DEPARTMENT OF MECHATRONICS
REGULATIONS 2018
B-FACT:: Flexible **A**ccommodative Choice Based **C**redit System for **T**echnology
B.Tech – MECHATRONICS

VISION

To be a globally recognized department, and to excel in academic, innovation and collaborative research, promoting technical and entrepreneurial skills.

MISSION

MS1: A conducive academic environment with contemporary and innovative curricula imparting high quality education.

MS2: State of the art laboratory infrastructure to enhance fundamental research.

MS3: Conducive platform to work closely with industries to materialize collaborative research.

MS4: Grounds to exhibit and enhance the technical, managerial and lifelong learning skills, embedded with ethical values and social relevance

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

PEO1: PREPARATION:

To provide students with sound fundamental in Mathematical, Scientific and Engineering fundamentals necessary to formulate, analyse, and comprehend the fundamental concepts in Mechatronics.

PEO2: CORE COMPETENCE:

To apply critical reasoning, quantitative, qualitative, designing and programming skills, to identify, solve problems and to analyze the experimental evaluations, and finally making appropriate decisions, and to enhance the techniques in the field of Mechatronics.

PEO3: PROFESSIONALISM:

To broaden knowledge to establish themselves as creative practicing professionals, locally and globally, in fields such as design, research, testing and manufacturing of Mechatronics Machines, Components and Systems

PEO4: SKILL:

To provide Industry based training for developing professional skills and soft skills such as proficiency in languages, technical communication, verbal, logical, analytical, comprehension, team building, inter personal relationship, group discussion and leadership skill to become a better professional.

PEO5: ETHICS:

To apply the ethical and social aspects of modern Engineering and Technology innovations to the design, development, and usage of new products, machines, gadgets, devices, etc.

MAPPING BETWEEN MISSION Vs PEOs

PEO'S	MISSION OF THE DEPARTMENT			
	M1	M2	M3	M4
PEO1: To provide students with sound fundamental in Mathematical, Scientific and Engineering fundamentals necessary to formulate, analyse, and comprehend the fundamental concepts in Mechatronics.	✓	✓		✓
PEO2: To apply critical reasoning, quantitative, qualitative, designing and programming skills, to identify, solve problems and to analyze the experimental evaluations, and finally making appropriate decisions, and to enhance the techniques in the field of Mechatronics.	✓		✓	
PEO3: To broaden knowledge to establish themselves as creative practicing professionals, locally and globally, in fields such as design, research, testing and manufacturing of Mechatronics Machines, Components and Systems		✓	✓	✓
PEO4: To provide Industry based training for developing professional skills and soft skills such as proficiency in languages, technical communication, verbal, logical, analytical, comprehension, team building, inter personal relationship, group discussion and leadership skill to become a better professional.			✓	✓
PEO5: To apply the ethical and social aspects of modern Engineering and Technology innovations to the design, development, and usage of new products, machines, gadgets, devices, etc.		✓	✓	✓

PROGRAMME OUTCOMES (POs):

On completion of B.Tech in Mechatronics Programme, Graduates will have to

(a) ENGINEERING KNOWLEDGE: Apply the knowledge of mathematics, science, engineering fundamentals to solve the complex engineering problems.

(b) PROBLEM ANALYSIS: Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using fundamentals of mathematics, physics, and engineering sciences.

(c) DESIGN/DEVELOPMENT OF SOLUTIONS: Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations.

(d) CONDUCT INVESTIGATIONS OF COMPLEX PROBLEMS: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

(e) MODERN TOOL USAGE: Create, select, and apply appropriate techniques, resources, and modern engineering and software tools including simulation and modeling to complex engineering activities with an understanding of the limitations.

(f) THE ENGINEER AND SOCIETY: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

(g) ENVIRONMENT AND SUSTAINABILITY: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

(h) ETHICS: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

(i) INDIVIDUAL AND TEAM WORK: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

(j) COMMUNICATION: Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports. Make effective presentations, and give and receive clear instructions.

(k) PROJECT MANAGEMENT AND FINANCE: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.

(l) LIFE-LONG LEARNING: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES

PSO I: Ability to apply the acquired Mechatronics knowledge for the advancement of society and self.

PSO II: Ability to implement the learned principles of Mechatronics to analyze, evaluate and create more advanced mechatronics systems or processes

MAPPING BETWEEN PROGRAMME EDUCATIONAL OBJECTIVES & PROGRAMMET OUTCOMES

PEOs\POs	a	b	c	d	e	f	g	h	i	j	k	l
PEO1	✓	✓			✓						✓	
PEO2				✓							✓	
PEO3									✓			
PEO4				✓			✓		✓		✓	
PEO5			✓	✓		✓						

MAPPING BETWEEN CORE COURSE & PROGRAMME OUTCOMES (POs)

Sem	Courses\POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO 1	PSO 2
I	**THEORY**														
	Communicative English	✓		✓	✓	✓		✓			✓	✓	✓		
	Engineering Mathematics –I	✓		✓											
	Waves and Optics	✓	✓		✓						✓				
	Engineering Chemistry	✓							✓						
	Problem Solving and Python Programming	✓	✓			✓		✓				✓	✓		
	Engineering Graphics & Design	✓	✓			✓		✓				✓			
	PRACTICAL														
	Wave Optics and Mechanics Lab	✓	✓		✓				✓						
	Chemistry Lab	✓	✓				✓	✓	✓						
	Problem Solving and Python Programming Laboratory	✓	✓		✓	✓							✓		
II	**THEORY**														
	Technical English			✓			✓				✓	✓	✓		
	Engineering Mathematics- II	✓				✓						✓			
	Introduction to Mechanics	✓													
	Environmental Sciences	✓	✓	✓			✓		✓						
	Biology for Engineers	✓	✓					✓			✓				
	Basic Electrical & Electronics Engineering	✓								✓					
	PRACTICAL														
	Wave Optics and Mechanics Lab	✓	✓	✓			✓		✓						
	Chemistry Lab	✓	✓					✓			✓				
	Workshop/Manufacturing Practices Lab	✓	✓		✓							✓			
	Basic Electrical & Electronics Engineering Laboratory	✓	✓			✓				✓					
III	**THEORY**					✓									
	Partial Differential Equations & Probability &Statistics	✓	✓									✓	✓		
	Kinematics of Machines	✓	✓							✓					
	Fundamentals of Electronic Circuits and Devices					✓									

	Measurement and Instrumentation					✓									
	Digital Electronics					✓				✓					
	Electrical Machines & Drives					✓									
	PRACTICAL														
	Electronic Circuits and Devices - Lab			✓		✓									
	Electrical Machines & Drives Lab	✓							✓	✓		✓			
IV	**THEORY**														
	Numerical Methods	✓				✓							✓		
	Dynamics of Machines	✓													
	Manufacturing Technology				✓	✓									
	Power Electronics	✓	✓	✓	✓	✓			✓	✓					
	Control Systems	✓	✓												
	Transducer Engineering	✓	✓												
	PRACTICAL														
	Machine Dynamics Lab						✓			✓					
	Sensors and Instrumentation Lab			✓		✓									
	Technical Seminar-I							✓							
V	**THEORY**														
	Microcontroller & PLC					✓									
	CNC Technology				✓	✓				✓					
	Integrated Circuits			✓					✓			✓			
	Organizational Behavior	✓	✓				✓			✓	✓	✓			
	Universal Human Values				✓	✓				✓					
	PRACTICAL														
	Microcontroller & PLC Lab					✓			✓						
	CNC Lab			✓											
VI	**THEORY**														
	Operations Research for Engineers	✓	✓												
	Applied Hydraulics & Pneumatics					✓		✓							
	PRACTICAL														
	CAD/CAM Lab					✓		✓							
	Hydraulics & Pneumatics Lab					✓		✓							
	Soft Skill	✓	✓				✓						✓		
	Summer Internship	✓	✓			✓				✓					

VII	**THEORY**														
	Robotics & Machine Vision System					✓	✓		✓						
	Design of Mechatronics system	✓				✓			✓	✓					
	Computer Integrated Manufacturing	✓	✓	✓	✓	✓		✓	✓						
	PRACTICAL														
	Project Stage-I														
	Robotics Lab					✓	✓		✓						
	Simulation and Programming Lab	✓		✓	✓		✓	✓		✓	✓				
VIII	**PRACTICAL**														
	Project Stage-II	✓	✓		✓		✓						✓		
	Comprehension	✓			✓	✓							✓		

MAPPING BETWEEN PROGRAMME ELECTIVES (PEs) AND PROGRAMME OUTCOMES (POs)

PE	**Courses\POs**	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**
I	Communication Engineering	✓				✓									
	Mechanics of Solids and Fundamentals of Fluids	✓					✓								
	Virtual Instrumentation			✓	✓			✓	✓						
	Process Automation					✓									
II	Consumer Electronics					✓			✓		✓				
	Dimensional Metrology	✓				✓									
	Textile Mechatronics		✓	✓											
	Biomedical Instrumentation					✓			✓						
III	Neural Network &Fuzzy Logic			✓	✓		✓	✓	✓		✓	✓			
	Composite Materials and Structure		✓			✓									
	Underwater Robotics					✓		✓	✓		✓				
	Building Automation					✓			✓		✓				
IV	Digital Signal Processing					✓			✓	✓					

	Unconventional Machining Processes	✓				✓									
	Cognitive Robot				✓	✓				✓	✓				
	Industrial Automation	✓				✓	✓				✓				
V	Digital Image Processing					✓									
	Rapid Prototyping			✓	✓	✓		✓	✓		✓	✓			
	Design of Mechatronics Systems					✓									
	Vetronics					✓									
VI	Embedded System Design			✓	✓			✓	✓		✓	✓			
	Total Quality Management		✓	✓				✓	✓		✓	✓			
	Micro Electronics and Nano Electronics					✓									
	Modern Manufacturing Process				✓	✓				✓					

CURRICULUM AND SYLABUS (R2018)

B-FACT:: Flexible **A**ccommodative **C**redit system for **T**echnology

(Applicable to the batches admitted from July 2018)

B.Tech – MECHATRONICS

FULL TIME

I – VIII SEMESTERS

SEMESTER I								
Sl.No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN101	HS	Communicative English	4	2	0	2	3
2	U18BSMA101	BS	Engineering Mathematics –I	4	3	1	0	4
3	U18BSPH 101	BS	Waves and Optics	3	3	0	0	3
4	U18BSCH101	BS	Engineering Chemistry	3	3	0	0	3
5	U18ESCS101	ES	Problem Solving and Python Programming	3	3	0	0	3
6	U18ESME101	ES	Engineering Graphics & Design	5	1	0	4	3
PRACTICAL								
7	*U18BSPH2L1	BS	Wave Optics and Mechanics Lab	3	0	0	3	0
	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	0
8	U18ESCS1L1	ES	Problem Solving and Python Programming Laboratory	3	0	0	3	1.5
ACTIVITY BASED COURSES								
9	U18MCAB101	MC	Physical health – Sports & Games	2	0	0	2	0
10	U18MCAB102	MC	Gardening & Tree Plantation -	2	0	0	2	0
			Total	35	15	1	19	20.5

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry.**

The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).

SEMESTER II								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18HSEN201	HS	Technical English	3	2	1	0	3
2	U18BSMA201	BS	Engineering Mathematics-II	4	3	1	0	4
3	U18BSPH201	BS	Introduction to Mechanics	3	3	0	0	3
4	U18BSCH201	BS	Environmental Sciences	3	3	0	0	3
5	U18BSBT101	BS	Biology for Engineers	2	2	0	0	2
6	U18ESEE101	ES	Basic Electrical & Electronics Engineering	3	3	0	0	3
PRACTICAL								
7	*U18BSPH2L1	BS	Wave Optics and Mechanics Lab	3	0	0	3	1.5
	*U18BSCH2L4	BS	Chemistry Lab	3	0	0	3	1.5
8	U18ESME1L2	ES	Workshop/Manufacturing Practices Lab	5	1	0	4	3
9	U18ESEE1L3	ES	Basic Electrical & Electronics Engineering Laboratory	3	0	0	3	1.5
ACTIVITY BASED COURSES								
10	18MCAB203	MC	Yoga	2	0	0	2	0
11	18MCAB204	MC	Physical health – NCC	2	0	0	2	0
			Total	36	17	2	17	25.5

***Laboratory Classes will be conducted on alternative weeks for Physics and Chemistry.**

The Lab Practical Examinations will be held only in the second semester (including the first semester experiments).

SEMESTER III								
S.No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA302	BS	Partial Differential Equations and Probability &Statistics	4	3	1	0	4
2	U18PCMT301	PC	Kinematics of Machines	4	3	1	0	4
3	U18PCMT303	PC	Fundamentals of Electronic Circuits and Devices	3	3	0	0	3
4	U18PCMT304	PC	Measurement and Instrumentation	3	3	0	0	3
5	U18ESEC302	PC	Digital Electronics	3	3	0	0	3
6	U18PCMT306	PC	Electrical Machines & Drives	3	3	0	0	3
PRACTICAL								
7	U18PCMT3L1	PC	Electronic Circuits and Devices - Lab	2	0	0	2	1
8	U18PCMT3L2	PC	Electrical Machines & Drives Lab	2	0	0	2	1
ACTIVITY BASED COURSES								
9	U18MCAB305	MC	Culture- Learning an art form	2	0	0	2	0
10	U18MCAB306	MC	Culture – Intangible Cultural, heritage(Festivals, Food ways, Local games)	2	0	0	2	0
Total				28	18	2	8	22

SEMESTER IV								
Sl.No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA401	BS	Numerical Methods	3	3	0	0	3
2	U18PCMT402	PC	Dynamics of Machines	4	3	1	0	4
3	U18PCMT403	PC	Manufacturing Technology	3	3	0	0	3
4	U18PCMT404	PC	Power Electronics	3	3	0	0	3
5	U18PCMT405	PC	Control Systems	4	3	1	0	4
6	U18PCMT406	PC	Transducer Engineering	3	3	0	0	3
7	U18MCTH401	MC	Constitution of India	2	2	0	0	0
PRACTICAL								
8	U18PCMT4L1	PC	Machine Dynamics Lab	2	0	0	2	1
9	U18PCMT4L2	PC	Sensors and Instrumentation Lab	2	0	0	2	1
10	U18EEMT4L3	EE	Technical Seminar	2	0	0	2	1
ACTIVITY BASED COURSES								
11	U18MCAB407	MC	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
12	U18MCAB408	MC	Literature & Media – Group Reading of Classics	2	0	0	2	0
Total				32	20	2	10	23

SEMESTER V								
Sl. No	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCMT501	PC	Microcontroller & PLC	4	3	1	0	4
2	U18PCMT502	PC	CNC Technology	3	3	0	0	3
3	U18HSBA501	HS	Organizational Behavior	3	3	0	0	3
4	U18PCMT503	PC	Integrated Circuits	3	3	0	0	3
5		PE	Professional Elective – I	3	3	0	0	3
6		PE	Professional Elective – II	3	3	0	0	3
7	U18MCTH502	MC	Universal Human Values	2	2	0	0	0
PRACTICAL								
8	U18PCMT5L1	PC	Microcontroller & PLC Lab	2	0	0	2	1
9	U18PCMT5L2	PC	CNC Lab	2	0	0	2	1
ACTIVITY BASED COURSES								
10	U18MCAB509	MC	Social Services – Social Awareness	2	0	0	2	0
11	U18MCAB510	MC	Social Services – NSS	2	0	0	2	0
			Total	29	20	1	8	21

SEMESTER VI								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18BSMA601	BS	Operations Research for Engineers	3	3	0	0	3
2	U18PCMT 601	PC	Applied Hydraulics & Pneumatics	4	3	1	0	4
3		PE	Professional Elective – III	3	3	0	0	3
4		PE	Professional Elective – IV	3	3	0	0	3
5		OE	Open Elective-I	3	3	0	0	3
6	U18MCTH603	MC	Essence of Indian Knowledge Tradition	2	2	0	0	0
PRACTICAL								
7	U18PCMT6L1	PC	CAD/CAM Lab	2	0	0	2	1
8	U18PCMT6L2	PC	Hydraulics & Pneumatics Lab	2	0	0	2	1
9	U18EEEA6L2	EE	Soft Skill	2	0	0	2	1
10	U18EEMT6L3	EE	Summer Internship	2	0	0	2	1
ACTIVITY BASED COURSES								
11.	U18MCAB611	MC	Self-Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
12.	U18MCAB612	MC	Self-Development - religion and Inter-faith	2	0	0	2	0
			Total	30	17	1	11	20

SEMESTER VII								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1	U18PCMT701	PC	Robotics & Machine Vision System	3	3	0	0	3
2	U18PCMT702	PC	Design of Mechatronics system	3	3	0	0	3
3	U18PCMT703	PC	Computer Integrated Manufacturing	3	3	0	0	3
4		PE	Professional Elective – V	3	3	0	0	3
5		OE	Open Elective – II	3	3	0	0	3
PRACTICAL								
6	U18EEMT7P1	EE	Project Work-I	6	0	0	6	3
7	U18PCMT7L1	PC	Robotics Lab	2	0	0	2	1
8	U18PCMT7L2	PC	Simulation and Programming Lab	2	0	0	2	1
ACTIVITY BASED COURSES								
9	U18MCAB713	MC	Behavioral and Interpersonal Skills	2	0	0	2	0
10	U18MCAB714	MC	Nature – Nature Club	2	0	0	2	0
			Total	29	12	0	14	20

SEMESTER VIII								
Sl. No.	**Code No.**	**Category**	**Course Title**	**Contact Periods**	**L**	**T**	**P**	**C**
THEORY								
1		PE	Professional Elective – VI	3	3	0	0	3
2		OE	Open Elective - III	3	3	0	0	3
3		OE	Open Elective-IV (MOOC)	-	2	0	0	2
PRACTICAL								
4	U18EEMT8P2	EE	Project Work-II	18	0	0	18	9
5	U18EEMT8C1	EE	Comprehension	1	0	0	1	1
ACTIVITY BASED COURSES								
6	U18MCAB815	MC	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
Total				27	7	0	21	18

Professional Elective- I

Code No.	Specialization	Course Title	L	T	P	C
U18PEMT011	Electronics	Communication Engineering	3	0	0	3
U18PEMT012	Mechanical	Mechanics of Solids and Fundamentals of Fluids	3	0	0	3
U18PEMT013	Mechatronics	Virtual Instrumentation	3	0	0	3
U18PEMT014	Automation	Process Automation	3	0	0	3

Professional Elective – II

Code No.	Specialization	Course Title	L	T	P	C
U18PEMT021	Electronics	Consumer Electronics	3	0	0	3
U18PEMT022	Mechanical	Dimensional Metrology	3	0	0	3
U18PEMT023	Mechatronics	Textile Mechatronics	3	0	0	3
U18PEMT024	Automation	Plant Layout and Material Handling	3	0	0	3

Professional Elective – III

Code No.	Specialization	Course Title	L	T	P	C
U18PEMT031	Electronics	Neural Network & Fuzzy Logic	3	0	0	3
U18PEMT032	Mechanical	Composite Materials and Structure	3	0	0	3
U18PEMT033	Mechatronics	Underwater Robotics	3	0	0	3
U18PEMT034	Automation	Building Automation	3	0	0	3

Professional Elective – IV

Code No.	Specialization	Course Title	L	T	P	C
U18PEMT041	Electronics	Digital Signal Processing	3	0	0	3
U18PEMT042	Mechanical	Unconventional Machining Processes	3	0	0	3
U18PEMT043	Mechatronics	Cognitive Robotics	3	0	0	3
U18PEMT044	Automation	Industrial Automation	3	0	0	3

Professional Elective – V

Code No.	Specialization	Course Title	L	T	P	C
U18PEMT051	Electronics	Digital Image Processing	3	0	0	3
U18PEMT052	Mechanical	Rapid Prototyping	3	0	0	3
U18PEMT053	Mechatronics	Internet of Things for Mechatronics	3	0	0	3
U18PEMT054	Automation	Vetronics	3	0	0	3

Professional Elective – VI

Code No.	Specialization	Course Title	L	T	P	C
U18PEMT061	Electronics	Embedded System Design	3	0	0	3
U18PEMT062	Mechanical	Total Quality Management	3	0	0	3
U18PEMT063	Mechatronics	Micro Electronics and Nano Electronics	3	0	0	3
U18PEMT064	Automation	Modern Manufacturing Process	3	0	0	3

LIST OF OPEN ELECTIVES COMMON TO ALL B.Tech PROGRAMMES

ALL THE COURSES WITH L=3, T=0, P=0 & C=3

1. U18OEBA001 Sociology
2. U18OEBA002-Lean Six Sigma
3. U18OEBA003-Cyber Law and Ethics
4. U18OEBA004-Economic Policies in India
5. U18OEBA005-Management Information System
6. Total Engineering Quality Management
7. U18OEBA007-Industrial Psychology
8. U18OEBA008-Entrepreneurship Development and IPR
9. U18OEBA009-Intellectual Property Rights
10. U18OEBA010-Engineering Economics and Cost Analysis
11. U18OEEN001- Soft Skills and Interpersonal Communication
12. U18OEEN002-Indian Writing in English
13. U18OEEN003-Creative Writing
14. U18OEEN004- Proficiency in English and Accent Training
15. U18OEMA001-Cryptography
16. U18OEMA002-Finite Automata Theory / Formal Languages
17. U18OEMA003-Linear Programming
18. U18OECE001 - Metro Systems and Engineering
19. U18OECE002-Pollution Regulations
20 U18OECE003-Road Safety
21. U18OECE004- Infrastructure Development
22. U18OECE005- Project Safety Management
23. U18OECE006- Environment, Health and Safety in Industries
24. U18OEME001-Design for Manufacturing and Assembly
25. U18OEME002Industrial Safety
26. U18OEME003-Refrigeration and Cryogenics
27. U18OEME004- Product Design and Development
28. U18OEAU001-Electric and Hybrid Vehicles
29. U18OEAU002-Intelligent Transportation System
30. U18OEAU003-Vibration and Noise Control
31. U18OEAU004-Automotive Sensors and Applications
32. U18OEMT001-MEMS and Nano Technology
33. U18OEMT002-Non-Destructive Testing
34. U18OEMT003-Bio Mechatronics
35. U18OEMT004-Artificial Intelligence for Robotics
36. U18OEAE001-Industrial Aerodynamics
37. U18OEAE002- Elements of Aeronautics and Astronautics
38. U18OEAE003- Unmanned Aerial Vehicle
39. U18OEAE004- Introduction to Avionics
40. U18OEAE005-Rocket Propulsion

