Sri Krishna College of Engineering and Technology

CURRICULUM DESIGN UNDER REGULATION 2017

MECHATRONICS ENGINEERING

SEMESTER I							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
1	17EN001	Technical Communication Skills I	3/0/2	5	4	40/60	HS
2	17MA101	Linear Algebra And Differential Calculus	3/2/0	5	4	60/40	BS
3	17CH101	Engineering Chemistry	3/0/2	5	4	40/60	BS
4	17MT201	Technical Drawing	1/0/3	4	3	60/40	ES
5	17MT202	Applied Mechanics	4/1/0	5	4	60/40	ES
6	17MT203	Production Technology Laboratory (Project Based Lab)	0/0/3	3	2	40/60	ES
7	17MT204	Engineering Graphics Laboratory	0/0/3	3	2	40/60	ES
			Total	**30**	**23**	**700**	

SEMESTER II							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
1	17EN002	Technical Communication Skills II	3/0/2	5	4	40/60	HS
2	16MA102/ 17MA102	Integral Calculus and Laplace Transforms	3/2/0	5	4	60/40	BS
3	16PH103/ 17PH101	Engineering Physics	3/0/2	5	4	40/60	BS
4	17MT205	Production Technology	4/0/0	4	3	60/40	ES
5	17MT301	Electrical, Electronic Devices and Circuits	3/0/0	3	3	60/40	PC
6	17MT206	Basic Mechatronics Laboratory	0/0/3	3	2	40/60	ES
7	17MT207	Mechatronics Machine Drawing Laboratory	0/0/3	3	2	40/60	ES
			Total	**28**	**22**	**700**	

SEMESTER III							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
1	16MA103/ 17MA103	Fourier Analysis And Partial Differential Equations	3/2/0	5	4	60/40	BS
2	16MT302/ 17MT302	Mechanics of Materials	2/2/0	4	3	60/40	PC
3	16MT303/ 17MT303	Thermodynamics and Applications	2/2/0	4	3	60/40	PC
4	16MT304/ 17MT304	Electrical Machines and Power Systems	3/0/0	3	3	60/40	PC
5	17CS201	Problem Solving Techniques and C Programming	3/0/3	6	5	40/60	ES
6	17MT305	Theory of Control Systems	3/0/0	3	3	60/40	PC
7	16MT306/ 17MT306	Thermal and Fluid Engineering Laboratory	0/0/3	3	2	40/60	PC
8	16MT307/ 17MT307	Electrical and Electronics Engineering Laboratory	0/0/3	3	2	40/60	PC
9	16MT701/ 17MT701	Mandatory Course-I	2/0/0	2	1	0/100	MC
			Total	**34**	**26**	**900**	

SEMESTER IV							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
1	16MA107/ 17MA107	Statistics andComplex Analysis	3/2/0	5	4	60/40	BS
2	16MT308/ 17MT308	Microcontroller and its applications	3/0/0	3	3	60/40	PC
3	15MT310/ 17MT309	Theory of Machines	3/1/0	4	4	60/40	PC
4	16CS212/ 17CS212	Linux and Programming In C++	3/0/2	5	4	40/60	ES
5	16MT310/ 17MT310	Fluid Engineering	2/2/0	4	3	60/40	PC
6	16MT311/ 17MT311	Theory of Machines Laboratory	0/0/3	3	2	40/60	PC
7	16MT312/ 17MT312	Microcontroller Laboratory (Project Based Lab)	0/0/3	3	2	40/60	PC
8	16MT702/ 17MT702	Mandatory Course-II	2/0/0	2	1	0/100	MC
9	16MT601/ 17MT601	Mini Project		2	2	40/60	PW
			Total	**31**	**25**	**900**	

SEMESTER V							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
1	15MT315/ 16MT313/ 17MT313	Hydraulics and Pneumatics	3/0/0	3	3	60/40	PC
2	15MT316/ 16MT314/ 17MT314	Embedded System	3/0/0	3	3	60/40	PC
3	15MT317/ 16MT315/ 17MT315	Power Electronics and Electrical Drives (Theory and Lab)	3/0/3	6	4	40/60	PC
4	15MT318/ 16MT316/ 17MT316	Machine Design	3/2/0	5	4	60/40	PC
5	15MT319/ 16MT317/ 17MT317	Sensor, Measurements and Instrumentation	3/0/0	3	3	60/40	PC
6	15MT4XX/ 16MT4XX/ 17MT4XX	Professional Elective-I	3/0/0	3	3	60/40	PE
7	15MT320/ 16MT318/ 17MT318	Hydraulics and Pneumatics Laboratory	0/0/3	3	2	40/60	PC
8	15MT321/ 16MT319/ 17MT319	Sensor and Instrumentation Laboratory (Project Based Lab)	0/0/3	3	2	40/60	PC
9	15MT703/ 16MT703/ 17MT703	Mandatory Course-III	2/0/0	2	1	0/100	MC
		Total		**31**	**25**	**900**	

SEMESTER VI							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
1	15MT322/ 16MT320/ 17MT320	Computer Integrated Manufacturing	3/0/0	3	3	60/40	PC
2	15MT323/ 16MT321/ 17MT321	Virtual Instrumentation (Theoryand Lab)	3/0/3	6	4	40/60	PC
3	15MT324/ 16MT322/ 17MT322	Industrial Automation	3/0/0	3	3	60/40	PC
4	15MT4XX/ 16MT4XX/ 17MT4XX	Professional Elective-II	3/0/0	3	3	60/40	PE
5	15MT4XX/ 16MT4XX/ 17MT4XX	Professional Elective-III	3/0/0	3	3	60/40	PE
6	15XX5XX/ 16XX5XX/ 17XX5XX	Open Elective	3/0/0	3	3	60/40	OE
7	17MT323	CAE Laboratory	0/0/3	3	2	40/60	PC
8	15MT326/ 16MT324/ 17MT324	Industrial Automation Laboratory	0/0/3	3	2	40/60	PC
9	15MT704/ 16MT704/ 17MT704	Mandatory Course-IV	2/0/0	2	1	0/100	MC
10	15MT602/ 16MT602/ 17MT602	Industrial Field Training	-	2	2	0/100	PW
		Total		**31**	**26**	**1000**	

SEMESTER VII							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
1	15MT327/16MT325/17MT325	Robotics and Machine vision System	3/0/0	3	3	60/40	PC
2	15MT328/16MT326/17MT326	Design and Modelling of Mechatronics Systems	3/2/0	5	3	60/40	PC
3	15HS003/16HS004/17HS003	Industrial Management and Professional Ethics (Industry Based Course)	3/0/0	3	3	0/100	HS
4	15MT4XX/16MT4XX/17MT4XX	Professional Elective-IV	3/0/0	3	3	60/40	PE
5	15MT4XX/16MT4XX/17MT4XX	Professional Elective-V	3/0/0	3	3	60/40	PE
6	15MT4XX/16MT4XX/17MT4XX	Professional Elective-VI	3/0/0	3	3	60/40	PE
7	15MT329/16MT327/17MT327	Robotics Laboratory	0/0/3	3	2	40/60	PC
8	15MT505/16MT505/17MT505	MOOC Certification	0/0/3	3	1	0/100	OE
		Total		**26**	**21**	**800**	

SEMESTER VIII							
S No.	**Course Code**	**Course**	**L/T/P**	**Contact hrs/week**	**Credit**	**Ext/Int**	**Category**
1	15MT603/16MT603/17MT603	Industrial Project	0/0/24	24	12	40/60	PW
		Total		**24**	**12**	**100**	

SCHEME OF CREDIT DISTRIBUTION - SUMMARY

S. No	Stream	Credits/Semester								Credits	%	AICTE
		I	II	III	IV	V	VI	VII	VIII			
1.	Humanities (HS)	4	4					3		11	**6.11**	**5-10**
2.	Basic Sciences(BS)	8	8	4	4					24	**13.33**	**15-20**
3.	Engineering Sciences(ES)	11	7	5	4					27	**15**	**15-20**
4.	Professional Core(PC)		3	16	14	21	14	8		76	**42.22**	**30-40**
5.	Professional Electives(PE)					3	6	9		18	**10**	**10-15**
6.	Open Electives(OE)						3	1		4	**2.22**	**5-10**
7.	Project Work(PW)				2		2		12	16	**8.89**	**10-15**
8.	Mandatory Course (MC)			1	1	1	1			4	**2.22**	**-**
Total		**23**	**22**	**26**	**25**	**25**	**26**	**21**	**12**	**180**	**100**	**100**

SCHEME OF SUBJECT DISTRIBUTION – SUMMARY

S. No	Stream	Subjects/Semester								Subjects
		I	II	III	IV	V	VI	VII	VIII	
1.	Humanities (HS)	1	1					1		**3**
2.	Basic Sciences(BS)	2	2	1	1					**6**
3.	Engineering Sciences(ES)	4	3	1	1					**9**
4.	Professional Core(PC)		1	6	5	7	5	3		**27**
5.	Professional Electives(PE)					1	2	3		**6**
6.	Open Electives(OE)						1	1		**2**
7.	Project Work(PW)				1		1		1	**3**
8.	Mandatory Courses (MC)			1	1	1	1			**4**
Total		**7**	**7**	**9**	**9**	**9**	**10**	**8**	**1**	**60**

HUMANITIES SCIENCES (11 credits)

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Ext/Int
1.	17EN001	Technical Communication Skills I	3/0/2	5	4	40/60
2.	17EN002	Technical Communication Skills II	3/0/2	5	4	40/60
3.	15HS003/ 16HS004/ 17HS003	Industrial Management and Professional Ethics	3/0/0	3	3	0/100

BASIC SCIENCES (24 Credits)

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Ext/Int
1.	17MA101	Linear Algebra And Differential Calculus	3/2/0	5	4	60/40
2.	17CH101	Engineering Chemistry	3/0/2	5	4	40/60
3.	16MA102/ 17MA102	Integral Calculus and Laplace Transforms	3/2/0	5	4	60/40
4.	16PH103/ 17PH101	Engineering Physics	3/0/2	5	4	40/60
5.	16MA103/ 17MA103	Fourier Analysis And Partial Differential Equations	3/2/0	5	4	60/40
6.	16MA107/ 17MA107	Statistics andComplex Analysis	3/2/0	5	4	60/40

ENGINEERING SCIENCES (27 Credits)

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Ext/Int
1.	17MT201	Technical Drawing	1/0/3	4	3	60/40
2.	17MT202	Applied Mechanics	4/1/0	5	4	60/40
3.	17MT203	Production Technology Lab	0/0/3	3	2	40/60
4.	17MT204	Engineering Graphics Laboratory	0/0/3	3	2	40/60
5.	17MT205	Production Technology	4/0/0	4	3	60/40
6.	17MT206	Basic Mechatronics Laboratory	0/0/3	3	2	40/60
7.	17MT207	Mechatronics Machine Drawing Laboratory	0/0/3	3	2	40/60
8.	17CS201	Problem Solving Techniques and C Programming	3/0/3	6	5	40/60
9.	16CS212/ 17CS212	Linux and Programming in C++	3/0/2	5	4	40/60

PROFESSIONAL CORE (76 credits)

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Ext/Int
1.	17MT301	Electrical, Electronic Devices and Circuits	3/0/0	3	3	60/40
2.	16MT302/ 17MT302	Mechanics of Materials	2/2/0	4	3	60/40
3.	16MT303/ 17MT303	Thermodynamics and Applications	2/2/0	4	3	60/40
4.	16MT304/ 17MT304	Electrical Machines and Power Systems	3/0/0	3	3	60/40
5.	17MT305	Theory of Control Systems	3/0/0	3	3	60/40
6.	16MT306/ 17MT306	Thermal and Fluid Engineering Lab	0/0/3	3	2	40/60
7.	16MT307/ 17MT307	Electrical and Electronics Engineering Laboratory	0/0/3	3	2	40/60
8.	16MT308/ 17MA308	Microcontroller and its applications	3/0/0	3	3	60/40
9.	17MT309	Theory of Machines	3/1/0	4	4	60/40
10.	16MT310/ 17MT310	Fluid Engineering	2/2/0	4	3	60/40
11.	16MT311/ 17MT311	Theory of Machines Lab	0/0/3	3	2	40/60
12.	16MT312/ 17MT312	Microcontroller Lab	0/0/3	3	2	40/60
13.	15MT315/ 16MT313/ 17MT313	Hydraulics and Pneumatics	3/0/0	3	3	60/40
14.	15MT316/ 16MT314/ 17MT314	Embedded System	3/0/0	3	3	60/40
15.	15MT317/ 16MT315/ 17MT315	Power Electronics and Electrical Drives (Theory and Lab)	3/0/3	6	4	40/60
16.	15MT318/ 16MT316/ 17MT316	Machine Design	3/2/0	5	4	60/40
17.	15MT319/ 16MT317/ 17MT317	Sensor, Measurements and Instrumentation	3/0/0	3	3	60/40
18.	15MT320/ 16MT318/ 17MT318	Hydraulics and Pneumatics Laboratory	0/0/3	3	2	40/60
19.	15MT321/ 16MT319/ 17MT319	Sensor and Instrumentation Lab	0/0/3	3	2	40/60
20.	15MT322/ 16MT320/ 17MT320	Computer Integrated Manufacturing	3/0/0	3	3	60/40
21.	15MT323/ 16MT321/ 17MT321	Virtual Instrumentation (Theory and Lab)	3/0/3	6	4	40/60

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Ext/Int
22.	15MT324/ 16MT322/ 17MT322	Industrial Automation	3/0/0	3	3	60/40
23.	15MT325/ 16MT323/ 17MT323	CAE Laboratory	0/0/3	3	2	40/60
24.	15MT326/ 16MT324/ 17MT324	Industrial Automation Lab	0/0/3	3	2	40/60
25.	15MT327/ 16MT325/ 17MT325	Robotics and Machine vision System	3/0/0	3	3	60/40
26.	15MT328/ 16MT326/ 17MT326	Design and Modeling of Mechatronics Systems	3/2/0	5	3	60/40
27.	15MT329/ 16MT327/ 17MT327	Robotics Laboratory	0/0/3	3	2	40/60

ELECTIVE/AUDIT COURSES (3+18 Credits)

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Ext/Int
OPEN/EMERGING ELECTIVES						
1.	15MT501/ 16MT501/ 17MT501	Reliability Engineering	3/0/0	3	3	60/40
2.	15MT502/ 16MT502/ 17MT502	Vehicle Dynamics	3/0/0	3	3	60/40
3.	15MT503/ 16MT503/ 17MT503	Micro and Nano Robotics	3/0/0	3	3	60/40
4.	15MT504/ 16MT504/ 17MT504	Field and Service Robotics	3/0/0	3	3	60/40

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Ext/Int
PROFESSIONAL ELECTIVES						
Stream I :Manufacturing and Design						
1.	15MT401/ 16MT401/ 17MT401	Advanced Manufacturing Processes	3/0/0	3	3	60/40
2.	15MT402/ 16MT402/ 17MT402	Micro and Nano Manufacturing	3/0/0	3	3	60/40
3.	15MT403/ 16MT403/ 17MT403	Additive Manufacturing Processes	3/0/0	3	3	60/40
4.	15MT404/ 16MT404/ 17MT404	Product Design and Manufacturing	3/0/0	3	3	60/40
5.	15MT405/ 16MT405/ 17MT405	CNCMachines and Programming	3/0/0	3	3	60/40
6.	15MT406/ 16MT406/ 17MT406	Mechanical Design for Robotics System	3/0/0	3	3	60/40
Stream II : Automobile and Robotics						
1.	15MT407/ 16MT407/ 17MT407	Theory of Automobile Engineering	3/0/0	3	3	60/40
2.	15MT408/ 16MT408/ 17MT408	Automotive Electronics	3/0/0	3	3	60/40
3.	15MT409/ 16MT409/ 17MT409	Autonomous Vehicle Guidance System	3/0/0	3	3	60/40
4.	15MT410/ 16MT410/ 17MT410	Automated Material Handling Systems	3/0/0	3	3	60/40
5.	15MT411/ 16MT411/ 17MT411	Medical Mechatronics	3/0/0	3	3	60/40
6.	15MT412/ 16MT412/ 17MT412	Mobile Robotics	3/0/0	3	3	60/40
Stream III :Intelligent Control System						
1.	15MT413/ 16MT413/ 17MT413	Integrated Electronic Circuit	3/0/0	3	3	60/40
2.	15MT414/ 16MT414/ 17MT414	Principles of AI and Expert Systems	3/0/0	3	3	60/40

S. No	Course Code	Course Title	L/T/P	Contact Hrs/Wk	Credits	Ext/Int
3.	15MT415/ 16MT415/ 17MT415	Embedded System in Automation	3/0/0	3	3	60/40
4.	15MT416/ 16MT416/ 17MT416	Internet of Things for Mechatronics	3/0/0	3	3	60/40
5.	15MT417/ 16MT417/ 17MT417	Automatic Control System	3/0/0	3	3	60/40
6.	15MT418/ 16MT418/ 17MT418	Intelligent Control System	3/0/0	3	3	60/40

MANDATORY COURSES (4 Credits)

S.No	Course Code	Course Title	Semester	Ext/Int
1.	16MT701/ 17MT701	Arduino Programming	III	0/100
2.	16MT702/ 17MT702	Foreign Languages / Spoken Hindi	IV	0/100
3.	15MT703/ 16MT703/ 17MT703	Entrepreneurship Development	V	0/100
4.	15MT704/ 16MT704/ 17MT704	Quantitative Aptitude and Soft Skills	VI	0/100

ONE CREDIT COURSES

S.No	Course Code	Course Title	Issuing / Approving Authority	Credits
1.	15MT901/ 16MT901/ 17MT901	Lab view certification	National Instruments	1
2.	15MT902/ 16MT902/ 17MT902	Certification in Embedded Software Development	Texas Instruments	1
3.	15MT903/ 16MT903/ 17MT903	Certification in Creo/ANSYS	PTC/ ANSYS	1
4.	15MT904/ 16MT904/ 17MT904	Industrial automation certification	Bosch, Rexroth, etc.,	1
5.	15MT905/ 16MT905/ 17MT905	Any other certification from MNCs	Department	1
6.	15MT906/ 16MT906/ 17MT906	Participation in international exhibition / Seminar / fair	Department	1
7.	15MT907/ 16MT907/ 17MT907	Online Course Certification from edx, Coursera, etc.,	Department	1
8.	15MT908/ 16MT908/ 17MT908	Certification in SAP – ERP, openCV Software	Department	1
9.	15MT909/ 16MT909/ 17MT909	Certification in Six Sigma Belt	Department	1
10.	15MT910/ 16MT910/ 17MT910	Certification in IELTS/TOEFL/GRE/GATE	IELTS/TOEFL/GRE/GATE	1
11.	15MT911/ 16MT911/ 17MT911	Publications in reputed Journals	Department	1
12.	15MT912/ 16MT912/ 17MT912	Any Certificate in IITs/NITs/Foreign Universities	Department	1
13.	15MT913/ 16MT913/ 17MT913	Patent / Book Publications	Department	1

SEMESTER I

17EN001 **TECHNICAL COMMUNICATION SKILLS I** **3/0/2/4**

Nature of Course: Theory

Pre Requisites: Basics of English Language

Course Objectives

1. To equip the students with the LSRW skills.
2. To develop communication skills and soft skills.
3. To facilitate the students to use the Language in practical mode.
4. To prepare the students for all competitive program like BEC/ IELTS/ TOEFL.

Course Outcomes

Upon successful completion of this course, the student will be able to:

C001.1Remember language skills for business related situations. [R]
C001.2Understand and intensely focus on improving and increasing LSRW skills. [U]
C001.3Apply a good command over basic writing and reading skills. [AP]
C001.4Analyze and use vocabulary in corporate work environment. [AN]

Course Contents

INTRODUCTION

Basics of English language- History of English language- Etymology of scientific terms - Importance of LSRW skills – Getting to know people- How to talk about personality types- Self introduction-Introducing others.

LISTENING

Importance of listening skills -Listening to short conversations or monologues-Seeking and supplying information -Listening for specific information- Active listening-Telephonic Conversation and Etiquette -Talking and conveying messages (over the phone)- Listening to speeches / talks- Giving directions / instruction.

SPEAKING

Importance of Speaking skills-Grammar and Vocabulary- Pronunciation - Business topics-Talk about preferences-Agree and disagree- Giving opinions- Listening and responding-Sense of persuasion- Situational approaches- Reasons and Consequences -Making Predictions- Short presentation -Interactive communication-Discourse markers and management.

READING

Importance of reading skills - Reading short texts such as notices, advertisements, memos, emails- Skimming and scanning -Identifying relationship between characters, facts and ideas-Comparing facts and figures-Reading and understanding specific meaning in a text - Cloze reading- Identifying relevant information- Identifying reasons and consequences through reading practices -Vocabulary practice.

WRITING

Importance of writing skills - Brevity of communication -Notes- Memo- Email - Formal and informal – Letter writing- Job application Letter - Resume Writing - Itinerary- Paragraph Writing - Essay Writing- Check list- -Requests and Obligation- Letter Phrases –Instructions-Recommendations- Jumbled sentences.

PARTS OF SPEECH

Present simple- Simple past- Connectors of addition and contrast- Present Continuous- Gerunds and Infinitives- Vocabulary development through prefixes-suffixes and word roots- Synonyms-Antonyms **-**Auxiliary Verbs - Countable and Uncountable Nouns - Present perfect -Future possibility/ Probability - Question formation-Sequencing words- Prepositions- If-Conditionals.

LABORATORY COMPONENTS				
EXP NO.	**NAME OF THE EXPERIMENT**	**TEXT BOOK**	**PAGES**	**LAB HOURS**
1	**LISTENING COMPREHENSION**	**T2**	**59-67**	**3**
2	**WRITING EMAILS AND LETTERS**	**T2**	**117-131**	**3**
3	**MINI PRESENTATION**	**T2**	**195-213**	**3**
4	**TELEPHONIC CONVERSATION**	**T1**	**20-23**	**3**
5	**READING COMPREHENSION**	**T1**	**66-77**	**3**

Total Hours :90

Text Books:

1. Whitby, Norman. Cambridge University Press- Students Book, 2013.
2. RizviAshraf M , “Effective Technical Communication”, McGraw Hill Education (India) Private Limited , 2016.
3. Dr.Sumanth S, “English for Engineers”, Vijay Nicole Imprints Private Limited, 2015.

Reference Books:

1. Wood, Ian,Paul Sanderson, Anne Williams with Marjorie Rosenberg, Pass Cambridge BEC Preliminary, Cengage learning. Second Edition, 2014.
2. Sharma R.C ,Mohan Krishna, “Business Correspondence and Report Writing”, McGraw Hill Education (India) Private Limited, 2016.
3. Lewis, Norman, Word Power Made Easy, Pocket Books, New York,1979.

Web References:

1. http://www.cambridgeindia.org
2. http://www.cambridgeenglish.org/exams/business-certificates/business
3. https://steptest.in

Online Resources:

1. https://www.coursera.org/specializations/business-english
2. http://www.academiccourses.com/Courses/English/Business-English/

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**Marks**
C001.1	Remember	Quiz	**5**
C001.2	Understand	Role Play	**5**
C001.3	Apply	E-mail Writing	**5**
C001.4	Apply	Group Discussion	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination**
	CIA1	**CIA2**	**Term End Assessment**	
Remember	20	20	20	20
Understand	40	40	40	40
Apply	40	40	40	40
Analyse	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

17MA101 LINEAR ALGEBRA AND DIFFERENTIAL CALCULUS 3/2/0/4

Nature of Course: J (Problem analytical)

Pre requisites : Basics of differentiation

Course Objectives:

1. To develop the skill to use matrix algebra techniques that is needed by engineers for practical applications.
2. To familiarize with functions of several variables applicable in many branches of engineering
3. To find the solution of ordinary differential equations as most of the engineering problems are characterized in this form.
4. To acquire sound knowledge of techniques in solving ordinary differential equations using numerical methods

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Recall the concepts of matrices, ordinary and partial derivatives	[R]
C101.2	Express a square matrix in the diagonal form	[U]
C101.3	Evaluate the extreme values of the given function	[AP]
C101.4	Apply the knowledge of differential equation to solve the engineering problems	[AP]
C101.5	Apply numerical method techniques to find the solution of ordinary differential equations	[AP]

Course Contents:

Matrices- Characteristic equation – Eigen values and eigen vectors of a real matrix – Properties and Cayley-Hamilton theorem (excluding proof) – Orthogonal transformation of a real symmetric matrix to diagonal form – Reduction of quadratic form to canonical form by orthogonal transformation- **Functions of several variables**- Total derivatives – Differentiation of implicit functions – Jacobians – Taylor series expansion – Maxima and Minima – Method of Lagrangian multipliers.

Ordinary differential equations-Second andHigher order linear differential equations with constant coefficients –Cauchy's and Legendre's linear differential equations- Method of variation of parameters - **Applications of second order differential equations**- Free and forced oscillations – Undamped and Damped system - Solution of specified differential equations connected with electric circuits and bending of beams (Differential equations and associated conditions need to be given)

.

Numerical solution to first order ordinary differential equations- Single step methods: Taylor series method - Euler's Method -Modified Euler's Method – Runge - Kutta Method of fourth order - Multistep method - Milne's Predictor- Corrector Method-Adam-Bashforth Predictor- Corrector Method.

Total Hours: 60

Text Books:

1 Kreyszig. E, “Advanced Engineering Mathematics” Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore 2014.
2 Grewal. B.S, “Higher Engineering Mathematics”, 43rd edition, Khanna Publications, Delhi, 2014.
3 N.P.Bali and Dr.ManishGoyal, “A Text book of Engineering Mathematics” 8th edition, Laxmi publications ltd, 2011.

Reference Books:

1 Veerarajan. T, “Engineering Mathematics for first year”, 3rdedition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2011.
2 Glyn James, “Advanced Modern Engineering Mathematics”, Pearson Education, 4th edition, 2012.
3 Jain M.K. Iyengar, K & Jain R.K., “Numerical Methods for Scientific and Engineering Computation”, New Age International (P) Ltd, Publishers 2013.

Web References:

1 http://www.nptel.ac.in/courses/111105035
2 http://www.nptel.ac.in/courses/122104017
3 http://nptel.ac.in/courses/122102009
4 http://nptel.ac.in/courses/111107063

Online Resources:

1 https://www.coursera.org/learn/linearalgebra2
2 https://www.coursera.org/learn/differentiation-calculus
3 https://www.coursera.org/learn/single-variable-calculus
4 https://alison.com/courses/Algebra-Functions-Expressions-and-Equations

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**Marks**
C101.1	Remember	Classroom or Online Quiz	**5**
C101.2	Understand	Class Presentation/Power point presentation	**5**
C101.3	Apply	Group Assignment	**5**
C101.4	Apply	Group activities	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom’s Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	50	50	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

17CH101 **ENGINEERING CHEMISTRY** **3 /0 /2 /4**

Nature of Course: E (Theory skill based)

Pre requisites : NIL

Course Objectives:

1. To make the students conversant with boiler feed water requirements, water treatment techniques, the principles and applications of electrochemistry.
2. To understand the working principles of electrodes and the significances of various component analyzer.
3. To learn the effect of corrosion in materials and the methods for prevention of corrosion.
4. To acquire knowledge in applications of plastics and rubber in engineering field.
5. To understand the concepts of photophysical and photochemical processes in spectroscopy
6. To gain knowledge about non conventional the energy sources, fuel cells and storage Devices.

