore, Harry Bohm, and Vickie, "Underwater Robotics: Science, Design & Fabrication" MATE Center,2013.

REFERENCES

1. Gianluca Antonelli, "Underwater Robots: Motion and Force Control of Vehicle-Manipulator Systems "(Springer Tracts in Advanced Robotics), Springer; 3rd ed. 2014 edition.
2. Kumar Sumit , Kumar Sunil , Singh Chandan Deep, "Modeling of Underwater Flexible Robot Considering Rayleigh Beam", LAP Lambert Academic Publishing (2015).
3. Harry Bohm, Steven W. Moore, and Vickie Jensen, "Underwater Robotics: Science, Design & Fabrication", Wiley and Sons, Singapore, Eleventh edition 2015.
4. Stephen Wood, "Underwater Robotics", Blurb, Incorporated,, 2016.
5. Daniel R Faust, "Underwater Robots (Robots and Robotics)", Power Kids Press; Reprint edition (2016).

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Select the components for design of underwater robotics.

CO2 Design, configuration and operation of platforms, both autonomous underwater vehicles (AUVs) and Remotely Operated Vehicles (ROVs)..

CO3 Use and interpretation of sensor data for control applications.

CO4 Software architectures for maritime robots..

CO5 Practical control system design for depth and heading control of underwater robots.

16MC417 **AUTOTRONICS**

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION **9**

Evolution of electronics in automobiles – emission laws – Euro standards – Equivalent Bharat Standards. Adaptive Lighting System-Charging systems: Working and design of charging circuit diagram – Alternators – Requirements of starting system - Starter motors and starter circuits.

UNIT II IGNITION AND INJECTION SYSTEMS **9**

Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition – Distribution less ignition - Direct ignition – Spark Plugs. Electronic fuel Control: Basics of combustion – Engine fueling and exhaust emissions – Electronic control of carburetion – Petrol fuel injection – MPFI technology – Diesel fuel injection-DTSI Technology.

UNIT III SENSOR AND ACTUATORS **9**

Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall Effect, Throttle angle, temperature, exhaust gas oxygen sensors, Brake Fluid Pressure Sensor, Engine Torque Sensor – study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, vacuum operated actuator.

UNIT IV ENGINE CONTROL SYSTEMS **9**

Control modes for fuel control-engine control subsystems – ignition control methodologies – different ECU's used in the engine management – block diagram of the engine management system. Vehicle networking solutions: CAN standard, FlexRay – Diagnostics systems in modern automobiles-OBD-I and OBD-II system.

UNIT V CHASSIS AND SAFETY SYSTEMS **9**

Traction control system – Cruise control system – electronic control of automatic transmission – antilock braking system – electronic suspension system – working of airbag and role of MEMS in airbag systems – centralized door locking system – climate control of cars. Keyless entry – Tyre pressure warning-Noise control – Reverse sensing / parking aid – Car navigation system – Telematics - Global Positioning System.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1 Ribbens, "Understanding Automotive Electronics", 7th Edition, Elsevier, Indian Reprint, 2013

2 Robert Bosch, Automotive Electronics Handbook, John Wiley and Sons.

REFERENCES

1 Tom Denton, "Automobile Electrical and Electronics Systems", Edward Arnold Publishers, 2000.

2 Barry Hollembeak, "Automotive Electricity, Electronics & Computer Controls", Delmar Publishers, 2001

3 Richard K. Dupuy "Fuel System and Emission controls", Check Chart Publication, 2000

4 Ronald. K. Jurgon, "Automotive Electronics Handbook", McGraw-Hill, 1999.

5 Newton, Steedsand Garet, "Motor Vehicles", Butterworth Publishers,1989.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Understand the fundamentals of automotive system.
CO2 Apply electronics into automobile systems
CO3 Use advanced sensors and actuators in the upgrading of automobiles.
CO4 Identify the different control systems in automotive and their control
CO5 Formulate and solve real time engineering problems

16MC418 **RAPID PROTOTYPING**

L	T	P	C
3	0	0	3

UNIT I OVERVIEW OF RAPID PROTOTYPING 9

Definitions-Evolution- CAD for RPT-Product design and rapid product development- Conceptual design, Detail design - Prototyping- Fundamentals of RP systems-3D solid/modelling software and their role in RPT-Creation of STL file.