41. U18OEEE001-Green Technologies
42. U18OEEE002-Electrical Safety and Quality Assurance
43. U18OEEE003-Energy Conservation Techniques
44. U18OEEE004-PLC and SCADA for Industrial
45. U18OEEC-001-Communication Systems
46. U18OEEC-002-VLSI circuits
47. U18OEEC-003-Image Processing Techniques
48. U18OEEC-004-Communication Networks
49. U18OEEC-005-An Introduction to DSP
50. U18OEEC-006-Basics of IoT
51. U18OEBM001-Medical Radiation Safety Engineering
52. U18OEBM002-Medical Waste Management
53. U18OEBM003-Quality Control in Healthcare
54. U18OEBM004-Wearable Technology
55. U18OEEI001-Analytical Methods and Instrumentation
56. U18OEEI002-Introduction to process Data Analytics
57. U18OEEI003-Reliability and Safety in Process industries
58. U18OEEI004-Multi sensor data fusion
59. U18OEBT001- Bioprocess Economics & Plant Design
60. U18OEBT002-Brewing technology
61. U18OEBT003-Biomining
62. U18OEBT004-Industrial Safety Engineering
63. U18OEAC001-Geo- informatics for Precision Farming
64. U18OEAC002-Livestock and poultry management
65. U18OEAC003-Extension methodologies and transfer of Agricultural Technologies
66. U18OEAC004-Soil and Water Conservation Engineering
67. U18OEIT001-Block Chain Technology
68. U18OEIT002-Semantic Web
69. U18OEIT003-Entrepreneurship Development
70. U18OEIT004-Ethical Hacking Techniques
71. U18OECS001-Mobile Application Development
72. U18OECS002-System Modelling and Simulation
73. U18OECS003-Web Programming
74. U18OECS004-Virtual Reality
75. U18OECS005- E Commerce
76. U18OEGE001-Metagenomics and Epigenomics
77. U18OEGE002-Molecular Genetics and Genomics
78. U18OEGE003-Principles of Molecular cell biology

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HUMANITIES AND SOCIAL STUDIES INCLUDING MANAGEMENT COURSES (HS)

Sl. No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18HSEN101	Communicative English	4	2	0	2	3
2	U18HSEN201	Technical English	3	1	1	0	3
3	U18HSBA501	Organizational Behavior	3	3	0	0	3
Total Credits							9

BASIC SCIENCE (BS)

Sl. No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18BSMA101	Engineering Mathematics –I	4	3	1	0	4
2	U18BSPH 101	Waves and Optics	3	3	0	0	3
3	U18BSCH101	Engineering Chemistry	3	3	0	0	3
4	U18BSMA201	Engineering Mathematics- II	4	3	1	0	4
5	U18BSPH201	Introduction to Mechanics	3	3	0	0	3
6	U18BSCH201	Environmental Sciences	3	3	0	0	3
7	U18BSBT101	Biology for Engineers	2	2	0	0	2
8	U18BSMA302	Partial Differential Equations and Probability &Statistics	4	3	1	0	4
9	U18BSMA401	Numerical Methods	3	3	0	0	3
10	U18BSMA601	Operations Research for Engineers	3	3	0	0	3
10	*U18BSPH2L1	Wave Optics and Mechanics Lab	3	0	0	3	1.5
11	*U18BSCH2L4	Chemistry Lab	3	0	0	3	1.5
Total Credits							35

ENGINEERING SCIENCE COURSES (ES)

Sl.No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18ESCS101	Problem Solving and Python Programming	3	3	0	0	3
2	U18ESME101	Engineering Graphics & Design	5	1	0	4	3
3	U18ESEE101	Basic Electrical & Electronics Engineering	3	3	0	0	3
4	U18ESCS1L1	Problem Solving and Python Programming Laboratory	3	0	0	3	1.5
5	U18ESME1L2	Workshop/Manufacturing Practices Laboratory	5	1	0	4	3
6	U18ESEE1L3	Basic Electrical & Electronics Engineering Laboratory	3	0	0	3	1.5
						Total	15

PROFESSIONAL CORE COURSES(PC)

Sl.No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18PCMT301	Kinematics of Machines	4	3	1	0	4
2	U18PCMT303	Fundamentals of Electronic Circuits and Devices	3	3	0	0	3
3	U18PCMT304	Measurement and Instrumentation	3	3	0	0	3
4	U18ESEC302	Digital Electronics	3	3	0	0	3
5	U18PCMT306	Electrical Machines & Drives	3	3	0	0	3
6	U18PCMT 402	Dynamics of Machines	4	3	1	0	4
7	U18PCMT 403	Manufacturing Technology	3	3	0	0	3
8	U18PCMT404	Power Electronics	3	3	0	0	3
9	U18PCMT 405	Control Systems	4	3	1	0	4
10	U18PCMT 406	Transducer Engineering	3	3	0	0	3

11	U18PCMT501	Microcontroller & PLC	4	3	1	0	4
12	U18PCMT502	CNC Technology	3	3	0	0	3
13	U18PCMT503	Integrated Circuit	3	0		0	3
14	U18PCM 601	Applied Hydraulics & Pneumatics	4	3	1	0	4
15	U18PCMT701	Robotics & Machine Vision System	3	3	0	0	3
16	U18PCMT702	Design of Mechatronics system	3	3	0	0	3
	U18PCMT703	Computer Integrated Manufacturing	3	3	3	0	3
17	U18PCMT3L1	Electronic Circuits and Devices - Lab	2	0	0	2	1
18	U18PCMT3L2	Electrical Machines & Drives Lab	2	0	0	2	1
19	U18PCMT4L1	Machine Dynamics Lab	2	0	0	2	1
20	U18PCMT4L2	Sensors and Instrumentation Lab	2	0	0	2	1
21	U18PCMT5L1	Microcontroller & PLC Lab	2	0	0	2	1
22	U18PCMT5L2	CNC Lab	2	0	0	2	1
23	U18PCMT6L1	CAD/CAM Lab	2	0	0	2	1
24	U18PCMT6L2	Hydraulics & Pneumatics Lab	2	0	0	2	1
25	U18PCMT7L1	Robotics Lab	2	0	0	2	1
26	U18PCMT7L2	Simulation and Programming Lab	2	0	0	2	1
						Total Credits	66

EMPLOYABILITY ENHANCEMENT (EE) COURSES

S.NO	Code No.		Course Title	Contact Periods	L	T	P	C
1	U18EEMT4L3	EE	Technical Seminar	2	0	0	2	1
2	U18EEEA6L2	EE	Soft Skill	2	0	0	2	1
3	U18EEMT6L3	EE	Summer Internship	2	0	0	2	1
4	U18EEMT7P1	EE	Project Work-I	6	0	0	6	3
5	U18EEMT8P2	EE	Project Work-II	18	0	0	18	9
6	U18EEMT8C1	EE	Comprehension	1	0	0	1	1
		Total Contact Hours		31	0	0	31	16

MANDATORY COURSES (MC)

S.No.	Code No.	Course Title	Contact Periods	L	T	P	C
1	U18MCTH401	Constitution of India	2	2	0	0	0
2	U18MCTH502	Universal Human Values	2	2	0	0	0
3	U18MCTH603	Essence of Indian Knowledge Tradition	2	2	0	0	0
4	U18MCAB101	Physical health – Sports & Games	2	0	0	2	0
5	U18MCAB102	Gardening & Tree Plantation -	2	0	0	2	0
6	18MCAB203	Yoga	2	0	0	2	0
7	18MCAB204	Physical health – NCC	2	0	0	2	0
8	U18MCAB305	Culture- Learning an art form	2	0	0	2	0
9	U18MCAB306	Culture – Intangible Cultural, heritage(festivals, Food ways, Local games)	2	0	0	2	0
10	U18MCAB407	Literature & Media – Literature, Cinema & Media	2	0	0	2	0
11	U18MCAB408	Literature & Media – Group Reading of Classics	2	0	0	2	0

12	U18MCAB509	Social Services – Social Awareness	2	0	0	2	0
13	U18MCAB510	Social Services – NSS	2	0	0	2	0
14	U18MCAB611	Self Development – Spiritual, Mindfulness & Meditation	2	0	0	2	0
15	U18MCAB612	Self Development - religion and Inter-faith	2	0	0	2	0
16	U18MCAB713	Behavioral and interpersonal skills	2	0	0	2	0
17	U18MCAB714	Nature – Nature club	2	0	0	2	0
18	U18MCAB815	Innovation – Project based – Sc., Tech, Social, Design & Innovation	2	0	0	2	0
Total Contact Hours			36	6	0	30	0

SUMMARY OF CURRICULUM STRUCTURE AND CREDIT & CONTACT HOUR DISTRIBUTION

S.No.	Sub Area	Credit As per Semester								No. of Credit	% of credit
		I	II	III	IV	V	VI	VII	VIII		
1	Humanities & Social Sciences (HS)	3	3	-	-	3	-	-	-	9	5%
2	Maths& Basic Sciences (BS)	10	15	4	3	-	3	-	-	35	21%
3	Engineering Sciences (ES)	7.5	7.5	-	-	-	-	-	-	15	9%
4	Professional Core (PC)	-	-	18	19	12	6	8	3	66	39%
5	Professional Electives (PE)	-	-	-	-	6	6	3	3	18	11%
6	Open Electives/ MOOC (OE)	-	-	-	-	-	3	3	5	11	6%
7	Employability Enhancement Courses (EE) Project Work, Seminar, Internship, Term Paper, etc.	-	-	-	1	-	2	3	10	16	9%
8	Mandatory course(MC)	0	0	0	0	0	0	0	0	0	0
	Total Credit	20.5	25.5	22	23	21	20	17	21	170	100%
	Total Contact Hour	35	36	28	32	29	30	29	27	246	246

TOTAL CREDITS=170

U18HSEN101	**COMMUNICATIVE ENGLISH**	**L**	**T**	**P**	**C**
	Total Contact Periods – 60	2	0	2	3
	Prerequisite – School English				
	Course Designed by – Department of English				
OBJECTIVES	To gain fundamental knowledge of language and the uses in daily life.				

UNIT I SPEAKING 6

Speaking- Pronunciation, Intonation, Stress and Rhythm -Common Everyday Situations: Conversations and Dialogues -Communication at Workplace -Interviews -Formal Presentations - introducing oneself – exchanging personal information- narrating events, - incidents , speaking about one's friend/pet -Wh- Questions- asking and answering-yes or no questions- parts of speech. Vocabulary development– prefixes- suffixes- articles, prepositions.

UNIT II READING 6

Reading – comprehension (multiple choice questions, short questions) - short narratives and descriptions from newspapers including dialogues and conversations also used as short reading texts-- and longer passages - understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences vocabulary and structures- Vocabulary Building -
The concept of Word Formation

UNIT III LISTENING 6

Listening – listening to longer texts and filling in the table- product description- asking about routine actions and expressing opinions. –Listening to telephonic conversations -degrees of comparison- pronouns- direct vs indirect questions- Vocabulary development – single word substitutes- adverbs- Identifying Common Errors in Writing - Subject-verb agreement - Noun-pronoun agreement

UNIT IV WRITING 6

Writing- letter writing, formal and personal letters- after listening to dialogues or conversations and completing exercises based on them. Understanding text structure- use of reference words and discourse markers-coherence-jumbled sentences -Tenses- simple present-simple past- present continuous and past continuous- Vocabulary development- synonyms-antonyms- phrasal verbs- Articles - Prepositions.

UNIT V LANGUAGE DEVELOPMENT 6

Writing short essays – developing an outline- identifying main and subordinate ideas- dialogue writing- listening to talks, conversations to complete the remaining, participating in conversations-short group conversations-Language development-modal verbs- present/ past perfect tense.– paragraph writing- topic sentence- main ideas short narrative descriptions . Synonyms, antonyms, and standard abbreviations- Basic Writing Skills- Sentence Structures- Use of phrases and clauses in sentences - Importance of proper punctuation - Creating coherence- Organizing principles of paragraphs in documents- Techniques for writing precisely

SOFTSKILL LABORATORY 30

LIST OF EXPERIMENTS / EXCERCISES

1. Group discussion
2. Making effective presentations
3. Watching interviews & conversations

4. Reading different genres of texts
5. International English Language Testing System (IELTS)
6. Test of English as a Foreign Language (TOEFL)
7. Mock interviews
8. Time management &stress management
9. Role play
10. Listening to lectures, discussions from TV/ Radio.
11. Articulation of sounds - intonation.
12. Creative and critical thinking.

TEXT BOOKS:

1. English A Course book for Under Graduate Engineers and Technologists. Orient Black Swan Limited,Hyderabad:2015
2. Richards, C. Jack. Interchange Students' Book-2 New Delhi: CUP, 2015.

REFERENCES

1. Bailey, Stephen. Academic Writing: A practical guide for students. New York: Rutledge, 2011.
2. Comfort, Jeremy, et al. Speaking Effectively: Developing Speaking Skills for Business English. Cambridge University Press, Cambridge: Reprint 2011
3. Dutt P. Kiranmai and Rajeevan Geeta. Basic Communication Skills, Foundation Books: 2013
4. Means,L. Thomas and Elaine Langlois. English & Communication for Colleges. Cengage Learning ,USA: 2007
5. **Practical English Usage. Michael Swan. OUP. 2005.**
6. **Remedial English Grammar. F.T. Wood. Macmillan.2007**
7. **On Writing Well. William Zinsser. Harper Resource Book. 2001**

COURSE OUTCOMES (COs)	
CO1	The student will be able to comprehend the text with clarity
CO2	The capacity to read and listen will improve
CO3	Writing technical report will be learnt properly
CO4	Speaking skills will be acquired
CO5	Overall communication skills will make them employable

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M										M	
	CO2		H							H			
	CO3			M							M		
	CO4				M		H						M
	CO5					M		M	L				
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18BSMA101	Engineering Mathematics – I	L	T	P	C
	Total Contact Periods – 60	3	1	0	4
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				
OBJECTIVES	The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate integration analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.				

UNIT I DIFFERENTIAL CALCULUS - One Variable (9+3)

Representation of functions – limit of a function – continuity – Derivatives – Differentiation rule – Maxima and minima of functions of one variable – Rolle's Theorem – Mean Value Theorem – Taylor's and Maclaurin's Theorem with remainders.

UNIT II INTEGRAL CALCULUS - One Variable (9+3)

Definite integrals – Substitution rule – Techniques of integration – Integration by parts – Trigonometric integrals – Trigonometric substitutions – Integrations of rational functions by partial fractions – Integrations of irrational functions- Integration of improper functions - Beta, Gamma functions and their properties.

UNIT III DIFFERENTIAL CALCULUS - Several Variables (9+3)

Partial derivatives –Euler's theorem on Homogeneous functions - directional derivatives – total derivative – Jacobian – Maxima and minima of two variables.

UNIT IV MULTIPLE INTEGRALS - Several Variables (9+3)

Double integrals in Cartesian co-ordinates – Change of order of integrations – Area as a double integral – Triple integrals in Cartesian co-ordinates –Volume as triple integrals – Double integrals in polar co-ordinates – simple problems.

UNIT V MATRICES (9+3)

Characteristic Equations – Eigenvalue and Eigenvectors of the real matrix– Properties–- Cayley-Hamilton Theorem – Diagonalization of matrices – Reduction of quadratic form to canonical form by orthogonal transformation – Nature of Quadratic form.

TEXT BOOKS

1. Grewal B. S, Higher Engineering Mathematics, Khanna Publisher, Delhi – 2014.
2. Kreyszig. E, Advanced Engineering Mathematics, 10th edition, John Wiley & Sons, Singapore, 2012.

REFERENCE BOOKS

1. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
2. Kandasamy P &co., Engineering Mathematics, 9th edition, S. Chand & co Pub., 2010.
3. N.P.Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
4. Narayanan S., Manicavachagam Pillai T.K., Ramanaiah G., Advanced Mathematics for Engineering students, Volume I (2nd edition), S.Viswanathan Printers and Publishers,
5. George B. Thomas ,Jr ,Maurice D.Weir, Joel Hass., Thomas' Calculus ,Twelfth Edition Addison-Wesley, Pearson.

COURSE OUTCOMES (COs)	
CO1	To apply both the limit definition and rules of differentiation to differentiate functions. Also they will have a basic understanding of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
CO2	To apply definite integrals of algebraic and trigonometric functions using formulas and substitution. Also they will have a basic understanding of Beta and Gama functions.
CO3	To apply differential and integral calculus to notions of curvature. Also apply differentiation to find maxima and minima of functions.
CO4	To apply multiple integrals to compute area and volume over curves, surface and domain in two dimensional and three dimensional spaces.
CO5	Identify Eigenvalue problems from practical areas using transformations; Diagonalising the matrix would render the Eigen values.

MAPPING BETWEEN COURSE OUTCOMES& PROGRAMME OUTCOMES												
COs \POs	**a**	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
1	S				M		W			W		
2	S		S	W	M			M				M
3	S				M				W			
4	S	M			M				W		W	
5	S		S		M				M	W		
Category	Basic Science (BS)											
Approval	47th Academic Council Meeting held in Aug, 2018											

U18BSPH101	Waves and Optics	L	T	P	C
	Total Contact Hours - 45	**3**	**0**	**0**	**3**
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				
OBJECTIVES: To develop Physics and Engineering strategies of Waves and Optics and to discuss their functionalities in modern optoelectronics.					

UNIT 1 NON-DISPERSIVE TRANSVERSE AND LONGITUDINAL WAVES IN ONE DIMENSION 9

Introduction - Transverse wave on a string, the wave equation on a string, Harmonic waves, reflection and transmission of waves at a boundary, standing waves, longitudinal waves and the wave equation for them, acoustics waves and speed of sound. Waves with dispersion, superposition of waves, wave groups and group velocity.

UNIT 2 ULTRASONIC WAVES 9

Production of ultrasonic by magnetostriction and piezoelectric methods - acoustic grating – Detection - Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C – scan displays, Industrial and Medical applications – Sonogram.

UNIT 3 THE PROPAGATION OF LIGHT AND GEOMETRIC OPTICS 9

Fermat's principle of stationary time and its applications e.g. in explaining mirage effect, laws of reflection and refraction, Light as an electromagnetic wave and Fresnel equations, reflectance and

transmittance, Brewster's angle, total internal reflection, and evanescent wave. Mirrors and lenses and optical instruments based on them

UNIT 4 WAVE OPTICS 9

Huygens' principle, superposition of waves and interference of light by wave front splitting and amplitude splitting; Young's double slit experiment, Newton's rings, Michelson interferometer. Fraunhofer diffraction from a single slit and a circular aperture, Diffraction gratings and their resolving power

UNIT 5 LASERS 9

Einstein's theory of matter radiation interaction and A & B coefficients; amplification of light by population inversion, different types of lasers: gas lasers (He-Ne, CO2), solid-state lasers(Neodymium), Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, applications of lasers in science, engineering and medicine.

TEXT BOOKS

1) M.N. Avadhanulu and P.G. Kshirsagar, "A Textbook of Engineering Physics" S.Chand Publishers, 2016 (for Units 1,3,4 & 5)
2) G.Senthil Kumar, "Engineering Physics", VRB publishers, Chennai, 2015 (for Unit 2)

REFERENCE BOOKS

1) Brij Lal and Subramanian, "Waves and Oscillation", Vikas Publishsing House, 2011
2) R.Murugesan,"Optics and Spectroscopy", S.Chand Publishers, 2015
3) BrijLal and Subramanian,"Optics", S.Chand Publishers 2006
4) Ian G. Main, "Vibration and waves in physics", Cambridge University Press, 1978
5) H.J. Pain, "The physics of vibrations and waves", 6th edition, Wiley 2006
6) Ajoy Ghatak, "Optics", Tata McGraw-Hill publishing company, New Delhi, 2009
7) O. Svelto, "Principles of Lasers", Springer, 2010
8) Online reference Wikipedia.org

Course Outcomes (COs)	
CO1	Understand the basic concept of waves and lights
CO2	Understand the importance of Ultrasonic waves and Non-Destructive Testing
CO3	Understand the propagation of light and geometrical optics
CO4	Understand the optical phenomenon like interference, diffraction and superposition of waves
CO5	Understand the concept of laser and its applications

MAPPING BETWEEN COURSE OUTCOMES& PROGRAMME OUTCOMES

COs/POs	a	b	c	d	e	f	g	h	i	j	**k**	**l**
1	S	S	M	S	M			M	S	S		M
2	W	S	M	M	S			M		W	S	S
3	S	W			W			M	M		M	W
4	S	W			W			M	M		M	W
5	S	M	M	M				M		S	W	

3	Category	Basic Sciences (BS)
4	Approval	47th Meeting of Academic Council held in Aug, 2018

U18BSCH101	**ENGINEERING CHEMISTRY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – School Level Chemistry				
	Course Designed by – Department of Chemistry				
OBJECTIVES: To gain fundamental knowledge of Engineering Chemistry and its applications					

UNIT I WATER TECHNOLOGY 9

Introduction - Characteristics: Hardness of Water – Types - Temporary and Permanent Hardness - Estimation by EDTA method. Alkalinity – Types of Alkalinity - Phenolphthalein and Methyl Orange Alkalinity - Determination – Domestic Water Treatment – Disinfection methods (Chlorination, Ozonation, and UV Treatment). Boiler feed water – Requirements – Disadvantages of using hard water in boilers (Caustic embrittlement, Boiler corrosion, Priming and foaming) – Prevention of scale formation – softening of hard water - Internal treatment (Calgon treatment method) – External treatment – Demineralization process – Desalination and Reverse osmosis.