Course Outcomes:

Upon completion of the course, students shall have ability to:

C101.1	Recall the requirements of boiler feed water, water treatment procedures for industries.	[R]
C101.2	Understand the working principle of Ion Selective Electrodes, pH electrodes and conductivity meters as an analyzer.	[U]
C101.3	Apply the various corrosion control techniques in real time industrial environments.	[A]
C101.4	Use the knowledge of polymers, various energy sources and storage devices in engineering field.	[U]
C101.5	Understand the principle and working of certain analytical techniques	[U]
C101.6	Solve theoretical problems based on the concepts acquired from the module in various engineering field.	[A]

Course Contents:

Water Treatment-Boiler feed water–Requirements-disadvantages of hard water - demineralization process– desalination-reverse osmosis. Applied electrochemistry: Electrochemical cells – electrolytic cell-reversible and irreversible cells -electrode potential - single, standard - oxidation and reduction potentials - emf of a cell - emf series–significances-pH measurement, glass electrodes, hydrogen electrodes, and reference electrodes.

Corrosion and its control: Mechanism - types–galvanic corrosion–differential aeration–pitting corrosion – factors-Corrosion control–cathodic protection–corrosion inhibitors-protective coatings–electroplating -electroless plating. Engineering polymers: Polymerisation -free radical mechanism-Plastics- types-preparation, properties and uses of PTFE- Polyurethane - Poly Carbonate -Nylon 6,6 and Nylon 6 - Rubber-Vulcanization of rubber-synthetic rubber -Butyl rubber and SBR.

Spectrophotometry: Beer-Lambert law – UV Visible – IR Spectrophotometers – Flame emission photometers - Atomic absorption spectrophotometers. Energy Sources: Nuclear energy- reactor-breeder reactor- Photovoltaic cells-Wind energy -Fuel cells. Storage Devices: Batteries- alkaline - Lead acid, nickel cadmium and lithium-TiS_2 batteries.

Lab Component

1	Water hardness	[E]
2	Alkalinity	[E]
3	Chloride content	[E]
4	Dissolved oxygen in water	[E]
5	pH meter	[E]
6	Conductivity meter	[E]
7	Potentiometer	[E]
8	Spectrophotometer	[E]
9	Electroplating of Nickel	[E]
10	Corrosion rate of a metal	[E]

Total Hours: 90

Text Books:

1. Dara S.S, Umare S.S, “Engineering Chemistry”, S. Chand & Company Ltd., New Delhi 2013.
2. N.Krishnamurthy,Vallinayagam D, “Engineering Chemistry” PHI Learning Pvt Ltd.,2014
3. R.V.Gadag, A.NithyanandaShetty “Engineering Chemistry” 3rd edition PHI Learning Pvt Ltd.,2014

Reference Books:

1. ShikhaAgarwal., “Engineering Chemistry and Applications”, Cambridge University press, 2016.
2. Liliya.,Bazylak.I.,Gennady.E.,Zaikov.,Haghvi.A.K.,”Polymers and Polymeric Composites” CRC Press,2014.
3. Lefrou.,Christine.,Fabry.,Pierre.,Poignet.,Jean-claude.,”Electrochemistry - The Basics, with examples” 2012 ., Springer.
4. Zaki Ahmad, Digby Macdonald, “Principles of Corrosion Engineering and Corrosion Control”, Elsevier Science, 2nd Edition 2012.
5. Perez, Nestor,”Electrochemistry and Corrosion Science”, Springer, 2016.
6. Ghazi A.Karim. “Fuels, Energy and the Environment”, CRC Press, Taylor and Francis group, 2012.

Web References:

1. http://www.analyticalinstruments.in/home/index.html
2. www.springer.com › Home › Chemistry › Electrochemistry
3. https://www.kth.se/.../electrochem/welcome-to-the-division-of-applied-electrochemistry
4. www.edx.org/
5. https://www.ntnu.edu/studies/courses
6. www.corrosionsource.com/

Online Resources:

1 nptel.ac.in/courses/105104102/hardness.htm
2 https://ocw.mit.edu/courses/chemistry
3 nptel.ac.in/courses/105106112/1_introduction/5_corrosion.pdf https://alison.com
4 - Spectroscopic technique, Colorimetry
5 https://ocw.mit.edu/courses/chemistry
6 nptel.ac.in/courses/113108051

Assessment Methods & Levels (based on Blooms' Taxonomy)					
Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Practical**	
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	**Rubric based CIA [40 Marks]**	
Remember	30	30	30	10	20
Understand	60	50	40	20	50
Apply	10	20	30	40	30
Analyse	-	-	-	30	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

17MT201 **TECHNICAL DRAWING** **1/0/3/3**

Nature of Course : (H) Theory technology

Pre requisites : Basic mathematical knowledge.

Course Objectives:

1. To develop in students, the visual science in the form of technical graphics.
2. To make them learning theory of orthographic projections of points, lines, planes and solids as per the BIS codes prevalent to drawing practice.
3. To develop in students the technical drafting skills of the engineering drawing concepts, ideas and design of engineering products.
4. To familiarize students in technical drawing standards.

Course Outcomes:

Upon completion of the course, students shall have ability to

C201.1	Read the projections of complex objects.	[R]
C201.2	Understand the different techniques of engineering drawing.	[U]
C201.3	Apply their visualization skills for developing new products.	[A]
C201.4	Imagine 3D objects from the given 2D diagram.	[E]

Course Contents:

Elements of dimensioning and systems of dimensioning; Geometric Constructions and Engineering Curves: Conic sections -parabola, ellipse and hyperbola. Special curves-Involutes, helix and Cycloidal curves.

Orthographic projections: First Angle Projections; Projection of straight lines; lines inclined to both HP and VP. Projection of Solids.Sections of Solids: Sectional views and true shape of the section.

Development of Surfaces: Methods of developments, development of various solid.Isometricprojection of simple solids. Introduction to design software.

Total Hours: 45

Text Books:

1. Venugopal.K, PrabuRaja.V, “Engineering Graphics” New Age International Publishers, 13th Edition, 2014
2. Shah.M.B and Rana.B.C, “Engineering Drawing”, Pearson Education, 2014.

Reference Books:

3. D. Natarajan.K.V, “A textbook of Engineering Graphics”, Dhanalakshmi Publishers, 2nd Edition, 2011.
4. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2014.

Web References:

1 http://nptel.ac.in/courses/112104172/

2 http://iitmweb.iitm.ac.in/phase2/courses/112104172/19

Online Resources:

1 www.engineeringdrawing.
2 https://ocw.mit.edu/courses/mechanical-engineering/2-007-design-and-manufacturing

Assessment Methods & Levels (based on Blooms' Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C201.1	Remember	Test	**5**
C201.2	Understand	Writing Skills	**5**
C201.3	Apply	Group assignment	**5**
C201.4	Evaluate	Project	**5**

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	10	10
Understand	40	30	30	30
Apply	40	40	30	30
Analyse	-	-	-	-
Evaluate	-	20	30	30
Create	-	-	-	-

17MT202 **APPLIED MECHANICS** **4/1/0/4**

Nature of Course:G (Theory analytical)

Pre Requisites : Fundamentals of basic mathematics and Physics

Course Objective:

1. To make the students understand the vector and scalar representation of forces and moments and the static equilibrium of particles and rigid bodies, effect of friction on equilibrium, laws of motion, kinematics of motion and the inter relationship.
2. To make the students understand the properties of surfaces and solids, prediction of behaviour of particles and rigid bodies under motion

Course Outcomes:

Upon completion of the course, students shall have ability to
C202.1: Define the law of mechanics and various theorems. [R]
C202.2: Understand the centroid or centre of gravity and moment of inertia. [U]
C202.3: Apply the equilibrium concept to force systems of particle or solids in 2D and 3D and also kinematic and kinetics of particles. [AP]
C202.4: Analyze the practical problems using free body diagrams. [AN]

Course Contents:

System of forces- Laws of Mechanics– scalars and vectors- Resolution and Resultant of Coplanar concurrent Forces; Equilibrium of a particle in two dimensions and in space; Moment of a force - Equivalent system of forces – Reduction of system of forces into single force and couple; Free body diagram and type of supports and reaction- Equilibrium of rigid bodies in two dimensions.

Simple Trusses- method of joints; Frames and machines; Centroid of Common Shapes of Area-Centroid And Area Moment of Inertia of Composite Areas (Rectangle, triangle, circle, quarter and semicircle) by using Standard formula. Parallel axis and perpendicular axis theorems, Polar moment of inertia; Centre of gravity of 3D composite bodies by using standard formula; Mass Moment of Inertia of Composite Bodies (Prismatic, Cylindrical and conical solids only); Principle Moments of Inertia of an area.

Dynamics: Displacements, Velocity and acceleration of uniform and uniformly accelerated rectilinear motion of particles; Motion of particles under Gravity; Relative motion analysis; Curvilinear motion- Tangential and normal components of acceleration; Motion of projectile; Newton's laws of motion- Work Energy Equation– Impulse and Momentum; Direct central impact of elastic bodies; Types of Friction-Laws; Simple contact and ladder friction; screw jack and friction plate clutches; Kinematics of rigid bodies – Translation and Rotation of Rigid Bodies – Fixed axis rotation- Velocity; General Plane motion –absolute and relative velocity and acceleration. Kinetics of rigid bodies- work done by a couple- impulse and momentum – Motion of vehicles; Lifting machines.

Total Hours : 60

Text Books:

1. Dr. H. J. Shah and S. B. Junnarkar, "Applied Mechanics", Charotar Publishing House Pvt. Ltd, Gujarat, India, 2013
2. F.P. Beer, and Jr. E.R Johnston, "Vector Mechanics for Engineers–Statics and Dynamics", Tata McGraw Hill Publishing Company, New Delhi, 2015.

Reference Books:

1. N.Kottiswaran, “Engineering Mechanics Statics and Dynamics”, Sri Balaji Publications, 2013
2. Irving H. Shames, “Engineering Mechanics-Statics and Dynamics”, Pearson Education Asia Pvt.Ltd., 2011

Web References:

1. www.googleweblight.com
2. http://www.myengineeringmechanics.com

Online Resources:

1. https://www.edx.org/course/engineering-mechanics-urfux-engm1-1-x
2. https://www.edx.org/course/mechanics-review-mitx-8-mrevx

Assessment Methods & Levels (based on Bloom’s Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**Marks**
C202.1	Remember	Test (Definition)	**5**
C202.2	Understand	Online Quiz	**5**
C202.3	Apply	Problem Solving	**5**
C202.4	Analyse	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom’s Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	15	15
Understand	40	20	30	30
Apply	40	40	40	40
Analyse	0	30	15	15
Evaluate	0	0	0	0
Create	0	0	0	0

17MT203 PRODUCTION TECHNOLOGY LABORATORY 0/0/3/2

Nature of Course : L (Problem experimental)

Co requisites: Nil

Course Objectives:

1. To familiarize students with the basic concepts of manufacturing processes
2. To expose hands-on training to the students by various experiments using machines like lathe, Shaper, Milling, drilling and grinding machines.

Course Outcomes:

Upon completion of the course, students shall have ability to

C203.1	Perform various turning operations on a given component using Lathe	[AP]
C203.2	Produce flat surface on the given component using milling, shaper and slotting machines	[AP]
C203.3	Improve surface finish in the given components using grinding machines	[AN]
C203.4	Apply and fabricate related mini projects.	[C]

Course Contents:

1. Introduction- lathe machine, plain turning, Step turning & grooving (Including lathe mechanisms, simple problems)
2. Make a Taper turning using compound rest method for the given diagram (Different degree of taper for each student)
3. Do an external threading in a lathe and mate it with the given nut (The pitch will vary for each student)
4. Make an internal and external dovetail using shaping machine and mate both.
5. Perform a Grinding (Cylindrical /Surface) and study the parameters that affects the surface finish.
6. Produce spur gears using Milling machine for different module.
7. Perform a drilling operation to make the shaft fit into the hole.
8. Mini Project work- Application oriented products using above experiments

Note: Calculation of Production cost – Sum of raw material cost, machining cost, labor cost, Power cost and Overhead charges, for mini project.

Total Hours: 45

Reference Books:

1 Kalpakjian, S., “Manufacturing Engineering and Technology”, Pearson education India, 4th edition,2012

2 HajraChoudhury, S.K., and HajraChoudhury, A.K., “Elements of Workshop Technology”, Volume I and II, Media Promoters and Publishers Private Limited, Mumbai, 2011.

Web References:

1 www.allaboutcircuits.com

2 www.circuitstoday.com

Online Resources:

1 http://iitb.vlab.co.in/?sub=43&brch=2211
2 http://vlab.amrita.edu/?sub=1&brch=282

Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	-	-
Understand	-	-
Apply	50	50
Analyse	30	30
Evaluate	-	-
Create	20	20

17MT204 **ENGINEERING GRAPHICS LABORATORY** **0/0/3/2**

Nature of Course: M (Practical application)

Co requisites: 17MT201 – Technical Drawing

Course Objectives:

1. To know the method to construct the conic curves used in Engineering Applications.
2. To develop an understanding of Isometric to Orthographic Views and vice versa.
3. To learn the basic projection of straight lines and plane surfaces.
4. To develop the imagination of solids inclined to one reference planes.
5. To know the sectioning of solids and development of surfaces used in various fields

Course Outcomes:

Upon completion of the course, students shall have ability to

C204.1:	Understand the basic concepts of Engineering Graphics.	[U]
C204.2:	Create isometric, orthographic projections and projection of lines and planes.	[C]
C204.3:	Develop section of solids including cylinders, cones, prisms and pyramids.	[C]
C204.4:	Construct projections of lines, planes, solids, isometric projections and sections of solids using Solid works.	[C]

Course Contents:

Software used: Auto CAD

1. Creation of simple component using Drawing and Modifying commands.
2. Drawing front, top and side views of isometric drawings.
3. Drawing front and top views of Plane surfaces (Hexagon, Pentagon and circle) inclined to HP
4. Drawing front and top views of Plane surfaces (Hexagon, Pentagon and circle) – Inclined to VP.
5. Drawing front and top views for a prism and a pyramid.
6. Drawing front and top views for a cone and a cylinders – Inclined to HP/VP
7. Drawing Sectional views of a prism and a pyramid
8. Drawing sectional views of a cone and a cylinder with Section plane Inclined to HP/VP
9. Drawing the development of Surfaces of a prism and a pyramid.
10. Drawing the development of Surfaces of a cone and a cylinder.
11. Create a model of simple machine components using CREO.

Total Hours: 45

Reference Books:

1 Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2013.

2 Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, 50th Edition, 2014.

3 Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2011.

Web References:

1. http://nptel.ac.in/courses/112102101/
2. www.autocad.com

Online Resources:

1 https://www.lynda.com/AutoCAD-training-tutorials/160-0.html

2 http://iclasstrainingcoimbatore.in/cad-cam-training-in

Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment[60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	0	0
Understand	20	20
Apply	0	0
Analyse	0	0
Evaluate	0	0
Create	80	80

SEMESTER II

17EN002 TECHNICAL COMMUNICATION SKILLS II 3/0/2/4

Nature of Course: Theory

Pre Requisites:BEC Preliminary

Course Objectives:

1. To develop the prominence of listening and reading practices using authentic business vocabulary.
2. To instill analytical thinking and logical reasoning to enhance LSRW skills in Business related situations.
3. To urge the need of effective communication in corporate sector with Business English.
4. To prepare students for competitive program like BEC, IELTS, TOEFL.

Course Outcomes:

Upon successful completion of this course, the student will be able to:

C002.1: Remember LSRW skills and employ cross-cultural communication in business related situations. [R]
C002.2: Understand and gain proficiency with business vocabulary. [U]
C002.3: Apply Task- Based activity to enhance an effective communication. [Ap]
C002.4: Analyse and apply Business English in working environment. [Ap]

Course Contents:

LISTENING
Taking and Leaving Voice mail messages –Identifying the information before listening- Inferring ideas- Listening to short monologues -Longer listening tasks -Recognise functions. **(CO1/R, U, AP/Extempore)**
SPEAKING
Expressing hypothetical Situations – Expressing obligation -Aspects of business – Giving examples- Giving reasons- Giving extra information- Presentation at a business meeting- Connecting ideas- Collaborative task – Short talk on a business topics- Film Reviews. **(CO2/R, U, AP/Technical presentation)**
READING
Science texts- Terms related about science and scientists - Scanning for specific information- Understanding cohesive features - Skimming the reading comprehensions - Interpret opinions and ideas expressed – Collocations - Identifying dependent preposition - Identifying the extra words. **(CO3/R, U, AP/Mini presentation)**
WRITING
Definitions, Extended Definitions -Letter writing (accepting and declining invitations)- Internal communication (notes/memo/E-mail writing to the head of the department, colleague, assistant , staff in the department etc) Report writing- Business proposal- circular- agenda and minutes- Appropriate linking words- Report Phrases - Asking for Information and Making Suggestions- Transcoding (Bar Chart, Flow Chart)- Letter for calling quotations, Replying for quotations- Placing an order and complaint letter. (**CO1, CO2, CO3 CO4/R, U, AP/Group Discussion)**.
PARTS OF SPEECH
Tenses - Adjectives - Adverbs - Articles- Modal verbs, Active and Passive, Impersonal Passive voice, Homophones- Homonyms- Acronyms- Abbreviations- British and American words- Comparatives and Superlatives- Gerunds- infinitives – Participles - Modal Verbs - Relative Pronouns- Reported Speech - Indirect Questions- Spotting errors.

LABORATORY COMPONENTS				
EXP NO.	**NAME OF THE EXPERIMENT**	**TEXT BOOK**	**PAGES**	**LAB HOURS**
1	**MINI PRESENTATION**	**T2**	**117-130**	**3**
2	**LOGICAL REASONING AND ETHICS IN A GIVEN SITUATION**	**T2**	**91-100**	**3**
3	**TECHNICAL PRESENTATION**	**T2**	**195-213**	**3**
4	**GROUP DISCUSSION**	**T2**	**165-187**	**3**
5	**EXTEMPORE**	**T2**	**117-130**	**3**

Total Hours: 60

Text Books:

1. Whitby, Norman. Cambridge University Press- Students Book. 2013.
2. Rizvi Ashraf M , “Effective Technical Communication”, McGraw Hill Education (India) Private Limited , 2016
3. Dr.Sumanth S, “English for Engineers”, Vijay Nicole Imprints Private Limited, 2015.

Reference Books:

1. Wood, Ian, Paul Sanderson, Anne Williams with Marjorie Rosenberg, Pass Cambridge BEC Vantage, Cengage learning. Second Edition. 2014.
2. Gunasekaran S, ‘A Text and Workbook of Technical English II”, UnitedGlobal Publishers, June 2010.
3. Lewis, Norman, Word Power Made Easy, Pocket Books, New York, 1979.

Web References:

1. http://www.cambridgeindia.org
2. http://www.cambridgeenglish.org/exams/business-certificates/business-vantage
3. https://**steptest**.in

Online Resources:

1.https://www.coursera.org/specializations/business-english

2. http://www.academiccourses.com/Courses/English/Business-English

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**Marks**
C002.1	Remember	Extempore	**5**
C002.2	Understand	Mini presentation	**5**
C002.3	Apply	Technical presentation	**5**
C002.4	Apply	Group Discussion	**5**

Blooms Taxonomy based Assessment Pattern:

Bloom’s Category	**Continuous Assessment Tests**			**Semester End Examination**
	CIA1	**CIA2**	**Term Examination**	
Remember	30	20	20	20
Understand	30	30	30	30
Apply	40	50	50	50
Analyse	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

16MA102/ 17MA102 INTEGRAL CALCULUS AND LAPLACE TRANSFORMS 3/2/0/4

Nature of Course : J (Problem analytical)

Pre requisites : Basics of integration

Course Objectives:

1. To gain knowledge in improper integrals, Gamma and Beta functions which are needed in engineering applications
2. To develop logical thinking and analytical skills in evaluating multiple integrals
3. To acquaint with the concepts of vector calculus needed for problems in all engineering disciplines
4. To apply numerical methods to evaluate integrals when the function in the analytical form is too complicated or the huge amounts of data are given such as series of measurements, observations or some other empirical information
5. Solve the differential equations using Laplace transform technique

Course Outcomes:

Upon completion of the course, students shall have ability to

C102.1	Recall basic integration formulae, scalar and vector point function concepts	[R]
C102.2	Differentiate and integrate vector point functions	[U]
C102.3	Evaluate integrals using Beta and Gamma functions	[AP]
C102.4	Evaluate double integral and triple integral to compute area, volume for two dimensional and three dimensional solid structure	[AP]
C102.5	Find the gradient, divergence and curl of vector point functions and related theorems useful for evaluation of engineering problems	[AP]
C102.6	Apply the Laplace transform technique to solve ordinary differential equations	[AP]

Course Contents:

Definite integrals-Evaluation of definite integrals using Bernoulli's formula-Beta and Gamma Integrals- Relation between Beta and Gamma Functions-Evaluation of Integrals using Beta and Gamma Functions-**Multiple integrals** - Double integration in Cartesian coordinates – Area as double integral –Change the order of integration-Triple integration in Cartesian co-ordinates –Volume as triple integral.

Vector calculus - Vector differential operator- Gradient of a scalar point function - Directional derivatives –Divergence and Curl of a vector point function – Irrotational and solenoidal vector fields –Simple problems– Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stoke's theorem(statements)– Simple applications involving cubes and rectangular parallelopipeds-**Numerical integration -** Trapezoidal rule – Simpson's 1/3 and 3/8 rules – Two and three point Gaussian Quadrature formulae –Trapezoidal rule and Simpson's rule to evaluate double integrals.

Laplace transform –Conditions for existence – Transform of elementary functions – Basic properties (without proof) – Derivatives and integrals of Laplace transform -Transforms of derivatives and integrals - Periodic functions - **Inverse Laplace transform**-Partial fraction method - convolution theorem , Initial and Final value theorems (statements)– Problems - Solution of second order differential equations with constant coefficients.

Total Hours: 60

Text Books:

1 Kreyszig. E, “Advanced Engineering Mathematics” Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore , 2014
2 Grewal. B.S, “Higher Engineering Mathematics”, 43rd edition, Khanna Publications, Delhi, 2014
3 N.P.Bali and Dr.ManishGoyal,”A Text book of Engineering Mathematics” 8th edition Laxmi publications ltd, 2011

Reference Books:

1 Veerarajan. T, “Engineering Mathematics for first year”, 3rdedition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2011
2 Glyn James, “Advanced Modern Engineering Mathematics”, Pearson Education, 4th edition, 2012
3 Jain M.K. Iyengar, K & Jain R.K., Numerical Methods for Scientific and Engineering Computation, New Age International (P) Ltd, Publishers 2013

Web References:

1 http://nptel.ac.in/video.php?subjectId=122107037
2 http://nptel.ac.in/courses/122107036/
3 http://nptel.ac.in/video.php?subjectId=117102060

Online Resources:

1 https://www.coursera.org/learn/pre-calculus
2 https://www.coursera.org/learn/linearalgebra1
3 https://alison.com/courses/Advanced-Mathematics-1
4 https://www.edx.org/course/algebra-lineal-mexicox-acf-0903-1x.
5 https://www.edx.org/course?search_query=laplace+transform

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**Marks**
C102.1	Remember	Classroom or Online Quiz	2
C102.2	Understand	Class Presentation/Power point presentation	4
C102.3, C102.4	Apply	Group Assignment	7
C102.5,C102.6	Apply	Group activities	7

Summative assessment based on Continuous and End Semester Examination				
Bloom’s Level	**Continuous Assessment**			**End Semester Examination**
	CIA1	**CIA2**	**Term End Assessment**	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	50	50	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

16PH103/ 17PH101 **ENGINEERING PHYSICS** **3/0/2/4**

Nature of Course: E (Theory skill based)

Pre requisites: Nil

Course Objectives:

1. To learn the basic concepts of physics needed for all branches of engineering
2. To understand the concepts and working principles of laser, fibre optics, quantum physics and crystal physics.
3. To identify suitable materials to be used in the engineering field.
4. To implement and visualize theoretical aspects in the laboratory
5. To familiarize the students to handle various instruments and equipment

Course Outcomes:

Upon completion of the course, students shall have ability to

C101.1	Recall the basic concepts of laser, fibre optics and quantum physics used in various engineering applications	[R]
C101.2	Understand the crystal structure of the various materials	[U]
C101.3	Understand the fundamental concepts of electrical and magnetic properties of materials.	[U]
C101.4	Interpret the behaviour of nanomaterials and shape memory alloys	[U]
C101.5	Apply the gained knowledge to solve the problems related to their field of study	[AP]

Course Contents:

Laser: Principle of absorption and emission - Types of laser: CO_2, Nd-YAG, semiconductor laser - Industrial applications - Holography. Fiber optics: Principle and propagation– numerical aperture and acceptance angle – classification of optical fibers - splicing - fiber optic communication system - light source - PIN detector. Fiber optic sensors: temperature and displacement. Quantum mechanics: Matter waves, de-Broglie wavelength, uncertainty principle – Schrödinger's wave equation – time independent and time dependent - physical significance - particle in a one dimensional potential box.

Conducting materials: Classical free electron theory of metals - Electrical and thermal conductivity- Wiedemann-Franz law - Band theory of solids-Fermi distribution function – Effect of temperature on Fermi function. Semiconducting materials: Intrinsic and extrinsic semiconductors – carrier concentration derivation – Fermi level – variation of Fermi level with temperature in intrinsic – electrical conductivity for intrinsic semiconductor – Band gap determination – Hall effect. Magnetic materials: Origin of magnetic moment –ferro magnetic material – domain theory – hysteresis – soft and hard magnetic materials – Ferrites.

Dielectric materials: properties- Electronic and ionic polarisation – frequency and temperature dependence – internal field-Claussius-Mosotti relation-dielectric loss –dielectric breakdown mechanisms - ferro electric materials – piezo electric materials - insulating materials - applications. Crystallography: Atomic packing factor for SC, BCC, FCC and HCP structures – miller indices. Advanced materials: Shape memory alloys-characteristics - properties of Ni-Ti alloy. Characterisation techniques: SEM, TEM and X-ray diffraction. Nanomaterials: Properties – synthesis techniques: ball milling, chemical vapour deposition and sol-gel method. Carbon nanotubes: structure - properties and applications.

Lab Component

1	Laser and optical fiber parameters	[E]
2	Lattice constant using x-ray diffraction pattern	[E]
3	Specific resistance-Carey Foster's Bridge	[E]
4	Band gap of a semiconductor	[E]
5	Characteristics of a solar cell /Photo diode	[E]
6	Thermal conductivity of a bad conductor	[E]
7	Young's modulus	[E]
8	Rigidity modulus	[E]
9	Thickness of a thin material using air wedge	[E]
10	Coefficient of viscosity for a liquid	[E]

Total Hours: 90

Text Books:

1. R. K. Gaur and S.C. Gupta, "Engineering Physics",DhanpatRai Publications (P) Ltd, New Delhi, 2014.
2. Rajendran, V "Engineering Physics", McGraw Hill Publications ltd, New Delhi, 2014.