UNIT II LIQUID BASED RP PROCESSES 9

Liquid based RP systems: Stereo lithography (SLA)-principle- process parameters-process details-machine details- applications, Solid Ground Curing - Principle- process parameters, process details-machine details, Applications, Rapid Freeze

UNIT III SOLID BASED RP PROCESSES 9

Fusion Deposition Modeling - Principle- process parameters-process details machine details, Applications. Laminated Object Manufacturing - Principle- process parameters- process details-machine details, Applications, Multi-Jet Modelling System (MJM)

UNIT IV POWDER BASED RP PROCESSES 9

Powder based RP systems: Selective Laser Sintering (SLS)- Principle- process parameters-process details-machine details- Applications. 3-Dimensional Printers - Principle- process parameters-process details-machine details, Applications, LENS- Principle- process parameters-process details-machine details- Applications Electron Beam Melting (EBM) and other Concept Modelers like Thermo jet printers, Sander's model maker.

UNIT V RAPID TOOLING 9

Indirect Rapid Tooling - Silicone rubber tooling, Aluminum filled epoxy tooling, Spray metal tooling, etc. Direct Rapid Tooling - Direct AIM, Quick cast process, Copper polyamide, Rapid Tool, Sand casting tooling, Laminate tooling, soft tooling vs hard tooling. Reverse Engineering – 3D scanning-3D digitizing and Data fitting.

SOFTWARE FOR RP: STL files, overview of solid view, magics, mimics, magics communicator, etc.,

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Chua, C K., Leong, K F and Lim, C S., "Rapid Prototyping: Principles and Applications", John Wiley, New York, 2003.
2. Pham, D.T. and Dimov, S.S., "Rapid Manufacturing", Springer-Verlag, London, 2001.

REFERENCES

1. Jacobs, Paul .F., "Stereolithography and other Rapid Prototyping and Manufacturing Technologies", Tata McGraw-Hill, New york,1996.
2. Hilton, P.D., "Rapid Tooling", Marcel Dekkar, London, 2000.
3. Zeid, I., "CAD/CAM: Theory and Practice", McGraw-Hill, Singapore, 1991.
4. Rafiq I. Noorani," Rapid Prototyping: Principles and Applications", John Wiley & Sons,2005
5. Radhakrishnan.R, "CAD/CAM/CIM",Lakshmi Publications,2008

COURSE OUTCOMES

At the end of the course student should be able to:

CO1	Learn fundamentals of manufacturing of prototypes from computer based models
CO2	Provide knowledge on different types of Rapid Prototyping systems and its applications in various fields
CO3	Convert CAD models in to real life engineering components.
CO4	Express the creation of computer based models to their physical realization and the various methods of manufacturing
CO5	Understand and familiarized with the various RP Tooling techniques so as to compare their strengths and limitations with other tooling methods.

16MC419	ARTIFICIAL INTELLIGENCE FOR ROBOTICS	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION **9**

History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents. PROBLEM SOLVING: Solving problems by searching –Informed search and exploration–Constraint satisfaction problems– Adversarial search, knowledge and reasoning– knowledge representation – first order logic.

UNIT II PLANNING **9**

Planning with forward and backward State space search – Partial order planning – Planning graphs– Planning with propositional logic – Planning and acting in real world.

UNIT III REASONING **9**

Uncertainity – Probabilistic reasoning–Filtering and prediction–Hidden Markov models–Kalman filters– Dynamic Bayesian Networks, Speech recognition, making decisions.

UNIT IV LEARNING **9**

Forms of learning – Knowledge in learning – Statistical learning methods –reinforcement learning, communication, perceiving and acting, Probabilistic language processing, perception.

UNIT V AI IN ROBOTICS **9**

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A modern approch", Pearson Education, India2003.
2. Negnevitsky, M, "Artificial Intelligence: A guide to Intelligent Systems",. Harlow: Addison Wesley, 2002.

REFERENCES

1. David Jefferis, "Artificial Intelligence: Robotics and Machine Evolution", Crabtree Publishing Company, 19992.
2. Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice Hall of India, New Delhi,1990.
3. Zurada .J.M., Introduction to Artificial Neural Systems, Jaico Publishers 1992
4. Stuart Russell , Artificial Intelligence: A Modern Approach (3rd Edition), ISBN 13: 978- 0136042594
5. Elaine Rich and Kelvin Knight, "Artificial Intelligence", Tata McGraw Hill, New Delhi, 1991

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Identify problems that are amenable to solution by AI methods.
CO2 Identify appropriate AI methods to solve a given problem.
CO3 Formalise a given problem in the language/framework of different AI methods.
CO4 Implement basic AI algorithms.
CO5 Design and carry out an empirical evaluation of different algorithms on a problem formalisation, and state the conclusions that the evaluation supports.