UNIT II PHASE RULE AND ALLOYS 9

Introduction: Statement of Phase Rule and Explanation of terms involved – One component system – Water system – Construction of phase diagram by thermal analysis - Condensed phase rule - Two Component System : Simple eutectic systems (lead-silver system) – eutectic temperature – eutectic composition – Pattinson's Process of desilverisation of Lead.

Alloys: Importance, ferrous alloys – nichrome and stainless steel – 18/8 stainless steel -heat treatment of steel – annealing –hardening – tempering - normalizing – carburizing - nitriding. Non-ferrous alloys: Brass and Bronze.

UNIT III NON-CONVENTIONAL ENERGY SOURCES AND STORAGE DEVICES 9

Introduction: Nuclear fission and nuclear fusion reactions – differences between nuclear fission and nuclear fusion reactions – nuclear chain reactions – nuclear energy critical mass - super critical mass - sub - critical mass Light water nuclear reactor for power generation – breeder reactor. Solar energy conversion – solar cells – wind energy. Fuel cells – hydrogen – oxygen fuel cell. Batteries: Primary and secondary Batteries – differences between Primary and secondary Batteries Secondary batteries: Lead–acid storage battery –working –uses. Nickel–cadmium battery -working –uses. Solid – state battery: Lithium battery.

UNIT IV FUELS 9

Introduction: Calorific value – types of Calorific value - gross calorific value – net calorific value. Analysis of Coal – Proximate and ultimate analysis – hydrogenation of coal - Metallurgical coke – manufacture by Otto-Hoffmann method. Petroleum processing and fractions– cracking – catalytic cracking – types – fixed bed catalytic cracking method- Octane number and Cetane number. Synthetic petrol – Bergius processes – Gaseous fuels- water gas, producer gas, CNG and LPG. Flue gas analysis – importance - Orsat apparatus.

UNIT V NANOCHEMISTRY 9

Introduction: Nanochemistry: Definition - Classification based on dimensions - Size dependent properties. Types of nanomaterials: Nanoparticles: Synthesis by Bottom-up and top-down approaches - Nanoporous materials: Synthesis by sol-gel method. Nanowires: Synthesis by VLS mechanism. Carbon Nanotubes (CNTs): Single walled and Multi walled nanotubes - Mechanical and electrical properties of CNTs - Applications of CNTs - Synthesis of CNTs by Electric arc discharge method and Laser ablation method. Nanochemistry in biology and medicines – nanocatalysis. NanocomSOsites – sensors and electronic devices.

TEXT BOOKS:

1. P.C.Jain and Monica Jain, "Engineering Chemistry" Dhanpat Rai Pub, Co., New Delhi (2002).
2. S.S.Dara "A text book of Engineering Chemistry" S.Chand & Co.Ltd., New Delhi (2006).
3. P. J. Lucia, M. Subhashini, "Engineering Chemistry, Volume 1", Crystal Publications, Chennai, (2007).
4. S. Vairam, P. Kalyani and Suba Ramesh, ―Engineering Chemistry‖, Wiley India PVT, LTD, New Delhi, 2013.
5. G. B. Sergeev, Nano chemistry, Elsevier Science, New York, 2006.

REFERENCES:

1. B.K.Sharma "Engineering Chemistry" Krishna Prakasan Media (P) Ltd., Meerut (2001).
2. Sivasankar "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).

COURSE OUTCOMES (COs)	
CO1	To impart knowledge to the Students about the principles, water characterization, conversant with boiler feed water requirements and water treatment techniques.
CO2	To make them understand the industrial importance of Phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys
CO3	To make the students to be well versed with the principles of Conventional and non-conventional energy sources and energy storage devices.
CO4	To make the students to have a deep knowledge of the Chemistry of Fuels and calorific value, manufacture of solid, liquid and gaseous fuels.
CO5	To make them understand the Nanochemistry, Types of nanomaterials: Nanoparticles, Nanochemistry in biology and medicines.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M			M		M		M		L		M
	CO2		L	M		H		M		H		L	
	CO3		H		S		L				H		L
	CO4	M		H	L			M			M		
	CO5		M		L		H				M		H
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18ESCS101	**PROBLEM SOLVING AND PYTHON PROGRAMMING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES	To gain fundamental knowledge of algorithmic problem solving and python programming				

MODULE 1 : ALGORITHMIC PROBLEM SOLVING 9

Introduction to components of a computer system - disks, memory, processor, operating system, compilers – Problems, Solutions, Idea of Algorithm –Representation of Algorithm. Building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Problem Illustrations

MODULE 2: DATA, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two Points.

MODULE 3: CONTROL FLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

MODULE 4: LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list, Processing list comprehension; Illustrative programs: selection sort, insertion sort, merge sort, histogram.

MODULE 5: FILES, PACKAGES 9

Files and exception: text files, reading and writing files, errors and exceptions, handling exceptions, packages: NumPy, SciPy, Matplotlib, Scikit-learn, Scilab Interface.

TEXT BOOKS:

1. Allen B. Downey, 'Think Python: How to Think Like a Computer Scientist', 2nd edition, Updated for Python3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)

2. Guido van Rossum and Fred L. Drake Jr, – An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES

1. John V Guttag, ―Introduction to Computation and Programming Using Python‘‘, Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, ―Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
3. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.
4. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.
5. Charles Dierbach, ―Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.
6. Paul Gries, Jennifer Campbell and Jason Montojo, ―Practical Programming: An Introduction to Computer Science using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013

COURSE OUTCOMES (COs)	
CO1	Develop algorithmic solutions to simple computational problems
CO2	Demonstrate programs using simple Python statements and expressions.
CO3	To gain knowledge regarding control flow and functions associated with python
CO4	Use Python data structures – lists, tuples & dictionaries for representing compound data
CO5	To gain knowledge on files, exception, modules and packages in Python for solving problems

Mapping of Course Outcomes with Programme Outcomes (POs)
CO/SO Mapping:S – Strong, M – Medium, W – Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S	S	S	M	S	M	W		M	W	M	S
	CO2	S	S	M	M		M		W			M	M
	CO3	M	M	W	S	M		W		W		M	W
	CO4	M	M	W	M	S	M	W	M	W		M	W
	CO5	M	S	W	M	M			M	M	W		W
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18ESME101	**Engineering Graphics & Design (Theory & Lab.)**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – +12 Level Maths and Physical Science				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To Prepare students to design a system, component, or process to meet desired needs, using the techniques, skills, and modern engineering tools necessary for engineering practice				

Detailed contents

Traditional Engineering Graphics:

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Computer Graphics:
Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM).
(Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory)

MODULE 1: INTRODUCTION TO ENGINEERING DRAWING (9+2)
Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Scales – Plain, Diagonal and Vernier Scales; Draw simple annotation, dimensioning and scale. Construction of Conic sections; Cycloid, Epicycloid, Hypo cycloid and Involute of circle.

MODULE 2: ORTHOGRAPHIC PROJECTIONS (10+2)
Principles of Orthographic Projections; Conventions; Projections of points and Orthographic projection of lines in first quadrant - Parallel to both the planes – Perpendicular to one plane – Parallel to one plane and inclined to other plane – Inclined to both the planes; Projections of planes inclined to either HP or VP.

MODULE 3: PROJECTIONS OF REGULAR SOLIDS& ISOMETRIC PROJECTIONS (10+3)
Projection of solids in first quadrant – Prism, Pyramid, Cone and Cylinder inclined to one plane; Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions - Isometric Views of Simple Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa.

MODULE4: SECTIONS OF SOLIDS AND DEVELOPMENT OF SURFACE (10+3)
Sectional view of Prism, Cylinder, Pyramid, Cone (simple position in first quadrant) with cutting planes perpendicular to one plane and parallel or inclined to another plane– True shape of sections; Development of lateral surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone.

MODULE 5: BUILDING DRAWING (9+2)
Introduction to building drawing; Types of Projection adopted in Building Drawing; Scales for various types of Drawings, Symbols, Conventions and Abbreviations. Drawing of residential single and two storied buildings with detail of Line plan, Foundation Plan, Ground floor Plan, First floor plan, Elevation and Sections.

MODULE 6: OVERVIEW OF COMPUTER GRAPHICS (12+3)
Introduction to CAD; Basic commands; Coordinate systems; Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerance; Orthographic constraints, Snap to objects manually and automatically; Setup a drawing with proper scale –Dimensioning commands, Editing Dimensions and Dimension text; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles; Create basic drawing of objects such as polygon and general multi-line figures; Creating orthographic views of simple solids like prism, pyramid, cylinder, cone. Drawing sectional views

of prism, pyramid, cylinder and cone; Preparation of fabrication drawing (Development of surfaces); Drawing front view, top view and side view of objects from the given pictorial view; Creation of 3-D models of simple objects.

TEXT BOOKS:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. &Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers
5. (Corresponding set of) CAD Software Theory and User Manuals

COURSE OUTCOMES (COs)	
CO1	Students will gain Exposure to engineering communication.
CO2	Students will learn standards of engineering graphics.
CO3	Students will get Exposure to basics of building construction
CO4	Students will get Exposure to computer-aided geometric design
CO5	Student will gain basic knowledge and Exposure to the visual aspects of Engineering Design.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M			H			M					
	CO2	M	M	L		L	H						L
	CO3			M									M
	CO4											M	
	CO5	M						L					
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18BSPH2L1	**WAVE OPTICS AND MECHANICS LABORATORY (Common to B.Tech-Civil, Mech, Mechatronics, Aero, Aerospace & Auto)**	L	T	P	C
		0	0	3	1.5
	Total Contact Hours - 45				
	Prerequisite – **Wave Optics and Mechanics**				
	Course designed by – Department of Physics				
OBJECTIVES: To impart Practical knowledge of Physics to the students					

Physics Lab experiments for Semester I & II

List of Experiments for Waves and Optics – Common for all branches

1) Ultrasonic Interferometer
2) Air-wedge Experiment
3) Particle size determination
4) Determination of acceptance angle
5) Determination of Laser Wavelength
6) Spectrometer – Determination of wavelength using grating

List of Experiments for Mechanics

1) Torsional Pendulum – without symmetrical mass
2) Torsional Pendulum – With symmetrical mass
3) Young's Modulus – Non-uniform bending
4) Young's Modulus – Uniform Bending
5) Compound Pendulum
6) Coefficient of viscosity of the given liquid – Poiseuille method

Course Outcome (CO's)													
CO1	Understand the fundamental concept of optics												
CO2	Understand the concept of production of ultrasonic waves												
CO3	Understand the basic concept of Mechanics												
Mapping of Course Outcomes(COs) with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S		S	S				S	W	M		
	CO2	S	S	W					S	W	M		S
	CO3	S	S	W					S	M	M	M	
3	Category	Basic Sciences (BS)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

U18BSCH2L4	**CHEMISTRY LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – Engineering Chemistry				
	Course Designed by – Department of Chemistry				
OBJECTIVES: To enhance the practical knowledge on Chemistry through Volumetric and circuit experiments					

LIST OF EXPERIMENTS

1. Determination of Total Hardness, Temporary Hardness and Permanent hardness of Water by EDTA method

2. Estimation of Alkalinity - Titrimetry
3. Estimation of Dissolved Oxygen
4. Estimation of Chlorides in Water by Argentometric Method (MOHR'S Method)
5. Estimation of Copper by EDTA method
6. Estimation of Iron in Water by Spectrophotometry
7. Conductometric Titration of Strong Acid with Strong Base
8 Determination of Molecular weight of a polymer by Viscosity Average Method
9. pH measurements for Acid - alkali Titrations
10 Determination of rate of corrosion by weight loss method.
11. Conductometric Precipitation titration
12. Determination of Water Crystallization

REFERENCES

1. R. Jeyalakshmi, "Practical Chemistry", Devi Publications 2014.
2. S.S. Dara, A text book on experiments and calculation Engg.

COURSE OUTCOMES (COs)	
CO1	Students will able to analyze - hardness, Alkalinity, Dissolved oxygen, Chlorides in Water by Argentometric Method, Determination of Water of Crystallization as well as estimation of Copper by EDTA method using volumetric analysis.
CO2	Students will understand basic principle of spectrophotometric method
CO3	Students will learn Conductometric Titration of Strong Acid with Strong Base and Conductometric Precipitation titration.
CO4	Studentswill be able to analyze Determination of Molecular weight of a polymer by Viscosity Average Method
CO5	Students will understand about pH measurements for Acid - alkali Titrations and rate of corrosion by weight loss method

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H		M	M		H		H		L		
	CO2	L	H			M		H		M		L	
	CO3		M		M						M		H
	CO4	H		M				M				H	
	CO5		H		L		M				H		
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18ESCS1L1	**PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – NIL				
	Course Designed by – Department of Computer Science & Engineering				
OBJECTIVES: To enhance the practical knowledge on writing programs using Python					

LIST OF EXPERIMENTS FOR PROBLEM SOLVING AND PYTHON PROGRAMMING LAB

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton‘s method)
3. Exponentiation (Power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First n prime numbers
9. Multiply matrices
10. Find the most frequent words in a text read from a file
11. Simulate elliptical orbits in Pygame
12. Simulate bouncing ball using Pygame
13. Simulate matrix operations with Scilab
14. Simulate fitting curve with NumPy and Matplotlib

REFERENCES:

1. Kenneth A. Lambert, ―Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012
2. Timothy A. Budd, ―Exploring Python‖, Mc-Graw Hill Education (India) Private Ltd.,, 2015.

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux and Scilab

COURSE OUTCOMES (COs)	
CO1	Write, test, and debug simple Python programs.
CO2	Implement Python programs with conditionals and loops
CO3	Develop Python programs step-wise by defining functions and calling them
CO4	Use Python lists, tuples, dictionaries for representing compound data
CO5	Read and write data from/to files in Python and to simulate using the packages Scilab, NumPy and Matplotlib

Mapping of Course Outcomes with Programme Outcomes (POs)
(S/M/W indicates strength of correlation) S-Strong, M-Medium, W-Weak

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	S	S	M	S	S	M	M	M	M		M	S
	CO2	S	S	W	S	S	M	W	M	M	M	M	S
	CO3	S	S	M	M	M	M		M	M	M	M	M
	CO4	S	M	S	S	S	M	M	M	M	W		S
	CO5	S	S	M	S	M	M		M	M	W	M	
3	Category	Engg Sciences (ES)											
4	Approval	47th Meeting of Academic Council held in Aug, 2018											

	TECHNICAL ENGLISH	**L**	**T**	**P**	**C**
U18HSEN201	Total Contact Periods – 45	2	1	0	3

	Prerequisite – I semester English
	Course Designed by – Department of English
OBJECTIVES	To gain fundamental knowledge of English language and its usage in day to day life.

UNIT I LISTENING 9

Listening- Listening to talks mostly of a scientific/technical nature and completing information-gap exercises- Speaking –Asking for and giving directions- extended definitions –listening to daily issue- -Vocabulary Development- technical vocabulary - Language Development –subject verb agreement – compound words.

UNIT II READING 9

Reading – reading longer technical texts- identifying the various transitions in a text- interpreting charts, graphs after reading the, practice in speed reading- vocabulary Development-vocabulary used in formal letters/emails and reports -Language Development personal passive voice, numerical adjectives.

UNIT III TECHNICAL WRITING 9

Writing after listening to classroom lectures- talk should be on engineering /technology– introduction to technical presentations- longer texts both general and technical, Describing a process, use of sequence words- Vocabulary Development- sequence words- Misspelled words.

UNIT IV FORMAL WRITING 9

Writing- email etiquette- job application – cover letter –Resume preparation (via email and hard copy)- analytical essays and issue based essays–Vocabulary Development- finding suitable synonyms-paraphrasing-. Language Development- clauses- dependant, independent, if conditionals.

UNIT V LANGUAGE DEVELOPMENT 9

Speaking –participating in a group discussion – role play, Writing– Writing reports- minutes of a meeting- accident and survey-Vocabulary Development- transitive, intransitive verbs, Language Development- reported speech.

TEXT BOOKS:

1. Fluency in English A Course book for Engineering and Technology. Orient Blackswan, Hyderabad: 2016
2. Sudharshana.N.P and Saveetha. C. English for Technical Communication. Cambridge University Press: New Delhi, 2016.

REFERENCES

1. Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
2. Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007
3. Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad,2015
4. Means, L. Thomas and Elaine Langlois, English & Communication For Colleges Cengage Learning, USA: 2007

COURSE OUTCOMES (COs)	
CO1	The student will acquire basic proficiency in English

CO2	Reading and listening ability will improve.
CO3	Comprehension techniques will develop.
CO4	writing and speaking skills will be acquired
CO5	Overall communication skills will make them employable.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M										H	
	CO2		H							M			
	CO3			H							H		H
	CO4				M		H						
	CO5					M		M	M				
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18BSMA201	**Engineering Mathematics II (Common to B.Tech – Civil, Mech, Mechatronics, Automobile, Aero, Aerospace, EEE, ECE, BME, CSE & IT)**	**L**	**T**	**P**	**C**
	Total Contact Periods - 60	**3**	**1**	**0**	**4**
	Prerequisite – School Level Mathematics				
	Course Designed by Department of Mathematics				
OBJECTIVE	The objective of this course is to equip the students of Engineering and Technology with techniques in ordinary equations, vector calculus, complex variables and Laplace transform with advanced level of mathematics and applications that would be essential to formulate problems in engineering environment.				

UNIT I ORDINARY DIFFERENTIAL EQUATIONS (9+3)

Higher order linear differential equations with constant coefficients – linear differential equations with variable coefficients– Euler's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients- Method of variation of parameters.

UNIT II VECTOR CALCULUS (9+3)

Scalar and vector point function - Gradient, Divergence and curl – Directional derivatives – Angle between two surfaces - Irrotational and Solenoidal vector fields – Line Integral - Green's theorem – Gauss divergence theorem and Stokes' theorem – Simple applications involving cubes and rectangular parallelepipeds.

UNIT III ANALYTIC FUNCTIONS (9+3)

Functions of complex variable - Analytic functions – Necessary and sufficient conditions (without

proof), Cauchy Riemann Equations in Cartesian and polar form – Harmonic functions – properties of analytic functions – Construction of analytic functions using Milne Thomson method – Conformal mapping : and Bilinear Transformation.

UNIT IV COMPLEX INTEGRATION (9+3)

Cauchy integral theorem – Cauchy's integral formula – problems – Taylor's and Laurent's Series – classification of Singularities – Poles and Residues – method of finding residues - Cauchy's residue theorem and its applications to evaluate real integrals – contour integration.

UNIT V LAPLACE TRANSFORMS (9+3)

Transforms of elementary functions – Basic properties – Shifting theorem- Transforms of derivatives and integrals – Initial and final value theorem – Laplace transform of Periodic Functions – Inverse Laplace transform – Convolution theorem – Periodic Functions – Applications of Laplace transform for solving linear ordinary differential equations up to second order with constant coefficient.

TEXT BOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Willie & Sons, 2006.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.

REFERENCE BOOKS

1. Venkataraman. M. K, Engineering Mathematics, National Publishing Company, 2000.
2. Bali .N.P and Manish Goyal, A Text book of Engineering Mathematics, Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
3. Veerarajan T, Engineering Mathematics, II edition, Tata McGraw Hill Publishers, 2008.
4. George B. Thomas Jr., Maurice D. Weir, Joel R. Hass., Thomas' Calculus, 12th Edition, Addison-Wesley, Pearson.