Reference Books:

1. Serway and Jewett, "Physics for Scientists and Engineers with Modern Physics", 6th Edition, Thomson Brooks/Cole, Indian reprint (9th Edition) 2013.
2. M.N.Avadhanulu, P.G. Kshirshagar, "A Text Book of Engineering Physics",S.Chand& Co Ltd, 2016.
3. P.K. Mittal, "Applied Physics", I.K. International Publishing House pvt.Ltd, 2013

Web References:

1. http://www.nanotech-now.com/Nanomat-Preso2.pdf
2. http://nptel.ac.in/courses/108106073
3. https://www.corning.com/in/en/products/communication-networks/.../fiber.html
4. https://physics.stanford.edu/node/201
5. https://www.amazon.com/Semiconductor-Materials-Physical...References/.../0849389...
6. https://books.google.co.in/books?isbn=1482238888
7. https://www.generalplastics.com/polyurethane-foam-dielectric-materials-f...
8. https://www.asme.org/.../nanotechnology/carbon-nanotube-super-fabric
9. https://web.iit.edu/.../web/.../Academic%20Resource%20Center/.../Miller...
10. https://www.boundless.com/physics/.../the-hall-effect-559-10926/

Online Resources:

1. https://www.coursera.org/learn/ap-physics-1
2. www.cleanroom.byu.edu › Semiconductor Properties
3. https://www.urmc.rochester.edu › ... › Our Resource Laboratories
4. https://www.jic.ac.uk/microscopy/links.html
5. https://www.merlot.org/merlot/materials.htm
6. www.fiberopticsonline.com/
7. https://ocw.mit.edu/courses/physics/8-04-quantum-physics-i-spring-2013/

Assessment Methods & Levels (based on Blooms' Taxonomy)					
Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Practical**	
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	**Rubric based CIA [40 Marks]**	
Remember	30	20	30	10	20
Understand	60	60	60	20	60
Apply	10	20	10	40	20
Analyse	-	-	-	30	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

17MT205 PRODUCTION TECHNOLOGY 4/0/0/3

Nature of Course: H (Theory Technology)

Pre requisites : 17MT201 Technical Drawing

Course Objectives:

1. To understand the various methods of manufacturing processes.
2. To develop the knowledge about the working principles of machines and their process capabilities.
3. To perform the different manufacturing processes.
4. To estimate the production cost for a given operation.

Course Outcomes:

Upon completion of the course, students shall have ability to

C205.1	Select the most appropriate manufacturing process for a given material and product.	[R]
C205.2	Interpret how a machine works	[U]
C205.3	Calculate the production cost for various manufacturing processes.	[AP]
C205.4	Decide the process parameters for different manufacturing processes.	[A]

Course Contents:

Introduction to manufacturing processes - Moulding materials. Patterns: Types and materials. Cupola and Induction furnace. Sand casting, Investment casting, pressure die casting, centrifugal casting, continuous casting, Casting defects.

Forging, rolling, Extrusion and wire drawing, Sheet metal working, Spinning, Swaging. Powder metallurgy and its applications, Brazing, soldering and welding; Resistance welding, arc welding; submerged arc welding, inert gas welding: Welding defects, inspection.

Lathe, milling, shaping, slotting, planing, drilling, boring, broaching, grinding, thread rolling and gear cutting machines.
Introduction to Digital Manufacturing

Total Hours: 45

Text Books:

1 SeropeKalpakijian , “Manufacturing Processes”, Pearson Education, 2012
2 HajraChoudhury, “Elements of Workshop Technology”, Vol. I and II, Media Promoters and Publishers Pvt., Ltd., Mumbai, 2012

Reference Books:

1 MJ Rao, “Manufacturing Technology: Foundry, Forming and Welding”, Tata McGraw Hill, 2012
2 G Boothroyd, “Fundamentals of Metal Cutting Machine Tools”, Tata McGraw Hill, 2009

Web References:

1 http://nptel.ac.in/courses/webcourse-contents/iit-roorkee/manufacturing-processes/
2 http://nptel.ac.in/courses/112105126/

Online Resources:

1 https://www.edx.org/course/fundamentals-manufacturing-processes-mitx-2-008x
2 https://www.canvas.net/manufacturing

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C205.1	Remember	Test (Definition)	**5**
C205.2	Understand	Online Quiz	**5**
C205.3	Apply	Problem Solving	**5**
C205.4	Analyse	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	15	15
Understand	40	20	30	30
Apply	40	40	40	40
Analyse	0	30	15	15
Evaluate	0	0	0	0
Create	0	0	0	0

17MT301 ELECTRICAL, ELECTRONIC DEVICES AND CIRCUITS 3/0/0/3

Nature of Course:C (Theory concepts)

Pre Requisites : Nil

Course Objectives:

1. To familiarize the basic concepts of electrical circuits and associated theorems.
2. To understand the fundamentals semiconductors devices.
3. To design various combinational and sequential logic circuits using logic gates.

Course Outcomes:

Upon completion of the course, students shall have the ability to

C301.1	Explore their acquired knowledge of electric circuits	[R]
C301.2	Describe various semiconductor devices.	[U]
C301.3	Explain the basic concepts of number systems and Boolean algebra.	[U]
C301.4	Apply the digital logic concept and design various combinational and sequential logic circuits.	[AP]

Course Contents:

Electrical and Electronics Circuits: KCL, KVL, Node and Mesh analysis, Thevenin's theorem, Norton's theorem, Superposition theorem, power and power factor in ac circuits.

ElectronicDevices: P-N junction, Zener diode, BJT, MOSFET, LED, photoconductive cell, photo diode, phototransistor, opto-isolator and solar cell; op-amps, inverting and non-inverting amplifiers.

Digital logic circuits: Number systems; Boolean algebra, minimization of functions using Boolean identities and K-map, logic gates and their static CMOS implementation.Combinational logic circuits: Code converters, multiplexers and decoders.Sequential circuits: Latches and flip-flops, counters and shift-registers.

Total Hours: 45

Text Books:

1. Edward Hughes, ""Electrical and Electronic Technology", 12th Edition, Pearson, Newyork, 2014
2. M. Morris Mano, Michael D. Ciletti, "Digital Design", Pearson, Newyork, 2013

Reference Books:

1. John Bird, "Electrical and Electronic Principles and Technology", 5th Edition, Routledge, UK, 2013.
2. Thomas L. Floyd, "Electronic Devices-Conventional current version", 10th Edition Pearson, Newyork, 2017
3. Anil K. Mani, "Digital Electronics: Principles, Devices and Applications", Wiley, New Jersy, 2007

Web References:

1. www.allaboutcircuits.com
2. www.circuitstoday.com

Online Resources:

1. http://www.electronics-tutorials.ws
2. http://www.electrical4u.com/digital-electronics.htm
3. http://www.technologystudent.com/elec1/dig1.htm

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C301.1	Remember	Test	**5**
C301.2	Understand	Writing Skills	**5**
C301.3	Understand	Online Quiz	**5**
C301.4	Apply	Problem solving	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	50	20	30	30
Understand	50	40	30	30
Apply	-	40	40	40
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

17MT206 BASIC MECHATRONICS LABORATORY 0/0/3/2

Nature of Course : M (Practical application)

Co requisites : Nil

Course Objectives:

1. To learn the use of basic hand tools and to know the need for safety in work place and to gain hands on experience on Carpentry, Fitting, Sheet metal, Plumbing, welding and Foundry.
2. To learn about basic electrical devices, meters and Electronics devices and meters and to gain knowledge about the fundamentals of various electrical and electronic gadgets, basic electronic instruments, their working and trouble shooting.
3. To gain knowledge about the basics of computer hardware and various operating systems

Course Outcomes:

Upon completion of the course, students shall have ability to

C206.1	Identify, formulate and solve the basic engineering problems at home and in workplace	[R,U,AP]
C206.2	Develop the surfaces and make simple components like tray, cylinder, funnel etc.	[C]
C206.3	Make simple metal joints using welding equipment and wooden joints using carpentry tools.	[AP]
C206.4	Prepare pipe connections and sand moulds	[AP]
C206.5	Examine and troubleshoot electrical and electronics circuits	[A]
C206.6	Identify various computer parts and learn to operate the various operating systems in computers.	[E]

Course Contents:

1. Fabrication of rectangular tray, cylindrical container and cone
2. Preparation of butt, lap and T joint using welding (Arc, MIG,TIG)
3. Preparation of Cross lap joint and T joint using carpentry tools
4. Preparation of connection of basic pipe lines
5. Preparation of Sand mould (Solid and Split Pattern)
   Study of sensors.
6. Troubleshooting of electrical and electronics components
7. Preparation of Residential wiring.
8. Soldering of electronic circuits
9. Operation of Cathode Ray Oscilloscope
10. PC Repair Fundamentals
11. Hard disk Partitioning, Installing Windows OS, Linux & Maintaining Windows OS, Linux and Disk De fragmentation.
12. Upgrading Memory and Hard Drives, Securing the PC and LAN.

Total Hours: 45

Reference Books:

1. S.Suyambazhahan “Engineering Practices Laboratory Manual” PHI Learning, Second Edition, 2011.
2. Sekhar Dash &K.Vijayakumar, “Electrical Engineering Practice Lab Manual”, Vijay Nicole Imprints Private Ltd., First Edition, 2013.
3. Scott Mueller “Upgrading and Repairing PCs”, 22nd Edition, QUE, Pearson Education, New Delhi, 2015.

Web References:

1. http://www.allaboutcircuits.com/education/
2. http://www.nptel.ac.in/courses/112107090/
3. nptel.ac.in/courses/112101005/14

Online Resources:

1 http://www.electrical4u.com/
2 http://vlab.co.in/

Assessment Methods & Levels (based on Bloom’s Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom’s Level	**Rubric based Continuous Assessment [60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	10	10
Understand	10	10
Apply	40	40
Analyse	20	20
Evaluate	10	10
Create	10	10

17MT207 MECHATRONICS MACHINE DRAWING LABORATORY 0/0/3/2

Nature of Course : M (Practical application)

Co requisites : Technical drawing

Course Objectives:

1. To establish the relationship between traditional drafting technique and computer.
2. To develop the ability of 2D drafting using design software.
3. To create a 3D model using modeling software.

Course Outcomes:

Upon completion of the course, students shall have ability to

C207.1	Understand part and assembly drawing of all machine components using CAD software.	[U]
C207.2	Interpret the given 2D drawing.	[A]
C207.3	Apply 2D drafting for industrial applications.	[A]
C207.4	Create a 3D model using the given 2D diagram of an object.	[C]

Course Contents:

1. Part and Assembly drawing of Plummer block.
2. Part and Assembly drawing of IC engine connecting rod.
3. Part and Assembly drawing of Machine vice.
4. Part and Assembly drawing of Stuffing box.
5. Part and Assembly drawing of Lathe tailstock.
6. Two shafts have to be connected for power transmission. Draw the part and assembly drawing of the any one of the components, which can solve this problem.
7. Name a component that can be used to convert rotary motion to linear motion. Draw the part and assembly of that component.
8. Name a component that can be used to lift heavy objects with minimum input. Draw the part and assembly of that component.
9. 3D modeling of Universal coupling
10. 3D modeling of Stuffing box
11. 3D modeling of Screw jack.

Total Hours: 45

Reference Books:

1 K.L Narayana, P.Kannaiah, K.Venkata Reddy, “Machine Drawing”, New Age International (P) Limited, 2013.
2 K. C. JOHN. Text book of Machine Drawing, PHI Publication, 2010.

Web References:

1 http://nptel.ac.in/courses/112103019/
2 http://nptel.ac.in/courses /112104172/

Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment[60 marks](in %)**	**End Semester Examination [40 marks](in %)**
Remember	-	-
Understand	30	30
Apply	0	0
Analyse	50	50
Evaluate	0	0
Create	20	20

SEMESTER III

16MA103/ 17MA103	FOURIER ANALYSIS AND PARTIAL DIFFERENTIAL EQUATIONS	3/2/0/4

Nature of Course : J (Problem analytical)

Pre requisites : 17MA101-Linear Algebra and Differential Calculus
17MA102-Integral Calculus and Laplace Transforms

Course Objectives:

1 To acquaint the student with Fourier transform techniques which are used in variety of engineering fields
2 To study the concept of mathematical formulation of certain practical problems in terms of partial differential equations and solving for physical interpretation
3 To understand the different possible forms of Fourier series and the frequently needed practical harmonic analysis that an engineer may have to make from discrete data
4 To solve boundary value problems encountered in engineering practices using Fourier series
5 To find numerical solution for partial differential equations

Course Outcomes:

Upon completion of the course, students shall have ability to

C103.1	Recall basic integration concepts and partial derivatives	[R]
C103.2	Formulate and solve the partial differential equations	[U]
C103.3	Interpret Fourier series solutions to the engineering problems	[AP]
C103.4	Apply analytical and numerical methods to solve wave and heat equation with boundary conditions	[AP]
C103.5	Use Fourier transforms techniques to evaluate integrals	[AP]

Course Contents:

Fourier Transforms - Complex form of Fourier Transforms -Fourier sine and cosine transforms-Properties(excluding proof)-Transforms of simple functions-Convolution theorem and Parseval's Identity (Statement) – Evaluation of integrals using Parseval's Identity.

Partial Differential Equations - Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions- Solution of non-linear partial differential equations of first order (standard types)- Lagrange's linear equations –Linear homogeneous partial differential equations of second and higher order with constant coefficients.

Fourier series - Dirichlet's conditions- General Fourier Series – Odd and Even Functions-Half range sine series and cosine series –Parseval's Identity- Harmonic analysis-**Applications of Partial Differential Equations -**One dimensional wave equation – One dimensional equation of heat conduction–Fourier series solutions in Cartesian coordinates-**Numerical Solution to PDE-**Finite difference techniques –Laplace equation–Liebmann's Iteration Process-Parabolic Equation –Bender-Schmidt's Difference Equation - Crank-Nicholson'sDifference Equation –Hyperbolic Equation

Total Hours: 60

Text Books:

1 Kreyszig. E, “Advanced Engineering Mathematics” Tenth Edition, John Wiley and Sons (Asia) Limited, Singapore 2014

2 Grewal. B.S, “Higher Engineering Mathematics”, 43rd edition, Khanna Publications, Delhi, 2014.

Reference Books:

1 Veerarajan. T, “Transforms and Partial differential equations”, 2nd edition, Tata McGraw-Hill Publishing Company Ltd., reprint,2015
2 N.P.Bali and Dr.ManishGoyal,”A Text book of Engineering Mathematics Sem-III/IV” 4th edition, Laxmi publications ltd, 2012
3 Glyn James, “Advanced Modern Engineering Mathematics”, Pearson Education, 4th edition, 2012
4 Rajasekaran S., Numerical methods in Science and Engineering – A Practical Approach, 3rd edition, Wheeler Publishing, 2003

Web References:

1 http://nptel.ac.in/video.php?subjectId=122107037
2 http://nptel.ac.in/courses/122107036/
3 http://nptel.ac.in/video.php?subjectId=117102060

Online Resources:

1 https://www.edx.org/course/calculo-diferencial-galileox-cmath001rx
2 https://www.edx.org/course/pre-university-calculus-delftx-calc001x-1
3 https://www.edx.org/course/calculus-1a-differentiation-mitx-18-01-1x
4 https://alison.com/courses/Advanced-Mathematics-1
5 https://ocw.mit.edu/courses/.../18-335j-introduction-to-numerical-methods-fall-2010 /ocw.usu.edu › Electrical and Computer Engineering › Signals and Systems

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C103.1	Remember	Classroom or Online Quiz	2
C103.2	Understand	Class Presentation/Power point presentation	4
C103.3	Apply	Group Assignment	6
C103.4& C103.5	Apply	Group activities	8

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination
	CIA1	CIA2	Term End Assessment	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	50	50	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

16MT302/1 MECHANICS OF MATERIALS 2/2/0/3
7MT302

Nature of Course : G (Theory analytical)

Pre requisites: 17MT202–Applied Mechanics

Course Objectives:

1. To impart knowledge on engineering materials and their mechanical properties.
2. To impart knowledge on stress and strains and deformation in components due to different loads.
3. To enable the students to understand the concepts of beam, column and shafts
4. To enable the students to understand the importance of Principal stresses and strain energy

Course Outcomes:

Upon completion of the course, students shall have ability to

C302.1	Define the basic properties of engineering materials.	[R]
C302.2	Visualize the various stresses and strains acting on different structures.	[U]
C302.3	Solve the problems and analyze various structural members like bar, beam, shaft and column.	[Ap]
C302.4	Analyze the effect of principal stresses in various members.	[A]

Course Contents:

Engineering Materials – Composite materials – Mechanical properties of materials – Concept of stress – Ultimate Strength of a material – Allowable load, allowable stress and factor of safety – Stress strain diagram for ductile and brittle materials – Hooke's law – Modulus of elasticity – Axial loading – Temperature stress – Poisson's ratio – Bulk Modulus – Stress-Strain relationship for fibre reinforced composite materials.

Torsion: Deformation in a circular shaft – Stresses in elastic range – Torsion in solid and hollow circular shafts – Torsion of noncircular shafts: Square and Rectangular cross sections – Pure bending – Bending equation – Shear Force and Bending Moment Diagrams: Simply Supported Beams, Cantilever Beams and Fixed beams with Point load and Uniformly Distributed Loads.

Transformations of stress and strains: Principal Stress, Maximum shearing stress – Mohr's Circle for plane stress – Stress in thin walled pressure vessels: Cylinders and Spheres – Deflectionof beams: Evaluation of beam deflection and slope by Double integration method and Macaulay Method –Analysisof Columns: Equivalent length of a column, Euler equation, Slenderness ratio, Rankine formula for columns – Strain Energy in uniaxial loading.

Total Hours: 60

Text Books:

1 Ferdinand P Beer, Russell Johnston, "Mechanics of Materials", McGraw Hill Education, 7th Edition , 2015.
2 R.K.Bansal, "Strength of Materials", Laxmi Publication, 6th Edition, 2015.

Reference Books:

1 R C Hibbeler, “Statics and Mechanics of Materials”, Pearson Education, 3rd Edition, 2004.
2 Popov E.P, “Engineering Mechanics of Solids”, Prentice-Hall of India, New Delhi, 2007.

Web References:

1 nptel.ac.in/courses/Webcoursecontents/.../strength%20of%20materials/homepage.htm
2 http://em2.yolasite.com/

Assessment Methods & Levels (based on Blooms’ Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**Marks**
C302.1	Remember	Quiz/Test	5
C302.2	Understand	Technical Quiz	5
C302.3	Apply	Assignment	5
C302.4	Analyse	Group Assignment	5

Summative assessment based on Continuous and End Semester Examination				
Bloom’s Level	**Continuous Assessment**			**End Semester Examination [60 Marks]**
	CIA1 [6 Marks]	**CIA2 [6 Marks]**	**Term End Assessment [8 Marks]**	
Remember	20	20	20	20
Understand	20	20	20	20
Apply	40	40	30	30
Analyse	20	20	30	30
Evaluate	0	0	0	0
Create	0	0	0	0

16MT303/1 THERMODYNAMICS AND APPLICATIONS 2/2/0/3
7MT303

Nature of Course : J (Problem analytical)

Pre requisites : 17MA101-Linear Algebra And Differential Calculus

Course Objectives:

1. To understand the laws and principles of thermodynamics and heat transfer.
2. To evaluate the performance of refrigeration system.
3. To analyse the performance of IC engines

Course Outcomes:

Upon completion of the course, students shall have ability to

C303.1	Describe the basic laws of thermodynamics and gas power cycles	[R]
C303.2	Evaluate efficiencies of simple power and refrigeration cycle	[U]
C303.3	Apply the knowledge of IC engines to determine performance parameters	[AP]
C303.4	Use thermodynamic tables and diagrams to analyze & solve simple problems in refrigeration.	[AN]
C303.5	Study the mode of heat transfer and calculate the heat conduction	[E]

Course Contents:

Basic concepts and definitions – Zeroth law - First law of thermodynamics for open and closed systems - Steady Flow Energy Equation - Second law of thermodynamics - Heat engines - Carnot cycle - Carnot theorem - Concept of entropy- principle of increase of entropy. Otto and Diesel cycles – calculation of air standard efficiency

IC engines: working principle of 2 stroke and 4 stroke SI and CI engines with port timing and valve timing diagrams – IC engine performance test to measure brake power, indicated power, fuel and air consumption – Introduction to MPFI, DTSI and CRDI.

Principles of refrigeration - Refrigerator and heat pump - Vapour compression refrigeration systems - Coefficient of performance - Vapour absorption systems - NH_3 - water system. Modes of heat transfer - Fourier's law of conduction in plane, radial and composite walls. Principles of Convective heat transfer - Radiative heat transfer – black body and white body - Stefan Boltzmann law.

Total Hours: 60

Text Books:

1. Nag P.K, Engineering Thermodynamics, Tata McGraw Hill, 2015
2. Mahesh M.Rathore, Thermal engineering, Tata McGraw Hill education pvt. Ltd, New Delhi, 2010.

Reference Books:

1. Yunus A. Cengel, Michael A. Boles, Thermodynamics an engineering approach, McGraw Hill education India pvt. Ltd. 7th edition, 2015.
2. R.C.Sachdeva, Fundamentals of engineering heat and mass transfer, New age internationalpublishers, fourth edition, 2010

Web References:

1 nptel.ac.in/courses/112105128/ Refrigeration And Air Conditioning

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C303.1	Remember	Test	**5**
C303.2	Understand	Online Quiz	**5**
C303.3, C303.4	Apply and Analyse	Assignment	**5**
C303.5	Evaluate	Open end topic and report submission	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	10	20	10	-
Understand	20	20	20	20
Apply	50	30	40	30
Analyse	20	30	30	30
Evaluate	-	-	-	20
Create	-	-	-	-

16MT304/ 17MT304 **ELECTRICAL MACHINES AND POWER SYSTEMS** **3/0/0/3**

Nature of Course: C (Theory Concept)

Pre requisites: 17MT301-Electrical, Electronic Devices and Circuits

Course Objectives:

To impart knowledge on

1. Constructional details, principle of operation, and applications of DC machines and AC machines and transformers
2. Concepts of Power systems.

Course Outcomes:

Upon completion of the course, students shall have ability to

C304.1	Identify the various electrical machines and components of Electric Power systems.	[R]
C304.2	Observe and understand the working of practical electrical machines and generation, transmission and distribution systems.	[U]
C304.3	Point out faults occurring in Electrical machines and Transmission and distribution networks.	[AN]
C304.4	Choose appropriate electrical machines suitable for a specific application based on their characteristics.	[E]

Course Contents:

Single phase transformer: equivalent circuit, phasor diagram, regulation and efficiency, applications; DC machines: separately excited, series and shunt, motoring and generating mode of operation and their characteristics, starting and speed control of dc motors, applications.

Three phase induction motors: principle of operation, types, performance, torque-speed characteristics, equivalent circuit, starting and speed control, applications; Operating principle of single phase induction motors.

Synchronous machines: cylindrical and salient pole machines, starting of synchronous motor, applications; BLDC motor; Stepper motors, servo motors and their applications; Power generation concepts, ac and dc transmission concepts, FACTS concepts.

Total Hours: 45

Text Books:

1 V.K.Mehta and R.Mehta, “Principles of Electrical Machines”, S.Chand Company, 2013.

2 S.N.Singh, “Electric Power Generation, Transmission and Distribution”, PHI Learning, 2011.

Reference Books:

1 Nagrath I.J. and D. P. Kothari, “Electric Machines”, 4/e, Tata McGraw Hill, 2010.
2 Leonard L. Grigsby, “Electric Power Generation, Transmission, And Distribution”, 3/e, CRC press, 2012.
3 B. S. Guru and H. R. Hiziroglu, “Electrical Machinery and Transformers”, 3/e, Oxford University Press, 2008.

Web References:

1 http://www.learnengineering.org/
2 http://nptel.ac.in/courses/108105053/

Online Resources:

1 http://www.electrical4u.com/

Assessment Methods & Levels (based on Bloom’s Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**Marks**
C304.1	Remember	Test	**5**
C304.2	Understand	Online Quiz	**5**
C304.3	Analyse	Case Study	**5**
C304.4	Evaluate	Open end topic and report submission	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom’s Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	20	20	20
Understand	60	40	50	50
Apply	20	-	10	10
Analyse	-	20	10	10
Evaluate		20	10	10
Create	-	-	-	-

17CS201 PROBLEM SOLVING TECHNIQUES AND C PROGRAMMING 3/0/3/5

Nature of Course:F (Theory Programming)

Pre Requisites: Nil

Course Objectives:

1. To understand problem solving concepts.
2. To gain knowledge about the control structures in C
3. To use arrays and pointers in C Programs
4. To write functions in C.

Course Outcomes:

Upon completion of the course, students shall have ability to

C201.1 Apply problems solving techniques to real world problems. [Ap]
C201.2 Design programs using fundamental C constructs. [U]
C201.3 Use the concepts of pointers , arrays and structures in programs. [Ap]
C201.4 Do modular programming with functions. [U]

Course Contents:

Computational Thinking: Introduction to Computational Thinking –From abacus to machine – The first Software –First Modern Computer-Information and data - Converting information into data -Data Capacity **Problem Solving Techniques:** General problem Solving concepts-: Algorithm, Pseudo-code and Flowchart Problem Solving with Sequential Logic Structure - Problem Solving with Decisions - Problem Solving with Loops **Case Study:** Raptor and Scratch Tools.

C Character Set – Identifiers and Keywords– Data Types- Constants Variables and Arrays-Declarations-Operators and Expressions Data input and output-Preparing and running a Complete C Program. **Branching:** if-else Looping: while-do while-for nested control structures -switch-break-continue-comma-goto. **Arrays:** Defining an array- Processing an array- Multi dimensional arrays Strings: Defining a string-Null character-initialization of strings – reading and writing a string- processing the string

Pointers: fundamentals – Pointer Declaration& Usage. **Functions and Structures:** Defining Function – Accessing a function – Function Prototypes. Passing arguments to a function – Recursion Structures: Defining a structure – processing a structure. **SELF STUDY:**Unions

Total Hours: 90

Lab Component:

1. Office Automation – Resume preparation , Spreadsheet processing
2. Draw Flowchart using Raptor Tool
   a. Simple Flow Chart
   b. Decision Making
   c. Looping[Pre test & Post test]

3. Create Animation / Gaming /Application using Scratch Tool
4. Program to process data types, format input and output.
   Program to evaluate an expression
5. Program using decision making statements
6. Program using looping statements
7. Program using single and two dimensional arrays
8. Program for string manipulation
9. Program using call by value and call by reference.
   Program using recursion
10. Program using structures

Text Books:

1. David Riley and Kenny Hunt, "Computational Thinking for the Modern Problem Solver", Chapman & Hall/CRC, 2014. [Unit I]
2. M. Sprankle, "Problem Solving and Programming Concepts", 9th Edition, Pearson Education, New Delhi, 2011. [Unit I]
3. Byron, S. Gottfreid, "Programming with C", Tata McGraw Hill, Schaum's outlines, 3rd Edition, 2014. [Unit II- V]

Reference Books:

1. Herbert Schildt, "The Complete Reference C", 4th edition ,TMH,2015.
2. S.ThamaraiSelvi and R.Murugesan, "Programming in ANSI C", 6E, TMH, 2012.
3. K.R.Venugopal and SudeepR.Prasad , "Mastering C", TMH ,Second edition , 2015

Web References:

1. http://nptel.ac.in/courses/106105085/
2. http://nptel.ac.in/courses/106106127/
3. http://raptor.martincarlisle.com/
4. https://scratch.mit.edu/

Online Resources:

1. www.leetcode.com
2. www.thenewboston.com
3. www.codesdope.com

Assessment Methods & Levels (based on Blooms' Taxonomy)					
Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Practical**	
	CIA1 [6 marks]	**CIA2 [6 marks]**	**Term End Assessment [8 marks]**	**Rubric based CIA [40 Marks]**	
Remember	30	30	20	-	20
Understand	40	30	30	30	30
Apply	30	40	50	70	50
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	-	-	-

17MT305 THEORY OF CONTROL SYSTEMS 3/0/0/3

Nature of Course : G (Theory analytical)

Pre requisites : 17MA102 Integral Calculus and Laplace Transforms
17MA103 Fourier Analysis And Partial Differential Equations

Course Objectives:

1 To impart the basic concepts of control systems components and its feedback control
2 To Interpret various time domain and frequency domain tools for analysis and design of linear control systems
3 To analyze the stability of systems from transfer function forms
4 To describe the methods of designing compensators

Course Outcomes:

Upon completion of the course, students shall have ability to

C305.1	Impart the knowledge on basic components of control systems, various time domain, frequency domain specifications, basic controllers and Characteristics equation of asystemfor stability	[R]
C305.2	Interpret various time domain and frequency domain tools for analysis and design of linear control systems	[U]
C305.3	Apply the various techniques for determining transfer function of a system and to design compensators	[AP]
C305.4	Analyze the stability of systems from transfer function forms	[A]
C305.5	Evaluate the steady state error of various type and order of a system	[E]

Course Contents:

Systems representation and Modeling: Mathematical modeling and representation of systems, Feedback principle and transfer function, Block diagrams and Signal flow graphs.