16MC420	COMPUTER INTEGRATED MANUFACTURING	L	T	P	C
		3	0	0	3

UNIT I INTRODUCTION **9**

Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system –Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production.

UNIT II PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING **9**

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

UNIT III CELLULAR MANUFACTURING **9**

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

UNIT IV FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS) **9**

Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control– Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.

UNIT V ECONOMICS OF GT/CMS **9**

Characteristics of cell – Economic Justification of cellular manufacturing – Use of computer models in GT/CMS – Human aspects of GT/CMS – case studies.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
2. Radhakrishnan P, Subramanyan S. and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.

REFERENCES

1. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India, 2003.
2. Gideon Halevi and Roland Weill, "Principles of Process Planning – A Logical Approach" Chapman & Hall, London, 1995.
3. P Rao, N Tewari &T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2000.
4. Yorem Koren, " Computer Integrated Manufacturing", McGraw Hill, 2005.
5. P N Rao, " CAD/CAM Principles and Applications", TMH Publications, 2007

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Understand the concept and requirement of the integration of the design and manufacturing
CO2 Appraise the concepts of cellular manufacturing and FMS in industrial activity.
CO3 Understand the use of computers in process planning and use of FMS and Robotics in CIM
CO4 Gain knowledge about the basic fundamental of CAD
CO5 Portray how computers are integrated at various levels of planning and manufacturingunderstand computer aided planning and control and computer monitoring

16MC450 VIRTUAL REALITY AND HAPTICS

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION TO VIRTUAL REALITY & HAPTICS 9

Virtual reality concepts – virtual world and real world – Interface to virtual world (inputs and outputs) – Types of interaction – Applications.

Definition - Importance of Touch - Tactile Proprioception - Tactual Stereo genesis – Kinesthetic Interfaces - Tactile Interfaces - Human Haptics - Overview of existing applications.

UNIT II DESIGN OF HAPTIC DEVICES 9

Virtual Reality Input and Virtual Reality Output parameters - Computing Architectures for VR - Haptic assembly architecture - Haptic Interface Design – Kinesthetic devices.

UNIT III KINEMATICS AND DYNAMICS 9

Homogeneous Transformation Matrices - Transformation Invariants – Force Computation – Force Smoothing and Mapping

UNIT IV GEOMETRIC MODELING 9

Virtual Object Shape - Object Visual Appearance – Position - Object Hierarchies – Physical Modeling: Collision Detection, Surface Deformation, Haptic Texturing.

UNIT V VIRTUAL REALITY PROGRAMMING 9

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Sherman, William R. and Alan B. Craig. Understanding Virtual Reality – Interface, Application, and Design, Morgan Kaufmann, 2002.
2. John vince, Essential Virtual Reality Fast (2012), Springer.

REFERENCES

1. Kelly S. Hale, Kay M. Stanney, Handbook of Virtual Environments: Design, Implementation, and Applications, 2014 by CRC Press.
2. Matjaz Mihelj, Jonezpodobnik, Haptics for virtual reality and tele operation (2012), Springer.
3. GrigoreBurdea, Philippe Coiffet, Virtual Reality Technology (2006), 2nd edition. Wiley India.
4. Virtual Reality by Steve Lavalle, online open book.
5. George Mather, Foundations of Sensation and Perception: Psychology Press; 2 edition, 2009.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Earn knowledge on haptic architecture.
CO2 Have the knowledge on various types of haptic devices.
CO3 Apply the knowledge of kinematics and dynamics in VR and Haptic devices.
CO4 Understand the geometric modelling of various objects and textures.
CO5 Program in Haptic Virtual Environments.

16MC422	INTELLIGENT MANUFACTURING TECHNOLOGY	L	T	P	C
		3	0	0	3

UNIT I MANUFACTURING SYSTEMS AND MODELS 9

Introduction to manufacturing models- types and principles of manufacturing system, manufacturing models - types and uses- physical models, mathematical models, model uses, model building.