COURSE OUTCOMES (COs)	
CO1	The mathematical tools for solution of differential equation that model physical process.
CO2	To evaluate the line, surface and volume integrals using Green's, Stoke's and Gauss Theorems and their verification.
CO3	To understand the analytic functions, conformal mapping and complex integration and their applications.
CO4	To evaluate real and complex integrals using the Cauchy's integral formula and Residue theorem.
CO5	To apply the concept of Laplace Transformation in analysis and solve differential equations.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs \POs	**Programme Outcomes (POs)**											
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**
CO1	M		W		S				M		S	M
CO2	S	M			S			M		W		
CO3	S		W				M		S			S
CO4								S	M	M	W	M
CO5	S		W	W			M				S	
Cate	Basic Science (BS)											

App	47th Academic Council Meeting held in Aug, 2018

U18BSPH201	INTRODUCTION TO MECHANICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Higher Secondary School Physics				
	Course designed by – Department of Physics				

OBJECTIVES: To impart basic knowledge of mechanics involving 1D, 2D and 3D motions ofa rigid body

UNIT 1 **9**

Forces in Nature; Newton's laws and its completeness in describing particle motion; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates

UNIT 2 **9**

Potential energy function; F = - Grad V, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation of Angular Momentum; Energy equation and energy diagrams; Elliptical and parabolic orbits;

UNIT 3 **9**

Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly-damped oscillators; Forced oscillations and resonance

UNIT 4 **9**

Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion, Kinetic energy of a rotating body

UNIT 5 **9**

Introduction to three-dimensional rigid body motion — only need to highlight the distinction from two-dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a coplanar manner: e.g. Rod executing conical motion with center of mass fixed

TEXT BOOKS

1. Dr.R.K.Bansal, "A Text Book of Engineering Mechanics", Laxmi publication (P) Ltd. 6th edition, 2013.

REFERENCE BOOKS

1. R.K.Gaur and S.L.Gupta, "Engineering Physics" Dhanpat Rai Publications" 2012.

2. M.K. Harbola, “Engineering Mechanics”, 2nd edition, Cengage, 2013.

3. M.K. Verma, “Introduction to Mechanics”, 1st edition, CRC press, 2009.
4. D.Kleppner&R.Kolenkow, “An Introduction to Mechanics”, McGraw Hill Education, 2017
5. JL Meriam and L.G.Kraige, “Engineering Mechanics – DynamicsVol 2”, 7th ed. Wiley, 2012
6. JP Den Hartog, “Mechanical Vibrations”, Dover Publications, Inc., 1985
7. WT Thomson, “Theory of Vibrations with Applications”, Pearson, 5th edition, 1997.
8. Online References: Wikipedia org

Course Outcomes

COURSE OUTCOMES (COs)	
CO1	Understand and solve the various equation of motions in different coordinates
CO2	Understand the conservation of energy and angular momentum
CO3	Understand the concept of harmonic motion in different damped conditions
CO4	Understand the rigid body motion in different criteria
CO5	Understand the rigid body motion in 3D

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			L	L					M		W	
	CO2	H		L	L	H				M		L	
	CO3	M				M				H		M	
	CO4	H		L	L					M		L	
	CO5	L		H	H	M				M		L	
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18BSCH201	**ENVIRONMENTAL SCIENCE**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – NIL				
	Course Designed by – Department of Chemistry				
OBJECTIVES	• To study the interrelationship between living organism and environment. • To study of the nature and concepts of ecosystem. • To learn about the integrated themes and biodiversity of an environment. • To study of pollution control and waste management. • To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.				

UNIT I -NATURAL RESOURCES 9

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people –Water resources: Use and over- utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems - Food resources: World food problems, changes caused by agriculture and overgrazing, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - Equitable use of resources for sustainable lifestyles.

UNIT II -ECOSYSTEMS 9

Introduction: concepts of an ecosystem. Structure and function of an ecosystem, producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem :- Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, (ponds, streams, lakes, rivers, oceans, estuaries)- Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation - Ethics : Issues and Possible Solutions, Climate change, global warming, acid rain, ozone layer depletion.

UNIT III -BIODIVERSITY AND ITS CONSERVATION 9

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

UNIT IV-ENVIRONMENTAL POLLUTION 9

Definition, Causes, effects and control measures of Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards. Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - pollution case studies - Disaster Management: floods earthquake, cyclone and landslides.

UNIT V- SOCIAL ISSUES AND HUMAN POPULATION 9

Social issues: Environmental Protection Act, Air (Prevention and Control of pollution) Act, Water (Prevention and Control of pollution) Act, Wildlife protection Act, Forest Conservation Act, Public awareness – Fireworks and its impact on the Environment – Chemicals used in Fireworks – (Fuel – oxidizing Agent – Reducing Agent –Toxic Materials – Fuel –Binder- Regulator) – Harmful nature of ingredients – chemical effects on health due to inhaling fumes.

Human population: population growth, variation among nations, Population explosion-Family Welfare programs, Environment and human health, Human Rights, Value Education, HIV and AIDS, Women and Child Welfare, Role of Information Technology in Environment and Human health - Case Studies.

TEXT BOOKS:

1. Gilbert M. Masters, Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education 2004.
2. Benny Joseph, Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
3. R.K. Trivedi, Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
4. Rajagopalan, R, Environmental Studies-From Crisis to Cure', Oxford University Press 2005.
5. K.V.B. Raju and R.T. Ravichandran, "Basics of Civil Engineering".

REFERENCES:

1. Cunningham, W.P. Cooper, T.H. Gorhani, Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
2. Dharmendra S. Sengar, Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.

COURSE OUTCOMES (COs)	
CO1	Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving
CO2	Appreciate concepts and methods from ecological and physical sciences and their application in environmental problem solving.
CO3	Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems
CO4	Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales
CO5	Apply systems concepts and methodologies to analyze and understand interactions between social and environmental processes

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H			M		H		H		L		H
	CO2	L	H	H		M		H		M		L	L
	CO3		M				L			H	M		
	CO4	H		M	L			M				M	H
	CO5		H		L		M				H		
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18BSBT101	**BIOLOGY FOR ENGINEERS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	0	2
	Prerequisite – Higher Secondary level biology, basic concepts in cell signaling				
	Course Designed by – Dept of Industrial Biotechnology				

OBJECTIVES: To provide a basic understanding of the biological systems and its applications in the industrial sector

UNIT I INTRODUCTION TO LIFE 6

Characteristics of living organisms-Basic classification-cell theory-structure of prokaryotic and eukaryotic cell- Introduction to biomolecules - general classification and important functions of carbohydrates-lipids-proteins-nucleic acids – vitamins

UNIT II BIODIVERSITY 6

Plant System: basic concepts of plant growth-nutrition-photosynthesis-Animal System: elementary study of digestive-respiratory-circulatory-excretory systems and their functions. Microbial System -types of microbes-economic importance and control of microbes.

UNIT III GENETICS AND IMMUNE SYSTEM 6

Evolution: theories of evolution- evidence of laws of inheritance-variation and speciation-nucleic acids as a genetic material-central dogma - immunity- antigens - antibody-immune response.

UNIT IV HUMAN DISEASES 6

Definition- causes, symptoms, diagnosis, treatment and prevention of diabetes, cancer, hypertension, AIDS and Hepatitis

UNIT V BIOLOGY AND ITS INDUSTRIAL APPLICATION 6

Transgenic plants and animals-stem cell and tissue engineering-bioreactors-biopharming-recombinant vaccines -cloning- bioremediation-biofertilizer-biocontrol- biosensors-biopolymers-bioenergy-biomaterials-biochips

TEXT BOOKS:

1. A Text book of Biotechnology, R. C. Dubey, S. Chand Higher Academic Publications, 2013
2. Diseases of the Human Body, Carol D. Tamparo and Marcia A. Lewis, F.A. Davis Company, 2011.
3. Biomedical instrumentation, Technology and applications, R. Khandpur, McGraw Hill Professional, 2004

REFERENCE BOOKS

1. Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011
2. Cell Biology and Genetics (Biology: The unity and diversity of life Volume I), Cecie Starr, Ralph Taggart, Christine Evers and Lisa Starr, Cengage Learning, 2008
3. Biotechnology Expanding horizon, B.D. Singh, Kalyani Publishers, 2012

COURSE OUTCOMES (COs)	
CO1	To understand the basic concepts of the cell and its structure
CO2	To understand about biodiversity and its conservation
CO3	To know the fundamentals of genetics and the immune system

CO4	To create an awareness about human diseases												
CO5	To give a basic knowledge of the applications of transgenics												
Mapping of Course Outcomes(COs) with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H					M	M			H	M	H
	CO2	H			M		H		M	M			H
	CO3	M		M			M						M
	CO4							H			M	M	
	CO5	H	H					H	M	M			H
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18ESEE101	**BASIC ELECTRICAL & ELECTRONICS ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	**3**	**0**	**0**	**3**
	Prerequisite – School Level Physics				
	Course Designed by – Department of Electrical & Electronics Engineering				
OBJECTIVES	To gain fundamental knowledge of Electrical and Electronics Engineering and its applications				

MODULE 1 : DC CIRCUITS **12**

Electrical circuit elements, voltage and current sources, Fundamental Relationship of VI for RLC circuit, Ohms Law, Source Transformation ,Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Basics of Superposition, Thevenin and Norton Theorems, Maximum Power Transfer Theorem.

MODULE 2: AC CIRCUITS **9**

Representation of sinusoidal waveforms, peak and RMS values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Time-domain analysis of first-order RL and RC circuits. Three-phase balanced circuits, voltage and current relations in star and delta connections.

MODULE 3: ELECTRICAL MACHINES & TRANSFORMERS **9**

Principles of operation and characteristics of; DC machines, Synchronous machines, three phase and single phase induction motors. Transformers (single and three phase) regulation and efficiency, all day efficiency and auto-transformer .

MODULE 4: SEMICONDUCTOR DEVICES AND APPLICATIONS **9**

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

Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier and its applications, Introduction to OP-AMP.

MODULE 5: DIGITAL ELECTRONICS 6

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – Fundamentals of A/D and D/A Conversion.

TEXT BOOKS:

1. John Bird, Electrical Circuit Theory & Technology, Taylor & Francis Ltd, 6th, edition. 2017.
2. Smarajit Ghosh, Fundamentals of Electrical and Electronics Engineering, Second Edition, PHI Learning, 2007.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 10th Edition, 2011.
5. V. D. Toro, "Electrical Engineering Fundamentals", Pearson, 2nd Edition, 2015.
6. Millman and Halkias, "Integrated Electronics", McGraw Higher Ed, 2nd Edition, 2011.
7. Vincent Del Toro, `Electrical Engineering Fundamental, Prentice Hall, 2nd Edition, 2015.
8. K.A.Krishnamurthy and M.R.Raghuveer, `Electrical and Electronics Engineering for Scientists', New Age International Pvt Ltd Publishers, 2011.

REFERENCES:

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, Third Reprint,2016.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", Mcgraw Higher Ed, 1st Edition, 2011.
3. Jacob Millman and Christos C-Halkias,"Electronic Devices and Circuits", Mcgraw Higher Ed, 4th Edition, 2015.

COURSE OUTCOMES (COs)	
CO1	**COURSE OUTCOMES (COs)**
CO2	To gain knowledge regarding the various laws and principles associated with DC Circuits.
CO3	To gain knowledge regarding fundamentals of AC circuits.
CO4	To gain knowledge regarding electrical machines and transformers.
CO5	To gain knowledge regarding various types of semiconductor devices and small signal amplifiers.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	L			M				H		L	H
	CO2	H	L			M				H		L	H
	CO3	H	M			M				H		L	H
	CO4	H	L			M				H		L	H

	CO5	H	L			M				H		L	H
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18ESME1L2	**Workshop/Manufacturing Practices Laboratory**	**L**	**T**	**P**	**C**
	Total Contact Periods – 75	1	0	4	3
	Prerequisite – NIL				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES	To educate the students on common manufacturing processes employed in Industries.				

Lectures & videos: **(15 hours)**

Detailed contents

- Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 lecture)**
- CNC machining, Additive manufacturing **(2 lecture)**
- Fitting operations & power tools **(2 lecture)**
- Carpentry **(2 lecture)**
- Plastic moulding, glass cutting **(2 lecture)**
- Metal casting **(2 lecture)**
- Welding (arc welding & gas welding), brazing **(2 lecture)**

WORKSHOP PRACTICE:

1. Machine shop **(6 hours)**
   a) Facing
   b) Turning
   c) Drilling Practice
2. Fitting shop **(6 hours)**
   a) Fitting Exercises–Preparation of square fitting
   b) Vee–fittingmodels.
3. Carpentry **(9 hours)**
   a) Preparation of Lap joints.
   b) Mortise and Tenon joints.
   c) Cross Half joints.
   d) Dove Tail joints.

4. Welding shop **(Arc welding 6 hrs + gas welding 3 hrs) (9 hours)**
Preparation of butt joints, lap joints and Tee joints

5. Sheet Metal working **(9 hours)**
a) Forming &Bending:
b) Model making–Trays, funnels, etc.
c) Different type of joints

6. Demonstration **(6 Hours)**
Smithy operations, upsetting, swaging, setting down and bending. Example–Exercise–Production of hexagonal headed bolt.

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

SUGGESTED TEXT/REFERENCE BOOKS:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers Private Limited, Mumbai.

2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology",4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan and A. Suresh Babu,"Manufacturing Technology – I" Pearson Education, 2008.

4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.

5. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

COURSE OUTCOMES (COs)													
CO1	**COURSE OUTCOMES (COs)**												
CO2	Students will gain knowledge of the different manufacturing processes.												
CO3	Students will be able to fabricate components with their own hands.												
CO4	Students will gain practical knowledge of the dimensional accuracies and dimensional tolerances.												
CO5	Students will be able to produce small devices of their interest.												
Mapping of Course Outcomes(COs) with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l

2	CO1											H	
	CO2			H	M							H	
	CO3		M										
	CO4	H			L							H	H
	CO5											H	
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18ESEE1L3	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	0	0	3	1.5
	Prerequisite – School Level Physics & Basic Electrical and Electronics Engineering				
	Course Designed by – Department of Electrical & Electronics Engineering				
OBJECTIVES: To enhance the practical knowledge on basics of electrical and electronics components and circuits.					

LIST OF EXPERIMENTS FOR BASIC ELECTRICAL ENGINEERING LAB

1. Verification of Ohms and Kirchoff's Voltage and Current Laws
2. Measurement of the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope). Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification.
3. Fluorescent lamp wiring
4. Staircase wiring
5. Measurement of energy using single phase energy meter
6. Observation of the no-load current waveform on an oscilloscope and Measurement of Primary and secondary voltages and currents of a Transformer
7. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
8. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

LIST OF EXPERIMENTS FOR BASIC ELECTRONICS ENGINEERING LAB

1. Measurement of ac signal parameters using cathode ray oscilloscope and function generator.
2. Characteristics – Half wave and Full wave Rectifiers
3. Characteristics – Common Base transistor configuration
4. Verification of truth tables of OR, AND, NOT, NAND, NOR gates and Flip-flops - JK and RS
5. Applications of Operational Amplifier

REFERENCE BOOKS:

1. S. K. Bhattacharya, "Basic Electrical and Electronics Engineeing", Pearson Education India,2011

COURSE OUTCOMES (COs)	
CO1	To handle basic electrical equipment and verify current and voltage law
CO2	To handle basic electrical equipment and verify current and voltage law
CO3	To understand the steady-state and transient time-response of R-L, R-C, and R-L-C circuits
CO4	To understand domestic wiring procedures practically.
CO5	To analyze ac signal parameters using cathode ray oscilloscope and function generator

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H			H				H		M	H
	CO2	H	H			H				H		M	H
	CO3	H	H			H				H		M	H
	CO4	H	H			H				H		M	H
	CO5	H	H			H				H		M	H
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

SEMESTER-III

U18BSMA302	**Partial Differential Equations, Probability and Statistics**	**L**	**T**	**P**	**C**
	Total Contact Periods - 60	**3**	**1**	**0**	**4**
	Prerequisite – Engineering Mathematics I & II				
	Course Designed by : Department of Mathematics				
OBJECTIVE	Grasp the Fourier series expansion for given periodic function in specific intervals and their different forms. Learn techniques of solving the standard types of first order and second order partial differential equations. Learn solving wave and heat equation using Fourier series. Learn basics of probability, Baye's Theorem. Understand the concept of random variable, moment generating functions and their properties; learn standard distributions in discrete and continuous cases. Learn measures of central tendency and correlation and regressions, rank correlation, statistical intervals for single sample and test of hypothesis for a small and large sample				

UNIT I FOURIER SERIES (9+3) Hrs

Dirichlet's conditions – General Fourier Series – Half range Sine and Cosine series – Parseval's Identity – Harmonic Analysis.

UNIT II PARTIAL DIFFERENTIAL EQUATIONS

(9+3) Hrs

Formation – Solutions of standard types of first order equations – Lagrange's linear equations – Linear partial differential equation of second and higher order with constant coefficients.

UNIT III BOUNDARY VALUE PROBLEMS FOR PARTIAL DIFFERENTIAL EQUATIONS (9+3) Hrs

Classifications second order linear partial differential equations – Solution of one dimensional wave equation – One dimensional heat equation – Steady state solution of two dimensional heat equation – Fourier Series solutions in Cartesian coordinates.

UNIT 1V PROBABILITY DISTRIBUTION (9+3)Hrs

Probability – Axioms of probability – Conditional probability – Baye's theorem – Random variables – Binomial – Poisson – Geometric – Uniform – Exponential and normal distribution and their properties.

UNIT V STATISTICS AND TESTING OF HYPOTHESIS (9+3)Hrs

Measures of central tendency – Moments – Skewness and kurtosis – Correlation and Regression – Rank correlation – Test of significance: Large sample test for single proportion, difference of proportions – Chi Square test for goodness fit and independence of attributes.

TEXT BOOKS

1. S. J. Farlow, Partial Differential Equations for Scientist and Engineers, Dover Publications 1993.
2. S.C.Gupta& V.K.Kapoor, "Fundamentals of Mathematical Statistics", Sultan Chand and Sons, New Delhi , 2003. [Units I to III].

REFERENCE BOOKS

1. R. Haberman, Elementary Applied partial differential equations with Fourier Series and Boundary Value Problems, 4th Ed., Prentice Hall, 1998.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2001.
3. Manish Goya and .N.P Bali l, Transforms and Partial Differential Equations, University Science Press, Second Edition, 2010.
4. Douglas C. Montgomery and George C. Runger. "Applied Statistics and Probability for Engineers" , 6th Edn. Wiley India Pvt Ltd., New Delhi-2. 2010.
5. TirupathiR.Chandrauptta. "Quality and Reliability in Engineering". Book Vistas, New Delhi.

COURSE OUTCOMES (COs)	
CO1	Expand given function using the knowledge of Fourier Series and frequently needed practical harmonic analysis that an engineer may have to make from discrete data.
CO2	Solve PDE and higher order with constant coefficients and physically interpret the results.
CO3	Boundary Value Problems and Differential Equations will be knowledgeable about and will be able to analyze solutions to two-point boundary value problems, boundary value problems for partial differential equations.
CO4	Evaluate the probability using addition and multiplication theorem. Apply Baye's Theorem for practical problems to find the probability. Apply the discrete and continuous distribution for solving practical problems. Evaluates the moments of distributions using moment generating functions.

CO5	Learn the basic idea of statistics including measures of central tendency .Identify the appropriate hypothesis testing procedure based on type of outcome variable and number of samples.												
Mapping of Course Outcomes(COs) with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M				H	M	L	L	M			
	CO2	M	H	L		H	M	L			M	M	
	CO3	H	H	M	L				L		L		

U18PCMT301	**KINEMATICS OF MACHINES**										**L**	**T**	**P**	**C**
	Total Contact Periods – 60										3	1	0	4
	Prerequisite – Engg Mathematics-I, Engg Mathematics-II, Basic Mechanics													
	Course Designed by – Department of Mechatronics													
OBJECTIVES	To understand the various concepts in kinematics of various machines and mechanisms.													
	CO4	H	H	M	L			L		M		H		
	CO5	H	H		L		M	L	L			H		
3	Category	Professional Core(PC)												
4	Approval	47th Academic Council, July 2018												

UNIT I INTRODUCTION TO MECHANISMS 12

Introduction-Science of mechanisms-Terms and definitions-Planar, Spherical and spatial mechanisms, Mobility-Classification of mechanisms-Indexing mechanisms, reciprocating mechanism etc. Straight line generators- kinematic inversion- Slider crank chain inversions- Four bar chain inversions- Grashof's law.

Determination of velocities and acceleration in mechanisms- Relative motion method (Graphical) for Mechanisms having turning, sliding and rolling pair.

UNIT II SYNTHESIS OF MECHANISMS 16

Classification of kinematics- Synthesis problems- Chebyshev's spacing, Two point synthesis-Freudenstein method- Four bar mechanism and slider crank mechanism.

Types of cams and followers- Follower motions- Uniform, parabolic, SHM, Cycloidal and polynomial-Synthesis of cam profiles for different followers. Cams with specified contours

UNIT III FRICTION 10

Friction-Types-Application-Inclined plane, Screw jack, Clutch, Brakes Bearings, Journal bearing, Flat pivot bearing, multi collar bearings Belt drives.

UNIT IV THEORY OF GEARING 12

Classification of gears, Law of gearing, nomenclature-Forms of teeth, Cycloidal teeth, Involute teeth-Length of path of contact-Length of arc of contact-Contact ratio-Interference and undercutting- Minimum number of teeth to avoid interf

erence- Internal gears- Extended center distance system- Long and short addendum system- Gear trains-Types-Epicyclical gear trains-Automobile differential unit.

UNIT V CONTROL MECHANISMS 10

Governors- Gravity controlled governors-Spring control governors, Hartnell governor, and Hartung governor-Governor characteristics- Governor effort and power.

Gyroscopes-Gyroscopic forces and couple- Forces on bearing due to gyroscopic action-Gyroscopic effects on the movement of aero plans and ships, stability of two wheel drive and four wheel drive, Gyroscopic effects in grinding machines.

TEXT BOOKS

1. S.S.Rattan-Theory of Machines- Tata McGraw Hill, 4th Edition, 2014.
2. Dr.R.K.Bansal," Theory of Machines", Laxmi Publications Pvt. Ltd,5th Edition,2015.

REFERENCES

1. R.S.Kurmi,Theory of Machines,S.chand,2005
2. V.Ramamurti,"Mechanics of Machines"3rd Edition,Narosa Publications,2010
3. Shigley.J.E-Theory of Machines and Mechanisms, 4th Edition- Oxford,2014
4. V.P.Singh-Theory of Machines ,Dhanapat Rai,3rd Edition,2013
5. Rao J.S. &DukkipattiR.V.,"Mechanisms and Machine Theory", 2nd Edition-Wiley Estern Ltd-1992.