Transient and Steady-state analysis of linear time invariant systems: Types of test input -First and second order system response, Time domain specifications, Error coefficients, Generalized error series, Steady state error, Effect of P, PI, PID controllers. **Frequency response:**Frequency domain specifications, Bode plots,Polar Plot, Correlation between frequency domain and time domain specifications.

Stability of systems: Characteristics equation, Location of roots in S plane for stability,Routh-Hurwitz, Nyquist criteria, Root loci. **Compensator design:** Performance criteria - Lag, lead and lag-lead networks and Compensator design using bode plot.

Total Hours: 45

Text Books:

1 A.J. Nagrath and M. Gopal, Control System Engineering, New Age International Publisher, New Delhi, 2011
2 D.SmarajitGhosh, Control Systems: Theory and Applications, Pearson Education, India, 2012.

Reference Books:

1 B.M. Gopal, Control System Principles and Design, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2014.
2 C.S. Palani, Control System Engineering, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2009.
3 Katsuhiko Ogata, "Modern Control Engineering", Prentice Hall of India Learning Ltd., New Delhi, 2010

Web References:

1 nptel.ac.in/courses/108103008/PDF/module1/m1_lec1.pdf
2 http://nptel.ac.in/courses/108101037
3 http://nptel.ac.in/courses/ElectricalEngineering/controlsystem/IITDelhi/webcourse-contents

Online Resources:

1 https://www.edx.org/course/introduction-control-system-design-first-mitx-6-302-0x
2 https://www.edx.org/course/introduction-state-space-control-mitx-6-302-1x
3 https://www.mooc-list.com/course/control-system-analysis-and-design-uninettuno

Assessment Methods & Levels (based on Bloom's Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom's Level	Assessment Component	Marks
C305.1	Remember	Surprise Test	**3**
C305.2	Understand	Online Quiz	**5**
C305.3	Apply	Assignment	**5**
C305.4	Analyze	Test	**5**
C305.5	Evaluate	Group Assignment	**2**

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	Continuous Assessment			End Semester Examination [60 marks]
	CIA-I [6 marks]	CIA-II [6 marks]	Term End Examination [8 marks]	
Remember	20	40	24	24
Understand	40	20	30	30
Apply	40	0	24	24
Analyse	0	20	16	16
Evaluate	0	20	6	6
Create	0	0	0	0

16MT306/ 17MT306 **THERMAL AND FLUID ENGINEERING LABORATORY** **0/0/3/2**

Nature of Course:M (Practical application)

Co Requisites : 17MT303-Thermodynamics and Applications

Course Objectives:

1. To understand the properties of the fluid and appreciate the complexities involved in solving the fluid flow problems.
2. To understand the laws and principles of thermodynamics and heat transfer.
3. To evaluate the performance of refrigeration and air conditioning system.

Course Outcomes:

C306.1: Calculate the fluid flow and head loss in pipes, determine operational aspects of a pump in a system and describe the basic types of fluid machinery. [AN]
C306.2: Use thermodynamic tables and diagrams to solve simple problems in refrigeration and air conditioning. [E]
C306.3: Calculate efficiencies of simple power and refrigeration cycle. [E]
C306.4 : Study the mode of heat transfer and calculate the heat conduction [E]

Course Contents:

1. Introduction - Orifice meter (Including co efficient of discharge, verify Bernoulli's theorem, simple problems)
2. Venturi meter (Including co efficient of discharge, verify Bernoulli's theorem, simple problems)
3. Calculate the flow of water using Rotameter
4. Make a set of pipes and calculate the friction factor
5. Performance test on 4 stroke twin cylinder diesel engine with electric dynamometer
6. Study about air compressor theoretically and do a performance test (compare the theoretical and practical results)
7. Study about refrigerator theoretically and do a performance test (compare the theoretical and practical results)
8. Study about air conditioner theoretically and do a performance test (compare the theoretical and practical results)
9. Make a composite wall with 2 or more different materials and perform a heat conduction (tabulate the result for different material composition)
10. Parallel flow and Counter flow Heat Exchangers – Comparison
11. Mini Project work- Application oriented products using above experiments

Total Hours: 45

Reference Books:

1. R.K.Bansal, "A Textbook of Fluid Mechanics", Laxmi Publications, Second edition, 2016.
2. Mahesh M.Rathore, "Thermal engineering", Tata McGraw Hill education pvt. Ltd, New Delhi, 2010.
3. Yunus A. Cengel, Michael A. Boles, "Thermodynamics an engineering approach", McGraw Hill education India pvt. Ltd. 7th edition, 2015.

4. R.C.Sachdeva, “Fundamentals Of Engineering Heat And Mass Transfer”, New age international publishers, fourth edition,2010

Web References:

1. nptel.ac.in/courses/105101082/ Fluid Mechanics
2. nptel.ac.in/courses/112105128/ Refrigeration And Air Conditioning

Assessment Methods & Levels (based on Bloom’s Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom’s Level	**Rubric based Continuous Assessment [60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	0	0
Understand	10	10
Apply	20	20
Analyse	20	20
Evaluate	40	40
Create	10	10

16MT307/ 17MT307 **ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY** **0/0/3/2**

Nature of Course : L (Problem experimental)

Pre-requisites : 17MT301 Electrical, Electronic Devices and Circuits

Co-requisites : 17MT304 Electrical Machines and Power Systems

Course Objectives:

1 To provide practical understanding of Electrical machines and Digital electronics.

Course Outcomes:

Upon completion of the course, students shall have ability to

C307.1	Analyse the performance of Electrical machines.	[AN]
C307.2	Analyse the methods of starting and speed control of various electrical machines.	[AN]
C307.3	Choose electrical machines for various applications based on their characteristics.	[E]
C307.4	Design digital electronic circuits for various applications.	[C]

Course Contents:

PART I

1. Comparing the performance of D.C. shunt and series motor.
2. Assessing the characteristics of methods of speed control of D.C. shunt motor.
3. Analysis of factors affecting losses and efficiency of single phase transformer
4. Validation of slip and torque-speed characteristics of three-phase induction motor.
5. Comparing the different types of D.C. motor and induction motor starters.(study experiment)

PART II

1. Comparing the working of different types of digital Logic gates.
2. Getting the addition and subtraction operations done in digital Adder and Subtractor circuits using logic gates.
3. Comparing two binary numbers using digital 2 bit magnitude comparator.
4. Transmitting and receiving serial data using digital multiplexer and de-multiplexer using logic gates
5. Identifying memory cells using digital encoder and decoder using logic gates
6. Displaying numbers in 7 segment display using BCD to 7 segment decoder circuit

Total Hours: 45

Reference Books:

1 V.K.Mehta and R.Mehta, “Principles of Electrical Machines”, S.Chand Company, 2013

2 Thomas L. Floyd, Digital Fundamentals, 10th Edition, Pearson Education, New Delhi, 2011

Web References:

1 http://www.electrical4u.com/

2 http://www.circuitstoday.com/

Online Resources:

1 https://sites.google.com/site/amtmttl/st2
2 http://www.ee.iitkgp.ac.in/faci_em.php

Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	-	-
Understand	20	20
Apply	30	30
Analyse	30	30
Evaluate	10	10
Create	10	10

SEMESTER IV

16MA107/ 17MA107 **STATISTICS AND COMPLEX ANALYSIS** **3/2/0/4**

Nature of Course : J (Problem analytical)

Pre requisites : Basic Probability concepts

Course Objectives:

1 To study the basic probability concepts
2 To acquire skills in handling situations involving more than one random variable
3 To understand and have a well – founded knowledge of standard distributions which can be used to describe real life phenomena
4 To apply analytic function techniques to transform irregular geometry to regular geometry
5 To learn the concept of testing of hypothesis using statistical analysis

Course Outcomes:

Upon completion of the course, students shall have ability to

C107.1	Recall basic probability and integration concepts	[R]
C107.2	Understand to handle situations involving single random variable	[U]
C107.3	Use distribution in cluster analysis of similar binary variables	[AP]
C107.4	Find the derivatives of the complex valued functions and to evaluate complex valued integrals	[AP]
C107.5	Derive the inference for engineering problems using testing of hypothesis	[AP]

Course Contents:

Probability - Probability concepts-Addition and Multiplication law of probability – Conditional probability - Total probability theorem, Bayes theorem(statement) – Problems-**Random Variables**- One dimensional random variable - Probability mass function - Probability density function – Discrete and continuous random variables.

Standard distributions-Discrete distributions - Binomial – Poisson – Geometric – Continuous distributions - Uniform – Exponential - Normal distributions – MGF- Simple problems-**Analytic Functions** -Necessary conditions, Cauchy-Riemann equations and Sufficient conditions (excluding proof) – Harmonic conjugate – Construction of analytic functions.

Complex integration–Cauchy Integral theorem(statement)-Laurent's series-Zeros and singularities – Residues – Cauchy Residue theorem (statement) - Contour integration(excluding poles on the real axis)- **Testing ofHypothesis** –Large sample - Z test-Test of significance - Proportions- Mean - Standard deviation- Small sample test – t test and F test for single mean–difference of means and variance - Chi-square test for goodness of fit and independence of attributes.

Total Hours: 60

Text Books:

1 Peebles Jr. P.Z., "Probability Random Variables and Random Signal Principles", Tata McGraw-Hill Publishers, Fourth Edition, New Delhi, 2010
2 Palaniammal, S., "Probability and Random Processes", Prentice hall of India, New Delhi, 2014,Reprint 2015.
3 Grewal. B.S, "Higher Engineering Mathematics", 43rd edition, Khanna Publications, Delhi, 2014.

4 Gupta, S.C., &Kapoor, V.K., “Fundamentals of Mathematical Statistics”, Sultan Chand & sons, 2000,Reprint 2014.

Reference Books:

1 Ross, S., “A First Course in Probability, Sixth edition”, Pearson Education, Delhi, 2014.
2 Henry Stark and John W. Woods “Probability and Random Processes with Applications to Signal Processing, Pearson Education”, Fourth Edition, Delhi, 2011
3 Veerarajan., T “Probability, Statistics and Random Processes”, Tata McGraw-Hill, Second Edition, New Delhi, 2010.
4 N.P.Bali and Dr.ManishGoyal,”A Text book of Engineering Mathematics Sem-III/IV” 4th edition Laxmi publications ltd, reprint 2012.

Web References:

1 http://nptel.ac.in/courses/111104079/
2 http://www.nptelvideos.in/2012/12/probability-random-variables.html
3 http://freevideolectures.com/Course/3028/Econometric-Modelling/22
4 http://freevideolectures.com/Course/2311/Digital-Communication/4
5 http://nptel.ac.in/syllabus/111105041/

Online Resources:

1 https://www.coursera.org/learn/probability-intro
2 https://ocw.mit.edu/courses/.../18-440-probability-and-random-variables-spring-2014/
3 https://www.coursera.org/learn/wharton-introduction-spreadsheets-models/lecture/Y3bCF/3-1-random-variables-and-probability-distributions
4 http://nptel.ac.in/upcoming_courses.php

Assessment Methods & Levels (based on Blooms’ Taxonomy)

Formative assessment based on Capstone Model (Max. Marks:20)

Course Outcome	Bloom’s Level	Assessment Component	Marks
C107.1	Remember	Classroom or Online Quiz	2
C107.2	Understand	Class Presentation/Power point presentation	4
C107.3	Apply	Group Assignment	7
C107.4 & C107.5	Apply	Group activities	7

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	Continuous Assessment			End Semester Examination
	CIA1	CIA2	Term End Assessment	
Remember	20	20	20	20
Understand	30	30	30	30
Apply	50	50	50	50
Analyse	-	-	-	-
Evaluate	-	-	-	-
Create	-	-	-	-

16MT308/ 17MT308 **MICROCONTROLLER AND ITS APPLICATIONS** **3/0/0/3**

Nature of Course : F (Theory Programming)

Pre requisites : 17MT301-Electrical, Electronic Devices and Circuits

Course Objectives:

1 To introduce the 8085 architecture and 8051 architecture.
2 To enable the students to understand the programming concepts of microprocessor and microcontroller
3 To enable the students to understand the hardware interfacing units of microprocessor and microcontroller.
4 To enable the students to understand the PIC microcontroller concepts
5 To enable the students to understand the architecture of ARM Processor.
6 To enable students to choose the appropriate micro controller for specific applications.

Course Outcomes:

Upon completion of the course, students shall have ability to

C308.1	Explore their acquired knowledge on recalling the architecture of microprocessor and microcontroller.	[R]
C308.2	Understand the instruction sets and programming concepts of microprocessor and microcontroller with examples.	[U]
C308.3	Apply the programming concepts to interface the hardware units with microprocessor and microcontroller	[AP]
C308.4	Analyse the architecture of PIC, ARM Processor and choose the appropriate micro controller for specific applications.	[AN]

Course Contents:

8085 Architecture - Addressing modes, instructions, memory mapping & Programming of 8085;Interfacing keyboards and LED displays, Programmable peripheral interface (8255), 8253 timer, programmable interrupt controller (8259), DMA controller.

8051 microcontroller architecture, Memory organization, Interrupts and interrupt handling, 8051 addressing modes, instructions; Interfacing 8051 timer, ADC, DAC, and sensors interfacing.

PIC16C61 Micro-controllers, CPU architecture, Register file structure and addressing modes, Introduction of ARM processor – Architecture- pipelining - applications.

Total Hours: 45

Text Books:

1 Krishna Kant “Microprocessor and Microcontrollers”, Eastern Company Edition, Prentice – Hall of India, New Delhi , 2012

2 Ramesh S.Goankar, ’Microprocessor Architecture: Programming and Applications with 8085’, Fourth edition, Penram International, 2010.

Reference Books:

1 Han Way,Huang," PIC Microcontrollers- An Introduction to Software and Hardware Interfacing", 2013
2 T.R.Padmanaban, "Introduction to Microcontrollers and their Applications", Narosa Publishing House, 2012

Web References:

1 http://nptel.ac.in/courses/Webcourse-contents.
2 http://nptel.ac.in/courses/Webcourse-contents/IIT-KANPUR.

Online Resources:

1 https://www.edx.org/course/computer-system-design-advanced microprocessor-concept.

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C308.1	Remember	Quiz	**5**
C308.2	Understand	Group Mini Project	**5**
C308.3	Apply	Simulation Exercises	**5**
C308.4	Analyse	Group Activities	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	20	10	10
Understand	80	20	20	20
Apply	-	30	30	30
Analyse	-	30	40	40
Evaluate	-	-	-	-
Create	-	-	-	-

15MT310/ 17MT309 **THEORY OF MACHINES** **3/1/0/4**

Nature of Course : (G) Theory Analytical

Pre requisites : 17MT202 Applied Mechanics

Course Objectives:

1. To develop competency in understanding of theory of all types of mechanisms
2. To understand the analysis of kinematics, force analysis, balancing and vibration
3. To make the student conversant with friction drives and mechanism for control
4. To develop competency in drawing the cam profile for its follower motion.

Course Outcomes:

Upon completion of the course, students shall have ability to

C309.1	Understand all types of mechanism concepts	[U]
C309.2	Apply kinematics to draw the velocity and acceleration diagrams	[AP]
C309.3	Analyze the friction drives, vibration and working principle of mechanisms for control	[A]
C309.4	Design the cam profile and analyze the dynamic force in engine components	[C]

Course Contents:

Mechanism Terminology - Kinematic Diagrams – Mobility- Kutzbach criterion- Grashoff's law - Kinematic Inversions of four bar and slider crank chains - pantograph, straight line mechanism - Parallel mechanism, toggle mechanism, Ackermann steering gear – Geneva mechanism. Displacement, velocity and acceleration- Graphical Method (Relative velocity method) - Coriolis Acceleration.

CAM: Displacement diagrams-parabolic, Simple harmonic and Cycloidal motions - Layout of plate cam profiles (Inline and offset of knife edge and roller follower only) Law of gearing and gear trains. Inertia force and Inertia torque – D' Alemberts principle - Dynamic Analysis of slider crank mechanism. Force analysis in Reciprocating engines (Analytical method) - Turning moment diagrams and Fly wheels.

Static and dynamic balancing - Balancing of several masses in different planes - Balancing of V engine and radial engines. VIBRATION: Free damped vibration- logarithmic decrement- Dunkerley's method and critical speed of shafts - Theory of Watt governor – types of brakes - Band and block brake- Effect of braking in vehicles – tensions and power transmission in belt and chain drives - Gyroscopic effect on Naval ships and Automobiles

Total Hours: 60

Text Books:

1. S.S.Rattan, "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2015
2. H.DavidMyszka, "Machines and Mechanism – Applied Kinematic analysis", Pearson Prentice Hall, 2010

Reference Books:

1. L.Robert Norton, "Design of machinery" McGraw-Hill, 2013.
2. J.E.Shigley and J.J.Uicker, "Theory of Machines and Mechanisms", Oxford University Press India, 2014

Web References:

1. Electronic Speed Control (ESC) governor
2. Theory of machine study material www.pearsoned.co.in

Online Resources:

1. https://india.oup.com/orcs/9780199454167/
2. https://india.oup.com/.../theory-of-machines-and-mechanisms-97801994

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C309.1	Understand	Quiz / Class Notes	**5**
C309.2	Apply	Assignment	**5**
C309.3	Analyse	Simulation Exercises	**5**
C309.4	Create	Mini Project	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	10	10	10	10
Understand	20	10	10	10
Apply	40	20	30	30
Analyse	40	30	30	30
Evaluate	-	10	10	10
Create	-	20	10	10

16CS212/ 17CS212 **LINUX AND PROGRAMMING IN C++** **3/0/2/4**

Nature of Course : F (Theory Programming)

Pre requisites : 17CS201-Problem Solving Techniques and C Programming

Course Objectives:

1 To introduce basic Linux concepts.
2 To understand Object Oriented Programming concepts like data abstraction and encapsulation.
3 To analyse different kinds of constructors, inheritance and polymorphism.
4 To understand and apply streams and file concepts.

Course Outcomes:

Upon completion of the course, students shall have ability to

C212.1	Remember the basic commands of Linux.	[R]
C212.2	Understand the basic Linux Commands and file system hierarchy	[U]
C212.3	Construct and apply C++ program to solve the given problems using basic programming constructs.	[AP]
C212.4	Apply the concepts of friend function and virtual functions.	[AP]
C212.5	Apply the concepts of polymorphism.	[AP]
C212.6	Make use of I/O functionality to code basic file operations and experiment with templates.	[AP]

Course Contents:

Introduction to Linux-Linux basic Commands- File System Hierarchy-Users, groups and permissions. Programming paradigms.

Basic concepts and benefits of Object Oriented Programming, An overview of C++, datatypes, Selection statements, Functions, Arrays, Function overloading. Classes and objects, Default constructor, operator overloading, Friend functions - virtual functions. Templates, Exception handling.

Derived classes- Inheritance, Virtual Base Class, Abstract class, Polymorphism and Virtual Functions-Virtual Base class. Console Input /output operation, File Handling. Error handling.

Lab Component:

1	Linux Commands	[E]
2	Shell Programming	[E]
3	Simple Classes for understanding objects, member functions and constructors	[E]
4	Compile time polymorphism	[E]
5	Run time polymorphism	[E]

Total Hours: 90

Text Books:

1 Christopher Negus, Christine Bresnahan, “Linux Bible”, Willey Publishing Inc., 2012.
2 Herbert Shildt , “ The Complete Reference C++” , Fifth Edition, TMH, 2014.

Reference Books:

1 K.R.Venugopal, RajkumarBuyya, T.Ravishankar, “Mastering C++”, TMH, 2013.
2 BjarneStroustrup, "The C++ programming language" Addison Wesley, Fifth edition, 2013.
3 Richard Blum, Christine, “Linux Command Line and Shell Scripting Bible” , 2nd Edition, Wiley Publishing Inc. 2011.

Web References:

1 http://nptel.ac.in/courses/117106113/
2 http://nptel.ac.in/syllabus/syllabus.php?subjectId=106106111

Online Resources:

1 www.edx.org/course/introduction-linux-linuxfoundationx-lfs101x-0
2 https://www.coursera.org/learn/c-plus-plus-a

Assessment Methods & Levels (based on Blooms’ Taxonomy)					
Summative assessment based on Continuous and End Semester Examination					
Bloom’s Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Practical**	
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	**Rubric based CIA [40 Marks]**	
Remember	30	30	30	-	20
Understand	30	40	40	20	40
Apply	40	30	30	30	30
Analyse	-	-	-	30	10
Evaluate	-	-	-	20	-
Create	-	-	-	-	-

16MT310/ 17MT310 **FLUID ENGINEERING** **2/2/0/3**

Nature of Course : J (Problem analytical)

Pre requisites : 17MA101-Linear Algebra and Differential Calculus
17MT202-Applied Mechanics

Course Objectives:

1. To understand the basic principles and equations of fluid mechanics
2. To understand the properties of the fluid and appreciate the complexities involved in solving the fluid flow problems.
3. To apply fluid mechanics principles in real world engineering devices

Course Outcomes:

Upon completion of the course, students shall have ability to

C310.1	Describe the basic properties, principles and applications fluids and force developed by flowing fluids	[R]
C310.2	Understanding lift and drag coefficients in flow over flat plates, spheres, cylinders and in air wings	[U]
C310.3	Calculate the fluid flow and head loss in pipes, determine operational aspects of a pump in a system and describe the basic types of fluid machinery.	[AP]
C310.4	Analyze the model and prototype and carryout computational fluid dynamics analysis	[AN]

Course Contents:

Fluid and Properties – fluid pressure and measurements –Types of flows - velocity field and acceleration – Continuity equation. Bernoulli's equation and its application in venturi meter, orifice meter and pitot tube - Laminar flow and turbulent flow (qualitative treatment only) - Flow through pipes – major & minor losses. Piping network and pump selection.

Lift and drag- Drag coefficients of common geometrics - parallel flow over flat plates – flow over cylinders and spheres. Dimensional Analysis and modeling: dimensional homogeneity- Buckingham Pi theorem – similarity and non-dimensional numbers – model laws. Pumps and types - Centrifugal pumps – Working principle, work done by the impeller and performance curves.

Turbines and types - Pelton wheel – working principles, work done by water on the runner, draft tube and specific speed. Introduction to computational fluid dynamics (CFD) – fundamentals - laminar CFD calculations (Qualitative treatment only).

Total Hours: 60

Text Books:

1. R. K. Bansal, A Textbook of Fluid Mechanics, Laxmi Publications, Second edition, 2016.
2. Yunus A. Cengel, John M. Cimbala, Fluid Mechanics, McGraw Hill education (India) Private Limited, Third edition, 2015.

Reference Books:

1. Frank M. White, Fluid Mechanics, McGraw Hill education India pvt. Ltd., Eighth edition, 2015.
2. Streeter, V. L. and Wyile E.B., Fluid Mechanics, McGraw Hill Publishing Co, 2010

Web References:

1. nptel.ac.in/courses/105101082/ Fluid Mechanics

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C310.1	Remember	Tutorial	**5**
C310.2	Understand	Online Quiz	**5**
C310.3	Apply	Assignment	**5**
C310.4	Analyze	Software output	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	10	20	10	-
Understand	20	20	20	20
Apply	50	30	40	50
Analyse	20	30	30	30
Evaluate	-	-	-	-
Create	-	-	-	-

16MT311/ 17MT311 **THEORY OF MACHINES LABORATORY** **0/0/3/2**

Nature of Course : [M] Practical Application

Co requisites : 17MT309–Theory of Machines

Course Objectives:

1.To develop competency in understanding of theory of all types of mechanisms
2.To understand the analysis of kinematics, force analysis and balancing
3.To make the student conversant with friction and mechanism for control
4.To develop competency in drawing the cam profile and understand the follower motion.

Course Outcomes:

Upon completion of the course, students shall have ability to

C311.1	Analyze the various mechanisms.	[U]
C311.2	Examine the working of universal Governors and balancing of vibrating systems.	[AP]
C311.3	Determine the natural frequency of bodies using various vibration experiments.	[A]
C311.4	Determine the moment of inertia of bodies using various systems	[E,C]

Course Contents:

1. Fabricate a four bar mechanism.
2. Compare the characteristics for Watt and Proell governors.
3. Determination of critical speeds of shaft and analyze it.
4. Balancing of reciprocating masses and interprets the unknown mass.
5. Balance the given rotating masses and apply it to balance the cycle wheel.
6. Determination of mass moment of inertia of the disc using Motorised Gyroscope.
7. Determine the mass moment of inertia of the object using compound pendulum setup experimentally. Verify the answer theoretically.
8. Determination of mass moment of inertia of flywheel axle system.
9. Determination of transverse frequency of beam and compare it theoretically.
10. Determination of natural frequency of given spring mass system in free longitudinal vibrations.
11. Measure and Comment on mechanical advantage, Transmission angle, joints and type of given mechanisms.
12. Tension, Impact and hardness test on Mild Steel, Copper and Brass.
13. Find the maximum deflection in the beams and verify it analytically.

Total Hours: 45

Reference Books:

1. L.Robert Norton, “Design of machinery” McGraw-Hill, 2013.
2. J.E.Shigley and J.J.Uicker, "Theory of Machines and Mechanisms", Oxford University Press India, 2014

Web References:

1. Electronic Speed Control (ESC) governor
2. Theory of machine study material www.pearsoned.co.in.

Online Resources:

1. https://india.oup.com/orcs/9780199454167/
2. https://india.oup.com/.../theory-of-machines-and-mechanisms-97801994

Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment[60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	-	-
Understand	20	20
Apply	30	30
Analyse	30	30
Evaluate	10	10
Create	10	10

16MT312/ 17MT312 **MICROCONTROLLER LABORATORY (Project Based Lab)** **0/0/3/2**

Nature of Course : K (Problem Programming)

Co requisites : 16MT308/17MA308-Microcontroller and its applications

Course Objectives:

1 To assemble the microprocessor and microcontroller kit.
2 To provide the practical understanding and programming concept of microprocessor and microcontrollers
3 To provide the programming concept of interfacing hardware units.

Course Outcomes:

Upon completion of the course, students shall have ability to

C312.1	Assemble the microprocessor and microcontroller kit by applying the theoretical knowledge gained in microprocessor and microcontroller.	[AP]
C312.2	Analyse the instruction set and programming concepts by executing simple example.	[AN]
C312.3	Observe and analyse the programming concepts of hardware interfacing units.	[AN]
C312.4	Create simple applications using ARM Processor and evaluate the obtained results	[C]

Course Contents:

1. Study of Assembly details in 8085 Microprocessor Kit.
2. Programming for arithmetic operations: 8 and 16 bit addition & subtraction, 8 bit multiplication, 8 bit division
3. Program with 8085 control instruction to find minimum and maximum number
4. Interfacing experiments of A/D and D/A using 8085/8051
5. Interfacing and programming of stepper motor using 8085/8051
6. Study of Assembly details in 8051 Micro controller.
7. Simple programs of 8051
8. Program and verify Timer in 8051/8085.
9. Interfacing and programming of seven segment display using 8085/ 8051
10. Write C program to interface ARM processor with LED Display and Stepper motor
11. Interfacing sensors using 8051 Microcontroller.