UNIT II ASSEMBLY LINES 9

Introduction- line balancing algorithms- COMSOL Random sequence generation, Ranked positional weight heuristics, optimal solutions- practical issues - mixed models – sequencing- unpaced lines- Shop scheduling with many products, Order release, flow shop sequencing – single and two machine flow shops- job shop scheduling.

UNIT III PROCESS MONITORING CONDITION MONITORING 9

Principle, Sensors for Process Monitoring - online and off line quality control, Quality parameter design Direct monitoring of fault based on process signals. Condition monitoring of manufacturing systems-principles –sensors for monitoring force, vibration and noise. Selection of sensors and monitoring techniques. Acoustics emission sensors-principles and applications-online tool wear monitoring.

UNIT IV AUTOMATIC IDENTIFICATION TECHNIQUES 9

MRP-MRPII-Shop floor control –Factory data collection systems – Automatic identification methods – Bar code technology, Two-Dimensional Bar Codes, Radio Frequency Identification, automated data collection system – Agile manufacturing- flexible manufacturing- Enterprise integration and factory information system.

UNIT V MACHINE LEARNING 9

Machine Learning – Impacts of Machine learning - Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks - Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Rao P.N., “Manufacturing Technology, Metal cutting and Machine Tools”, Tata McGraw Hill, 2000.
2. Sabriesalomon, Sensors and Control Systems in Manufacturing, McGraw Hill int.edition,1994.

REFERENCES

1. Ronald G. Askin and Charles R. Standridge, “Modeling and analysis of manufacturing systems” John Wiley & Sons, Inc. 2000
2. Groover M.P., “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice-Hall of India Pvt. Ltd., New Delhi, 1996.
3. Jha, N.K., “Handbook of Flexible Manufacturing Systems”, Academic Press Inc., 1991.
4. Intelligent Manufacturing Systems, Andrew Kusiak.,Prentice Hall.
5. Artificial Neural Networks.Yagna Narayana,PHI,2006

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Understand the Concept of condition monitoring and identification techniques.
CO2 Apply various knowledge based techniques
CO3 Learned about the different processing technologies in non-traditional process in manufacturing
CO4 Design the Jigs, fixtures and dies for industrial applications.
CO5 Adopt intelligent system

16GE305	INTELLECTUAL PROPERTY RIGHTS	L	T	P	C
	(Common to all B.E. / B. Tech. Courses)	3	0	0	3

UNIT I INTRODUCTION **9**

Meaning, Relevance, Business Impact, Protection of Intellectual Property - Copyrights, Trademarks, Patents, Designs, Utility Models, Trade Secrets and Geographical Indications.

UNIT II PATENTS **9**

Concept of Patent - Product / Process Patents & Terminology - Duration of Patents- Law and Policy Consideration Elements of Patentability - Procedure for Filing of Patent Application and types of Applications - Ownership and Maintenance of Patents - Assignment and licensing of Patents.

UNIT III TRADEMARK **9**

The rationale of protection of trademark as (a) an aspect of commercial and (b) of consumer rights - Definition and concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Procedure for Registration of Trademarks.

UNIT IV COPYRIGHT **9**

Nature of Copyright - Author & Ownership of Copyright - Rights Conferred by Copyright - Assignment, Transmission, Licensing of Copyrights - Copyright pertaining to Software/Internet and other Digital media.

UNIT V INDUSTRIAL DESIGNS **9**

What is a Registrable Design - Novelty & Originality - Procedure for Registration of Designs - Copyright under Design - Assignment, Transmission, Licenses - Procedure for Cancellation of Design.

L:45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Aswani Kumar Bansal, 'Law of Trademarks in India', Commercial Law Publisher, 3rd edition, 2014.
2. B L Wadehra, 'Law Relating to Patents, Trademarks, Copyright, Designs and Geographical Indications', Universal Law Publishing Co, Fifth Edition, 2014.

REFERENCES

1. Krishnamurthy G.V.G, 'The Law of Trademarks, Copyright, Patents and Design'. Macmillan Publishers Limited, 2012.
2. Satyawrat Ponkse, 'The Management of Intellectual Property', Bhate & Ponkshe Publishers, 1991.

COURSE OUTCOMES

At the end of the course student should be able to:

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

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

CO3 Identify activities and constitute IP infringements and the remedies available to the IP owner and describe the precautious steps to be taken to prevent infringement of proprietary rights in products and technology development

CO4 Familiar with the processes of Intellectual Property Management (IPM) and various approaches for IPM and conducting IP and IPM auditing and explain how IP can be managed as a strategic resource and suggest IPM strategy.