COURSE OUTCOMES (COs)	
CO1	Upon completion of this course, the students can able to apply fundamentals of mechanism for the design of new mechanisms and analyse them for optimum design
CO2	Will know the impact of numerical methods in engineering analysis
CO3	Better understanding on the theoretical background of mechanisms
CO4	Will get the confidence in using mechanisms
CO5	Capability of solving engineering problems will increased

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H		L	M		M	L	H			H
	CO2	H							L		M	L	
	CO3		H					M		H	M	L	H
	CO4				L	M		L	L		M	L	
	CO5	H	H		L					H			H
3	Category	Professional Core(PC)											

4	Approval	47th Academic Council, July 2018	

U18PCMT303	**FUNDAMENTALS OF ELECTRONIC CIRCUITS AND DEVICES**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Basic Electronics Engineering				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To understand the basics concepts of semiconductors and the working of semiconductor based circuits				

UNIT I SEMICONDUCTOR THEORY AND SPECIAL DEVICES 9

SEMICONDUCTOR DIODES: Review of intrinsic & extrinsic semiconductors – Theory of PN junction diode – Energy band structure – current equation – space charge and diffusion capacitances – effect of temperature and breakdown mechanism – Zener diode and its characteristics.

SPECIAL DIODES : Tunnel diodes – PIN diode, varactor diode — UJT – Diac and Triac – Laser, CCD, Photodiode, Phototransistor, Photoconductive and Photovoltaic cells – LED, LCD.

UNIT II-TRANSISTOR CONFIGURATIONS 9

Transistor construction and operation - characteristics of CB, CC and CE configurations – Transistor amplifying action – Limits of operation - Transistor biasing: Operating point, load line analysis of fixed bias circuit - Darlington connection.

UNIT III - FEEDBACK AMPLIFIERS AND WAVE SHAPING CIRCUITS 9

Basic concepts of feedback- Four types of negative feedback – Effect of feedback on input resistance, output resistance- Voltage gain and current gain- Advantages of negative feedback- RC wave shaping circuits- Diode clippers and clampers- Voltage multipliers.

UNIT IV OSCILLATORS AND MULTIVIBRATORS 9

Oscillators: Classification of oscillators – Barkhausen criterion,Working of RC phase shift, Wien's bridge, Hartely, colpitts oscillators.

Multivibrators: Astable, monostable and bistable – Analysis of performance parameters of multivibrators ,Schmitt Trigger, Blocking oscillators.

UNIT V RECTIFIERS AND POWER SUPPLIES 9

Single –phase, half-wave and full-wave rectifiers – Bridge rectifiers – Ripple factor, rectification efficiency-Transformer Utilisation Factor and regulation – Performance characteristics of rectifiers with filters – Regulated power supply – Series and shunt type voltage regulators – Switched mode power supplies.

TEXT BOOKS

1. Robert L.Boylestad& Louis Nashelsky,"Electronic Devices and Circuit Theory", Pearson India Education Services Pvt, 11th Edition,2015
2. K. Rama Sudha, K. VenkataRao, "Electronic Devices and Circuits ",Tata McGraw Hill ,1st Edition,2015
3. Thomas L.Floyd,"Electronic Devices "Pearson Education,10th Edition,2018.

REFERENCE

1. Robert T. Paynter, "Introducing Electronics Devices and Circuits", Pearson Education, 7thEdtion, 2006.
2. Mahesh B.Patil,"Basic Electronic Devices and Circuits ", PHI Learning Pvt, 2013.
3. .J. Millman&Halkins, SatyebrantaJit, "Electronic Devices & Circuits", Tata McGraw Hill, 2nd Edition, 2008.
4. David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 5th Edition, (2008).
5. S. Salivahanan, N. Suresh kumar and A. Vallavanraj, "Electronic Devices and Circuits",Tata McGraw Hill, 2nd Edition, (2008).

COURSE OUTCOMES (COs)	
CO1	Able to get the knowledge about the working of semiconductors and Special diodes
CO2	Able to get the knowledge about the different configurations of transistors.
CO3	To learn about the concept of amplification and wave shaping circuits.
CO4	Able to get the basic concepts of Oscillators and Multivibrators.
CO5	To understand the working principle of Rectifiers.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	L		M	H	L						M
	CO2		L		M	H	L				H	L	
	CO3						M	M	M	M			M
	CO4	M	L		M	H		L			L	L	
	CO5	M					L	M				L	M
3	Category	Professional core (PC)											
4	Approval	47th Academic Council, July 2018											

U18PCMT304	**MEASUREMENT AND INSTRUMENTATION**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Basic Electrical & Electronics Engineering				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To increase the ability of the students to model and analyze electrical apparatus and their application to power system				

UNIT I INTRODUCTION 9

Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – Standards and calibration.

UNIT II ELECTRICAL AND ELECTRONICS INSTRUMENTS 9

Principle and types of analog and digital voltmeters, ammeters, multimeters – Single and three phase wattmeters and energy meters – Magnetic measurements – Determination of B-H curve

and measurements of iron loss – Instrument transformers – Instruments for measurement of frequency and phase.

UNIT III COMPARISON METHODS OF MEASUREMENTS 9

D.C & A.C potentiometers, D.C & A.C bridges, transformer ratio bridges, self-balancing bridges.Interference & screening – Multiple earth and earth loops – Electrostatic and electromagnetic interference – Grounding techniques.

UNIT IV STORAGE AND DISPLAY DEVICES 9

Magnetic disk and tape – Recorders, digital plotters and printers, CRT display, digital CRO, LED, LCD & dot matrix display – Data Loggers.

UNIT V TRANSDUCERS AND DATA ACQUISITION SYSTEMS 9

Classification of transducers – Selection of transducers – Resistive, capacitive & inductive transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – A/D, D/A converters – Smart sensors.

TEXT BOOKS

1. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements &Instrumentation' Dhanpat Rai and Co 2004.
2. J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria& Sons, Delhi,2003.
3. Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.

REFERENCE

1. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw Hill, II Edition 2004.
2. D.V.S. Moorthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2007.
3. A.J. Bouwens, 'Digital Instrumentation', Tata McGraw Hill, 1997.
4. Martin Reissland, 'Electrical Measurements', New Age International (P) Ltd., Delhi, 2001.
5. Alan. S. Morris, Principles of Measurements and Instrumentation, 2nd Edition, Prentice Hall of India, 2003.

COURSE OUTCOMES (COs)	
CO1	To introduce the basic functional elements of instrumentation
CO2	To introduce the fundamentals of electrical and electronic instruments
CO3	To educate on the comparison between various measurement techniques
CO4	To introduce various storage and display devices
CO5	To introduce the various classifications of transducers

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	L		M	H	L	L				L	
	CO2		L					L	M	L	M		H
	CO3	M										M	
	CO4		L	L	M				M	M	M		L

	CO5	M			M	H		L					M
3	Category	Professional Core (PC)											
4	Approval	47th Academic Council, July 2018											

U18ESEC302	DIGITAL ELECTRONICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Basic Electronics Knowledge				
	Course Designed by – Department of Mechatronics Engineering				

OBJECTIVES

- To get a basic understanding of how circuits and systems are designed with digital electronic circuit elements.
- To be able to analyze and design circuits and systems made from digital electronic circuit elements such as gates and flip-flops.
- To master basic design and programming.

UNIT-I NUMBER SYSTEMS AND CODES 9

Review of binary, octal and Hexa decimal representations of numbers and their conversion, Binary arithmetic; conversion algorithms.Weighted binary codes.Non weighted binary codes error-detecting and error-correcting codes-Alphanumeric codes.

UNIT-II BOOLEAN ALGEBRA 9

Introduction to Boolean algebra- The AND, OR and not operations. Laws of Boolean algebraof Boolean expressions. Boolean expressions and logic diagrams.Universal building blocks.Negative logic.

UNIT-III COMBINATIONAL LOGIC9

Truth tables and maps.Sum of products and product of sums; Map reduction hybrid functions.Incompletely specified functions.Multiple- Output minimization. Variable- Entered maps. Tabular minimization.Analysis of logic schematics.Synthesis of combinational functions.

UNIT-III LOGIC FUNCTION RELIZATION WITH MSI CIRCUITS 9

Multiplexers, De-multiplexers,Decoders and code converters. Arithmetic circuits, Adder, Number complements. Subtracting positive binary numbers with adders.Signed number addition and subtraction.

UNIT-IV SYNCHORONOUS SEQUENTIAL CIRCUITS 9

Basic latch circuits, De-bouncing switch. Flip-flops, truth table and excitation table. Shift registers. Asynchronous and synchronous counters. Shift counters.

UNIT-V ASYNCHRONOUS SEQUENTIAL CIRCUITS 9

Analysis and Design of Asynchronous Sequential Circuits , Reduction of State and Flow Tables ,Race-free State Assignment, Hazards.

TEXT BOOKS:

1. T. L Floyd & Jain, “Digital fundamentals”, Pearson Education,3rd edition,2011.
2. Morris Mano M., “Digital Logic and Computer Design”, Pearson Education,2010.

REFERENCE BOOKS:

1. Heiser Man, "Digital IC applications", Pearson Education,2007.
2. Raj Kamal, "Digital Systems Principles and Design", Pearson Education, First Edition, 2007.
3.CharlesH.Roth, Jr. and Larry L. Kinney, "Fundamentals of Logic Design", CL Engineering, 7th Edition, 2013.
4.WilliamH.Gothmann, "Digital electronics: an introduction to theory and practice",Prentice-Hall,2006 .
5.http://www.b-u.ac.in/sde_book/digi_com.pdf

COURSE OUTCOMES (COs)	
CO1	Perform arithmetic operations in any number system.
CO2	Understand the hierarchical memory system and data transfer with in a digital computer.
CO3	Use Boolean simplification techniques to design a combinational hardware circuit.
CO4	Understand the concept of number system.
CO5	Learn the various gates like AND, OR, NOT, XOR.
CO6	Learn the concept of synchronous and asynchronous sequential circuits.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k
2	CO1	H	H	H	M	M	M	H	H	M		M
	CO2	M	H	M	H						M	
	CO3	M		H	H	H	L	H	M			M
	CO4	H	M							M	M	H
	CO5	H		H	M		H	M	M			M
	CO6	M	H	M		M				L	L	
3	Category	Professional Core (PC)										
4	Approval	47th Academic Council, July 2018										

U18PCMT306	**ELECTRICAL MACHINES & DRIVES**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Engg Mathematics-I, Engg Mathematics-II, Basic electrical engineering				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To understand the basics concepts of various types of DC and AC machines with its drives				

UNIT I CIRCUITS AND TRANSFORMERS 6

D.C. Voltage, current, power-Ohms law-series, parallel circuits – Kirchoff's laws – mesh analysis – A.C. voltage – sinusoidal waves, phasor representation – power factor – complex power - basic idea of transformers – simple problems.

UNIT II ELECTRICAL MOTORS 12

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

UNIT III SPEED CONTROL AND STARTING 9

Speed control of D.C. motors – three phase induction motors – starting methods of D.C. motor and three phase induction motor – electrical braking – simple problems.

UNIT IV ELECTRICAL DRIVES 9

Type of Electrical Drives – Selection & factors influencing the selection – heating and cooling curves – loading condition and classes of duty – determination of power rating – simple problems.

UNIT V SOLID STATE DRIVES (QUALITATIVE TREATMENT ONLY) 9

Advantages of solid state drives – D.C. motor control using rectifiers and choppers – control of induction motor by V, V/f and slip power recovery scheme using inverters and A.C. power regulators.

TEXTBOOKS

1. S.K. Bhattacharya "Electrical Machines" Tata McGraw-Hill Pvt. Company Ltd., 3rd edition, 2008.
2. ShaahinFilizadeh,"Electric Machines and Drives: Principles, Control, Modeling, and Simulation",CRC Press,2013.

REFERENCE

1. I.J. Nagrath, T.P. Kothari., "Basic Electrical Engineering", McGraw-Hill Publishing company Ltd., Second edition, 2002.
2. Ned Mohan,"Electrical Machines and Drives" First course ,Wiley Publication,2012.
3. Jan A. Melkebeek,"Electrical Machines and Drives: Fundamentals and Advanced Modelling,Springer,2018.
4. Dieter Gerling,"Electrical Machines: Mathematical Fundamentals of Machine Topologies",springer,2014.
5. G.K. Dubey "Fundamental Electrical Drives", Narosa Publications, Second edition, 2002.

COURSE OUTCOMES (COs)	
CO1	Able to get the basic knowledge about the Electric and Magnetic circuits, AC fundamentals and transformers.
CO2	Able to get the knowledge about the construction and working of DC, AC and Special machines.
CO3	Able to get the knowledge about the starting and speed control AC and DC machines.
CO4	Able to get the basic concepts of Drives, Electric drives, types and factors influencing

	the choice of electrical drives												
CO5	To understand the working principle of DC &AC motors drives and their characteristics and its braking methods												
Mapping of Course Outcomes(COs) with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	L		M	H	L	L					H
	CO2		H	L			L		M	L	M	M	H
	CO3		H									L	
	CO4			L					M	L			
	CO5	M	L			H	L	L					M
3	Category	Professional Core (PC)											
4	Approval	47th Academic Council, July 2018											

U18PCMT3L1	**ELECTRONIC CIRCUITS AND DEVICES – LAB**	**L**	**T**	**P**	**C**
	Total Contact Periods – 30	0	0	2	1
	Prerequisite – Engg Mathematics-I, Basic electronics Lab				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To design an working of basic electronics circuits like power supply, oscillator, amplifier etc				

LIST OF EXPERIMENTS

1. Characteristics of PN junction and Zener diode.
2. Input and Output characteristics of CB ,CE configuration.
3. Drain and Transfer characteristics of JFET.
4. Characteristics of SCR ,Triac, Diac& UJT.
5. Half wave Rectifier & Full Wave rectifier.
6. Series voltage regulator.
7. Design of RC coupled amplifier &FET Amplifier.
8. Hartley Oscillator &Colpitt's oscillator.
9. Astable, Monostable ,BistableMultivibrator.
10. Clippers & clampers.

LIST OF EQUIPMENTS AND COMPONENTS

1. Variable Power Supply (0-30V) - 6
2. CRO - 4
3. Digital Multimeter - 6
4. Function Generator - 4
5. DC Ammeter - 4

Consumables

6. Transformers
7. Resistors ¼ Watt Assorted
8. Capacitors
9. Inductors
10. Diodes and Zener diodes
11. Bread Boards
12. ICS – 555, 741, LM 328, LM 324
13. BC107, BC147,BC 108, BC 148, BC547, BC 548, SL 100, SK100 or Equivalent transistors
14. Wires

COURSE OUTCOMES (COs)	
CO1	To study the characteristics of diodes like PN diode and zener diode
CO2	To study the I/O characteristics of transistors in various configurations
CO3	To study the various characteristics of power transistors
CO4	To study the various characteristics of special transistors
CO5	To design and test rectifier circuits and series voltage regulators

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M		H						L		L	H
	CO2	M				H	L	M	M				
	CO3			H		H			M	L		L	H
	CO4						L	M					
	CO5	M		H		H							
3	Category	Professional Core (PC)											
4	Approval	47th Academic Council, July 2018											

U18PCMT3L2	**ELECTRICAL MACHINES &DRIVES LAB**	**L**	**T**	**P**	**C**
	Total Contact Periods – 30	0	0	2	1
	Prerequisite – Engg Mathematics-I, Basic Electrical Lab				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	The ability to conduct testing and experimental procedures on different types of electrical machines.				

LIST OF EXPERIMENTS

1. Load test on D.C. shunt motor.
2. Speed control of D.C. shunt motor.

3. Swinburne's test
4. Load test on three phase induction motor.
5. No load and blocked rotor tests on three-phase induction motor.
6. Load test on single phase induction motor.
7. No load and blocked rotor tests on single phase induction motor.
8. Load test on Synchronous motors
9. Performance characteristics of Stepper motors.
10. Performance characteristics of single phase transformer.

LIST OF EQUIPMENT

(For a batch of 30 students)

S.No	**Equipments**	**Qty**
1.	Shunt motor 5HP	3
2.	Single phase Induction Motor 2HP	2
3.	Three phase induction Motor 5HP	2
4.	Single phase transformer 2KVA	1
5.	Three phase quto transformer	2
6.	Single phase auto transformer	2
7.	3 point starter	3
8.	DPST, TPST	Each 2
9.	DC source 300v, 100A	1
10.	Ammeter (0-5A), (0-10A) MC	Each 2
11.	Ammeter (0-5A), (0-10A) MI	Each 2
12.	Voltmeter (0-300V) MC	3
13.	Voltmeter (0-150V), (0-300V), (0-600V) MI	Each 2
14.	Wattmeter 150/300V, 5/10A UPF	2
15.	Wattmeter 300/600V, 5/10A UPF	2
16.	Wattmeter 150/300V, 5/10A LPF	2
17.	Wattmeter 300/600V, 5/10A LPF	2
18.	Stepper motor 5Kg	1
19.	Synchronous motor 5KW	1
20.	Rheostat 360 ohm/1.2A	3
21.	Rheostat 50 ohm/5A	3
22.	Tachometer	5

COURSE OUTCOMES (COs)	
CO1	Understand the concept of efficiency and the short circuit impedance of a three-phase transformer from no-load test, winding resistance, short circuit test, and load test.
CO2	Understand the effect of unbalanced loading on a three-phase transformer with different connections, and the effects and limitations of each connection..
CO3	Understand the starting and connecting procedures of synchronous generators, and to obtain the 'V' curves of synchronous motors.
CO4	Experimentally obtain the load characteristics of various dc motors and generators

CO5		Experimentally obtain the load characteristics, starting current and starting torque of a squirrel-cage induction motor and to derive circuit parameters from no-load and blocked-rotor tests											
Mapping of Course Outcomes(COs) with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H				M		H	H		H	
	CO2	H		M	H	M	H	M					H
	CO3							M	M	H			
	CO4		M	H	M			H				H	M
	CO5					H	M			M			
3	Category	Professional Core (PC)											
4	Approval	47th Academic Council, July 2018											

18MCAB305	**CULTURAL- LEARNING AN ART FORM**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite – NIL				
	Course Designed by – AICTE				

Learning an Art Form

Cultivation of arts is an integral part of the development of human beings since the arts are what make us most human, most complete as people. They offer us the experience of wholeness because they touch us at the deepest levels of mind and personality. They come into being not when we move beyond necessity but when we move to a deeper necessity, to the deeper human need to create order, beauty and meaning out of chaos. They are the expressions of deepest human urges, imperatives and aspirations.

While enriching the process of learning through enhanced perceptual and cognitive skills, learning of arts promotes self-esteem, motivation, aesthetic awareness, cultural exposure, creativity, improved emotional expression, as well as social harmony and appreciation of diversity. They promote an understanding and sharing of culture, and equip the learners with social skills that enhance the awareness and respect of others. Each institution will offer a range of introductory courses in different art forms: music, dance, theatre, painting, and other art forms. Care should be taken to give adequate representation to local and regional art forms in which our culture abounds. For example, Banaras has local traditions in vocal music like *Chaiti*, *Hori*, *Kajri* and *Birha*.

An institution in Banaras area can offer courses on these art forms apart from regular classical and semi-classical vocal music forms. Similar local art tradition can be utilized in different cities and regions. This will, in turn, also ensure wider community involvement/interaction with the

institution. Students will be given an option to choose a particular art form, and learn and practice it under an artist -instructor. At the end of the course, a student should be able to demonstrate basic proficiency in that particular art form. Contact hours per week should be 3-4 hours.

Towards the end of the course, the institution can organize a function/program in which all the students publicly demonstrate their skills.

U18MCAB306	**CULTURAL- INTANGIBLE CULTURAL HERITAGEO(Festivals, Food ways, Local Games)**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite – Nil				
	Course Designed by –				

Intangible Cultural Heritage (Festivals, Food ways, Local Games)

As part of our rich intangible cultural heritage, foodways, fares and festivals, local games and sports are important sources for discovering the social and cultural values of our people and understanding the inner dynamics of our society, as these are sites where we witness the most significant and intimate representations of our society's self-perception—how our society perceives itself. These traditions have shaped and strengthened our social and cultural identities, and also the notion of community at the local, regional, and national levels. They have played a significant role in the making of our social life, and through them we have constructed for ourselves, individually and collectively, a sense of shared lived past and group identity. They facilitate the transmission of a culture's most deeply held values, from one generation to another and their continuity or discontinuity helps us to understand the changing social structure and culture of a society. For example, each community has its own foodways, and their overall health, well-being and cultural continuity are directly related to their ability to eat traditional foods and continue their traditional food practices. These traditional foods and food practices are deeply intertwined with their cultures and value systems, and play an important role in religious ceremonies and spirituality. Similar is the case with fares and festivals, and local games and sports. These traditions are bound up with rituals, customs, beliefs, and often also with trade, craft and professions. They are not mere superstitious rituals often condemned and denounced as being regressive, stagnant and backward, but repositories of our indigenous knowledge and wisdom which have evolved over centuries, and they still continue to serve social and cultural functions. This knowledge has been the basis for agriculture, food preparation, health care, education, conservation and the wide range of other activities that sustain societies in many parts of the world.

Most of these traditions are either on the verge of extinction or undergoing drastic changes due to globalization, acculturation, migration, questions of identity related to social mobility to confirm

to a higher social order or simply because the context in which these traditions originated or were conceived no longer exist and their effectiveness or need seems no longer relevant. For example, while the agro-ecological and food systems offer some signs of resilience and adaptation, a range of factors are increasingly threatening these systems and peoples' well-being. The knowledge and skills of elders concerning traditional food preparation, and the use of traditional herbs and plants for healing purposes have not been passed on to the next generation and is at risk of being lost and disappearing altogether from reservation life and culture.