Note: A mini project using either microprocessor or microcontroller

Total Hours: 45

Reference Books:

1 Krishna Kant “Microprocessor and Microcontrollers”, Eastern Company Edition, Prentice – Hall of India, New Delhi , 2012

2 Ramesh S.Goankar, “Microprocessor Architecture: Programming and Applications with 8085”, Fourth edition, Penram International, 2010

3 Raj Kamal, “Embedded Systems Architecture, Programming and Design” Tata McGraw-Hill, New Delhi,2010.

Web Reference

1. www.electrical4u.com/microprocessor and microcontroller.html

Online Resources:

1. http://nptel.ac.in/courses

Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	-	-
Understand	20	20
Apply	30	30
Analyse	30	30
Evaluate	10	10
Create	10	10

16MT601/ 17MT601 **MINI PROJECT** **2 Credits**

Guidelines for MINI PROJECT

Week	Guidelines
1	Students may form a group of maximum of 4 members. They shall identify a problem of societal importance and do Mechatronics Engineering oriented project or Re-engineer any of the automated systems.
2	Students shall fix guide who is appropriate to their field of interest and discuss with the guide to fix the title of the project
3	Literature review pertaining to problem identified shall be done by the students
4	
5	Students shall make the block diagram of the project and tentative budget of the project.
6	ZEROTH REVIEW – To verify the literature review and the feasibility of the project.
7	Students shall do design calculation and find the methodology to execute the project
8	Students shall collect the hardware components required for the project.
9	FIRST REVIEW – To verify Design and bill of materials of the project
10	Fabrication of the proposed project shall be accomplished by the students preferably at our college premises.
11	
12	
13	Students shall present a paper on their project in symposium/ conference organized by premier institutions
14	Students shall do the documentation to prepare a report of the project
15	SECOND REVIEW -Students shall submit and demonstrate their projects
16	End Semester Project VIVA-VOCE Examination

Assessment Components		
S.No.	**Category**	**Marks**
1	Fixing the Project title	**05**
2	Zeroth Review	**15**
3	First Review	**20**
4	Second Review	**20**
5	Viva Voce	**40**
Total		**100**

SEMESTER V

15MT315/ 16MT313/ 17MT313 **HYDRAULICS AND PNEUMATICS** **3/0/0/3**

Nature of Course : D (Theory Application)

Pre requisites : Nil

Course Objectives:

1. To understand the concepts of fluid power.
2. To understand the Hydraulic and Pneumatic Systems.
3. To understand the design of Hydraulic and Pneumatic circuits applied in industries

Course Outcomes:

Upon completion of the course, students shall have ability to

C313.1	Draw symbols used in hydraulic and pneumatic systems.	[R]
C313.2	Select appropriate components for hydraulic and pneumatic circuits.	[U]
C313.3	Troubleshoot the pneumatic and hydraulic systems.	[AP]
C313.4	Design simple pneumatic and hydraulic circuits	[A]

Course Contents:

Hydraulics – Fluid power properties, Advantages & Disadvantages - Principles of oil hydraulics - Hydraulic Pumps – Classification, Performance & Selection- Symbols of hydraulic components - Hydraulic Actuators - Hydraulic motors –Torque, Power & flow rate calculation - Hydrostatic transmissions - Cylinders - Types - Cushioning mechanism - Force, velocity and power calculations – Direction, Pressure and Flow control valve – Accumulators - Intensifiers – Hydraulic power pack.

Hydraulic circuits - Regenerative circuits, Speed control circuits - Synchronizing circuits – Air over oil circuit- Safety circuits. **Pneumatics** – Gas laws - Air Compressor - Filter – Pressure regulator - Lubricator – Muffler – Air control valves – Actuators – Symbols of Pneumatic components - Principle of Vacuum - Vacuum systems.

Introduction to Electro Hydraulic & Pneumatics- PLC applications in fluid power control - Limit switches Pneumatic circuits - Cascade – Step counter method - Installation and Maintenance of fluid power system, Fault finding - Case studies: Car barrier system – Aircraft landing system.

TOTAL HOURS : 45 HOURS

Text Books:

1 Anthony Esposito, “Fluid Power with Applications”, Pearson Education, South Asia, 2014.
2 Majumdar S.R., “Oil Hydraulics”, Tata McGraw-Hill, 2010

Reference Books:

1 Pinches, “Industrial Fluid Power”, Prentice hall, New Delhi, 2008.
2 J.Michael, Pinches and G.John Ashby, "Power Hydraulics", Prentice Hall, New Delhi,2013.
3 S.R.Majumdar, “Pneumatic System Principle and Maintenance” Tata McGraw-hill. New Delhi,2006
4 Anthony Lal, “Oil hydraulics in the service of industry”, Allied publishers, New Delhi 2002.

Web References:

1 http://nptel.ac.in/courses/112106175/Module%201/Lecture%201.pdf
2 http://nptel.ac.in/courses/112106175/Module%201/Lecture%207.pdf
3 http://nptel.ac.in/courses/112106175/Module%203/Lecture%2024.pdf
4 http://nptel.ac.in/courses/112105046/m9L35.pdf
5 http://nptel.ac.in/courses/112106175/Module%204/Lecture%2042.pdf

Online Resources:

1 http://www.itclearning.com/products/online-courses/hydraulic-power.html

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C313.1	Remember	Test (Definition)	**5**
C313.2	Understand	Online Quiz	**5**
C313.3	Apply	Circuit construction	**5**
C313.4	Analyse	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	40	20	20	20
Understand	30	30	30	30
Apply	20	30	20	20
Analyse	10	20	30	30
Evaluate	0	0	0	0
Create	0	0	0	0

15MT316/ 3/0/0/3
16MT314/ EMBEDDED SYSTEM
17MT314

Nature of Course : H (Theory Technology)

Pre requisites : 17MT301-Electrical, Electronic Devices and Circuits

Course Objectives:

1. To understand the basic concept of Embedded system.
2. To know about the working principles of buses and devices for Embedded networking.
3. To study the concept of Real time operating systems.
4. To explain the Real Time operating system tools and its real time applications.

Course Outcomes:

Upon completion of the course, students shall have ability to

C314.1	Define the Embedded system hardware and its software.	[R]
C314.2	Describe Devices and Buses used in Embedded networking.	[U]
C314.3	Implement various real time operating systems concept.	[AP]
C314.4	Examine the real time operating system tools with examples.	[A]

Course Contents:

Introduction to embedded systems, Architecture of advanced processors, Hardware and software components, System on Chip- I/O Devices, Communication Buses, Device drivers and interrupt service Mechanism.

Introduction to Embedded C Programming- meeting real time constraints- Emulators, debuggers- Real time operating systems basics- Processes, Tasks, Threads and their synchronization using Inter Process communication, priority inversion.

Real time operating system Programming: MicroC / OS-II , MUCOS, VxWorks Case study: Coding for an Automatic Chocolate Vending Machine , Embedded system for an Adaptive Cruise Control Systems in a Car, Embedded Systems for a Smart Card.
UART Driver, CAN BUS, Lin BUS (Quanlitative Analysis)

Total Hours: 45

Text Books:

1 Rajkamal, “Embedded Systems Architecture, Programming and Design”, TATA McGraw-Hill, Fifth reprint, 2016.
2 James K .Peckol, Embedded Systems Contemporary Design Tools, John Wiley & Sons 3rd Reprint, 2013.

Reference Books:

1 David E.Simon, “An Embedded Software Primer”, Pearson Education Asia, First Indian Reprint 2011.
2 K.V.K.K.Prasad “Embedded /Real-Time Systems: Concepts, Design and Programming”, Dream tech, Wiley, 2013.
3 Wayne Wolf, “Computers as Components: Principles of Embedded Computing System Design”, Morgan Kaufmann, 2 edition, 2008.

Web References:

1.www.nptel/ElectricalEngineering/EmbeddedSystems/IITDelhi
2.www.nptel/ElectricalEngineering/EmbeddedSystems/IITkarahpur

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C314.1	Remember	Test	**5**
C314.2	Understand	Online Quiz	**5**
C314.3	Apply	Case study	**5**
C314.4	Analyse	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	15	20
Understand	40	30	30	25
Apply	40	30	35	30
Analyse	0	30	20	25
Evaluate	0	0	0	0
Create	0	0	0	0

15MT317/ 16MT315/ 17MT315 **POWER ELECTRONICS AND ELECTRICAL DRIVES** **3/0/3/4**

Nature of Course: H (Theory Technology)

Pre requisites: 17MT301-Electrical, Electronic Devices and Circuits,
17MT206-Basic Mechatronics Laboratory,
17MT304- Electrical Machines and Power Systems,
17MT307- Electrical and Electronics Engineering Laboratory

Course Objectives:

1 To learn the operation and characteristics of power semiconductor devices.
2 To design protection circuits and converters using power semiconductor devices for various applications
3 To understand the basics of electrical drives with different loads.
4 To learn the implementation of power semiconductor devices in industrial drives applications.
5 To familiarize the students by introducing MATLAB simulation and help them to simulate and analyse different converters
6 To enable the student to study and simulate drives circuits using Matlab.
7 To apply the power electronics and drives concepts for real time applications

Course Outcomes:

Upon completion of the course, students shall have ability to

C315.1 Compare the principles of operations of power semi-conductor devices. [U]
C315.2 Differentiate various single phase and three phase power converter circuits [AP]
C315.3 Acquire the knowledge about fundamental of electrical drives and its control [AP]
C315.4 Identify the electrical drives for various control applications [A]
C315.5 Design and simulate converter, chopper & inverter circuits for drives applications [C]

Course Contents:

Power diodes, power transistors, SCRs, TRIAC, GTO, power MOSFETs, IGBTs-Principles of operation, characteristics, protection of thyristors against over voltage,over current, dv/dt and di/dt. Uncontrolled and Controlled converters- single phase and three phase half controlled and fully controlled rectifiers – Single phase dual converters- Effect of source Inductance - Thyristor triggering circuits.

Principle of chopper operations-control strategies – Step up and step down chopper – Quadrant operation-Buck and boost switched mode regulators. DC-AC converters-1-phase/3- phase (both 120 degree and 180 degree), VSI, CSI, PWM techniques-sinusoidal PWM, modified sinusoidal PWM-multiple PWM-Single phase ac voltage controller-On-off control and phase control.

Basic Elements – Types of Electric Drives –selection of motor, feedback control of drives, Induction motor drive –stator voltage control and V/f control methods-stepper motor drives and servo motor drives applications.

Lab Component:

1. To Obtain the SCR, MOSFET & IGBT V-I characteristics. [U]
2. To conduct the operation of SCR and TRIAC phase control circuit [C]
3. To design the Single phase half controlled converters and obtain the wave forms across R, RL load. [C]
4. To design the Single phase fully controlled converters and obtain the wave forms across R, RL load. [C]
5. To conduct the operation of Series inverter and Parallel inverter. [C]
6. To design the step up and step down chopper and compare its voltage results. [C]
7. To analyse the performance of voltage and current commutated chopper. [C]
8. To conduct speed control of converter fed DC motor by using Matlab simulation. [C]
9. To conduct speed control of chopper fed DC motor by using Matlab simulation. [C]
10. Design and simulate the 180 degree/120 degree mode of Three phase inverter with RLE load. [C]

Total Hours: 90

Text Books:

1. Singh. M.D &Khanchandani, K.B, “Power Electronics”, Tata McGraw Hill Publishing Co. Ltd., NewDelhi, 2008
2. Muhammad H. Rashid, “Power Electronics – Circuits, Devices & Applications”, Prentice Hall of India, New Delhi, 2013
3. Ned Mohan,T.M.Undeland and W.P Robbin, “Power Electronics: Converters, Application and Design” John Wiley and sons, 2006

Reference Books:

1. A.Bhimbra. Dr.P.S., “Power Electronics”, Khanna Publishers, New Delhi, 2012.
2. Gopal K Dubey, "Fundamentals of Electrical Drives”, Alpha Science International Limited, 2006.

Web References:

1. http://nptel.iitm.ac.in/courses/Webcoursecontents/IITKharagpur/PowerElectronics/

Online Resources:

1. https://www.coursera.org/course/fundamentals-power electronic converters

Assessment Methods & Levels (based on Blooms’ Taxonomy)					
Summative assessment based on Continuous and End Semester Examination					
Bloom’s Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Practical**	
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	**Rubric based CIA [40 Marks]**	
Remember	20	20	10	-	10
Understand	60	40	30	20	20
Apply	20	40	40	40	30
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	20	40	40

15MT318/ 16MT316/ 17MT316 **MACHINE DESIGN** **3/2/0/4**

Nature of Course : J (Problem analytical)

Pre requisites : 17MT202–Applied Mechanics
17MT302–Mechanics of materials

Course Objectives:

1. To formulate and analyse stresses and strains in machine elements and structures subjected to various loads.
2. To design and analyse various joints, power transmission shafts carrying various elements with geometrical features.

Course Outcomes:

Upon completion of the course, students shall have ability to

C316.1	Understand, identify and quantify failure modes of mechanical parts.	[U]
C316.2	Analyse the stress and strain on mechanical components.	[A]
C316.3	Evaluate the stress developed in various joints.	[E]
C316.4	Design and dimensioning various mechanical power transmission elements.	[C]

Course Contents:

Design Process - Mechanical properties of materials - Types of loads - Stresses - Static, varying, thermal, impact and residual - Factors of safety - Theories of failure – Stress concentration factors, Limits system- Fits – types, Tolerances- types.Welded Joints- types- Design of Transverse, parallel fillet and Butt welded joints – Design of Threaded joints and Power screws .

Design of helical and leaf springs.Design of Solid and Hollow shafts – Based on strength and rigidity– Design of flanged coupling and Bushed pin coupling - Design of Journal Bearings – selection of ball bearings.Design and selection of V belts, timing belts- wire ropes - pulleys.

Selection and design of Transmission chains and Sprockets - Gear classification - Gear tooth forces – Component design of spur, helical, bevel and worm gears based on Lewis equation.

Direct shifting gear box (DSG) (qualitative treatment only)

Total hours: 60

Text Books:

1. Bhandari V.B, “Design of Machine Elements”, third edition, Tata McGraw-Hill education, 2010.
2. Joseph Edward Shigley and Charles R.Mischke, “Mechanical Engineering Design”, tenth edition, McGraw-Hill International Edition, 2016.

Reference Books:

1. Norton R.L, “Design of Machinery”, Tata McGraw-Hill Book Co, Ebook fifth edition, 2011.
2. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine Design”, fifth Edition, Wiley, 2015

Web References:

1. http://nptel.ac.in/downloads/112105125/
2. http://www.uptu.ac.in/pdf/sub_eme_501_30sep14.pdf

Online Resources:

1. https://ocw.mit.edu/courses/mechanical-engineering
2. https://www.coursera.org/browse/physical-science-and.../mechanical-engineering

Assessment Methods & Levels (based on Bloom’s Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**Marks**
C316.1	Understand	Online Quiz	**5**
C316.2	Analyse	Group Assignment	**5**
C316.3	Evaluate	Problem Solving	**5**
C316.4	Create	Time line component reengineering	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom’s Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	0	0	0	0
Understand	20	20	20	20
Apply	0	0	0	0
Analyse	40	30	30	30
Evaluate	40	30	40	40
Create	0	20	10	10

15MT319/ 16MT317/ 17MT317 **SENSOR, MEASUREMENTS AND INSTRUMENTATION** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : Nil

Course Objectives:

1. To Understand the basic concepts of sensor and instruments
2. To Select appropriate instruments for various applications
3. To Familiarize students in handling various types of sensors

Course Outcomes:

Upon completion of the course, students shall have ability to

C317.1	Compare the different types of sensors and transducers.	[R]
C317.2	Classify the need of sensors for various processes	[U]
C317.3	Design a measuring system.	[AP]
C317.4	Rectify errors in sensors.	[A]

Course Contents:

Sensors –Classification of sensors - Fiber optic, Chemical, semiconductor, Bio, Pop up, Blind Spot, Millimeter, smart, Micro sensors - Linear measuring instruments: Vernier Caliper and Micrometer - Comparators- Mechanical, Pneumatic and Electric. Types- Terms in Surface Evaluation - Tomlinson surface meter Characteristics of instruments, Errors in instruments, GD&T.

Electronic Voltmeter and their advantages Electronic multimeter and ohmmeter – Current measurement - Power measurement Microprocessor based DMM with auto ranging and self-diagnostic features -Vibrometer and Accelerometer – Densitometer.

Angular velocity: Tachometers, Tacho generators, Digital tachometers and Stroboscopic methods – Encoders, decoders and resolvers. Nano Instrumentation- Biomedical Instrumentation, Analytical Instrumentation.

Total Hours: 45

Text Books:

1 Patranabis, “Sensors and Transducers”, Prentice Hall India Pvt. Ltd, New Delhi 2014
2 R.K.Jain, “Engineering Metrology ”, Khanna publishers, New Delhi 2010.

Reference Books:

1 D. V. S. Murthy, “Transducers and Instrumentation”, Prentice Hall of India Pvt. Ltd., New Delhi, 2009
2 A.K.Sawhney, “A Course in Mechanical Measurements and Instrumentation”, DhanpatiRai& Sons, New Delhi, 2014.

Web References:

1 http://nptel.ac.in/course.php?disciplineId=108
2 http://www.instrumentationworld.com/instrumentation_guide.htm

Online Resources:

1 https://www.edx.org/course?search_query=sensor%2C+measurements+and+instrumentation
2 https://www.coursera.org/courses?languages=en&query=measurements+and+instrumentation

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C317.1	Remember	Test (Definition)	**5**
C317.2	Understand	Online Quiz	**5**
C317.3	Apply	Problem Solving	**5**
C317.4	Analyse	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	20	20	15
Understand	30	30	30	30
Apply	30	.30	30	40
Analyse	20	20	10	15
Evaluate	0	0	0	0
Create	0	0	0	0

15MT320/ 16MT318/ 17MT318 **HYDRAULICS AND PNEUMATICS LABORATORY** **0/0/3/2**

Nature of Course : M (Practical application)

Co Requisites :17MT313- Hydraulics and Pneumatics

Course Objectives:

1. To design and test Hydraulic circuits
2. To design and test Pneumatic circuits
3. To simulate circuits using Fluid Sim and Automation Studio

Course Outcomes:

Upon completion of the course, students shall have ability to

C318.1 Understand the hydraulic symbols and Pneumatic symbols. [U]
C318.2 Analyse the Industrial Hydraulic and Pneumatic circuits. [A]
C318.3 Design Hydraulic and Pneumatic circuits. [Ap,E]

Course Contents:

1. Study of pneumatic and hydraulic components
2. Simulation and Actuation of Hydraulic Linear & Rotary actuator
3. Speed Control of Hydraulic Actuator
4. Simulation and Actuation of an Accumulator Circuit
5. Simulation and Actuation of Counter Balancing Circuit
6. Simulation and Actuation of Regenerative Circuit and safety circuit
7. Simulation and Actuation of Single and Double Acting Cylinder, parallel and series Circuit
8. Simulation and Actuation of logical circuits using Shuttle Valve & two pressure valve
9. Simulation and Actuation of Metering In and Metering Out Circuit
10. Simulation and Actuation of Sequential Circuit (2 & 3 Cylinder circuit)
11. Simulation and Actuation of Sequential Circuit Using Cascading Method (2 & 3 Cylinder circuit)
12. Simulation and Actuation of Electro Pneumatic circuits

Total Hours 45

Reference Books:

1. Anthony Esposito, “Fluid Power with Applications”, Pearson Education, 2014.
2. MajumdarS.R.,“Pneumatic systems – Principles & Maintenance”, Tata McGraw Hill, 2010
3. Festo Basic Pneumatic, Electro pneumatic, Hydraulic text and work books, 2015.
4. John Pippenger, Fluid Power Controls, Literary Licensing LLC, 2012.

Web References:

1. http://nptel.ac.in/courses/112106175/Module%203/Lecture%2024.pdf
2. http://nptel.ac.in/courses/112106175/Module%204/Lecture%2041.pdf
3. http://hydraulicspneumatics.com/fluid-power-basics/circuits

Online Resources:

1. http://www.itclearning.com/products/online-courses/hydraulic-power.html

Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	-	-
Understand	20	20
Apply	20	20
Analyse	30	30
Evaluate	30	30
Create	-	-

15MT321/ 16MT319/ 17MT319 **SENSOR AND INSTRUMENTATION LABORATORY** **0/0/3/2**

Nature of Course : M (Practical application)

Co requisites : 17MT317-Sensor, Measurements and Instrumentation

Course Objectives:

1. To understand the working principle of various sensors
2. To select appropriate sensor for specified application
3. To Familiarize students in handling various types of sensors

Course Outcomes:

Upon completion of the course, students shall have ability to

C319.1	Apply the basic knowledge of science.	[Ap]
C319.2	Design a simple measurement system.	[Ap]
C319.3	Proper selection of sensors for various processes.	[A]
C319.4	Calibrate the instruments.	[U]

Course Contents:

1. Measurement of linear displacement using inductive sensor.
2. Liquid level measurement using capacitive sensor
3. Measurement of light intensity using optical sensor
4. Piezo Electric accelerometer for vibration measurement
5. Measurement of pressure using Bourdon Gauge
6. Measurement of temperature using Thermocouple, RTD sensor
7. Measure the torque developed using torque sensor
8. Measure and control the speed of motor using stroboscope
9. Measurement of flow using Rotameter.
10. Measure the strain applied in the cantilever beam using strain sensor
11. Measurement of speed using proximity sensor
12. Digital shaft angle using Encoder Decoder.

Total Hours: 45

Reference Books:

1 Sawhney, A. K., “A Course in Mechanical Measurements and Instrumentation, DhanpatRai& Sons”, New Delhi, 2014

2 J. P. Bentley, “Principles of Measurement Systems”, Addison Wesley Longman Ltd., UK, 2010.

Web References:

1 http://nptel.ac.in/course.php?disciplineId=108

2 http://www.instrumentationworld.com/instrumentation_guide.htm

Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	-	-
Understand	10	10
Apply	40	40
Analyse	10	10
Evaluate	40	40
Create	0	0

SEMESTER VI

15MT322/ 16MT320/ 17MT320 **COMPUTER INTEGRATED MANUFACTURING** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : 17MT205-Production Technology

Course Objectives:

1. To study about CNC machines and its constructional features
2. To learn basics of manufacturing automation
3. To study the need of automated material handling system.
4. To learn basics of computer aided inspection

Course Outcomes:

Upon completion of the course, students shall have ability to

C320.1	Get clear understanding of NC/CNC machines and its various elements of CNC machines.	[U]
C320.2	Learn the different types of FMS layouts, material handling storage and retrieval Systems	[U]
C320.3	Get an insight of automation in manufacturing and to demonstrate knowledge of their understanding of drives, controls and modeling in automation.	[AP]
C320.4	Simulate and apply modeling methods with their impact on the designed systems.	[A]

Course Contents:

CIM Definition - CIM wheel - CIM components, Evolution of CIM - needs of CIM - Benefits of CIM -components of NC system - NC motion control system - applications of NC - advantages and disadvantages of NC -computer Numerical control - advantages of CNC - functions of CNC - DNC systems.

Manufacturing Automation - Manufacturing Support Systems - Types of Automation- Computerized manufacturing Support System - Automated material Handling and storage systems. Group Technology - Cell design - Flexible Manufacturing Systems- Process Planning – MRP - MRP II – JIT - Types of production monitoring system.

process control & strategies - direct digital control - Supervisory computer control- computer aided quality control - QC and CIM – contact and non-contact inspection methods - CMM and Flexible Inspection systems - Integration of CAQC with CIM

TOTAL HOURS : 45

Text Books:

1 Mikell P. Groover, “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India Private Ltd., New Delhi, 2016
2 P. Radhakrishnan, “CAD / CAM / CIM”, New age international, 2016

Reference Books:

1 Kant Vajpayee. S., “Principles of Computer Integrated Manufacturing”, Prentice Hall of India, 2010
2 YoremKoren, “Computer Control of Manufacturing System”, McGraw Hill, 2011

Web References:

1 http://www-personal.umich.edu/~ykoren/uploads/
2 http://vigyanpariyojana.weebly.com/uploads/2/4/2/5/24253861/cad_cam.pdf

Online Resources:

1 www1.rmit.edu.au/courses/015034
2 nptel.ac.in/courses/112102011/

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C320.1	Understand	Test (Definition)	**5**
C320.2	Understand	Online Quiz	**5**
C320.3	Apply	Case Study	**5**
C320.4	Analyse	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	20	20	20
Understand	30	30	15	30
Apply	40	30	30	35
Analyse	10	20	35	15
Evaluate	0	0	0	0
Create	0	0	0	0

15MT323/ 16MT321/ 17MT321 **VIRTUAL INSTRUMENTATION** **3/0/3/4**

Nature of Course : F (Theory programming)

Pre requisites : 17MT317-Sensor, Measurements and Instrumentation

Course Objectives:

1 To familiarize the basics of Virtual Instruments
2 To differentiate traditional instrumentation and virtual instrumentation
3 To provide practical knowledge and hands on experience on basic concepts of LabVIEW programming
4 To know about the programming structure of the software
5 To understand various bus
6 To implement data acquisition and interfacing
7 To develop applications using LabVIEW

Course Outcomes:

Upon completion of the course, students shall have ability to

C321.1	Understand the basic concepts of Virtual Instruments.	[U]
C321.2	Implement various bus interfaces	[AP]
C321.3	Program and simulate systems using LabVIEW.	[C]
C321.4	Acquire data using DAQ and implement various interfaces.	[AP]
C321.5	Apply LabVIEW for various application	[AP]

Course Contents:

Introduction to Virtual Instrumentation - Block diagram & architecture of Virtual Instrumentation - graphical programming in data flow, comparison with conventional programming - Introduction to LabVIEW – Programming techniques.

DAQ Hardware Configuration - Selecting and configuring a Data Acquisition device - components of computer based measurement system - Bus Interfaces: USB, RS 232C, RS422, RS485, GPIB, Firewire, Instrument Interfaces: PCI, PCI Express, PXI, PCMCIA, VXI, SCXI, LXI, Ethernet control of PXI, VISA and IVI.

Instrument control- Hardware in the Loop (HIL) - Image acquisition and processing- Motion control – LabVIEW based Robot Control System

Lab Component:

1. Programming Exercises for performing arithmetic operations. [U]
2. Programming exercises for verification of half adder and full adder. [AP]
3. Programming to find Addition of First n natural numbers using for and while loop [AP]
4. Programming to create a sine wave using formula node. [AP]
5. Programming to control Traffic light. [AP]
6. Programming exercises on case and sequence structures, file Input / Output. [AP]
7. Programming to develop voltmeter and ammeter using DAQ cards. [C]
8. Programming to plot VI characteristics of a diode [C]
9. Programming for implementing half wave and full wave rectifier using DAQ [C]
10. Programming for implementing Seven Segment Display using DAQ. [C]
11. Programming to perform temperature measurement using DAQ. [C]
12. Programming for simple fire detection and alarm [C]

Total Hours: 90

Text Books:

1 Jovitha Jerome, "Virtual Instrumentation using LabVIEW", PHI Learning Private Limited, 2012.

2 S. Sumathi and P. Surekha, "LabVIEW based Advanced Instrumentation Systems" Springer-Verlag Berlin Heidelberg, 2011.

3 John Essick, "Hands-On Introduction to LabVIEW for Scientists and Engineers", Second edition, Oxford University press, 2013.

Reference Books:

1 Sanjay Gupta, Joseph John, "Virtual Instrumentation using LabVIEW – Principles and Practices of Graphical Programming", Second Edition, Tata McGraw Hill Education Private Limited, 2011.