CO5 Apply the different procedures in IP of various IPs

16MC423	MODELLING AND SIMULATION	L	T	P	C
		3	0	0	3

UNIT I SYSTEM AND SYSTEM ENVIRONMENT 9

System and System Environment: Component of a system Continuous and discrete systems Models of a system modelling, simulation as a decision making tool.

UNIT II RANDOM NUMBER GENERATION 9

Random Number Generation: Midsquare- The midproduct method Constant multiplier method Additive Congruential method Test for random numbers: the Chi-square test the KoimogrovSmimov test Runs test Gap test- Generation of Pseudo techniques of generating pseudo random numbers.

UNIT III RANDOM VARIABLE GENERATION 9

Random Variable Generation: Inverse transform technique Exponential distribution Poisson distribution Uniform distribution Weibull distribution Empirical distribution Normal distribution Building and empirical distribution The Rejection method. Direct Transformation for normal distribution.

UNIT IV DATA ANALYSIS 9

Simulation of Systems: Simulation of continuous system Simulation of discrete system Simulation of an event occurrence using random number table. Simulation of component failures using Exponential and weibull models. Verification and validation of simulation models.

UNIT V SIMULATION LANGUAGES 9

Comparison and selection of GPSS, SIMSCRIPT, SLAM. Development of simulation models using Arena simulation package for queuing system, Production system, Inventory system, Maintenance system – An Electronic Assembly and testing system.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Banks J., Carson J.S. and Nelson B.L., "Discrete – Event System Simulation", 3rd Edition, Pearson Education, Inc 2004 .
2. David Kelton.W .and Randall P. Sowdowski, "Simulation with Arena", 2nd Edition , McGraw Hill, 2002.

REFERENCES

1. Geoffrey Gorden, "System Simulation", Prentice Hall of India, 2003.
2. NarsinghDeo., "System Simulation with Digital Computer", Prentice Hall of India, 2003.
3. David V Hutton, "Fundamentals of Finite Element Analysis", McGraw Hill Int. Ed., New Delhi 2004.
4. Rao S S,"The Finite element Method in Engineering", Pergammon Press, 2005
5. Rogers.D.F. and Adams.J.A., Mathematical Elements in Computer Graphics, 2nd Edition, Tata McGraw-Hill, New Delhi, 2003.

COURSE OUTCOMES

At the end of the course student should be able to:

- **CO1** Summarize the working of system and system Environment.
- **CO2** Design & Simulation of systems
- **CO3** Outline operations of Random variable generation systems
- **CO4** Simulation methods and tools for modelling and simulation of continuous, discrete and combined systems.
- **CO5** Create simulation models of various types

16MC424 FIELD AND SERVICE ROBOTICS

L	T	P	C
3	0	0	3

UNIT I INTRODUCTION **9**

History of service robotics – Present status and future trends – Need for service robots - applications examples and Specifications of service and field Robots. Non conventional Industrial robots.

UNIT II LOCALIZATION **9**

Introduction-Challenges of Localization- Map Representation- Probabilistic Map based Localization Monte carlo localization- Landmark based navigation-Globally unique localization- Positioning beacon systems- Route based localization.

UNIT III PLANNING AND NAVIGATION **9**

Introduction-Path planning overview- Road map path planning- Cell decomposition path planning Potential field path planning-Obstacle avoidance - Case studies: tiered robot architectures.

UNIT IV FIELD ROBOTS **9**

Ariel robots- Collision avoidance-Robots for agriculture, mining, exploration, underwater, civilian and military applications, nuclear applications, Space applications.

UNIT V HUMANOIDS **9**

Wheeled and legged, Legged locomotion and balance, Arm movement, Gaze and auditory orientation control, Facial expression, Hands and manipulation, Sound and speech generation, Motion capture/Learning from demonstration, Human activity recognition using vision, touch, sound, Vision, Tactile Sensing, Models of emotion and motivation. Performance, Interaction, Safety and robustness, Applications, Case studies

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, „Introduction to Autonomous Mobile Robots", Bradford Company Scituate, USA, 2004
2. Riadh Siaer, „The future of Humanoid Robots- Research and applications", Intech Publications, 2012.