The course aims at exposing students to these traditions, and making them aware of the veritable treasure house of indigenous knowledge which can be utilized as resource for realizing a vision of sustainable future.

Each locality/region our Indian sub-continent abounds in a rich variety of food-ways, fares and festivals, games and sports. Students should be asked to identify one of these traditions and study them in detail. For example, the following guidelines can be adopted in the study of food-ways:

To study and document the indigenous knowledge and wisdom of everyday food habits and food items consumed;

To study and document the prevalent social practices and beliefs regarding traditional foods;

To study and document the feasts on religious and social occasions of different communities;

To identify and document the food items consumed by different communities and determine their nutritional values;

To conduct chemical analysis of food ingredients;

To identify and document the kitchen generated health ingredients used by different communities;

To find out the uses of leftover food stuff of different communities;

To develop hygienic food chart for people ailing and suffering from different metabolic disorders; and

To develop suitable communication strategies to effectively disseminate traditional knowledge regarding food habits.

Similarly, in the case of fares and festivals, and games and sports one could study how these traditions create a sense of community bonding and lead to the rules of commensality and social interaction and behavior. Suitable guidelines along the lines of foodways can be developed and adopted for such a study.

At the end of the course, students will be required to submit a detailed project report. Options should be given to the students to make short documentaries and films on these traditions.

SEMESTER -IV

U18BSMA401	**Numerical Methods (Common to B.Tech - Mech, Mechatronics, Automobile, Aero, EEE, EIE, ECE, CSE, IT, Civil & Bio Medical)**	**L**	**T**	**P**	**C**
	Total Contact Periods: 45	**3**	**0**	**0**	**3**
	Prerequisite – Engineering Mathematics I & II				
	Course Designed by : Department of Mathematics				
OBJECTIVES	The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate integration analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.				

UNIT 1 SOLUTION OF POLYNOMIAL AND TRANSCENDENTAL EQUATIONS **9 Hrs**

Fixed Point Iteration methods - Newton - Raphson method and Regula-Falsi method for single variable - solutions of linear system of equations by Gaussian, Gauss-Jordan, Jacobian and Gauss-Siedel methods.

UNIT 2 INTERPOLATION **9 Hrs**

Finite differences - Relation between finite difference operators- Interpolation using Newton's forward and backward difference formulae, Interpolation with unequal intervals-Newton's Divided difference formula, Lagrange's Interpolation formula.

UNIT 3 NUMERICAL DIFFERNTIATION AND INTEGRATION **9 Hrs**

Numerical Differentiation with interpolation polynomials, Numerical integration by Trapezoidal and Simpson's Both $1/3^{rd}$ and $3/8^{th}$ rules. Double integration using Trapezoidal rule and Simpson rule.

UNIT 4 INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATION **9 Hrs**

Single step methods- Taylor series, Euler and modified Euler methods, Runge Kutta method of fourth order for solving first and second order differential equations, Multiple step methods- Milne and Adam's - Bash forth predictor and corrector methods.

UNIT 5 BOUNDARY VALUE PROBLEMS FOR ORDINARY AND PARTIAL DIFFERENTIAL EQUATION **9 Hrs**

Finite difference - solution of 2^{nd} order ODE - Finite difference solutions for two dimensional Laplace and Poisson equations, Finite difference solutions for one dimensional heat equation both implicit and explicit (Bender-Schmidt and Crank-Nicholson methods), Finite difference explicit method for one dimensional wave equation.

TEXT BOOKS

1. Sastry.SS "Introductory Numerical Methods" 5^{th} edition, PHI, 2012.
2. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 42^{nd} Edition, 2016.

3. Jain K.K. Iyengar, S.R.K and Jain, R.K. "Numerical Methods for Scientific and Engineering Computation" 4rd edition, 2005 .

REFERENCE BOOKS

1. Curtis F. Gerald. "Applied Numerical Analysis" 7th Edn. Pearson Education,
2. Dennis G. Zill and Warren S.Wright. "Advanced Engineering Mathematics", 3rd Edn. Jones & Bartlett Publishers, UK. 1992.
3. P.Kandasamy, K.Thilagavathy, K. Gunavathi - Numerical methods, S.Chand & Company, 2nd Edition 2010.

COURSE OUTCOMES (COs)	
CO1	Students will gain knowledge for solving equations by Newton-Raphson and Regula-Falsi methods and system of linear equations by various methods.
CO2	Students will be able to interpolate the value of a dependent variable in the given data by Newton's forward and backward difference formulae and also unequal intervals.
CO3	Understanding the concept of numerical differentiation and integration using Trapezoidal and Simpson's rules.
CO4	Be exposed Taylor's series and Runge-Kutta methods to solve initial value problems of ODE
CO5	Student will be able to solve two dimensional Laplace, Poisson equations and one dimensional heat and wave equations of PDE.

CO/PO Mapping

S – Strong, M – Medium, W – Weak

COs	**Students Outcomes (SOs)**											
	SO1	**SO2**	**SO3**	**SO4**	**SO5**	**SO6**	**SO7**	**SO8**	**SO9**	**SO10**	**SO11**	**SO12**
CO1	S	M			S		W	M	W	W	M	S
CO2	S	W		M	S	W		M			W	M
CO3	S		M		S		W		W		W	M
CO4	S	M			M				W			
CO5	S	M	S	M	M	W			M	W	M	
Category	Basic Science (BS)											
Approval	47th Academic Council, July 2018											

U18PCMT402	**DYNAMICS OF MACHINES**	**L**	**T**	**P**	**C**
	Total Contact Periods – 60	3	1	0	4
	Prerequisite – Engineering Mechanics				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the concept of dynamics of machines. To acquaint the student with various techniques involved in dynamics and various new technology in dynamics of machines.				

UNIT I FORCE ANALYSIS OF MECHANISMS 12

Static, Inertia and combined force analysis- Graphical and analytical method- Slider crank mechanism and four bar mechanism. Turning moment diagram and flywheel-Applications in engine, Punching presses.

UNIT II BALANCING 12

Static and dynamic balancing-Balancing of rotating masses- Balancing of several masses in different planes. Primary and secondary unbalanced forces of reciprocating parts-Balancing of in line engines- Firing order- Balancing of 'V' and 'W' engines.

UNIT III FREE VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEM 12

Fundamentals of vibrations-Undamped free vibrations of single d.o.f systems–Derivation & solution of differential equation-Torsional Vibrations-single rotor- Equivalent stiffness of spring combinations-Bifilar, Trifilar suspensions-Compound pendulum-Types of damping-Damped free vibrations of single d.o.f-over, critical, under damped- Damping coefficient - Critical damping coefficient-Logarithmic decrement

UNIT IV FORCED VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS 12

Forced vibrations with-Constant harmonic excitation-Rotating & Reciprocating unbalance-Excitation of the support-Energy dissipated by damping-Forced vibrations with coulomb, viscous damping-Vibration Isolation and Transmissibility- Vibration Absorbers

UNIT V CRITICAL SPEEDS AND SHAFTS WITH ROTORS 12

Lateral vibration of beams - Whirling speed of shaft - Shafts with two & three rotors-Geared system. Dunkerly's method for different types of beams & shaft with several loads.

TEXTBOOKS

1. S.S.Rattan-Theory of Machines- Tata McGraw Hill(4th Edition), 2014.
2. Singh.V.P. Mechanical Vibrations-Dhanpatrai & co (p) Ltd(4th edition), 2010

REFERENCES

1. Rao.J.S. and Dukkipatti, Mechanism and Machines Theory, 2nd Edition-Wiley Eastern Ltd, 2007.
2. Balaguru.S. Dynamics of Machinery, Sci Tech Publications (India) Pvt Ltd, 2011.
3. Grover.G.K. Mechanical Vibrations- Nemchand & Bros.(8th Edition), 2012
4. https://books.google.co.in/books?isbn=1259051285.

COURSE OUTCOMES (COs)	
CO1	To learn the concept about force analysis for mechanism.
CO2	To understand the various methods of balancing in different situation.
CO3	To learn the Concept about free vibration of single degree of freedom.
CO4	To study the Concept about forced vibration of single degree of freedom.
CO5	To learn the lateral vibration of beam
CO6	To learn the concept about critical speed of rotating shaft
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low	

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M			M			L				
	CO2	H											H
	CO3		M						L				
	CO4		M			M							M
	CO5	H	M	M					L				
	CO6	H				M							H
3	Category	Professional Core (PC)											
4	Approval	47th Academic Council, July 2018											

U18PCMT403	**MANUFACTURING TECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite –Nil				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To Understand the various concept of manufacturing technology to produce new product and to acquaint the student with various manufacturing technologies used in production engineering.				

UNIT I FOUNDRY TECHNOLOGY 9

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

UNIT II FORMING– PROCESSES 9

Hot and Cold Working

Rolling: Introduction – Rolling Mills – Rolling Operations – Production of Seamless Tubing and Pipe.

Forging : Introduction – Related Forging Operations – Drop forging

Extrusion and Drawing: Extrusion Practice – Hot, Cold, Impact and Hydrostatic extrusion. Drawing Process – Defects and Residual Stresses – Drawing Equipment. Sheet metal operations – Blanking, Punching and Piercing.

UNIT III MATERIAL – REMOVAL PROCESSES 9

Lathes and Lathe Operations, Drilling and Drilling Machines, Reaming and Reamers, Tapping and Taps – Tool nomenclature, cutting speed, feed, machining Time calculations.

UNIT IV MATERIAL – REMOVAL PROCESSES 9

Milling Machines and Operations, Planning and Shaping, Broaching, Gear Hobbing and Shaping.

Grinding Process – Abrasives – Finishing Operations – Lapping, Honing Powder coating.

UNIT V PRINCIPLES & APPLICATIONS OF JOINING PROCESSES 9

Gas welding, Basic Arc Welding Processes, Thermit Welding, Electron – Beam Welding, Laser – Beam Welding. Solid State Welding: Cold Welding, Ultrasonic Welding, Friction Welding,

Resistance Welding and Explosive Welding. Principles and applications of Brazing and Soldering.

TEXTBOOKS

1. KALPAKJIAN, S., "Manufacturing Engineering and Technology", Pearson education India, 7th edition, 2015 (**SBN-13:** 978-9814514828)

REFERENCES

1. Hajra Choudhury, S.K., and Haqjra Choudhury, A.K., "Elements of Workshop Technology", Volume I and II, Media Promoters and Publishers Private Limited, Mumbai, 2010.
2. Paul Degarma E, Black J.T. and Ronald A. Kosher, Eighth edition, Materials and Processes in Manufacturing Prentice – Hall of India, 2011.
3. Sharma P.C. A Textbook of Production Technology, S. Chand and Co., Ltd., 2007.
4. https://books.google.co.in/books?isbn=8185099154, 1118163737, 8121911141.

COURSE OUTCOMES (COs)													
CO1	To learn different types of foundry technology												
CO2	To understand the different types of forming– processes												
CO3	To learn the material removal processes and machine (i.e. lathe)												
CO4	To learn the material removal processes and machine **(**i.e. milling**)**												
CO5	To learn the principles & applications of joining processes.												
CO6	To Understand Principles and applications of Brazing and Soldering.												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M			H	H							H
	CO2					H							
	CO3		M		H	H							H
	CO4				M	H							
	CO5					H							H
	CO6	M			M	H							
3	Category	Professional Core (PC)											
4	Approval	47th Academic Council, July 2018											

U18PCMT404	**POWER ELECTRONICS**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite –Fundamentals of Electronics Circuits and Devices				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To get an overview of different types of power semi-conductor devices and to understand parameters of controlled rectifiers, inverters, AC voltage controller and cycloconverters.				

UNIT I POWER SEMI CONDUCTOR DEVICES 9

Principle of operation – Characteristics of power diodes, SCR, TRIAC, GTO, Power BJT, Power MOSFET and IGBT – Thyristor protection circuits.

UNIT II PHASE CONTROLLED CONVERTERS 9

Single phase full converters, 3 phase half converter and 3 phase full converter – inverter operation – input power factor – effect of source inductance – Thyristor triggering circuits.

UNIT III DC TO DC CHOPPERS 9

DC Chopper – Principle of operation – step up and step down chopper – Forced commutation – different techniques – voltage, current and load – commutated choppers – step up and step down chopper.

UNIT IV INVERTERS 9

Voltage source inverters – series, parallel and bridge inverters – PWM inverters – current source inverters.

UNIT V AC VOLTAGE CONTROLLERS AND CYCLOCONVERTERS 9

Single phase AC voltage controller – multistage sequence control – step up and step down cycloconverters – three phase to single phase and three phase cycloconverters.

TEXTBOOKS

1. Rashid, M.H., "Power Electronics – Circuits Devices and Application" Prentice Hall International, New Delhi, 3rd Edition, 2011.

REFERENCES

1. Lander, W., "Power Electronics" McGraw-Hill and Company, 4th Edition, 2009.
2. Singh, M.D., Khanchandani, K.B., "Power Electronics", Tata McGraw-Hill, 2008.
3. Dubey, G.K., Doradia, S.R., Joshi, A. and Singh, R.M., "Thyristorised Power Controllers", Wiley Eastern Limited, 2005.
4. Joseph Vithayathil, "Power Electronics – Principle and Applications", and Robbins, "Power Electronics", McGraw-Hill Inc, New York, 2006.
5. Mohan Undeland and Robbins, "Power Electronics", John Wilry and Sons, New York, 2011.

COURSE OUTCOMES (COs)	
CO1	To learn different types of power semi-conductor devices and their characteristics.
CO2	To understand the operation, characteristics and performance parameters of controlled rectifiers
CO3	To study the operation, switching techniques and basic topologies of DC-DC converters.
CO4	To learn the operation of different types of inverters like VSI, CSI, PWM Inverters, Series inverter and parallel inverter.
CO5	To study the operation of AC voltage controller and cycloconverters.
CO6	To study the Principle of operation step up and step down chopper

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l

2	CO1	H	H	M	H	L			H	H			H
	CO2	H	H	H	H	H			H	H			H
	CO3	H	H	H	H	H			H	H			H
	CO4	H	H	L	H	M			H	H			M
	CO5	M	M	H	H	H			H	H			M
	CO6	H	H	H	H	H			H	H			H
3	Category	Professional Core (PC)											
4	Approval	47th Meeting of Academic Council, May, 2018											

U18PCMT405	**CONTROL SYSTEMS**	**L**	**T**	**P**	**C**
	Total Contact Periods – 60	3	1	0	4
	Prerequisite – Engg Mathematics-I, Engg Mathematics -II, Basic Electrical & Electronics Engineering				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To provide an introduction to the analysis of linear control systems. This will permit to exploit time domain and frequency domain tools.				

UNIT I SYSTEMS AND THEIR REPRESENTATION 9

Basic elements in control systems – open and closed loop systems Examples – Mathematical model, Translational & Rotational systems – transfer function – block diagram reduction techniques – signal flow graph.

UNIT II TIME RESPONSE 9

Time response – time domain specifications – types of test inputs – I and II order system response – error coefficients – generalized error series – steady state error – P, PI, PD, PID Controller characteristics.

UNIT III FREQUENCY RESPONSE ANALYSIS AND DESIGN 9

Performance specifications – correlation to time domain specifications – Bode plots and polar plots – gain and phase margin – constant M and N circles and Nichols chart – all pass and non-minimum phase systems.

UNIT IV STABILITY OF CONTROL SYSTEMS 9

Characteristic equation – location of roots in s-plane for stability – Routh Hurwitz criterion – root locus techniques – construction – gain margin and phase margin – Nyquist stability criterion.

UNIT V COMPENSATION DESIGN 9

Design concepts – realization of basis compensation – cascade compensation in time domain and frequency domain (simple MATLAB applications to analysis and compensators design problems.)

TEXTBOOKS:

1. M. Gopal, "*Control Systems: Principles and Design*", 3rd Edition, McGraw, Hill, 2014.

REFERENCE:

1. Katsuhiko Ogata, "Modern Control Engineering" 5th Edition, Prentice Hall of India Private Ltd., New Delhi, 2012.
2. ChesmondC.J. "Basic Control System Technology", Viva Low Priced Student Edition, 2012.
3. Datton K., Banaclough W. and Thompson S., "The Art of Control Engineering", Addison Wesley 2005.
4. R.C. Dorf and R.H. Bishop, "Modern Control Systems", 12th Edition, Prentice, Hall, 2010.
5. Leonard N.E. and William Levine, "Using MATLAB to Analyze and Design Control Systems", Addision Wesley (2nd edition), 2006.
6. http//www.controlsys.com

COURSE OUTCOMES (COs)													
CO1	To learn the concept of System and their representation.												
CO2	To understand the Concept of time response analysis.												
CO3	To learn the Concept of frequency response analysis.												
CO4	To study the various methods for stability of the systems.												
CO5	To learn the various types of compensation techniques.												
CO6	To Understand Transient response analysis, Root locus, Bode diagrams, Nyquist plots with MATLAB												
Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H			M							
	CO2	H	H	L		M							
	CO3	H	H		L	M							
	CO4	H	H			M							
	CO5	H	H			M							
	CO6	H	H			M							
3	Category	Professional Core (PC)											
4	Approval	47th Academic Council, July 2018											

U18PCMT406	**TRANSDUCER ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Periods – 45	3	0	0	3
	Prerequisite – Measurement and instrumentation				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To improve the ability to model and analyze transducers.				

UNIT I SCIENCE OF MEASUREMENTS AND CLASSIFICATION OF TRANSDUCERS 9

Units and standards – Calibration methods – Static calibration – Classification of errors :- Limiting error and probable error – Error analysis :– Statistical methods – Odds and uncertainty – Classification of transducers – Selection of transducers.

UNIT II CHARACTERISTICS OF TRANSDUCERS 9

Static characteristics: – Accuracy, precision, resolution, sensitivity, linearity, span and range -

Dynamic characteristics: – Mathematical model of transducer – Zero, I and II order transducers – Response to impulse, step, ramp and sinusoidal inputs.

UNIT III VARIABLE RESISTANCE TRANSDUCERS 9

Principle of operation, construction details, characteristics and applications of potentiometer, strain gauge, resistance thermometer, Thermistor, hot-wire anemometer, piezoresistive sensor and humidity sensor.

UNIT IV VARIABLE INDUCTANCE AND VARIABLE CAPACITANCE TRANSDUCERS 9

Induction potentiometer – Variable reluctance transducers – EI pick up – Principle of operation, construction details, characteristics and applications of LVDT –Capacitive transducer and types – Capacitor microphone – Frequency response.

UNIT V OTHER TRANSDUCERS 9

Piezoelectric transducer – Hall Effect transducer – Magneto elastic sensor- Digital transducers – Smart sensors – Fibre optic sensors- Film sensors-Introduction to MEMS and Nano sensors.

TEXT BOOKS

1. D. Patranabis, Sensors and Transducers, 2nd edition, Prentice Hall of India, 2010. E.A.

REFERENCES

1. John P. Bentley, Principles of Measurement Systems, III Edition, Pearson Education, 2000.
2. Murthy, D.V.S., Transducers and Instrumentation, 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
3. S.Vijayachitra,"Transducer Engineering",PHI Learning Private Limited,2016
4. Clarence W.de Silva,"Sensors and Actuators:Engineering System Instrumentation,2nd Edition,CRC Press,2015
5. BelaG.Liptak, Instrument Engineers' Handbook, Process Measurement and Analysis, 4th Edition, Vol. 1, ISA/CRC Press, 2003.
6. Ian Sinclair, Sensors and Transducers, 3rd Edition, Elsevier, 2012.
7. Neubert H.K.P., Instrument Transducers – An Introduction to their Performance and Design, Oxford University Press, Cambridge, 2003.
8. Doebelin E.O. and Manik D.N., Measurement Systems – Applications and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.

COURSE OUTCOMES (COs)	
CO1	To understand how physical quantities are measured
CO2	To learn the basics of calculating errors.
CO3	To have an adequate knowledge in resistance, transducers.
CO4	To develop the knowledge of inductance and capacitance transducers.
CO5	To study the characteristics of Transducers.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	H			M							
	CO2	H	H	L		M							
	CO3	H	H		L	M							

	CO4	H	H			M							
	CO5	H	H			M							
3	Category	Professional Core (PC)											
4	Approval	47th Academic Council, July 2018											

U18MCTH 401	CONSTITUTION OF INDIA	L	T	P	C
	Total Contact Hours - 45	2	0	0	0
	Prerequisite – Professional Courses				
	Course Coordinator Name & Department:- Department of Management studies				

OBJECTIVES

To know about Indian constitution. To know about central and state government functionalities in India. To know about Indian society.

COURSE OUTCOMES (COs)

CO1	To understand the historical background and fundamental rights
CO2	To understand the structure and functions of governments
CO3	To understand the Indian social structure
CO4	To gain knowledge in Indian federal system
CO5	To gain knowledge Indian social structure
CO6	To gain knowledge the right of women, children and SC&ST

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) **3 – Strong, 2 – Medium, 1 – Weak**

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	1		3									
	CO2					3			2	1			
	CO3	1					3			1			
	CO4							2		1			
	CO5	1					2		2				
	CO6												

	Category	Mandatory Course
4	Approval	47th Academic Council, July 2018

UNIT I **9**

Historical Background – Constituent Assembly of India – Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens.

UNIT II **9**

Union Government – Structures of the Union Government and Functions – President – Vice President – Prime Minister – Cabinet – Parliament – Supreme Court of India – Judicial Review.

UNIT III **9**

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.

UNIT IV **9**

Indian Federal System – Center – State Relations – President's Rule – Constitutional Amendments – Constitutional Functionaries - Assessment of working of the Parliamentary System in India.