2 Jim Kring, Jeffrey Travis, "LabVIEW for Everyone: Graphical Programming Made Easy and Fun", 3rd Edition, Pearson Education, 2011.

3 John Essick, "Hands-On Introduction to LabVIEW for Scientists and Engineers" Oxford University Press, 2nd Edition, 2013.

Web References:

1 http://www.ni.com

2 http://k12lab-support-pages.s3.amazonaws.com/lvbasichome1.html

Online Resources:

1 www.nptel.ac.in/syllabus/112106152/

2 nptel.ac.in/courses/108105062/10

Assessment Methods & Levels (based on Blooms' Taxonomy)					
Summative assessment based on Continuous and End Semester Examination					
Bloom's Level	**Continuous Assessment**				**End Semester Examination (Theory) [40 marks]**
	Theory			**Practical**	
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	**Rubric based CIA [40 Marks]**	
Remember	20	20	10	-	10
Understand	60	40	30	20	20
Apply	20	40	40	40	30
Analyse	-	-	-	-	-
Evaluate	-	-	-	-	-
Create	-	-	20	40	40

15MT324/ 16MT322/ 17MT322 **INDUSTRIAL AUTOMATION** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : Nil

Course Objectives:

1. To understand the various types of Automation processes.
2. To study about the hardware and software involved in a PLC.
3. To provide the control functions involved in DCS and SCADA.
4. To give adequate information in the interfaces used in HMI.

Course Outcomes:

Upon completion of the course, students shall have ability to

C322.1	Relate the significance of control in automation.	[U]
C322.2	Connect the PLC peripherals with the ladder programming.	[AP]
C322.3	Summarize the working of various elements of DCS and SCADA.	[U]
C322.4	Identify and interpret the processes in HMI.	[AP]

Course Contents:

Introduction to Industrial Automation, Requirements of Industrial Automation, Types of Automation-Localized Process-Distributed process-supervisory and data acquisition, Components of Industrial Automation, Advantages of industrial automation.
PLC architecture, Parts of PLC, CPU and Memory, Input/output modules, power supplies, relays, switches, Relay logic, PLC programming languages, Ladder logic, Timers and Counters, selection of PLC based on input and output.

Distributed Control System (DCS) architecture, Database organization in DCS, System elements of DCS-Field station-Intermediate station-Central computer station, Reliability parameters of DCS, Classifications of Alarms in DCS. Introduction, Application areas of SCADA, Major elements of SCADA systems, Comparison of SCADA, DCS and PLC, Considerations and benefits of SCADA system.Introduction to field-programmable gate array (FPGA).

HMI –Automation system structure, Instrumentation subsystem, control subsystem, Human interface subsystem-operator panel-construction of the panel-Interfacing with control sub system-Types of Mimic panels, Advance HMI system-Intelligent operator panel-operator station- Data logging station.
Case studies: Loading and unloading, Material Transfer application.

Total Hours: 45

Text Books:

1 Frank D Petruzella, “Programmable Logic Controllers”, Tata McGraw Hill Publications, 2016
2 DobrivojePopovic and Vijay Bhatkar, “Distributed control for Industrial Automation”, Marcel Dekker Inc, 2012.

Reference Books:

1 Michael P.Lukas, “Distributed Control system”, Van Nostrand Reinhold co, Canada, 2012.
2 Stuart A Boyer, “SCADA-supervisory control and data acquisition”, International Society of automation, 3rd edition,2011.

Web References:

1 http://nptel.ac.in/courses/webcourse-contents/IITKharagpur/Industrial
2 http://nptel.ac.in/courses/112102011/

Online Resources:

1 https://www.control.com
2 https://www.ourinstrumentationgroup.com

Assessment Methods & Levels (based on Bloom’s Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**Marks**
C322.1	Remember	Test (Definition)	**5**
C322.2	Understand	Online Quiz	**5**
C322.3	Apply	Programming	**5**
C322.4	Analyse	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom’s Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	10	10
Understand	40	40	50	50
Apply	40	50	40	40
Analyse	0	0	0	0
Evaluate	0	0	0	0
Create	0	0	0	0

17MT323 **CAE LABORATORY** **0/0/3/2**

Nature of Course : M (Practical application)

Pre requisites : 17MT201- Technical Drawing
17MT207 - Mechatronics Machine Drawing Laboratory

Course Objectives:

1. To understand the types of element used, type of analysis done, interpretation of results, method of solving and analyzing a given problem
2. To Create a computer aided manufacturing (CAM) model and generate the machining codes automatically using the CAM software
3. To impart knowledge on how these tools are used in Industries by solving some real time problems using these tools.

Course Outcomes:

Upon completion of the course, students shall have ability to

C323.1	Understand and analyse the given component.	[U]
C323.2	Apply appropriate commands for simple shapes and complex figures in ANSYS	[A]
C323.3	Generate automated tool paths for a given engineering component.	[AP]
C323.4	Develop G and M codes for turning and milling components.	[C]

Course Contents:

1. Study of ANSYS software.
2. Stress analysis of beam -cantilever beam with point load
3. Stress analysis of beam-simply support beam with distributed loads
4. Stress analysis of beam-fixed beam with varying load
5. Stress analysis of a corner angle bracket
6. Thermal analysis
7. CNC programming for turned components using FANUC Controller
8. CNC programming for milled components using FANUC Controller
9. Automated CNC Tool path & G-Code generation using Master CAM
10. Demo on FDM Rapid Prototyping machine

Total Hours: 45

Reference Books:

1 Daryl L Logan, Thomason, “A first course in the Finite element method”, Third Edition, 2014.
2 Radhakrishnan P, “Computer Numerical Control Machines”, New Central Book Agency, 2012.

Web References:

1 https://caeai.com/ansys-e-learning-series
2 http://nptel.ac.in/courses/112102103/9

Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	10	10
Understand	20	20
Apply	20	20
Analyse	30	30
Evaluate	0	0
Create	20	20

15MT326/ 16MT324/ 17MT324 **INDUSTRIAL AUTOMATION LABORATORY** **0/0/3/2**

Nature of Course : M (Practical application)

Co requisites : 17MT322-Industrial Automation

Course Objectives:

1. To Analyze the input and output interfaces of the PLC system.
2. To Develop programs on PLC using timer and counter instructions.
3. To Identify the HMI operations on an automation environment.

Course Outcomes:

Upon completion of the course, students shall have ability to

C324.1	Identify basic components of a PLC and describe their functions.	[U]
C324.2	Read and understand simple ladder logic programs. Effectively write basic and intermediate level PLC programs.	[Ap]
C324.3	Perform simple debugging of programs.	[Ap]
C324.4	Identify and interpret the processes in HMI.	[U]

Course Contents:

1. To study the block diagram and input and output modules interfaces of Programmable Logic Controller.
2. Introduction to ladder programming and to implement basic logic gates.
3. Water level control with PLC programming.
4. Water level control with HMI.
5. Temperature control with PLC programming.
6. Temperature control with HMI.
7. Belt conveyor control with PLC programming.
8. Belt conveyor control with HMI.
9. Stepper motor control for linear applications using PLC programming.
10. Stepper motor control for linear applications using HMI.
11. Stepper motor control for Rotary applications using PLC programming.
12. Stepper motor control for Rotary applications using HMI.
13. Create a New SCADA for Temperature control application.
14. Create a New SCADA for Water level control application.

Total Hours:45

Reference Books:

1 Frank D Petruzella, “PLC”, Tata McGraw Hill Publications, 2016.

2 Webb, John W, “Programmable Logic Controllers - Principles and applications”, PHI Publication,5th edition,2016.

Web References:

1 http://nptel.ac.in/courses/112102011/
2 www.plcs.net

Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	-	-
Understand	30	30
Apply	50	50
Analyse	0	0
Evaluate	0	0
Create	20	20

15MT602/ 16MT602/ 17MT602 **Industrial Field Training** **2 Credits**

SOP for Industrial Field Training

1. A minimum of 15 days in-plant training has to be undergone by the student in the fifth semester vacation.

2. Students have to undergo practical training in Mechatronics engineering related industry/ project site or design / planning office so that they become aware of the practical application of theoretical concepts studied in the class rooms.

3. The student has to decide the company and period of training in the mid of fifth semester. The information of the company has to be intimated to their respective tutors.

4. The student shall make a presentation before a committee constituted by the department which will assess the student based on the report submitted and the presentation made.

5. The report should contain the details of the Company layout, organizational structure, work flow, etc. At the end of the training student will submit a report as per the prescribed format to the department.

6. A certificate from company stating that the student has undergone the training successfully, has to be produced after the training.

Assessment Components		
S.No.	**Category**	**Marks**
1	Fixing Industry	**10**
2	Certificate	**10**
3	Power point Presentation	**40**
4	Report	**40**
Total		**100**

SEMESTER VII

15MT327/ 16MT325/ 17MT325 **ROBOTICS AND MACHINE VISION SYSTEM** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : 17MT313 - Hydraulics and Pneumatics
17MT308 - Microcontroller and Its Applications
17MT309 - Theory of Machines

Course Objectives:

The objective of this course is to

1. Introduce the principles of robotics.
2. Familiarize the concepts and techniques in robot manipulator control and robot dynamics.
3. Understand the design and implementation of robot applications and their relationship to other automated technologies.
4. Understand the basis of machine vision & its application in robotics.

Course Outcomes:

Upon completion of the course, students shall have ability to

C325.1	Understand the basic concepts of Robotics & Robot component	[R]
C325.2	Apply the concept of sensors used in robotics application & basic robot programming techniques	[AP]
C325.3	Apply the concept of image processing & it's real time application in robotics	[AP]
C325.4	Analyse the robot kinematic position & dynamic actuator force.	[A]

Course Contents:

Basic components of robot-Laws of robotics- classification and application of robots -work space- accuracy-resolution –repeatability of robot. Rotary to rotary motion, Rotary to linear motion, Harmonics drives. Robot kinematics: Introduction- Matrix representation- Rigid motion & homogeneous transformation- forward & inverse kinematics (DH – Parameter) - trajectory planning.

Robot Dynamics: Introduction - Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation – Basics of Trajectory Planning. Robot End effectors: Introduction- types of End effectors- Mechanical gripper- types of gripper mechanism- special purpose grippers- Lead through Programming.

Machine vision: image acquisition, digital images - sampling and quantization - levels of computation Feature extraction - windowing technique- segmentation- Thresholding - edge detection - binary morphology - grey morphology, Feature Extraction and vision sensors and their types. Image resolution – Depth and volume, Colour processing, and Object recognition by features, Depth measurement, and specialized lighting techniques. Segmentation using motion – Tracking. Image Data Compression; Real time Image processing, Application of Vision systems,Case study –Remote Centred Compliance(RCC)

Total Hours: 45

Text Books:

1 King Sun Fu, Rafael C. González, C. S. George Lee, “Robotics: control, sensing, vision, and intelligence”, Tata Mcgraw-Hill Publication, 2014.
2 M.P.Groover, “Industrial robotics- Technology, programming and Applications”, McGraw-Hill, 2016
3 Saeed B. Niku, “Introduction to Robotics: Analysis, Systems, Applications”, 2nd edition, Pearson Education India, 2011.

Reference Books:

1 SathyaRanjan Deb, “Robotics Technology & flexible Automation”, Sixth edition, Tata Mcgraw-Hill Publication, 2011
2 John.J.Craig, “Introduction to Robotics: Mechanics & control”, Second edition, 2012.

Web References:

1 http://www.gorobotics.net/
2 http://www.robotbooks.com/general-robotics-links.html
3 http://nptel.ac.in/courses/112101099/

Online Resources:

1 https://www.edx.org/course/robotics-columbiax-csmm-103x
2 https://ocw.mit.edu/courses/mechanical-engineering/2-12-introduction-to-robotics-fall-2005/lecture-notes/

Assessment Methods & Levels (based on Bloom’s Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**Marks**
C325.1	Remember	Test (Definition)	**5**
C325.2	Apply	Online Quiz	**5**
C325.3	Apply	Problem Solving	**5**
C325.4	Analyse	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom’s Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	15	15
Understand	40	20	30	30
Apply	40	40	40	40
Analyse	0	30	15	15
Evaluate	0	0	0	0
Create	0	0	0	0

15MT328/ 16MT326/ 17MT326 **DESIGN AND MODELING OF MECHATRONICS SYSTEM** **3/2/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : Nil

Course Objectives:

1. To provide the mechatronic system design and their structure, ergonomic and safety
2. To learn the design of mechatronics products.
3. To provide an exposure on carryout mechatronic modeling and design.
4. To reduce the product design and development cost and time through simulation.

Course Outcomes:

Upon completion of the course, students shall have ability to

C326.1	Understand the mechatronic system design and their structure.	[U]
C326.2	Create Mechatronic modeling and design	[C]
C326.3	Evaluate and validate the simulation models.	[E]
C326.4	Design of mechatronic products.	[C]

Course Contents:

Introduction to Mechatronics system– Key elements Mechatronics Design process – Traditional and Mechatronics designs- concurrent design- procedure for mechatronics systems, modeling procedure mechanisms and structures: loading conditions, modeling and simulation, industrial design and ergonomics information, transfer and safety.Role of modeling in mechatronics design, modeling as part of design process, goals of modeling.

Bond graphs (BGs) BG terminology basic elements and junctions object oriented modeling Derivation of state space equations Mechatronic design quotient (MDQ) application to Industrial fish cutting machine and kinematic design optimization of Acrobot Mechatronic design quotient (MDQ).

Appropriateness of simulation, Areas of application models and steps in a simulation study, Simulation of manufacturing and material handling systems frequency test, chi-square test; verification and validation of simulation models. Modeling and simulation of semi-active suspension system, Internal combustion engine with drive train, Camera drive, Disk drive - Auto control system for greenhouse temperature, Mechatronics in landmine detection and removal – Validation using MATLAB.

Total Hours: 45

Text Books:

1 Georg Pelz , “Mechatronic Systems Modelling and Simulation with HDLs”, John Wiley & Sons Ltd, 2013

2 Robert H. Bishop., “The Mechatronics Handbook”, 3rd Edition, CRC press, London, 2012

Reference Books:

1 Clarence W. de Silva, "Mechatronic Systems-Devices, design, control, operation and monitoring", CRC Press, Taylor & Francis group, 2011

2 Banks J., Carson J.S. and Nelson B.L., "Discrete – Event System Simulation", 3rd Edition, Pearson Education, Inc 2004 (ISBN 81-7808-505-4).

Web References:

1 nptel.ac.in/courses/112104158/
2 nptel.ac.in/courses/112104158/lecture1.pdf

Online Resources:

1 ieeexplore.ieee.org/document/1411763/
2 mechatronics.colostate.edu/resources.html

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C326.1	Understand	Online quiz	**5**
C326.2	Create	Test	**5**
C326.3	Evaluate	Problem Solving	**5**
C326.4	Create	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	10	10
Understand	30	20	20	25
Apply	40	30	40	25
Analyse	10	20	15	15
Evaluate	0	20	0	15
Create	0	0	15	10

15HS003/ 16HS004/ 17HS003 **INDUSTRIAL MANAGEMENT AND PROFESSIONAL ETHICS** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : Nil

Course Objectives:

1. To familiarize the moral issues in engineering
2. To provide tools for analyzing the issues.
3. To give sufficient experience and confident to resolve the issues in working environment.

Course Outcomes:

Upon completion of the course, students shall have ability to

C003.1	Explain the various industrial management principles	[U]
C003.2	Analyse the impact of social environment on individuals and groups	[A]
C003.3	Optimize the resources of an organization and improve productivity	[E]
C003.4	Demonstrate the knowledge of designing plants and controlling Production.	[C]

Course Contents:

Introduction to organizational structure, work study and method study – Time study– Standard data - Method Time Measurement (M-T-M) – Work sampling – Plant location - Factors - Plant layout - Types - Layout design process – Computerized Layout Planning – Construction and Improvement algorithms -ALDEP and CRAFT.

Heuristic methods of grouping by machine matrices product design and plant layout - Types of productions, Production cycle- Forecasting, Loading, Scheduling, Dispatching, Routing- Simple problems.

Ethics-scope-Engineering as social experimentation-commitment to safety- Safety and risk, assessing and reducing risk -work place responsibilities and rights- Team work, confidentiality and conflicts of interest, Rights of Engineers. Case studies-Air bags, containers, TV antenna.

Text Books:

1 Buffa E.S, “Modern Production / Operational Management”, John Wiley & Sons, 2013.

2 Mike.W.Martin, Roland Schinzinger, “Ethics in Engineering” Tata McGraw- Hill, fourth edition, 2011.

Reference Books:

1 Charles E, Harris.JR, Michael S.Pritchard, Michael J.Rabins, “Engineering ethics” fifth edition, 2013.
2 Nigel Slack, Stuart Chambers, Robert Johnston., “Operation Management”, Pearson Education, sixth edition 2011.
3 R.Panneerselvam, “Production and operation management”, PHI learning Pvt.ltd, Sixth edition, 2014.

Web References:

1 http://nptel.ac.in/courses/109104032/
2 http://www.youtube.com/watch?v=vS31o3xfh_0

Online Resources:

1 https://www.leeds.ac.uk/arts/info/125162/.../2431/professional_ethics_short_course

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C003.1	Understand	Online Quiz	**5**
C003.2	Analyse	Group Assignment	**5**
C003.3	Evaluate	Case studies	**5**
C003.4	Create	Online course	**5**

Summative assessment based on Continuous and End Semester Examination			
Bloom's Level	**Continuous Assessment**		
	CIA-I [30 marks]	**CIA-II [30 marks]**	**Term End Examination [40 marks]**
Remember	20	0	10
Understand	20	30	20
Apply	20	10	20
Analyse	40	30	30
Evaluate	0	20	10
Create	0	10	10

15MT329/ 16MT327/ 17MT327 **ROBOTICS LABORATORY** **0/0/3/2**

Nature of Course : M (Practical application)

Co requisites : 17MT325-Robotics And Machine Vision System

Course Objectives:

1. To familiarize the concepts and techniques in robot, manipulator control via teach pendant.
2. To understand rapid programming and create programs to perform certain tasks.
3. To understand the basics of machine vision using LabVIEW& its application in robotics.

Course Outcomes:

Upon completion of the course, students shall have ability

C327.1	To understand the basics & classification of robots.	[U]
C327.2	To apply the concept & techniques in robot, manipulator control via Teach pendant.	[Ap]
C327.3	To apply Rapid programming and create programs to perform industrial tasks.	[Ap]
C327.4	To apply the basics of machine vision in robotics.	[AP]

Course Contents:

1. Verifying the work volume of given six robots.
2. Simple rapid programming for Teach pendant.
3. Teach Work object and TCPsettingto ABB six axis robot using Teach pendant
4. Teach the ABB six axis robot to identify the given components are Metal or Non - metal using Teach pendant
5. Teach the Machine tending operation of ABB six axis robot using Teach pendant
6. Teach the welding simulation of ABB six axis robot using Teach pendant
7. Teach the painting simulation of ABB six axis robot using Teach pendant
8. Perform the Matrix palletizing operation of ABB six axis robot using Teach pendant with single suction cup
9. Perform the Cartoon palletizing operation of ABB six axis robot using Teach pendant with multi suction cup
10. In ABB six axis robot, identify and sorting the defective and non defective components using Teach pendent and vision system.

Total Hours: 45

Reference Books:

1 Saeed B. Niku, “Introduction to Robotics: Analysis, Systems, Applications”, 2nd edition, Pearson Education India, 2013.

Web References:

1 http://new.abb.com/products/robotics/robotstudio/tutorials

Assessment Methods & Levels (based on Bloom's Taxonomy)		
Summative assessment based on Continuous and End Semester Examination		
Bloom's Level	**Rubric based Continuous Assessment [60 marks] (in %)**	**End Semester Examination [40 marks] (in %)**
Remember	0	0
Understand	30	30
Apply	0	0
Analyse	50	50
Evaluate	0	0
Create	20	20

15MT505/ 16MT505/ 17MT505 | **MOOC Certification** | **1 Credit**

SOP FOR MOOC Certification

1. The MOOC certification should be on technical domains, either related to their project or placement activities.
2. The Student should complete 2 courses within the same semester.
3. The first course should be completed in the first half of the semester and the second course should be completedin the second half of the semester.
4. The MOOC course should be approved by the Department.
5. The minimum duration should be 4 weeks per course.
6. The student should earn the MOOC certificates individually.
7. The student should prepare the power point of the FIRST course in the middle of the semester and present the same.
8. The student should prepare the power point of the SECOND course at the end of the semester and present the same.
9. The course dates should be updated with the assignedfaculty incharges every week.

Assessment Components		
S.No.	**Category**	**Marks**
1	MOOC Certification- Course-I	**25**
2	Power point Presentation of course-I	**25**
3	MOOC Certification- Course-II	**25**
4	Power point Presentation of course-II	**25**
Total		**100**

SEMESTER VIII

15MT603/ 16MT603/ 17MT603 **INDUSTRIAL PROJECT** **0/0/24/12**

SOP FOR INDUSTRIAL PROJECT

1. Students must do the project based on their subjective domain.
2. Students can do projects either by individual or group containing maximum of 4 per batches.
3. Students should fix one External guide from Industry and One Internal guide from department based on their field of domain or area of interest.
4. Students have to carry project in the industry for the complete duration of the semester.
5. Students should present all their reviews compulsory as per the fixed schedule.
6. Students must publish a paper in National and International Journals or in National/International conference organized by premier institutions.
7. Students must produce Attendance and Industrial certificates from their project carrying Industry.
8. Students must prepare their documents without any plagiarism.
9. Students should follow all the procedures, formats and instructions in their documentation works as per the guidelines by the institution.

Week	Guidelines
1	Permission shall be obtained from the industries for doing project during mid of 7^{th} semester
	Students shall visit the industries to identify problem for which solution has to be obtained
2	Students shall fix guide, one internal guide in department and one external guide in industry who is appropriate to their field of interest and fix the title of the project
3	ZEROTH REVIEW – To verify the level of industrial exposure to the students and project feasibility
4	Literature review pertaining to problem identified shall be done by the students
5	Students shall propose a new system with block diagram and tentative budget of the project (Students may submit the project proposal to the funding agencies - Optional)
6	FIRST REVIEW to verify the literature review and proposed model
7	Students shall do design calculation and find the methodology to execute the project
8	Students shall collect the hardware components required for the project/ The simulation required for the project shall be carried out.
9	SECOND REVIEW – To verify Design and bill of materials of the project
10	Fabrication of the proposed project shall be accomplished by the student at the concerned industrial premises.
11	Students shall publish a paper in National and International Journals or in National/ International conference organized by premier institutions
12	THIRD REVIEW – To evaluate the fabrication of project
13	Students shall do the documentation to prepare a report of the project
14	END SEMESTER PROJECT VIVA EXAM

Assessment Components		
S.No.	**Category**	**Marks**
1	Fixing Industry	**20**
2	Zeroth Review	**10**
3	First Review	**10**
4	Second Review	**10**
5	Third Review	**10**
6	Report & Final Viva Voce (Conference – 10, Journal Publication - 10)	**40**
Total		**100**

OPEN ELECTIVES

15MT501/ 16MT501/ 17MT501 **RELIABILITY ENGINEERING** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : Nil

Course Objectives:

1. To use statistical tools to characterize the reliability of an item.
2. To select appropriate reliability validation methods.
3. To get the working knowledge for finding the reliability of a system and suggest approaches to enhancing system reliability.
4. To apply engineering knowledge and specialist techniques to prevent or to reduce the frequency of failures**.**

Course Outcomes:

Upon completion of the course, students shall have ability to

C501.1	Know the relationship of key concepts in reliability engineering and application to maintenance strategies in a manufacturing environment;	[R]
C501.2	Establish maintenance strategies according to system characteristics and design transition programs to implement these strategies	[U]
C501.3	Apply the appropriate methodologies and tools for enhancing the inherent and actual reliability of components and systems, taking into consideration cost aspects	[AP]
C501.4	Analyse the interference between strength and stress, or life data for estimating reliability of the system.	[A]

Course Contents:

Reliability basics, maintainability, availability, quality, cost and system effectiveness, life characteristic phases, modes of failure, areas of reliability, quality and reliability assurance rules, product liability, importance of reliability. Probability distributions -binomial, normal, Poisson, lognormal, Weibull, exponential, standard deviation, variance, skewness coefficient, series, parallel, mixed configuration, k- out of n structure, analysis of complex systems-

Enumeration method, conditional probability method, delta-star method for conditional probability analysis, - types of stand by redundancy Objectives of maintenance, types of maintenance, maintainability, factors affecting maintainability, system down time, availability - inherent, achieved and operational availability, reliability and maintainability trade-off, maintainability tools and specific maintainability design considerations.

Failure mode effects analysis, severity/criticality analysis, FMECA examples, RPN, Ishikawa diagram for failure representation, fault tree construction, basic symbols development of functional reliability block diagram, minimal cut set method, minimal tie set method, Delphi methods, Monte Carlo evaluation.

Total Hours : 45

Text Books:

1. L.S.Srinath, “Reliability Engineering”, EWPublishers, 3rd Edition, 2012.
2. Alessandro Birolini , “Reliability Engineering Theory and Practice”, Springer,2011.

Reference Books:

1. Roy Billinton and Ronald N Allan, “Reliability Evaluation of Engineering Systems”, Springer,2012.
2. S S. Rao, “Reliability Based Design”, McGraw Hill Inc. 2011.
3. E Balagurusamy, “Reliability Engineering”, Tata McGraw-Hill Publishing Company Limited, 2012.

Web References:

1 http://nptel.iitm.ac.in/courses/Webcoursecontents/IITKharagpur/Reliability Engineering/

Assessment Methods & Levels (based on Bloom’s Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**Marks**
C501.1	Remember	Test (Definition)	**5**
C501.2	Understand	Online Quiz	**5**
C501.3	Apply	Design a system and estimate the reliability of the system	**5**
C501.4	Analyse	Assignment	**5**

Summative assessment based on Continuous and End Semester Examination

Bloom’s Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	15	15
Understand	40	20	30	30
Apply	40	40	40	40
Analyse	0	30	15	15
Evaluate	0	0	0	0
Create	0	0	0	0

15MT502/ 16MT502/ 17MT502 **VEHICLE DYNAMICS** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : Nil

Course Objectives:

1. To understand the basic concepts of forces acting on the Vehicles on road.
2. To gain knowledge on acceleration and braking performance of vehicles.
3. To make the students choose appropriate suspension and steering system for vehicles.
4. To design the size and load rating of tires.

Course Outcomes:

Upon completion of the course, students shall have ability to

C502.1	Be aware of the basic forces acting on a vehicle during on road	[R]
C502.2	Understand the accelerating and braking performances.	[U]
C502.3	Analyze the suspension and steering system of a vehicle	[A]
C502.4	Compute the size and load ratings of tires.	[AP]

Course Contents:

Introduction to Vehicle Dynamics– Dynamic Axle loads – Static loads on level ground – Low-speed acceleration – Loads on grades. Acceleration Performance: Power limited acceleration and Traction limited acceleration. Braking Performance: Basic Equations of Constant deceleration and Deceleration with Wind resistance. Braking forces: Rolling resistance, Aerodynamic Drag, Driveline Drag and grade. Brake Factor. Tire road friction: Velocity, Inflation pressure and Vertical Loads.

Aerodynamic forces, Drag, Side force and Lift force. Suspension: Solid axles – Hotchkiss, Four link and De Dion – Independent Suspensions, Anti Squad and Anti Pitch Suspension geometry – Anti Dive Suspension Geometry. Active Suspensions.

Steering System: Steering linkages, Steering geometry error, Front wheel geometry, Steering system forces and moments and Steering system Models. Tires: Tire construction, Size and load rating, Terminology and Axis system, Mechanics of force generation. Combined braking and cornering steer– Tire Vibrations.