REFERENCES

1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.
2. Kelly, Alonzo; Iagnemma, Karl; Howard, Andrew, "Field and Service Robotics ", Springer, 2011
3. AleksandarLazinica, "Mobile Robots Towards New Applications", Advanced Robotic Systems International, 2006.
4. Yangsheng Xu Huihuan Qian Xinyu Wu, "Household and Service Robots", Elsevier Ltd, 2015.
5. Gregory Dudek,Michael Jenkin, "Computational Principles of Mobile Robotics", 2nd edition, Oxford University Press, 2010

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Explain the basic concepts of working of robot
CO2 Understand the various kinematics and inverse kinematics of robots
CO3 Analyse the function of sensors in the robot
CO4 Write program to use a robot for a typical application
CO5 Use Robots in different applications

16MC425	DIAGNOSTIC TECHNIQUES	L	T	P	C
		3	0	0	3

UNIT I DEFECTS AND FAILURE ANALYSIS 9

Maintenance Concept, Maintenance objective, Challenges in maintenance. Defect generation – Types of failures - Defect reporting and recording - Defect analysis -Failure analysis - Equipment down time analysis - Breakdown analysis - FTA - FMEA - FMECA.

UNIT II MAINTENANCE SYSTEMS 9

Planned and unplanned maintenance - Breakdown maintenance - corrective maintenance- Opportunistic maintenance - Routine maintenance - Preventive maintenance – Predictive Maintenance - Condition based maintenance system - Design out maintenance – Maintenance by objectives – Selection of maintenance system.

UNIT III SYSTEMATIC MAINTENANCE 9

Codification and Cataloguing - instruction manual and operating manual - Maintenance manual and departmental manual - Maintenance time standard - Maintenance work order and work permit - job monitoring – Feedback and control – Maintenance records and documentation. Introduction to Total Productive Maintenance (TPM).

UNIT IV COMPUTER MANAGED MAINTENANCE SYSTEM 9

Selection and scope of computerization – Equipment classification – Codification of breakdown, material and facilities - Job sequencing - Material management module – Captive engineering module. Decision making in maintenance. Economic aspects of maintenance.

UNIT V CONDITION MONITORING 9

Condition monitoring techniques – Visual monitoring– Temperature monitoring– Vibration monitoring – Lubricant monitoring – Cracks monitoring – Thickness monitoring - Noise and sound monitoring – Condition monitoring of hydraulic system. Machine diagnostics – Objectives - Monitoring strategies – Examples of monitoring and diagnostics - Control structures for machine diagnosis.

L : 45 T: 0 P: 0 Total: 45 PERIODS

TEXT BOOKS

1. Sushil Kumar Srivastava, "Industrial Maintenance Management", S.Chand & Company Ltd, New Delhi, 1998.
2. Jha, Nand K. "Handbook of Flexible Manufacturing Systems", Academic Press, Orlando, 2006.

REFERENCES

1. AmitavaMitra,," Fundamentals of Quality Control and Improvement ",Wiley India Private Limited; Third edition, 2013.
2. Manfred, H. Bibring, Handbook of Machine Tools, Vol.3, John Wiley & Sons
3. Mishra R.C., Pathak K. Maintenance Engineering and Management, Prentice Hall of India Private Ltd., New Delhi, 2002
4. Venkataraman K," Maintenance Engineering and Management", PHI,2007
5. Viswanathan .N, Navahari .Y "Performance Modeling of Automated Manufacturing Systems", Prentice Hall of India Pvt. Ltd., 1998.

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Know basics of various diagnostics techniques for proper maintenance
CO2 Identify the causes of defects for the operation.
CO3 Analyse the defects and rectify the faults
CO4 Describe the importance of maintenance.
CO5 Analyse and monitoring the maintenance.

16MC426	PROJECT WORK PHASE II	L	T	P	C
		0	0	20	10

THE PROJECT WORK INVOLVES THE FOLLOWING

1. Preparing a project brief proposal including
   - Problem identification
   - A statement of system / process specification proposed to be developed (Block diagram / concept tree)
   - List of possible solutions including alternative and constraints
   - Cost benefit analysis
   - Time Line of activities
2. A report highlighting the design finalization (based on functional requirements & standards (if any)
3. A presentation including the following:
   - Implementation Phase (Hardware / Software / both)
   - Testing & Validation of the developed system
   - Learning in the Project
   - Consolidated project report preparation

GENERAL GUIDELINES

1. The progress of the project is evaluated based on a minimum of three reviews.
2. The review committee may be constituted by the Head of the Department.
3. A project and project reports are required at the end of the semester.