UNIT V **9**

Society : Nature, Meaning and definition; Indian Social Structure; Castle, Religion, Language in India; Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections.

TEXT BOOKS:

1. Agarwal R.C., " (1997) Indian Political System ", S.Chand and Company, New Delhi.
2. Durga Das Basu, " Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.

REFERENCES:

1. Gahai U.R, "(1998) Indian Political System ", New Academic Publishing House, Jalaendhar.
2. Maciver and Page, "Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.
3. Sharma K.L, " (1997) Social Stratification in India: Issues and Themes ", Jawaharlal Nehru University, New Delhi.

4. Sharma R.N., "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.
5. Sharma, Brij Kishore, "Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
6. Yogendra Singh, "(1997) Social Stratification and Charge in India ", Manohar, New Delhi
7. www.cgsird.gov.in/**constitution**

U18PCMT4L1	MACHINE DYNAMICS LAB	L	T	P	C
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Nil				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To learn about Governors /CAM, Motorized Gyroscope and Vibrating system Spring mass.				

LIST OF EXPERIMENTS

1. Governors - Determination of sensitivity, effort, etc. for watt, porter, proell, Hartnell governors
2. Cam - Study of jump phenomenon and drawing profile of the cam.
3. Motorized Gyroscope-Verification of law's -Determination of gyroscopic couple.
4. Whirling of shaft-Determination of critical speed of shaft with concentrated loads.
5. Balancing of reciprocating masses.
6. Balancing of rotating masses.
7. Determination of Moment of inertia by oscillation method for connecting rod and flywheel.
8. Vibrating system Spring mass-system-Determination of damping co-efficient of single degree of freedom system.
9. Determination of influence co-efficient for multi degree freedom suspension system.
10. Determination of transmissibility ratio - vibrating table.
11. Determination of tensional frequencies for compound pendulum and flywheel -system with lumped Moment of inertia
12. Transverse vibration –free- Beam. Determination of natural frequency and deflection of beam.

LIST OF EQUIPMENT (for a batch of 30 students)

1. Cam analyzer. - 1 No
2. Motorized gyroscope. - 1 No.
3. Governor apparatus - watt, porter, proell and hartnell governors. - 1 No.
4. Whirling of shaft apparatus. - 1 No.
5. Dynamic balancing machine. - 1 No.
6. Static and dynamic balancing machine. - 1 No.
7. Vibration test facilities apparatus - 1 No.

COURSE OUTCOMES (COs)	
CO1	To learn&Pratices about Governors /CAM
CO2	To Learn &Practice The Experiments Like Gyroscope

CO3	To Learn &Practice The Experiments Like Vibrating System Mass.
CO4	To Learn &Practice The Experiments Like Determination of Moment of inertia
CO5	To know the concepts of electrical actuator

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k
2	CO1			M			H			H	H	
	CO2			M			H			H	H	
	CO3			M			H			H	H	
	CO4			M			H			H	H	
	CO5											
3	Category	Professional Core(PC)										
4	Approval	47th Meeting of Academic Council, July, 2018										

U18PCMT4L2	**SENSOR AND INSTRUMENTATION LAB**	**L**	**T**	**P**	**C**
	Total Contact Periods – 30	0	0	2	1
	Prerequisite – Electronic Circuits and Devices - Lab				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the concept of various instrument involved in industry with various practical concepts in instrumentation and control and to introduce the various advanced technology in controlling technique.				

LIST OF EXPERIMENTS

1. PRESSURE MEASUREMENT AND CONTROL
   Pressure measuring devices – Pressure and vacuum gauge calibration.
2. TEMPERATURE MEASUREMENT AND CONTROL
   Temperature measuring devices like platinum resistance thermometer, thermocouple etc
3. SPEED MEASUREMENT AND CONTROL
   Studying the devices and characters and measuring the speed using tachometer, stroboscope, etc.
4. FORCE MEASUREMENT
   Force measuring devices, load cells and proving rings.
5. TORQUE MEASUREMENT
   Torque measurement –using torque measuring devices.
6. POSITION MEASUREMENT
   Position and velocity measurement using encoders,linear scales
7. STRAIN MEASUREMENT
   Study and use of strain – strain gauge indicator.
8. DISPLACEMENT MEASUREMENT
   LVDT-Displacement and velocity measurement using encoders.
9. Analog to Digital Converters

10. Study on the application of data acquisition system for industrial purposes.

COURSE OUTCOMES (COs)	
CO1	To learn the practical experiments about pressure measurement and control
CO2	To understand the practical experiments about force and torque measurement
CO3	To learn the practical experiments about temperature measurement and control
CO4	To learn the practical experiments about speed measurement and control
CO5	To learn the practical experiments about application of data acquisition system for industrial purposes

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/SOs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1		M	H	M	H							
	CO2			H	M	H							
	CO3	L			M	H							
	CO4		M	H	M	H							
	CO5	L	M		M	H							
3	Category	Professional Core (PC)											
4	Approval	47th Academic Council, July 2018											

U18EEMT4L3	**TECHNICAL SEMINAR**	**L**	**T**	**P**	**C**
	Total Contact Hours -15	0	0	2	1
	Prerequisite – Basic English knowledge				
	Course Designed by –Department of Mechatronics				
OBJECTIVES	To improve the communication skills of the students				

During the Seminar session each student is expected to prepare and present a topic on engineering/ technology, for duration of about 8 to 10 minutes. In a session of three periods per week, 15 students are expected to present the seminar. A faculty guide is to be allotted and he/she will guide and monitor the progress of the student and maintain attendance also.
Students are encouraged to use various teaching aids such as over head projectors, power point presentation and demonstrative models. This will enable them to gain confidence in facing the placement interviews.

COURSE OUTCOMES(CO_S)	
CO	To improve the communication skills of the students

	LITERATURE & MEDIA – LITERATURE ,CINEMA& MEDIA	**L**	**T**	**P**	**C**
U18MCAB407					

	Total Contact Hours - 30	0	0	2	0
	Prerequisite –				
	Course Designed by –				

The objective is to inculcate the habit of active (or interactive) consumption of the best content available in literature, films and media, rather than passive consumption. Description

Literature is perhaps as old as history or may be older and it is difficult to think of a fully educated person without any exposure to the best of the world literature (not just the literature of their own country or in their own language). Cinema is more recent and mass media is even more recent, but all these have a vital role in today's society. The problem is that the content available easily to most people (partly due to extensive promotion) caters to the lowest common denominator. Engineering students should be encouraged to read the best of the world literature and watch the best of the world cinema (regardless of their viewpoints). They should also be made aware that news is best collected from different sources, which don't necessarily agree, so that they can understand the true meaning of democracy and also learn to form educated opinions about various topics based on the information from diverse sources. They should learn that being opinionated without being properly informed (say, by relying only on one source of news on TV based on TRPs) is not the right way to be a good citizen. They should get the experience of their opinion being contradicted by the most reliable evidence, so that they realize that there is no shame in changing a wrong opinion in the light of overwhelming evidence. For that, they will also have to learn how to find out the degree of reliability of different sources. One way to achieve this is to conduct workshops where students, aided by invited experts, read news from different sources, watch the best cinema and read or watch different media sources. They can then discuss these with their peers and with the invited experts and learn to talk peacefully with people of different viewpoints, as well as learn to form their own opinions. They should then be encouraged to write about their takeaways from these discussions or their opinions and their reasons for forming those opinions. Such activities can counter the current culture of being 'trolls' on the social media, for example. Instead, we should have citizens who give due respect to their fellow citizens and learn to analyze, discuss and reach conclusions in an agreeable manner, without unnecessary feelings of bitterness and enmity.

Another related exercise could be to read or watch advertisements and then analyze them in terms of the biases they promote (such as the desirability of fair skin) or the deception they indulge in to psychologically compel consumers to buy things they don't really need. Some advertisements even promote the habit of treating fellow human beings with contempt for being different from them (even in terms of possessing the products they are promoting). A well-educated citizen should be less susceptible to such practices in advertisements. Advertisements are just one example. Something similar could be done with all kinds of propaganda material

U18MCAB408	**LITERATURE & MEDIA – GROUP READING OF CLASSICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0

	Prerequisite –
	Course Designed by –

This will make group to read one or two books during a semester.

Process: An hour may be fixed for a small group for a particular classic. Group sitsand each person reads aloud (if possible with proper modulation) taking turns. This if done properly for an hour one may complete 30-40 pages in an hour. A normal classic can be finished in 15 to 20 days. If serious books on philosophy etc. are taken up a discussion can be held after every idea is complete.

SEMESTER-V

U18PCMT501	MICRO CONTROLLER &PLC	**L**	**T**	**P**	**C**
	Total Contact Hours – 60	3	1	0	4
	Prerequisite – Nil				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the Architecture of 8051 and addressing modes. To get the knowledge about 8051 micro controller design, testing design and the applications of the PLC.				

UNIT I INTRODUCTION TO MICROCONTROLLER 12

8051 Architecture: Microcontroller Hardware – I/O Pins, Ports – External memory – Counters and Timers – Serial data I/O – Interrupts –Instruction set of 8051-Addressing modes- Data transfer instructions, Arithmetic and Logical Instructions, Jump and Call Instructions, interrupts.

UNIT II 8051 MICROCONTROLLER DESIGN 12

8051 Microcontroller Design: 8051 Microcontroller Specification 8051 – Microcontroller System Design – Testing the Design, Timing Subroutines, Look up Tables – Serial Data Transmission.

UNIT III INTERFACING AND APPLICATIONS 12 Stepper motor control-Keyboard interfacing-Alpha-Numeric display interfacing Devices –Analog to digital converter interfacing-Digital to analog converter interfacing- Interfacing of Electronic weighing bridge.

UNIT IV INTRODUCTION TO PLC 12 Programmable Logic Controllers: Introduction – Parts of PLC – Principles of operation – PLC sizes – PLC hardware components — PLC programming Simple instructions – Connecting PLC to computer interlocks and alarms -Latching relays PLC ladder diagram, Converting simple relay ladder diagram in to PLC relay ladder diagram.

UNIT V APPLICATIONS OF PLC 12

Timer instructions ON DELAY, OFF DELAY and RETENTIVE Timers, UP COUNTER, DOWN COUNTER and UP DOWN COUNTERS, control instructions – Data manipulating instructions, match instructions; Applications of PLC –case study of Tank level control system - Automatic lubrication of supplier Conveyor belt - Automatic control of warehouse door.

TEXTBOOKS:

1. Kennath J. Ayala.The 8051 Microcontroller Architecture, Programming and Applications, Penram International Publishing (India), 3rd Edition, Mumbai.

1. Microcontroller-Internals, Instructions, Programming & Interfacing by Subrata Ghoshal, Pearson.
2. David Calcutt, Frederick Cowan, and Hassan Parchizadeh," 8051 Microcontroller: An ApplicationsBased Introduction ".

3. FrankD.Petruzella."Programmable Logic Controllers", McGraw–HillBook, 1989.3rd Ed

REFERENCES

1. B.P. Singh, Microprocessors and Microcontrollers, Galcotia Publications (P) Ltd, 2nd Edition, New Delhi, 1997.

2. Embedded Controller Hand book, Intel Corporation, USA.

3. Microcontroller Hand Book, INTEL, 1984.

COURSE OUTCOMES (COs)	
CO1	To learn the Architecture of 8051 microcontroller.
CO2	To understand the 8051 micro controller design and testing design.
CO3	To learn the 8051 micro controller applications.
CO4	To learn the programmable logic controllers.
CO5	To learn the applications of the PLC.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1				L	H							
	CO2	M			M	H							
	CO3				L	H		M					
	CO4				L	H		M					
	CO5				M	H							
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

	CNC TECHNOLOGY	**L**	**T**	**P**	**C**

U18PCMT502	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Engineering Mechanics				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the CNC technology for to production of product sand to learn the student with various CNC technology used in production engineering. To introduce the industrial current trends in the production technology				

UNIT I FUNDAMENTALS OF CNC MACHINES 9

Introduction to Computer Numerical Control: CNC Systems – An Overview of Fundamental aspects of machine control, Different types of CNC machines – Advantages and disadvantages of CNC machines.

UNIT II CONSTRUCTIONAL FEATURES OF CNC MACHINES AND RETROFITTING 10

Features of CNC Machines: Structure, Drive Mechanism, gearbox, Main drive, feed drive, Spindle Motors, Axes motors. Timing belts and pulleys, Spindle bearing – Arrangement and installation. Slide ways. Re - circulating ball screws – Backlash measurement and compensation, linear motion guide ways. Tool magazines, ATC, APC, Chip conveyors.Retrofitting of Conventional Machine Tools: Modification to be carried out on conventional machines for retrofitting.

UNIT III CONTROL SYSTEMS, FEED BACK DEVICES AND TOOLING 10

Description of a simple CNC control system.Interpolation systems. Features available in a CNC system – introduction to some widely used CNC control systems. Types of measuring systems in CNC machines – Incremental and absolute rotary encoders, linear scale – resolver – Linear inductosyn – Magnetic Sensors for Spindle Orientation. Qualified and pre-set tooling – Principles of location – Principles of clamping – Work holding devices.

UNIT IV CNC PART PROGRAMMING 9

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

UNIT V ECONOMICS AND MAINTENANCE 7

Factors influencing selection of CNC Machines – Cost of operation of CNC Machines – Practical aspects of introducing CNC machines in industries – Maintenance features of CNC Machines – Preventive Maintenance, Other maintenance requirements.

TEXTBOOKS

1.YoremKoren, “Computer Control of Manufacturing Systems”, McGraw Hill, 2005.

REFERENCE

1. P Radhakrishnan., Computer Numerical Control Machines and Computer Aided Manufacture , New Age International Publishers, 2018.

2. GROOVER, M.P., Automation, Production Systems and Computer Integrated Manufacturing, Prentice Hall (4th Edition), 2015.
3. G.E.THYER, Computer Numerical Control of Machine Tools (2nd Edition),Butterworth-Heinemann Publisher, 2014.
4. MIKE MATTSON, "CNC Programming Cengage Learning, 2009.

COURSE OUTCOMES (COs)	
CO1	To introduce the fundamentals of CNC Technology.
CO2	To understand the constructional features and retrofitting of CNC machines.
CO3	To learn the types of controls system, various feedback devices and tooling.
CO4	To practice writing programs using G codes and M Codes.
CO5	To learn the economics and maintenance of CNC installation.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M			H	H						M	
	CO2					H			M	H		L	
	CO3		M		H	H							
	CO4				M	H			M				
	CO5					H				H		L	
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18HSBA501	**ORGANIZATIONAL BEHAVIOUR**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Management Studies				
OBJECTIVES	To provide an overview of theories and practices in organizational behavior in individual, group and organizational level				

Module I Focus and Purpose 5 Hours

Definition, need and importance of organizational behavior – Nature and scope – Frame work – Organizational behavior models.

Module II Individual Behavior 12 Hours

Personality – types – Factors influencing personality – Theories – Learning – Types of learners – The learning process – Learning theories – Organizational behaviour modification. Misbehaviour – Types – Management Intervention. Emotions - Emotional Labour – Emotional Intelligence – Theories. Attitudes – Characteristics – Components – Formation – Measurement Values. Perceptions – Importance – Factors influencing perception – Interpersonal perception Impression Management. Motivation – Importance – Types – Effects on work behavior.

Module III Group behavior 10 Hours

Organization structure – Formation – Groups in organizations – Influence – Group dynamics – Emergence of informal leaders and working norms – Group decision making techniques – Team building - Interpersonal relations – Communication – Control.

Module IV Leadership and Power 8 Hours

Meaning – Importance – Leadership styles – Theories – Leaders Vs Managers – Sources of power – Power centers – Power and Politics.

Module V Dynamics of Organizational Behaviour 10 Hours

Organizational culture and climate – Factors affecting organizational climate – Importance. Job satisfaction – Determinants – Measurements – Influence on behavior. Organizational change – Importance – Stability Vs Change – Proactive Vs Reaction change – the change process – Resistance to change – Managing change. Stress – Work Stressors – Prevention and Management of stress – Balancing work and Life. Organizational development – Characteristics – objectives –. Organizational effectiveness Developing Gender sensitive workplace

REFERENCES

1. Mc Shane & Von Glinov, Organisational Behaviour, 4th Edition, Tata Mc Graw Hill, 2007.
2. Nelson, Quick, Khandelwal. ORGB – An innovative approach to learning and teaching. Cengage learning. 2nd edition. 2012
3. Ivancevich, Konopaske&Maheson, Oranisational Behaviour& Management, 7th edition, Tata McGraw Hill, 2008.
4. UdaiPareek, Understanding Organisational Behaviour, 3rd Edition, Oxford Higher Education, 2011. 5. Jerald Greenberg, Behaviour in Organization, PHI Learning. 10th edition.

COURSE OUTCOMES (COs)	
CO1	Understanding the concepts of Management. They will know the framework for managing individual and group performance.
CO2	Students will have a better understanding of human behavior in organization.
CO3	In-Department h Understanding about the concepts of Group Behavior
CO4	Understanding the Organization Theory & Approach.
CO5	Students will have a better understanding of organizational behavior

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l

2	CO1	H					H					H	
	CO2		H		M					H			
	CO3	M							M		H		
	CO4			M	H							H	
	CO5							M					
3	Category	Basic Science(BS)											
4	Approval	47 th Meeting of Academic Council, May,2018											

U18PCMT503	**INTEGRATED CIRCUITS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Fundamentals of Electronic Devices and Circuits				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the concept of Integrated Circuits and Various new technology in Integrated Circuits. To acquaint the student with various concepts used in integrated circuits				

UNIT I CHARACTERISTICS OF OPAMP & ITS FUNDAMENTALS 9

Ideal OP-AMP characteristics, DC characteristics, AC characteristics, offset voltage and current: voltage series feedback and shunt feedback amplifiers, differential amplifier; frequency response of OP-AMP; Basic applications of opamp - summer, differentiator and integrator, V/I &I/V converter.

UNIT II APPLICATIONS OF OPAMP 9

Sign Changer, Scale Changer, Phase Shift Circuits, Logarithmic amplifier, Precision rectifier, Instrumentation amplifier, Comparators, multivibrators, Schmitt trigger, waveform generators, clippers, clampers, peak detector, S/H circuit, First and Second order active filters, Low-pass, high-pass and band-pass Butterworth filters

UNIT III ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS 9

Analog and Digital Data Conversions, D/A converter – specifications – weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications – Flash type – Successive Approximation type – Single Slope type – Dual Slope type – A/D Converter using Voltage-to- Time Conversion – Over-sampling A/D Converters.

UNIT IV SPECIAL ICs & VOLTAGE REGULATORS 9

555 Timer circuit - Functional block, characteristics & applications; 566-voltage controlled oscillator circuit, OP-Amp Voltage regulator-Series, Shunt and switching regulator.

UNIT V ANALOG MULTIPLIER AND PLL 9

Analog Multiplier using Emitter Coupled Transistor Pair – Gilbert Multiplier cell – Variable trans conductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing.

TEXT BOOKS

1. RamakantAGayakward, "Op-amps and Linear Integrated Circuits", IV edition, Pearson Education/ PHI 2003.
2. Roy Choudhary.D, SheilBJani, "Linear Integrated Circuits", II edition, New Age, 2003.
3. Morris Mano.M, "Digital Logic and Computer Design" Published byDelhi Pearson,2009.
4. Robert FCoughlin, Fredrick F.Driscoll, "Op-amp and Linear ICs", Pearson Education, 4th edition, / PHI 2002.
5. https://zawequbipy.files.wordpress.com

REFERENCES

1. David A.Bell, "Op-amp & Linear ICs", Prentice Hall of India, 4th edition,2002.
2. Charles H.Roth, "Fundamentals Logic Design", Jaico Publishing, 6th edition, 2006.

Floyd, "Digital Fundamentals", 10th edition, Pearson Education, 2008

COURSE OUTCOMES (COs)	
CO1	To learn the characteristics of op-amp & its fundamentals.
CO2	To understand the various application of op-amp.
CO3	To learn the various types of digital to analog and analog to digital converters.
CO4	To learn the concept of Special IC's and Voltage regulator.
CO5	To learn the concept of phase logged loop and function generator.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	L			H							
	CO2	H	L			H		L					
	CO3	H	L			H							
	CO4	H	L			H							
	CO5	H	L			H							
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

U18PCMT5L1	MICRO CONTROLLER &PLC LAB	L	T	P	C
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Nil				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the programming concepts in 8051 Microcontroller and interfacing of Electronics Devices to it .				

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

1. Study of Microcontroller Kits.
2. 8051 / 8031 Programming Exercises.
3. Stepper Motor interface.
4. D.C. motor controller interface.
5. Study of interrupt structure of 8051.
6. Interfacing high power devices to microcomputer port lines, LED relays and LCD displays.
7. Linear actuation of hydraulic cylinder with counter and speed control.
8. Hydraulic rotation with timer and speed control.
9. Sequential operation of pneumatic cylinders.
10. Traffic light controller.
11. Speed control of DC motor using PLC.
12. Testing of Relays using PLC.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

S.No	Equipments	Qty
1	Regulated power supply	7
2	Pulse generator	1
3	Function generator	5
4	Cathode ray osilloscope	5
5	8051 MicroController Kit	5
6	stepper Motor	2
7	stepper motor interfacing board	2
8	PLC trainer kit and related software	2
9	Hudraulic cylinder	1
10	Pneumatic cylinder	1
11	LED/LCD interface units	1
12	SCR/Triac/Power MOSFET interface unit	1

COURSE OUTCOMES (COs)	
CO1	To learn the basic programming of 8051 microcontroller.
CO2	To understand the 8051 micro controller interface Programming Exercises.
CO3	To learn the 8051 micro controller applications.
CO4	To learn the ladder programming in PLC

CO5	To learn the sequential operation in pneumatic cylinders

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1				M	H							
	CO2	M			M	H		M			L		
	CO3				M	H			H				
	CO4				M	H		M					
	CO5				M	H					L		
3	Category	Professional Core(PC)											
4	Approval	47 th Meeting of Academic Council, May,2018											

U18PCMT5L2	**CNC LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours -30	0	0	2	1
	Prerequisite – Basic Mechanical engineering				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To teach part programming in the CNC machines and produce various shapes CNC machine.				