Total Hours: 45

Text Books:

1 Thomas D Gillespie, “Fundamentals of Vehicle Dynamics”, SAE, 2013.
2 William F Milliken and Douglas L Milliken, “Race Car Vehicle Dynamics”, SAE, 2008

Reference Books:

1 Reza N Jazar, “Vehicle Dynamics”, Springer, 2nd Edition, 2013
2 Giancarlo Genta, “Motor Vehicle Dynamics”, World Scientific Publishers, 2007

Web References:

1 http://nptel.ac.in/courses/107106080/
2 http://training.sae.org/seminars/99020/

Online Resources:

1 https://iversity.org/en/courses/vehicle-dynamics-i-accelerating-and-braking
2 sae.org/credentialing/certificate/vehicledynamics.htm

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C502.1	Remember	Test (Definition)	**5**
C502.2	Understand	Online Quiz	**5**
C502.3	Analyse	Problem Solving	**5**
C502.4	Apply	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	30	15	10	15
Understand	35	25	25	30
Apply	35	35	40	40
Analyse	0	25	25	15
Evaluate	0	0	0	0
Create	0	0	0	0

15MT503/ 16MT503/ 17MT503 **MICRO AND NANO ROBOTICS** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : Nil

Course Objectives:

1. To understand scientific concepts underlying engineering and technological applications.
2. To acquire the knowledge of manipulation for advance technology applications
3. To get familiarized with the new concepts of real-time manipulation & assembly

Course Outcomes:

Upon completion of the course, students shall have ability to

C503.1	Explain the basic theory of stiffness, workspace, kinematics and dynamics related to robotics	[R]
C503.2	Understand the Micro/Nano manufacturing techniques	[U]
C503.3	Analyze mechanism's DOF and singularity by scaling laws	[A]
C503.4	Apply the algorithms for controlling.	[AP]

Course Contents:

Introduction to Robotics – Overview of Micro/Nano-robotic systems. Physics of reduced length scales (scaling effects in the physical parameters, surface forces, contact mechanics, and micro/nano-scale dynamical phenomena).

Basics of micro/nano-manufacturing, microfabrication and soft lithography, Biomimetic design strategies for mobile micro-robots, Principle of transduction, material properties and characteristics of actuators (piezoelectric, shape-memory alloy, and a variety of MEMS and polymer actuators).Control requirements and challenges of micro/nano-actuators, sensors for microrobotic applications, manipulation- Fabrication of grippers (scanning probe microscopy, operation principles, designing experiments for nanoscale mechanical characterization of desired samples).

Type design, DOF and singularity analysis, kinematics Modelling, dynamics Modelling, the incidence relation between outputs of end-effector and inputs of actuators, reducible matrix, how to design micro/nano robot using reducible matrix, control algorithm.
Case Study of Micro/Nano Robot.

Total Hours: 45

Text Books:

1 Ning xi &Guangyoungli, "Introduction to Nanorobotic Manipulation & Assembly" Artech house Press, 2012
2 Yi Guo ,"Selected Topics in Micro/Nano-robotic for Biomedical Applications", Springer media, 2013

Reference Books:

1 Klaus D. Sattler, "Hand Book of Nanophysics: Nano medicine &Nanorobotics", CRC Press, 2010.
2 Mustapha Hamdi, Antoine Ferreira, "Design, Modelling and Characterization of Bio-Nanorobotic Systems", Springer, 2011.

Web References:

1 http://www.nptel.ac.in/courses/112101098/Robotics1/Lecture
2 http://nptel.ac.in/courses/112101096/

Online Resources:

1 https://www.iit-kharagpur-offers-course-in-microrobotics
2 https://www.ieee-ras.org/micro-nano-robotics-and-automation

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C503.1	Remember	Test (Definition)	**5**
C503.2	Understand	Online Quiz	**5**
C503.3	Analyse	Problem Solving	**5**
C503.4	Apply	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	30	15	10	15
Understand	35	25	25	30
Apply	35	35	40	40
Analyse	0	25	25	15
Evaluate	0	0	0	0
Create	0	0	0	0

15MT504/ 16MT504/ 17MT504 **FIELD AND SERVICE ROBOTICS** **3/0/0/3**

Nature of course **:**H(Theory Technology)

Pre requisites **:**Nil

Course Objectives:

1. To understand the various parts of robots .
2. To develop the knowledge of various kinematics and inverse kinematics of robots.
3. To study the control of robots for specific applications.

Course outcomes:

Upon completion of the course, students shall have the ability to

C504.1Elucidate the basic concepts of robot [R]
C504.2Identify the function of sensors in the robot [U]
C504.3 Inscribe program to use a robot for advanced applications [AP]
C504.4 Use Robots in different applications [A]

Course contents:

Field and service robots-Classification, applications, sensing and perception, social and ethical implications of robotics. 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. Autonomous Mobile robots: Kinematics, locomotion, perception, motion planning and control, localization and mapping; Intelligent unmanned vehicles.Underwater robot.

Kinematics and dynamics, modeling and simulation, navigation, guidance and control.Planning And Navigation -Introduction-Path planning overview- Road map path planning- Cell decomposition path planning-Potential field path planning-Obstacle avoidance

TOTAL: 45 hours

Text Books:

1. R Siegwart, I. R. Nourobakhsh, Introduction to Mobile robotics, MIT Press, Cambridge, 2014
2. G. Antonelli: Underwater Robots, 2nd Edition, Springer-Verlag, Berlin Heidelberg, 2011

References:

1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd.2011.
2. Kelly, Alonzo; Iagnemma, Karl; Howard, Andrew, "Field and Service Robotics", Springer, 2011

Web References:

1. http://nptel.ac.in/courses/112101099/
2. http://nptel.ac.in/downloads/112101098/

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C504.1	Remember	Test (Definition)	**5**
C504.2	Understand	Online Quiz	**5**
C504.3	Apply	Problem Solving	**5**
C504.4	Analyse	Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	15	15
Understand	40	20	30	30
Apply	40	40	40	40
Analyse	0	30	15	15
Evaluate	0	0	0	0
Create	0	0	0	0

PROFESSIONAL ELECTIVES

15MT401/ 16MT401/ 17MT401 **ADVANCED MANUFACTURING PROCESSES** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : 17MT205 -Production Technology

Course Objectives:

1. To give a good perspective with adequate depth to understand the unconventional machining processes.
2. To impart the knowledge of relative advantages of advanced manufacturing processes over conventional techniques.
3. To analyse the process parameters of different advanced manufacturing processes.

Course Outcomes:

Upon completion of the course, students shall have ability to

C401.1	Detail the fundamentals of advanced manufacturing processes.	[R]
C401.2	Select the appropriate process based on the requirement	[U]
C401.3	Analyse the process parameters of different methods	[A]
C401.4	Analyse and improve manufacturing processes from design stage to manufacturing stage	[A]

Course Contents:

Introduction to Modern machining Processes – Process selection – Abrasive Jet Machining, Water Jet Machining and Ultrasonic Machining: Working Principles – Equipment used – Process parameters – MRR – Variation in techniques used – Applications. Electric Discharge Machining (EDM) - Working Principles – Equipments - Process Parameters – MRR – Tool – Power Circuits – Tool Wear – Dielectric – Flushing . Wire cut EDM: Applications – Electrical Discharge Grinding – Working Principle – Equipment – Process Parameters – Applications.

Chemical machining: Process principle - Process Parameters – Masks – Etchants – Applications. Electro-Chemical machining: Principles – Equipments – MRR - Electrical circuit - Process Parameters – Applications: Electro Chemical Grinding (ECG) and Electro Chemical Honing (ECH). Laser Beam machining (LBM), Plasma Arc machining (PAM) and Electron Beam Machining (EBM): Principles – Equipment – Types – Beam control techniques – Applications.

High Energy Rate Forming (HERF) – Electromagnetic forming - Explosive forming - Electrohydraulic forming. Surface Treatment: Classification – Removal Processes – Conversion Coatings – Thermal Treatments – Metal Coatings – Physical Vapor Deposition (PVD) – Chemical Vapor Deposition (CVD) – Ion Planting – Organic Coatings – Process capabilities and Design Aspects.

Total Hours: 45

Text Books:

1 Benedict. G.F. “Non-traditional Manufacturing Processes”, Taylor & Francis, New York, 2010.
2 Pandey P.C. and Shan H.S. “Modern Machining Processes” Tata McGraw-Hill, New Delhi, 2009.

Reference Books:

1 John A. Schey, “Introduction to Manufacturing Processes”, McGraw Hill, 2014.
2 McGeough, “Advanced Methods of Machining” Chapman and Hall, London, 2008.

Web References:

1 http://www.wisegeek.com/what-is-virtual-manufacturing.htm
2 http://nptel.ac.in/courses/112107144/Metal%20Forming%20&%20Powder%20metallurgy/lecture9/lecture9.htm

Online Resources:

1 https://www.edx.org/course/fundamentals-advanced-manufacturing-processes-mitx-2-012x
2 https://www.canvas.net/advancedmanufacturing

Assessment Methods & Levels (based on Bloom’s Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**Marks**
C401.1	Remember	Test (Definition)	**5**
C401.2	Understand	Online Quiz	**5**
C401.3	Apply	Problem Solving	**5**
C401.4	Analyse	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom’s Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	15	15
Understand	40	20	30	30
Apply	40	40	40	40
Analyse	0	30	15	15
Evaluate	0	0	0	0
Create	0	0	0	0

15MT402/ 16MT402/ 17MT402 **MICRO AND NANO MANUFACTURING** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : 17MT205 - Production Technology

Course Objectives:

1. To understand the Micro Nano Fabrication processes.
2. To develop the knowledge about the working principles Laser based Micro Nano fabrications.
3. To made the innovation on present devices.
4. To gain knowledge in Nano design.

Course Outcomes:

Upon completion of the course, students shall have ability to

C402.1	Predict the different micro Nano fabrication process.	[R]
C402.2	Determine the laser based Micro & Nano fabrication.	[U]
C402.3	Apply the innovation on present device.	[AP]
C402.4	Design the Nano products using designing software.	[A]

Course Contents:

Nano technology concepts and applications, Micro- and Nanofabrication, Nano technology in India, Scope for micro-fabrication, Rise Nano technology Fields, Commercialization issues of Micro-Nano technology. Mechanical Micromachining, Physical Fabrication Methods, Lithography, Nano Lithography, Precision Micro- and Nano grinding , Use of Spectrometers & Microscopes. Micro pumps and motors.

Laser-Based Micro and Nanofabrication, Pulsed Water Drop Micromachining, Nano Materials, Synthesis of Nano materials, Bio Materials, Nano Composites, Development of Nano Particles. Nano chips, Nano tubes and Nano wires, Integration of chips and microprocessors, Technology Support, Meeting Social Needs.

Computer Aided Nano Design, VLSI product detailing Finite Element Analysis of Microstructures, 3-D Molecular Modeling

Total Hour : 45

Text Books:

1 Mark J. Jackson, “Micro and nano-manufacturing”, Springer, 2012
2 N. P. Mahalik, “Micro-manufacturing and nanotechnology”, Springer, 2011.

Reference Books:

1 Jeremy Ramsden, “Micro &nano technologies”, Elsevier,2016
2 Gabor L. Hornyak, H.F. Tibbals, JoydeepDutta, and John J. Moore, “Introduction to Nano science and Nanotechnology”, CRC Press, 2012.

Web References:

1 https://micronanomanufacturing.asmedigitalcollection.asme.org/
2 nptel.ac.in/courses/112108092/module2/lec07.pdf

Online Resources:

1 https://www.edx.org/course/micro-nanofabrication-mems-epflx-memsx

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C402.1	Remember	Test (Definition)	**5**
C402.2	Understand	Online Quiz	**5**
C402.3	Apply	Problem Solving	**5**
C402.4	Analyse	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	20	20
Understand	40	20	30	30
Apply	40	40	30	30
Analyse	0	30	20	20
Evaluate	0	0	0	0
Create	0	0	0	0

15MT403/ 16MT403/ 17MT403 **ADDITIVE MANUFACTURING PROCESSES** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : 17MT205 - Production Technology

Course Objectives:

1. To design, optimize, manufacture, and validate a physical system component using rapid prototyping methods and computer-aid tools.
2. To familiarize with the various Rapid Prototyping and Tooling (RPT) techniques so as to compare their strengths and limitations.
3. To understand RP data format, applications areas and industrial case studies.

Course Outcomes:

Upon completion of the course, students shall have ability to

C403.1	Remember the techniques for processing of CAD models for rapid prototyping	[R]
C403.2	Understand and apply fundamentals of rapid prototyping techniques.	[U]
C403.3	Choose appropriate tooling for rapid prototyping process.	[A]
C403.4	Apply rapid prototyping techniques for reverse engineering.	[A]

Course Contents:

Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP. CAD model preparation, Data Requirements, Data formats (STL, SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP), Data interfacing, Part orientation and support generation, Support structure design, Model Slicing and contour data organization, direct and adaptive slicing, Tool path generation. Stereolithography (SL), SL resin curing process, SL scan patterns, Micro-stereolithography, Applications of Photo-polymerization Processes.

Selective laser Sintering (SLS), Powder fusion mechanism and powder handling, SLS Metal and ceramic part creation, Electron Beam melting (EBM), Applications of Powder Bed Fusion Processes.Fused Deposition Modelling (FDM), Principles, Plotting and path control, 3D printing (3DP), Research achievements in printing deposition, Technical challenges in printing, Printing process modelling, Applications of. Printing Processes.

Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications. Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Processing-structure-properties, relationships, Benefits and drawbacks. Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.

Total Hours: 45

Text Books:

1 Chua C.K. et al., " Rapid Prototyping: principles and applications" Wiley,2013.
2 Pham D.T &Dimov.S.S, "Rapid manufacturing" , Springer-Verlag, London, 2011.

Reference Books:

1 Hilton P.D, “Rapid Tooling”, Marcel Dekkar Publishers, 2010.
2 Jacobs P.F, “Stereolithography and other Rapid Prototyping & Manufacturing Technologies”, McGrawHill, New york, 2011.

Web References:

1 http://www.stratasys.com/solutions/rapid-prototyping
2 http://www.materialise.com/en/manufacturing/rapid-prototyping

Online Resources:

1 http://professional.mit.edu/programs/short-programs/rapid-prototyping-technology
2 https://www.udacity.com/course/rapid-prototyping--ud723

Assessment Methods & Levels (based on Bloom’s Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**Marks**
C403.1	Remember	Test (Definition)	**5**
C403.2	Understand	Online Quiz	**5**
C403.3	Apply	Problem Solving	**5**
C403.4	Analyse	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom’s Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	15	15
Understand	40	20	30	30
Apply	40	35	40	40
Analyse	0	35	15	15
Evaluate	0	0	0	0
Create	0	0	0	0

15MT404/ 16MT404/ 17MT404 **PRODUCT DESIGN AND MANUFACTURING** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : Nil

Course Objectives:

1. To introduce students to principles and evaluation methods of various aspects of designing components.
2. To study the process capability, tolerance and form design of materials.
3. To develop the students to acquire skills to analyse product design and be able to design products that are easier to manufacture, assemble, service and friendlier to environment.

Course Outcomes:

Upon completion of the course, students shall have ability to

C404.1	Understand the design principles for manufacturing processes	[U]
C404.2	To expose the impact of design on environment to achieve eco-friendly component design.	[Ap]
C404.3	Perform economic and break even analysis of various design process.	[E]
C404.4	Demonstrate the knowledge of CAD software for case studies.	[A]

Course Contents:

Product design- factors- morphology of design- role of allowance, process capability and tolerance in assembly- strength consideration in product design- Design for Machinability, accessibility, assembly.

Design for production of metal parts (forging, casting,, powder metallurgy) – Designing with plastics, rubber, ceramics- product value- design for safety, reliability and environmental considerations-economic analysis- break even analysis.

Human engineering consideration in product design-Ergonomics, Aesthetics- Role of computer in product design, manufacturing and management- case studies.

Neural network in design and manufacturing (Qualitative treatment only)

Total hours: 45

Text Books:

1 A.K. Chitale, R.C. Gupta, “Product Design and Manufacturing”, Prentice Hall of India private limited, New Delhi, 6th Revised edition, 2014.
2 Karl T. Ulrich and Steven D. Eppinger. “Product Design and Development” TataMcGraw-Hill Publishing Company Limited, 6th edition, 2015.

Reference Books:

1 Boothroyd, G, “Product Design for Manufacture and Assembly”, New York, CRC Press, London, third edition, 2013.
2 Otto, Kevien and Wood, Kristin, “Product Design”. Pearson Publication, New Delhi, 2nd edition, 2011.

Web References:

1 nptel.ac.in/courses/112101005/
2 courses.washington.edu/inde494/Design%20for%20X.ppt

Online Resources:

1 https://www.edx.org/course/fundamentals-manufacturing-processes-mitx-2-008x
2 https://ocw.mit.edu/courses/.../2-007-design-and-manufacturing-i-spring-2009

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C404.1	Understand	Online Quiz	**5**
C404.2	Applying	Group Assignment	**5**
C404.3	Analyse	Open source course	**5**
C404.4	Evaluate	Problem solving	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	20	20
Understand	40	30	20	20
Apply	20	20	20	20
Analyse	20	20	20	20
Evaluate	0	20	20	20
Create	0	0	0	0

15MT405/ 16MT405/ 17MT405 **CNC MACHINES AND PROGRAMMING** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : Nil

Course Objectives:

1. To study the features of CNC tools and classify the NC/CNC/DNC
2. To understand the CNC part programming, and apply the knowledge in automated manufacturing.
3. To learn about interpolators and control loop for CNC manufacturing system
4. To learn about computerized numerical control drives

Course Outcomes:

Upon completion of the course, students shall have the ability to

C405.1	Understand NC,CNC, DNC machines	[U]
C405.2	Understand manual part programming and COMPACT II	[U]
C405.3	Apply the drive concept in selection of various motors.	[AP]
C405.4	Illustrate CNC technology and the control systems of CNC	[A]

Course Contents:

Introduction to NC/CNC/DNC machine tools, Classification, Advantage, disadvantages, Applications, micro computers in CNC –Machine structure, slide- ways, motion transmission element, swarf removal and safety considerations, automatic tool changers, tooling for CNC machines and multiple pallet system, sensors and feedback devices in CNC machines, constructional detail of CNC turning and machining centers, classification of CNC control system. CNC open architecture.

Introduction to NC part program- manual programming, basic concepts, G & M coding for turning and milling- computer aided programming, general information, post processors – APT commands and programming, dialog programming - description of COMPACT – II.

DDA hardware interpolator, linear, circular and complete interpolators - control of point to point system, incremental open loop and closed loop controls, absolute closed loop circuit. Drives , hydraulic system, DC motors, stepping motors- feedback devices- counting devices, CIM – case studies about CNC technology in today's industries, trends of CNC cutting tool, application of developed CNC in AERO shop.

Total hours: 45

Text Books:

1 Yoramkoren, "Computer Control of Manufacturing System" McGraw Hill Education, 2015
2 Michael Fitzpatrick , " Machining and CNC Technology" McGraw Hill Education, 2011.

Reference Books:

1 John Stenerson and Kelly Curran, "Computer Numerical Control: Operation and Programming", PHI, New Delhi, 2012.
2 TC Chang, RA Wysk and HP Wang, "Computer Aided Manufacturing", PHI, New Delhi, 2011.

Web References:

1 http://nptel.ac.in/courses/112103174/38
2 http://www.cnccookbook.com/CCCNCGCodeCourse.htm

Online Resources:

1 http://millwright.in/freecnc/
2 https://www.coindia.in/training.html

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C405.1	Understand	Online Quiz	**5**
C405.2	Applying	Group Assignment	**5**
C405.3	Analyse	Open source course	**5**
C405.4	Evaluate	Problem solving	**5**

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	20	20
Understand	40	30	20	20
Apply	20	20	20	20
Analyse	20	20	20	20
Evaluate	0	20	20	20
Create	0	0	0	0

15MT406/ 16MT406/ 17MT406 **MECHANICAL DESIGN FOR ROBOTICS SYSTEM** **3/0/0/3**

Nature of Course : C (Theory Concept)

Pre requisites : 17MT325- Robotics and Machine vision System

Course Objectives:

1. To understand the mechanical components in robots.
2. To Study the types and force analysis of end effectors.
3. To select the appropriate Servo motor.

Course Outcomes:

Upon completion of the course, students shall have ability to

C406.1	Predict and apply the appropriate Mechanical linkages	[AP]
C406.2	Determine the Robot joint dimensions	[U]
C406.3	Design of End Effectors	[E]
C406.4	Design complete robot mechanical components for particular application	[E]

Course Contents:

Robotics system and robot anatomy- Specification of robots- Mechanical components of robots – Elementary mechanical concepts – Motion conversion – Robot End Effectors: classification, drive system, mechanical grippers, gripper force analysis and gripper design. Selection procedure for stepper motor.

Design of multiple DOF instrumented robot hand. Kinematics chains – Design of robotic joints and links. Step by step procedure for selecting a servo motor and final consideration.

Complete robot design along with calculation of torques and selection of components for an Egg packing problem.
Case study 1: Autonomous mobile robot design

Total Hours: 45

Text Books:

1 Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, “Robotics Engineering an Integrated Approach”, PHI Learning, 2011.
2 S.R. Deb and S. Deb, “Robotics Technology and Flexible Automation” , Tata McGraw-Hill, 2012.

Reference Books:

1. Mikell P Groover& Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, AshishDutta, “Industrial Robotics, Technology programming and Applications”, McGraw Hill, 2012
2 A.Smali, F.Mard, “Mechatronics integrated technologies for intelligent machines”, Oxford Publication, 2015.

Web References:

1 https://en.wikibooks.org/wiki/Robotics/Design_Basics/Mechanical_Components
2 www.brighthubengineering.com ›
3 Roboticsieeexplore.ieee.org/document/5669867/

Online Resources:

1 https://www.edx.org/course/robot-mechanics-control-part-i-snux-snu446-345-1x

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C406.1	Remember	Test (Definition)	**5**
C406.2	Understand	Online Quiz	**5**
C406.3	Apply	Problem Solving	**5**
C406.4	Apply	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	0	0	0	0
Understand	50	30	20	20
Apply	50	40	60	60
Analyse	0	30	20	20
Evaluate	0	0	0	0
Create	0	0	0	0

15MT407/ 16MT407/ 17MT407 **THEORY OF AUTOMOBILE ENGINEERING** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : Nil

Course Objectives:

1. To understand the construction and working principle of various parts of an automobile.
2. To have the practice for assembling and dismantling of engine parts and transmission system
3. To evaluate the performance of engine with different alternate fuels
4. To compare the different injection and ignition systems.

Course Outcomes:

Upon completion of the course, students shall have ability to

C407.1	Identify the basic Automobile Components	[R]
C407.2	Explain the Construction and Working principle of Front Axle, Rear Axle, Final Drive, Steering System, Brakes and Suspension System.	[U]
C407.3	Conduct experiment in engine with different alternate fuels.	[AP]
C407.4	Compare the different injection and ignition systems available in automobiles	[A]

Course Contents:

Types of automobiles - vehicle construction and different layouts – chassis - frame and body - resistances to vehicle motion - need for a gearbox - components of engine - their forms, functions and materials. 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 - Turbo chargers - Fuel injection system- Engine emission control by three way catalytic converter system.

Introduction to Transmission system. Front axle – Elliot axle – Steering mechanism – Steering ratio – Steering lock – Steering box – Rack and Pinion steering gear – Power steering – Steering geometry – Front wheel alignment. Construction and operation of front suspension – Independent suspension system – Leaf spring – Rear axle suspension – Trailing arm and Shock absorbers – Mac Pherson Strut type suspension.

Purpose of braking – Hand brake system – Disc brakes – Pneumatic and Hydraulic Braking Systems - Antilock Braking System and Traction Control. 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.

Total Hours: 45

Text Books:

1 Kirpal Singh, “Automobile Engineering - VOL 1 & 2”, Standard Publishers, Seventh edition 2011, New Delhi.
2 Srinivasan S, “Automotive Mechanics”, McGraw Hill Education, New Delhi, 2015.

Reference Books:

1 William H Crouse, Donald L Anglin, “Automotive Mechanics”, McGraw Hill, 2011.
2 Newton, Steeds and Garet, “Motor vehicles”, Butterworth Publishers, 2010.

Web References:

1 http://www.autoguide.com/new-cars/2016/audi/a6/3-0t-prestige/4dr-sdn quattro/specs.html
2 http://indiatoday.intoday.in/education/story/automobile-engineering/1/353575.html

Online Resources:

1 https://www.edx.org/course/fundamentals-manufacturing-processes-mitx-2-008x
2 https://www.canvas.net/manufacturing

Assessment Methods & Levels (based on Bloom’s Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**Marks**
C407.1	Remember	Component Identification	**5**
C407.2	Understand	Online Quiz	**5**
C407.3	Apply	Problem Solving	**5**
C407.4	Analyse	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom’s Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	15	15
Understand	40	20	30	30
Apply	40	40	40	40
Analyse	0	30	15	15
Evaluate	0	0	0	0
Create	0	0	0	0

15MT408/
16MT408/AUTOMOTIVE ELECTRONICS 3/0/0/3
17MT408

Nature of course : H (Theory Technology)

Pre requisites : 17MT301 - Electrical, Electronic Devices and Circuits

Course Objectives:

1. To interpret the basic electronic engine control used in automobiles
2. To select appropriate Sensors and actuators for engines
3. To learn and illustrate Electronic fuel injection, ignition system and advanced control system in automobiles

Course Outcomes:

Upon completion of the course, students shall have ability to

C408.1 Elucidate the role of electronic control in vehicles. [R]
C408.2 Understand various sensors and actuators in automobiles. [U]
C408.3 Implement Electronic injection and ignition systems [AP]
C408.4 Analyse advanced vehicle control system. [A]

Course Contents:

Basics of automotive electronics-Electronic Engine Control system - Exhaust Catalytic Converters - Electronic Fuel Control System - Analysis of Intake Manifold Pressure - Idle Speed Control - Electronic Ignition-Automotive Control System.

Engine Management System - Automotive Engine Control Actuators -Carburettors - Electronic fuel injection -Safety and Comfort System-Powertrain System-Body Electronics System-Infotainment and Telematics System-Digital Engine Control - EGR Control.

Automatic Transmission Control - Variable Valve timing control - Integrated engine control system - Vehicle motion control-Electronic suspension system - Antilock braking system, Traction control system - Electronic control- system diagnostic - Onboard diagnosis system - Expert Systems in Automotive diagnosis

Total Hours: 45

Text/Reference Books:

1. B.WilliamRibbens, "Understanding Automotive Electronics", 7th Edition, Butterworth, Heinemann, Woburn, 2015
2. H.William Crouse, Donald L.Anglin, "Automotive Mechanics", 10th Edition, McGraw Hill Education Pvt. Ltd., New Delhi, 2013

Reference books:

1. Robert Bosch GmbH, "Bosch Automotive Electrics and Automotive Electronics", 5th Edition, Springer Views, Germany, 2011.
2. E.WalterBilliet, F.Leslie Goings, "Automotive Electrical Equipment", 3rd Edition, American Technical Society Ltd., Chicago, 2010.
3. D.JamesHalderman, "Diagnosis and Troubleshooting of Automotive, Electronic, and Computer Systems", 6th Edition, Prentice Hall, New Delhi, 2012

WEB RESOURCES:

1. http://nptel.ac.in/courses/112103174/3
2. http://www.azinet.com/articles/real98.htm
3. www.automotive-electronics.co.uk

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C408.1	Remember	Test	**5**
C408.2	Understand	Online Quiz	**5**
C408.3	Apply	Assignment	**5**
C408.4	Analyse	Seminar	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	15	15
Understand	40	20	30	30
Apply	40	40	40	40
Analyse	0	30	15	15
Evaluate	0	0	0	0
Create	0	0	0	0

15MT409/ 16MT409/ 17MT409 **AUTONOMOUS VEHICLE GUIDANCE SYSTEM** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : Nil

Course Objectives:

1. To introduce the concepts behind autonomous vehicle guidance and coordination.
2. To design and implement guidance strategies for vehicles incorporating planning, optimizing and reacting elements.
3. To develop the theory behind coordinated swarms of autonomous vehicles.
4. To describe the theory and implementation of motion detection systems.