The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

L: 0 T: 0 P: 300 Total: 300 PERIODS

COURSE OUTCOMES

At the end of the course student should be able to:

CO1 Propose solutions to the problem based on literature survey and future trends.
CO2 Perform analysis using appropriate tools/methods for the problem.
CO3 Identify the process for fabrication / manufacturing.
CO4 conduct experiment and Summarize result
CO5 Pertain the knowledge and demonstrate a project work using real life problems by Publishing their project work in a reputed journal / Conference Proceedings.

16MCOC1 **INTRODUCTION TO COMPUTATION SOFTWARE (SCILAB)**

Introduction:

Installation of the software Scilab- Basic syntax, Mathematical Operators, Predefined constants. Built in functions-Complex numbers, Polynomials, Vectors, Matrix - Handling these data structures using built in functions.

Programming:

Functions – Loops - Conditional statements - Handling .sci files

Graphics handling:

2D, 3D, Generating .jpg files, Function plotting, Data plotting

Applications:

Numerical Linear Algebra (Solving linear equations, Eigen values)- Numerical Analysis – iterative methods- ODE – Blotting solution curves

Total: 15 PERIODS

REFERENCES

1. Stephen Campbell, Jean-Philippe Chancelier and Ramine Nikoukhah "Modeling and Simulation in SCILAB / SCICOS 4.4"Springer,2010

16MCOC2 **BASICS OF EMBEDDED SYSTEMS**

Assembly level and C Programming in 8051- Timer and serial programming in 8051- Interfacing 8051 with LCD, Keypad, ADC- PIC(16F877A) Microcontroller- Timer & Interrupt programming in PIC- Interfacing PIC with LCD, Keypad, ADC- ARM Architecture- Input/output Programming in LPC21xx- Real time execution on Atmel/PIC development kit

Total: 15 PERIODS

REFERENCES

1. Martin Bates “PIC Microcontrollers: An Introduction to Microelectronics” Elsevier, 2011 - Technology & Engineering

16MCOC3 **FUNDAMENTALS OF SIMULINK SOFTWARE(MATLAB)**

Overview of MATLAB :

MATLAB Interactive Sessions - One and Two Dimensional Numeric Arrays - Multidimensional Numeric Arrays-Matrix Operations - Polynomial Operations Using Arrays- Cell Arrays - Structure Arrays.

Fuzzy Sets:

Classical Set Theory, Fuzzy Sets, Fuzzy Operations, Properties and Relations, Fuzzification, Fuzzy Rules, Fuzzy Control Design, MATLAB Simulation

Total: 15 PERIODS

REFERENCES

1. Rajjan Shinghal "Introduction to Fuzzy Logic" Prentice Hall India Learning Private Limited (2012)

16MCOC4 BASICS OF PROGRAMMABLE BOARDS (ARDUINO)

Getting started with Arduino:

Introduction to Arduino, setup computer to use Arduino, Understanding electronics elements- Resistors, Capacitors, Transistors, Relays etc.,

LEDs & Serial Monitoring:

Blinking, fading, Controlling of LEDs, Reading analog and digital inputs.

Interfacing:

Interfacing with of LCD and seven segment display, Interfacing with servo motors

Total: 15 PERIODS

REFERENCES

1. Mark Torvalds “Arduino: Step-By-Step Guide To Master Arduino Hardware And Software” CreateSpace Independent Publishing Platform, 2017

16MCOC5 **TECHNICAL AND SCIENTIFIC DOCUMENTATION (LaTeX)**

Introduction:

Installation of the software LaTeX-Understanding Latex compilation- Basic Syntax, Writing equations, Matrix, Tables- Page Layout – Titles, Abstract Chapters, Sections, References, Equation references, citation. List making environments, Table of contents, Generating new commands, Figure handling, numbering, List of figures, List of tables, Generating index.

Packages:

Geometry, Hyper ref, math, symbol, algorithms, algorithmic graphic, color, titles listing.

Classes: article, book, report, beamer, slides.

Theory, Practical and exercises based on:

Writing Resume-Writing question paper-Writing articles/ research papers-Presentation using beamer.

L : 15 T: 0 P: 0 Total: 15 PERIODS

REFERENCES

1. Chetan Shirore "A Beginners Guide to Latex" Lulu.com, 2015