Course Outcomes:

Upon completion of the course, students shall have ability to

C409.1	Understand the basic working principles of Autonomous Vehicle Guidance systems.	[U]
C409.2	Develop path planning systems for autonomous vehicle guidance.	[C]
C409.3	Design and implement obstacle avoidance methods within an autonomous regime.	[C]
C409.4	Implement search algorithms for autonomous vehicle guidance, navigation and control.	[A]

Course Contents:

Introduction to Electric Vehicle- development - system layout - basic system components - Electric battery solar cells - Rapid charging system - Motor drive system - fuel cell Electric vehicle - Hybrid vehicle - Series - Hybrid Vehicle - Parallel Hybrid Vehicle - CNG Electric hybrid vehicle. Autonomous vehicles systems (AVS) – Introduction, missions, capabilities, types, configurations and subsystems.

UAVs -unmanned aerial vehicle - ground, surface water & underwater- Remotely operated vehicle (ROV) - levels of autonomy - coordinate systems - equations of motion and transformations for payloads - sensors & actuators - inertial measurement& navigation, Global Positioning System (GPS) **-** PID automatic control – guidance – navigation - vision-based guidance for ground vehicles.

Communication & telemetry systems - mission planning - ground control systems & operator interfaces - estimation of vehicle weight, power, & performance - manual remote control technologies & operations - embedded computer system design **-** Introduction to Vehicle motion control - Adaptive cruise control-Electronic transmission control - Vehicle stabilization system - Antilock braking system - Traction control system- Electronic stability program - low tyre pressure warning system - Onboard diagnosis system

Introduction to vehicle intelligence (Qualitative Treatment Only)

Total Hours: 45

Text Books:

1 William B. Ribbens, “Understanding Automotive Electronics”, 7th edition Elsevier Science, 2012.
2 Richard Kendall Miller, “Survey On Autonomous Vehicle Guidance Systems”, 2010

Reference Books:

1 Ronald K. Jurgen, “Electric and Hybrid-electric vehicles”, SAE, 2012.
2 Ichiro Masaki, “Vision-based Vehicle Guidance”, Springer verlag, New York, 2011.

Web References:

1 ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=6723936.
2 journals.cambridge.org/article_S0263574700016568.

Online Resources:

1 ieeexplore.ieee.org/document/5262854/
2 https://github.com/takeitallsource/awesome-autonomous-vehicles

Assessment Methods & Levels (based on Bloom’s Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**Marks**
C409.1	Understand	Online quiz	**5**
C409.2	Create	Class notes	**5**
C409.3	Create	Problem Solving	**5**
C409.4	Analyse	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom’s Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	10	10
Understand	30	20	20	25
Apply	40	30	40	25
Analyse	10	20	15	15
Evaluate	0	20	0	15
Create	0	0	15	10

15MT410/ 16MT410/ 17MT410 **AUTOMATED MATERIAL HANDLING SYSTEMS** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : Nil

Course Objectives:

1. To develop skills of analyzing the automation concepts.
2. To design an automated materials handling, storage and assembly system.

Course Outcomes:

Upon completion of the course, students shall have ability to

C410.1	Understand the importance of manufacturing unit layout and process flow chart.	[R]
C410.2	Apply the productivity improvements due to the automation of material handling methods & Automated storage system	[AP]
C410.3	Apply automatic transfer lines & automated manufacturing system	[AP]
C410.4	Do the quantitative analysis of automated assembly system	[A]

Course Contents:

Overview of material handling equipment – Considerations in material handling system design – 10 principles of material handling – Automation of material handling – Mechanism of part handling - Industrial trucks – AGV systems – mobile Robots – Mono Rails, manipulators, storage systems, elevators, racks, bins, and other Rail Guided Vehicles.

Conveyors systems – Cranes and Hoists – Analysis of Material transport systems. Storage system performance – storage location strategies – Conventional storage methods and equipment's – Automated storage systems.

Engineering Analysis of Automated storage systems - AS/RS – Quantitative analysis- Carousel storage system. Fundamentals of Automated Assembly systems – Design for Automated Assembly – Bar-code techniques – Robotics in material handling system.

Total Hours: 45

Text Books:

1 Mikell.P.Groover, "Automation, Production System and Computer integrated manufacturing", Prentice Hall of India Pvt. Ltd., New Delhi, 2013
2 S.Kant. Vajpayee , "Principles of Computer Integrated Manufacturing", Prentice Hall of India Pvt. Ltd., 2016.
3 G.K. Agarwal, "Plant Layout and material handling", Jain Brothers, Delhi, 2011.

Reference Books:

1 Mulcahy.D.E. "Material handling hand book", McGraw Hill, New York, 2013
2 Kulwiec R.A." Material Handling Hand book" 2nd Edition, JohnWiely& Sons Inc., New York, 2012.
3 Charles D Reese, "Material Handling Systems", Taylor And Francis, 2011.

Web References:

1 http://www.mmh.com/topic/category/automation
2 http://galecia.com/content/automated-materials-handling
3 http://www.cisco-eagle.com/material-handling-systems
4 https://www.bastiansolutions.com/case-studies

Online Resources:

1 http://nptel.ac.in/courses/112102011/

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C410.1	Remember	Test	**5**
C410.2	Apply	Online Quiz	**5**
C410.3	Apply	Current trends in AMHS - report	**5**
C410.4	Analyse	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination

Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	15	15
Understand	40	20	30	30
Apply	40	40	40	40
Analyse	0	30	15	15
Evaluate	0	0	0	0
Create	0	0	0	0

15MT411/ 16MT411/ 17MT411 **MEDICAL MECHATRONICS** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : Nil

Course Objectives:

1. To understand how to measure biochemical parameters and various physiological information.
2. To study the need and technique of electrical safety in Hospitals.
3. To study the use of radiation for diagnostic and therapy.
4. To study about recorders and advanced equipment in medicine

Course Outcomes:

Upon completion of the course, students shall have ability to

C411.1	Explain different measurement techniques used in physiological parameter measurement.	[R]
C411.2	Describe the sensors and signal conditioning circuits used in biomedical engineering.	[U]
C411.3	Comment on various measurement systems used in diagnostics.	[A]
C411.4	Differentiate the working of recorders and explain the advanced systems used in medicine.	[AP]

Course Contents:

Introduction- Cell structure – electrode – electrolyte interface, electrode potential, resting and action potential , source of bioelectric potentials – electrodes for their measurement, ECG, EEG, EMG – machine description – methods of measurement.Basic transducer principles Types –— resistive, inductive, capacitive, fiber-optic, photoelectric, chemical, active and passive transducers and their description and feature applicable for biomedical instrumentation – Bio, Nano sensors and application.

Blood pressure measurement: by ultrasonic method – plethysmography – blood flow measurement by electromagnetic flow meter, cardiac output measurement by dilution method – phonocardiography – vector cardiography. Heart lung machine – artificial ventilator – Anesthetic machine – Basic ideas of CT scanner – MRI and ultrasonic scanner – cardiac pacemaker –defibrillator patient safety - electrical shock hazards - Centralized patient monitoring system.

Oscillographic, galvanometric and thermal array recorder, photographic recorder, storage oscilloscopes, electron microscope. Biotelemetry, Diathermy, Audiometers, Dialysers, Lithotripsy.
Case Study:-Hot wire Anemometry for respiratory flow measurements, Surgical robots.

Total Hours: 45

Text Books:

1 Khandpur, R.S., “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, 2014.
2 Cromwell, Weibell and Pfeiffer, “Biomedical Instrumentation and Measurements”, Prentice Hall of India, 2012.

Reference Books:

1 SiamakNajarian, “Mechatronics in Medicine – A Bio medical engineering approach" , Tata McGraw Hill, 2011.
2 Geddes L.A., and Baker, L.E., “Principles of Applied Bio-medical Instrumentation”, John Wiley and Sons, 3rd Edition, 2010.

Web References:

1 http://www.nptel.ac.in/courses/ 102106057/
2 http://nptel.ac.in/course.php
3 http://www.davincisolutions.net/Services.html

Online Resources:

1 https://www.edx.org/course/medical-genomics-101-davidsonx-medgen101x
2 https://www.edx.org/course/cyber-physical-systems-uc-berkeleyx-eecs149-1x

Assessment Methods & Levels (based on Bloom’s Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom’s Level**	**Assessment Component**	**Marks**
C411.1	Remember	Test	**5**
C411.2	Understand	Online Quiz	**5**
C411.3	Analyse	Presentation-Case study	**5**
C411.4	Apply	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom’s Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	45	20	15	20
Understand	30	20	20	20
Apply	25	25	35	35
Analyse	0	35	20	25
Evaluate	0	0	10	0
Create	0	0	0	0

15MT412/ 16MT412/ 17MT412 **MOBILE ROBOTICS** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : Knowledge of Python

Course Objectives:

1. To familiarize the students with mobile robots.
2. To understand the basic methods for achieving mobility and autonomy.
3. To provide a practical understanding of robotic navigation and locomotion

Course Outcomes:

Upon completion of the course, students shall have ability to

C412.1	Select various sensors used for perception, localization and mapping	[R]
C412.2	Formulate control algorithms involved in mobile robots	[U]
C412.3	Analyse kinematic modeling in mobile robots	[A]
C412.4	Create various algorithms in path planning and navigation	[AP]

Course Contents:

Introduction - Locomotion, Classification- Key issues in locomotion. Mobile Robot Kinematics - Kinematic model- Forward Kinematic model, Representing position, Wheel kinematic constraints. Motion control - Control theory - Control design basics, Cruise-Controllers, Performance Objectives. Simple robot – State space model, Linearization, LTI system, stability. PID control, basic control algorithms

Perception - Sensors for mobile robots – Classification, performance, uncertainty in sensors, wheel sensor, heading sensor, accelerometers, inertial measurement, motion sensor, range sensors. Vision sensor- Basics of computer vision, image processing techniques, feature extraction – image, range data location recognition.

Localization - Major challenges, localization based navigation. Belief representation, map representation, probabilistic Map. Examples of localization systems. Autonomous map building Planning and Reaction- Path Planning – graph search, D* algorithm, Potential field. Obstacle avoidance – bug algorithm, histogram, curvature velocity techniques. Navigation architecture, Case study- Mobile robot in military application.

Total Hours: 45

Text Books:

1 Roland Siegwart, IllahR.Nourbakhsh, “Introduction to Autonomous Mobile Robots”, 2nd Edition, 2011
2 Choset. et al, “Principles of Robot Motion: Theory, Algorithm & Implementations”, MIT Press, 2011

Reference Books:

1 Thrun, Burgard, Fox, “Probabilistic Robotics”, MIT Press, 2013
2 Siciliano, Khatib, Eds., “Handbook of Robotics”, Springer, 2011

Web References:

1 http://nptel.ac.in/courses/112108093/module1/lecture.pdf
2 http://nptel.ac.in/courses/112101099/
3 http://www.cas.kth.se/cosy-lite/presentations/robot-intro.pdf

Online Resources:

1 https://www.open2study.com/courses/mobile-robotics
2 http://www.skyfilabs.com/online-courses/mobile-robotics?v1

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C412.1	Remember	Simulation Exercise	**5**
C412.2	Understand	Quiz	**5**
C412.3	Analyse	Presentation on advanced robots	**5**
C412.4	Apply	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	15	15
Understand	40	20	30	30
Apply	40	40	40	40
Analyse	0	30	15	15
Evaluate	0	0	0	0
Create	0	0	0	0

15MT413/ 16MT413/ 17MT413	**INTEGRATED ELECTRONIC CIRCUIT**	**3/0/0/3**

Nature of Course : C (Theory Concept)

Pre requisites : 17MT301- Electrical, Electronic Devices and Circuits

Course Objectives:

1. To provide insight on basic feedback amplifier.
2. To understand Power amplifier and signal generation circuits.
3. To develop knowledge of Tuned amplifier.
4. To enable the students to be aware of the application areas of operational amplifiers

Course Outcomes:

Upon completion of the course, students shall have ability to

C413.1	Demonstrate operation of Integrated circuits and Feedback amplifiers	[R]
C413.2	Explain the working of Oscillators and Signal generator	[U]
C413.3	Interpret the working of Tuned amplifiers used in Electronic Circuit design.	[AP]
C413.4	Analyse linear and non-linear applications of operational amplifiers.	[AN]

Course Contents:

Integrated Circuits: Fabrication and Characteristics; Transistor at Low Frequencies; Feedback amplifiers; Stability and Oscillators; Power amplifiers: class A, B, AB, C, D, E stages, output stages, short circuit protection; Signal generation: sinusoidal oscillators- RC, LC, and crystal oscillators, multi-vibrators.

Tuned Amplifiers: Single tuned amplifier, Overview of Double tuned amplifier and stagger tuned amplifier. Operational Amplifiers :Basic information about IC741 op-amps, Applications- Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier.

Integrator, Differentiator, Comparators, Schmitt trigger, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.
Case study- µA741-operational amplifier

Total Hours: 45

Text Books:

1. Jacob Millman, Chritos C Halkias, SatyabrataJit, “Electronic Devices and Circuits”, 4th edition (SIE), McGraw Hill Education India Private Ltd., 2015.
2. D.RoyChoudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd., 2011.

Reference Books:

1. Robert L. Boylestad and Louis Nashelsky, “Electronic Devices and Circuit Theory”, 9th Edition, Pearson Education / PHI, 2014.
2. Floyd, “Electronic Devices”, 9th Edition, Pearson Education, 2011

Web References:

1 www.allaboutcircuits.com
2 www.circuitstoday.com

Online Resources:

1 http://www.electronics-tutorials.ws

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C413.1	Remember	Quiz	**5**
C413.2	Understand	Test	**5**
C413.3	Apply	Group Assignment	**5**
C413.4	Analyse	Class Presentation	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	40	20	20	20
Understand	60	60	40	40
Apply	-	20	20	20
Analyse	-	-	20	20
Evaluate	-	-	-	-
Create	-	-	-	-

15MT414/ 16MT414/ 17MT414 **PRINCIPLES OF AI AND EXPERT SYSTEMS** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : Nil

Course Objectives:

1. To study the idea of intelligent agents and search methods.
2. To study the reasoning and decision making in uncertain world.
3. To study the concepts of expert systems and machine learning

Course Outcomes:

Upon completion of the course, students shall have ability to

C414.1	Identify problems that are amenable to solution by AI methods.	[R]
C414.2	Formalise a given problem in the language/framework of different methods.	[U]
C414.3	Identify appropriate AI methods to solve a given problem.	[A]
C414.4	Implement Basic AI algorithms.	[AP]

Course Contents:

Introduction to AI: Intelligent agents – Problem solving- Solving problems by searching, Informed search methods- Knowledge and reasoning- logical reasoning system- First order logic.

Planning- Practical planning, planning and acting, conditional planning- Uncertainty- Making simple and complex decisions- Learning from observations, Learning in neural and belief network, Reinforcement learning, Knowledge in learning- Communicate agent.

Practical natural language processing- Perception. Expert systems - Architecture of an expert system–Knowledge Acquisition in expert systems – Expert system shells- Expert system tools. Machine learning, Adaptive learning
Case Study-Robotic process automation combines artificial intelligence.

Total Hours: 45

Text Books:

1 Stuart Russel and Peter Norvig, “Artificial Intelligence A Modern Approach”, Second Edition, Pearson Education, 2014.
2 Timothy Jordanides& Bruce Torby, “Expert System and Robotics”, Springer Publishing Company,2012.

Reference Books:

1 George F.Luger, “Artificial Intelligence – Structures and Strategies for Complex Problem Solving”, Fourth Edition, Pearson Education, 2011.
2 N.P.Padhy, “Artificial Intelligence and intelligent system”, Oxford Universal Press, 2010.
3 Matt Ginsberg, “Essentials of Artificial Intelligence”, Morgan Kaufmann Publishers, 2012.
4 Michel Gondran, “AI and Expert Systems”, Prentice-Hall of India Pvt.ltd, 2012.

Web References:

1 http://www.nptel.ac.in/courses/106106126/
2 http://nptel.ac.in/courses/106105077//

Online Resources:

1 https://www.edx.org/course/artificial-intelligence-ai-columbiax-csmm-101x
2 https://www.coursera.org/learn/machine-learning

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C414.1	Remember	Test (Definition)	**5**
C414.2	Understand	Online Quiz	**5**
C414.3	Analyse	Problem Solving	**5**
C414.4	Apply	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	25	15	25	20
Understand	35	25	25	25
Apply	40	30	25	30
Analyse	0	30	25	25
Evaluate	0	0	0	0
Create	0	0	0	0

15MT415/ 16MT415/ 17MT415 **EMBEDDED SYSTEM IN AUTOMATION** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : 17MT314-Embedded System

Course Objectives:

1. To familiarize embedded C and assembly programming.
2. To learn software modeling fundamentals
3. To know about typical engineering issues of embedded software development

Course Outcomes:

Upon completion of the course, students shall have ability to

C415.1	Design of Embedded system	[R]
C415.2	Program Embedded Systems	[U]
C415.3	Develop, test & analyse new micro architecture for Embedded Processors	[A]
C415.4	Design systems for Real-Time Processing.	[AP]

Course Contents:

Introduction to embedded system- Embedded system Design and Development Process - Programming concepts and embedded programming in C- Programming in Assembly Language(ALP) and in High Level Language 'C ' ,'C' Program Element ,Use of Loops, Function calls, Multiple Function Calls in Cyclic Order, Queuing of Function on Interrupts and Interrupt Service Routine Queues.

Programming modelling concepts- Embedded software development process and tools-Hardware testing, simulation and debugging techniques and tools-Integration and Testing, Testing Methods, Debugging Techniques.

Design examples and case studies of program-modelling and programming with RTOS: Digital camera, application to communication- Network router for IP Packets, Embedded system in robotics, Orchestra playing robots, mobile phone software for key inputs, RTOS for control systems

Total Hours: 45

Text Books:

1 Raj Kamal, "Embedded systems- Architecture, Programming and design, Tata McGraw-Hill,2016

2 James K Peckol, "Embedded systems- A Contemporary design tool", Wiley, 2013.

Reference Books:

1 Hermann Kopetz, "Real-Time Syatems- Design Principles for distributed Embedded Applications", Second Edition, Springer 2011.

2 Jean J. Labrosse, "Embedded Systems Building Blocks: Complete and Ready- To-Use Modules in C", The Publisher, Paul Temme, 2011.

Web References:

1 http://www.nptel.ac.in/courses/108102045/1
2 http://nptel.ac.in/courses/Webcourse-contents/IITKharagpur/Embedded systems/New_inex1.html

Online Resources:

1 https://www.embedded.com
2 https://www.ecpe.nu.ac.th/ponpisut/22323006-Embeddded-c-Tutorial

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C415.1	Remember	Test (Definition)	**5**
C415.2	Understand	Online Quiz	**5**
C415.3	Analyse	Problem Solving (Programming)	**5**
C415.4	Apply	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	30	15	10	15
Understand	35	25	25	30
Apply	35	35	40	40
Analyse	0	25	25	15
Evaluate	0	0	0	0
Create	0	0	0	0

15MT416/ 16MT416/ 17MT416 **INTERNET OF THINGS FOR MECHATRONICS** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : Nil

Course Objectives:

1. To understand the basics of Internet of Things
2. To understand different applications of Internet of Things
3. To understand the fundamental aspects of IoT.

Course Outcomes:

Upon completion of the course, students shall have ability to

C416.1	Explain the basic architecture and platform of IoT.	[R]
C416.2	Explain the working principle of IoT	[U]
C416.3	Develop, test & analyse a new IoT system.	[A]
C416.4	Design systems for Real-Time Processing.	[AP]

Course Contents:

Definitions and Functional Requirements –Motivation – Architecture - IoT architecture and platforms - IoT Devices vs. Computers - Trends in the Adoption of IoT - Societal Benefits of IoT – IoT Information Security - Embedded Systems. Sensing methods - Sensors types – Active, Passive sensors – Environmental sensing methods.

Sensor Fusion - Evolving Sensor Technologies - Leveraging Sensor Fusion for the IoT - IoT Sensor Manufacturers - IoT Sensor Data Platforms. Basics of Controllers - Interfacing methodologies - Controllers selection – GPIO interfaces – SPI interfaces – I2C interfaces – RTC interfaces – IDE usage – Bootloader – Memory utilization (EEPROM /Flash).

Basic programing of controllers – Controllers Expansion boards (breakouts). Hardware Platforms - Intel Galileo, Edison, Arduino, Beaglebone Black & Raspberry Pi.
Software Platforms - Intel XDK, Node-RED, VISUINO, Fritzing, 123dCircuits, Scratch.

Total Hours: 45

Text Books:

1 MaciejKranz, “Building Internet of Things”, John Wiley and Sons, 2016
2 Peter Waher, “Learning Internet of Things”, Packt Publishing, 2015.

Reference Books:

1 Samuel Greengard, “The Internet of Things”, Second Edition, MIT Press, 2015.
2 Michael Miller, “The Internet of Things”, Que Publishing, 2015.

Web References:

1 iofthings.org/
2 https://www.theguardian.com /Technology/Internet of things

Online Resources:

1 https://www.coursera.org/specializations/iot
2 http://web.mit.edu/professional/digital-programs/courses/IoT/

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C416.1	Remember	Weekly Milestones	**5**
C416.2	Understand	Online Quiz	**5**
C416.3	Analyse	Prototypes	**5**
C416.4	Apply	Demonstration / Showcasing an Idea	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	30	15	10	15
Understand	35	25	25	30
Apply	35	35	40	40
Analyse	0	25	25	15
Evaluate	0	0	0	0
Create	0	0	0	0

15MT417/ 16MT417/ 17MT417 **AUTOMATIC CONTROL SYSTEM** **3/0/0/3**

Nature of Course : H (Theory Technology)

Pre requisites : 17MT305- Theory of Control Systems

Course Objectives:

1. To apply the knowledge of mathematics, science and engineering.
2. To analyze different controllers for various applications.
3. To design and develop real time systems

Course Outcomes:

Upon completion of the course, students shall have ability to

C417.1	Predict system behavior based mathematical model in time or frequency domain	[R]
C417.2	Devise a safe and effective method of investigating a system	[A]
C417.3	Design controllers using classical PID methods.	[AP]
C417.4	Determine the (absolute) stability of a closed-loop control system	[A]

Course Contents:

Introduction to Automatic Control - Configurations of controllers, time and frequency domain performance measures, PID control of SISO systems and TITO systems, PID controller, its variants and limitations, PI-PD control, effects of measurement noise and load disturbances, Identification of plant model, frequency domain, off-line, on-line, accuracy and sensitivity.

Time domain based and state space based identification methods, accuracy and sensitivity, model based controller design, model-free controller design, automatic and on-line tuning of controllers, real time applications of the control algorithms, Field programmable analog/digital array based design of controllers.

Introduction to Sequence Control, PLC, RLL - Sequence Control. Scan Cycle, Simple RLL Programs.

Total Hours: 45

Text Books:

1 Benjamin C.Kuo, FaridGolnaraghi, “Automatic Control Systems”, 8th Edition, John Wiley & Sons, 2013.
2 Katsuhiko Ogata, “Modern Control Engineering”, 4th Edition, Prentice Hall of India 2010.

Reference Books:

1. Richarc C. Drof and Robert H. Bishop, “Modern Control System”,11th Edition Person International, 2012
2. Nagrath and Gopal, “Control Systems Engineering”, New Age Publication, 2011

Web References:

1 http://www.nptelvideos.in/2012/11/industrial-automation-and-control.html
2 http://freevideolectures.com/Course/2345/Industrial-Automation-and-Control/11

Online Resources:

1 https://www.edx.org/course?search_query=automatic+control+systems
2 https://www.coursera.org/courses?languages=en&query=automatic+control+systems

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C417.1	Remember	Test (Definition)	**5**
C417.2	Understand	Online Quiz	**5**
C417.3	Apply	Problem Solving	**5**
C417.4	Analyse	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	20	10	15	15
Understand	40	20	30	30
Apply	40	40	40	40
Analyse	0	30	15	15
Evaluate	0	0	0	0
Create	0	0	0	0

15MT418/ 16MT418/ 17MT418 **INTELLIGENT CONTROL SYSTEMS** **3/0/0/3**

Nature of Course : H (Theory and Technology)

Pre requisites : 17MT305- Theory of Control system

Course Objectives:

1. To introduce the ideas of artificial neural network, fuzzy sets and fuzzy logic
2. To study basics of control-theoretic foundations such as stability and robustness in the frame work of intelligent control.
3. To impart knowledge on various control techniques
4. To create awareness of the application areas of intelligent technique

Course Outcomes:

Upon completion of the course, students shall have ability to

C418.1	Select the most appropriate biological intelligent system	[U]
C418.2	Optimize the system using various techniques	[A]
C418.3	Analyse the stability of the system	[A]
C418.4	Apply intelligent techniques to overcome real world problems	[AP]

Course Contents:

Artificial neural networks, Back-propagation networks, Radial basis function networks, and recurrent networks - Fuzzy logic, knowledge representation and inference mechanism, genetic algorithm, and fuzzy neural networks.

Fuzzy and expert control (standard, Takagi - Sugeno, Parametric optimization of fuzzy logic controller using genetic algorithm - System identification using neural and fuzzy neural networks - Lyapunov stability theory.

Adaptive control using neural and fuzzy neural networks, Direct and Indirect adaptive control, and Self-tuning PID Controllers- Applications to pH reactor control, robot manipulator dynamic control, under actuated systems such as inverted pendulum and inertia wheel pendulum control

Total Hours: 45

Text Books:

1 S.N.Sivanandam, S.N. Deepa, “Principles of soft computing”, John Willey & sons, 2013
2 J.S. R. Jang, C.T. Sun, and E. Mizutani, “Neuro-Fuzzy and Soft Computing - A computational approach to learning and machine intelligence”, Prentice Hall, 2011.

Reference Books:

1 LaureneFauseett, “Fundamentals of Neural Networks”, Prentice Hall India, New Delhi, 2012
2 ErdalKayacan, MojtabaAhmadiehKhaneswar, “ Fuzzy neural networks for Real time control applications”, Elsevier, 2015

Web References:

1 http://www.softcomputing.es
2 www.soft-computing.de/def.html

Online Resources:

1 https://www.edx.org/course/artificial-intelligence-ai-columbiax-csmm-101x

Assessment Methods & Levels (based on Bloom's Taxonomy)			
Formative assessment based on Capstone Model (Max. Marks:20)			
Course Outcome	**Bloom's Level**	**Assessment Component**	**Marks**
C418.1	Understanding	Test (Definition)	**5**
C418.2	Analyse	Online Quiz	**5**
C418.3	Analyse	Case study	**5**
C418.4	Apply	Group Assignment	**5**

Summative assessment based on Continuous and End Semester Examination				
Bloom's Level	**Continuous Assessment**			**End Semester Examination [60 marks]**
	CIA-I [6 marks]	**CIA-II [6 marks]**	**Term End Examination [8 marks]**	
Remember	0	0	0	0
Understand	40	30	40	40
Apply	30	40	35	40
Analyse	30	30	25	20
Evaluate	0	0	0	0
Create	0	0	0	0