LIST OF EXPERIMENTS

1. Manual part programming using G and M codes for Turning, step turning, Taper turning, thread cutting and radius turning on cylindrical components.
2. Programming and Simulation of machining using the following features.
   a. Linear and Circular interpolation
   b. Pocket milling, slotting, peck drilling and other fixed canned cycles.
3. Given a component drawing to write the manual part programming and execute on CNC Lathe and Milling Machine.

LIST OF EQUIPMENT (for a batch of 30 students)

1. CNC Lathe with Fanuc controller - 1 No.
2. CNC Milling Machine with Fanuc controller- 1 No.
3. Master CAM software - 15 Licenses
4. Computer nodes - 15 Nos

COURSE OUTCOMES (COs)	
CO1	To explain the concept of metrology and measurement and various terms used in the metrology
CO2	To practices on programming and simulation of machining
CO3	To practices on Linear and Circular interpolation

CO4	To practices on Pocket milling, slotting, peck drilling and other fixed canned cycles
CO5	

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			H	M								
	CO2			H	M								
	CO3			H	M	L							
	CO4			H	M								
	CO5												
3	Category	Professional Core(PC)											
4	Approval	47 th Meeting of Academic Council, May,2018											

U18MCAB509	**SOCIAL SERVICES – SOCIAL AWARENESS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite – Nil				
	Course Designed by – AICTE				

Social awareness (Artisans-relates to engg., visit to hospitals, orphanages, policestation, courts, trauma centers, consumer forums)

Human beings live in relationship with their family members and with others in the society. As a society, mankind strives to achieve ordered and organized life through which an environment of cooperation and coexistence is expected. A healthy society creating an environment of fearlessness is a key for the mankind to achieve higher goals because it is society which makes us most human, most complete as people.

Although as a society, our expectation is fearlessness, but due to lack of understanding of our role in a society, we fail to fulfill the expectation. The social awareness activity shall promote an understanding and sharing of issues of societal problem through exposure to variety of artisans

and different kind of organizations. It is expected that this exposure will enable the learners to appreciate social issues, problems and challenges.

Each institution will offer a range of introductory activity based courses focusing on local artisans related to engineering so that students are sensitized to appreciate their problems and can take up some of the problems to solve while they do their regular studies. This course shall also include visits to visit to hospitals, orphanages, police station, courts, trauma centers, consumer forums so that they get exposed to different facets of societal problems. Care should be taken to give adequate representation to local and regional organizations and artisans. For example, Banaras has local traditions in *BanarasiSaari*, Toy making, etc and has almost all types of organizations. An institution in Banaras area can offer courses on these artisans. This will, in turn, also ensure wider community involvement/interaction with the institution. At the end of the course/semester, a student should be able to identify a social issue, prepare project report and give presentation on the selected issues. Contact hours per week should be 3 -4 hours. Towards the end of the course, the institution can organize an exhibition in which all the students publicly demonstrate findings of their reports and their future plan of action.

U18MCAB510	**SOCIAL SERVICES – NSS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite – Nil				
	Course Designed by – AICTE				

Social Service (teach in neighborhood, adopt an underprivileged school, village stay / visit (NSS), cleanliness drive, and skill transfer**)**

SEMESTER-VI

U18BSMA601	**Operations Research For Engineers (common to B.Tech - Mech, Mechatronics & Automobile)**	**L**	**T**	**P**	**C**
	Total Contact periods: 45	**3**	**0**	**0**	**3**
	Prerequisite – Engineering Mathematics I & II and statistics				
	Course Designed by Department of Mathematics				

OBJECTIVES	To provide the student with the concept and an understanding of basic concepts in Linear Programming techniques, Duality Principles, Transportation and Assignment problems, Inventory models, PERT/CPM, Queuing and Replacement Models.

UNIT I LINEAR PROGRAMMING
9 Hrs

Introduction to phases of an Operations Research study– Linear programming – Formulation of the Programming – Graphical method – Simplex method – Dual simplex method-Two phase method.

UNIT II TRANSPORTATION &ASSIGNMENT PROBLEMS
9 Hrs

Transportation models – Vogel's approximation method MODI method – Unbalanced transportation problem – Degeneracy in transportation models - Assignment problems – Hungarian method

UNIT III NETWORKS & REPLACEMENT MODELS
9 Hrs Networks – PERT and CPM – Network diagrams – Shortest route – Minimum spanning tree, Replacement models– Individual and Group replacement policy

UNIT IV INVENTORY MODELS 9 Hrs

Inventory models – Deterministic models – Production models – Economic Ordering Quantity Models – Quantity Discount Model – Multi Product Models – Inventory Control Models in practice.

UNIT V QUEUEING MODELS & RESOURCE SCHEDULING
9 Hrs

Queuing theory – Queuing system and structure – Kendal's notation– Poisson arrival and Exponential service time – Characteristic of queuing models – Single channel and multiple models. Resource scheduling – Sequencing of n- jobs through 2 machines and 3 machines.

TEXT BOOKS

1. Gupta and Hira D.S " Operations Research", S. Chand & Co, New Delhi, 2006
2. H. A. Taha, "Operations Research", Prentice Hall of India, 2002, Seventh Edition 2007.

REFERENCE BOOKS

1. Kanti Swarup, Gupta P.K., and Manmohan, "Operations Research", Sultan Chand & Sons 1997. Paneerselvam R., Operations research, Prentice-Hall of India, New Delhi, 2001.
2. T. Veerarajan, "Operations Research", Published by Orient Black Swan, 2010.

COURSE OUTCOMES (COs)	
CO1	To Explain the basic concepts of optimization and to formulate and solve linear programming problems, Apply duality principle in day to day life style.
CO2	Apply the concepts of Transportation Problem and Assignment Problem, Participate in the class room discussion on Transportation algorithm.
CO3	Explain and demonstrate the basic concepts of PERT- CPM and their application, reproduce the network model.

CO4	Explain the basic concepts of optimization and to formulate and solve inventory problems.
CO5	Explain and apply the concepts of Queueing theory, sequencing problem and their application.

CO/PO Mapping
S – Strong, M – Medium, W – Weak

COs	**Students Outcomes (SOs)**											
	SO 1	**SO2**	**SO 3**	**SO 4**	**SO5**	**SO6**	**SO7**	**SO8**	**SO9**	**SO10**	**SO11**	**SO12**
CO1	S	S		S			M	M			W	
CO2	S	S	M		M					W		
CO3	S	S		M	S	W						
CO4	S	S	S	M	W				W			
CO5	S						W	M	S			
Category	Basic Science (BS)											
Approval	47th Academic Council, July 2018											

U18PCMT601	**APPLIED HYDRAULICS &PNEUMATICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 60	3	1	0	4
	Prerequisite – Nil				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To learn about the basic concepts of fluid power systems and various application and its circuits.				

UNIT I FLUID POWER SYSTEMS AND FUNDAMENTALS 12

Introduction: Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids – Fluid power symbols.Basics of hydraulics – Applications of Pascal's Law-Laminar and turbulent flow – Reynolds's number-Darcy's equation – Losses in pipe, valves and fittings.

UNIT II HYDRAULIC SYSTEM AND COMPONENTS 12

Sources of Hydraulic Power: Pumping theory – Pump classification – Gear pump, Vane Pump, piston pump, construction and working of pumps – pump performance – Variable displacement pumps.

Fluid Power Actuators: Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting special cylinders like tandem, Rodless, Telescopic. Cushioning mechanism, Construction of double acting cylinder, Rotary actuators. Fluid motors, Gear, Vane and Piston motors.

UNIT III DESIGN OF HYDRAULIC CIRCUITS 12

Construction of Control Components: Directional control valve – 3/2 way valve – 4/2, 4/3 way valve – Shuttle valve – check valve – pressure control valve – pressure reducing valve sequence valve, Flow control valve – Fixed and adjustable, electrical control solenoid valves, Relays, ladder diagram.

Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier – Intensifier circuit

UNIT IV PNEUMATIC SYSTEMS & COMPONENTS 12

Pneumatic Components: Properties of air – Compressors – Filter, Regulator, and Lubricator Unit – Air control valves, Quick exhaust valves, Pneumatic actuators, Fluid Power Circuit Design-Speed control circuits, Synchronizing circuit, Electro Pneumatic circuit, Sequential circuit design for simple applications using cascade method.

UNIT V DESIGN OF PNEUMATIC CIRCUITS 12

Servo systems – Hydro Mechanical servo systems, Electro hydraulic servo systems and proportional valves,Fluidics – Introduction to fluidic devices, Simple circuits,PLC -Introduction, ladder diagrams, PLC applications in fluid power control, Fluid power circuits, failure and trouble shooting.

TEXT BOOKS

1. Anthony Esposito, "Fluid Power with Applications", Pearson New International Edition, 2014

REFERENCES

1. Andrew Parr,"Hydraulics and Pneumatics ,A Technicians and Engineers Guide",Elsevier Ltd,2011
2. Patrick J. Klette,"Fluid Power Systems",American Technical Publishers, Incorporated, 2014
3. James R. Daines"Fluid Power: Hydraulics and Pneumatics",G-WPublisher,2013
4. Peter Chapple"Principles of Hydraulic System Design"Momentum Press,2014
5. Ian C Turner,"Engineering Applications of Pneumatics and Hydraulics"Routledge,2011

COURSE OUTCOMES (COs)	
CO1	To introduce fundamentals of fluid power systems.
CO2	To learn various types and function of hydraulic components.
CO3	To design hydraulic circuits for simple practical applications.
CO4	To learn various types and function of pneumatic components.
CO5	To design pneumatic circuits for simple practical applications.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1					H							
	CO2	M			M	H							H
	CO3				M	H		H		L			
	CO4				M	H		H					M
	CO5				M	H		H					

3	Category	Professional Core(PC)
4	Approval	47th Academic Council, July 2018

U18PCMT6L1	**CAD/CAM LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – CNC Lab, Finite element Analysis, Computer Aided Machine				
	Course Designed by – Dept of Mechatronics				
OBJECTIVES	To impart knowledge about various software tools in CAD to design and model different products.				

LIST OF EXPERIMENTS

1. Solid modeling using Ideas / Pro Engineering / CATIA software of gives components / products such as (at least 3 components)
2. Analysis of engineering problems using FEA package (at least 3 problems)
3. Exercise in surface machining – Multi Axis Machining and software Development for manufacturing. (at least 3 jobs)
4. Computer assisted part programming using Master Computer Software for various internal and external curved surface machining.

LIST OF EQUIPMENT (FOR A BATCH OF 30 STUDENTS)

1. Any CAD software – 10 licenses
2. Any FEA software – 5 licenses
3. Any CAM software – 10 licenses

COURSE OUTCOMES (COs)	
CO1	To learn to design components like screw jack using Pro E
CO2	To learn to design components like Knuckle joint using Creo software
CO3	To learn to design products using Pro E &CATIA
CO4	To learn to analyze engineering problems using FEA package
CO5	To study about operations like drilling, boring in lathe using Precut software

Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l

2	CO1					H							H
	CO2	M			M	H							
	CO3				M	H		H		L			M
	CO4				M	H		H					
	CO5				M	H		H					
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18PCMT6L2	**HYDRAULICS &PNEUMATICS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite – Nil				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce design and testing hydraulic and pneumatic circuits. To learn the various control valves like flow, pressure, direction. To practice the simulation using given software.				

LIST OF EXPERIMENTS

1. **Design and testing of hydraulic circuits such as**
   - **ii)** Pressure control
   - **iii)** Flow control
   - **iv)** Direction control
   - **v)** Design of circuit with programmed logic sequence, using an optional PLC in hydraulic Electro hydraulic Trainer.
2. **Design and testing of pneumatic circuits such as**
   - **i)** Pressure control
   - **ii)** Flow control
   - **iii)** Direction control
   - **iv)** Circuits with logic controls
   - **v)** Circuits with timers
   - **vi)** Circuits with multiple cylinder sequences in Pneumatic Electro pneumatic Trainer.
3. Modeling and analysis of basic electrical, hydraulic, and pneumatic systems using **MATLAB/LABVIEW** software.
4. Simulation of basic hydraulic, pneumatic and electrical circuits using Automation studio software.

LIST OF EQUIPMENT(for a Batch of 30 students)

S.No	**Equipments**	*Qty*
	Hydraulic Equipments	
1	Pressure relief valve	4
2	Pressure reducing valves	2
3	Flow control valves	2
4	Pressure switch	1
5	Limit switches	2
6	Linear actuator	1
7	Rotary actuator	1
8	Double solenoid actuated DCV	2
	Single solenoid actuated DCV	1
9	Hydraulic power pack with 2 pumps & 2 pressure relief valve	1
10	PLC	1

S.No	**Pneumatics Equipment**	**Qty**
1	Pneumatic trainer kit with FRL Unit, Single acting cylinder, push buttons.	1
2	Pneumatic trainer kit with FRL unit, Double acting cylinder, manually actuated DCV.	1
3	Pneumatic training kit with FRL unit, Double acting cylinder, pilot actuated DCV.	1
4	Pneumatic trainer kit with FRL unit, Double acting cylinder, Double solenoid actuated DCV, DCV with sensors/ magnetic reed switches.	1
5	PLC with Interface card	1
6	LABVIEW Software& Automation studio software	

COURSE OUTCOMES (COs)	
CO1	To design and test the hydraulic circuits using various valves.
CO2	To design and test the pneumatics circuits using various valves.
CO3	To model and analysis of fluid power system using MATLAB/LABVIEW.
CO4	To simulate basic electric, hydraulic and pneumatic circuits.
CO5	To learn the practical experiments about pneumatics circuits.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/Pos	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1					H							
	CO2	M			M	H							
	CO3				M	H		H		L			
	CO4				M	H		H					
	CO5				M	H		H					

3	Category	Professional Core(PC)
4	Approval	47th Academic Council, July 2018

U18EEEA6L2	**SOFT SKILL LAB**		**L**	**T**	**P**	**C**
	Total Contact Hours –30		0	0	2	1
		Prerequisite – Communicative English				
		Course Designed by – Department of English				

OBJECTIVES	Develop their communicative competence in English with specific reference to speaking and listening

COURSE OUTCOMES (COs)		
CO1		Develop their communicative competence in English with specific reference to speaking and listening
CO2		Enhance their ability to communicate effectively and efficiently in interviews.
CO3		Strengthen their prospects of success in competitive examinations.
CO4		Work with peer group in a smooth manner.
CO5		Develop inter personal and intra personal skills
CO6		Develop their communicative competence in English with specific reference to speaking and listening

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1												
	CO2							H					
	CO3												
	CO4				H								
	CO5				M								
	CO6												
	Category	Humanity Science (HS)											
4	Approval	47th Academic Council, July 2018											

UNIT I LISTENING AND SPEAKING SKILLS 6 hours

Conversational skills (formal and informal)- group discussion- making effective presentations using computers, listening/watching interviews conversations, documentaries. Listening to lectures, discussions from TV/ Radio.

UNIT II READING AND WRITING SKILLS **6 hours**

Reading different genres of texts ranging from newspapers to creative writing. Writing job applications- cover letter- resume- emails- letters- memos- reports. Writing abstracts- summaries- interpreting visual texts.

UNIT III ENGLISH FOR NATIONAL AND INTERNATIONAL EXAMINATIONS AND PLACEMENTS 6 hours

International English Language Testing System (IELTS) - Test of English as a Foreign Language (TOEFL) - Civil Service(Language related)- Verbal Ability.

UNIT IV INTERVIEW SKILLS 6 hours

Different types of Interview format- answering questions- offering information- mock interviews-body language(paralinguistic features)- articulation of sounds- intonation.

UNIT V SOFT SKILLS 6 hours

Motivation- emotional intelligence-Multiple intelligences-managing changes-time management-stress management-leadership traits-team work- career planning -intercultural communication- creative and critical thinking

To be totally learner-centric with minimum teacher intervention as the course revolves around practice.

1. Suitable audio/video samples from YouTube to be used for illustrative purposes.
2. GD/Interview/Role Play/Debate could be conducted off the laboratory (in a regular classroom) but learners are to be exposed to telephonic interview and video conferencing.
3. Learners are to be assigned to read/write/listen/view materials outside the classroom as well for graining proficiency and better participation in the class.

REFERENCES:

1. Anderson, P.V, **Technical Communication**, Thomson Wadsworth , Sixth Edition, New Delhi, 2007.
2. Prakash, P, **Verbal and Non-Verbal Reasoning**, Macmillan India Ltd., Second Edition, New Delhi, 2004.
3. John Seely, **The Oxford Guide to Writing and Speaking**, Oxford University Press, New Delhi, 2013.
4. Evans, D, **Decision maker**, Cambridge University Press, 2010.

U18EEMT6L3	**SUMMER INERNSHIP**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	2	0	2	0
	Prerequisite –				
	Course Designed by –				

Industrial / Practical Training / Internship / Mini Project

The Industrial / Practical Training shall carry 100 marks and shall be evaluated through continuous assessment only. At the end of Industrial / Practical training / internship / Summer Project, the student shall submit a brief report on the training undergone and a certificate from the organization concerned. The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a three member Departmental Committee constituted by the Head of the Department. Certificates (issued by the Organization) submitted by the student shall be attached to the mark list and sent to the Controller of Examinations by the Head of the Department.

U18MCAB611	**SELF DEVELOPMENT –SPRIRITUAL, MINDFULNESS & MEDITATION**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite – Nil				
	Course Designed by – AICTE				

Spiritual, Mindfulness and Meditation

The human mind especially among the youth needs to transcend its preoccupation with negative experiences such as fear, anxiety, anger and obsession and to become more comfortable with the experience of compassion, acceptance and forgiveness.

The student's attitude of acceptance towards negativity, aggression and turbulent emotions should be diffused with the practice of mindfulness. Rather than suppressing emotions or by indulging in them, the student be taught to handle such vibes with acceptance and generosity and with the observation of the self.

A mindful state has to be achieved when negative thoughts and experiences are becoming more personalized and do not serve as dictators of subsequent feelings and activities (e.g. suicide attempts, violence etc.). Both concentrative and insight meditation techniques may be practiced for 10-day sessions during every two months. Behavioral techniques of self monitoring should also be practiced to observe the stream of consciousness from the perspective of a vigilant but detached observer.

The students should be trained to practice different models of mindfulness and meditation so as to elicit a state of deep physical and behavioral relaxation. They may work on selectively influencing or changing the symmetry in hemispheric brain activity. Positive addiction, meta - cognitive practices etc. are exercised to make the students experience the universal human capacity through spiritual experiences.

The students may learn to turn-off or bypass the cognitive processing of usual daily pre-occupations and concerns, allowing access to mindful, spiritual and meditative state of self realization.

Activities:

Reading (10 books/ narrations)

Exercises (Mindfulness based Stress Reduction (MBSR) and 10 more)
Sessions: multiple 10-day sessions may be organized over a semester.

U18MCAB612	**SELF DEVELOPMENT – RELIGION AND INTER -FAITH**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite – Nil				
	Course Designed by – AICTE				

The objective is to gain knowledge about the beliefs and philosophies of different religions on issues like environment, gender equality, unity, financial equality etc.

The scholars of different religious and philosophical sects should be invited to talk about the issues mentioned above. Efforts should be made to ensure that such talks and discourses should stay clear-off making a critical study on these areas.

Following activities must be included.

Reading of books on religious texts of different faiths by famous authors. (Reading methods may be as suggested under ‘book reading’.)

Organizing lecture on interfaith issues covering philosophies and chronology and contemporary situations world over at a given time.

SEMESTER-VII

U18PCMT701	ROBOTICS &MACHINE VISION SYSTEM	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Applied Hydraulics & Pneumatics, Transducer Engineering				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the basic concepts and components of robotics .To learn the machine vision concepts based on Image Processing Techniques				

UNIT I ROBOTICS INTRODUCTION 9

Robotics – Introduction–Basic Structure– Classification of robot and Robotic systems –laws of robotics – robot motions – work space, precision of movement.

Drives and control systems: Hydraulic systems, power supply – servo valve – sump – hydraulic motor – DC servo motors – stepper motors – operation.

Mechanical Components of Robots: Power transmission systems: Gear transmission. Belt drives, cables, Roller Chains, Link – Road Systems, Rotary to linear motion conversion, Rack and pinion drives, ball bearing screws, speed reducers, Harmonic drives.

UNIT II KINEMATICS OF ROBOT 10

Introduction, Matrix Representation, Homogeneous transformation, forward and inverse Kinematics, Inverse Kinematics Programming, Degeneracy, dexterity, velocity and static forces, velocity transformation force control systems, Basics of Trajectory planning.

UNIT III ROBOT END EFFECTORS 8

Types of end effectors – Mechanical grippers – Types of Gripper mechanisms – Grippers force analysis – Other types of Grippers – Vacuum cups – Magnetic Grippers – Adhesive Grippers – Robot end effector interface.

Sensors: Position sensors – Potentiometers, encoders – LVDT, Velocity sensors, Acceleration Sensors, Force, Pressure and Torque sensors, Touch and Tactile sensors, Proximity, Range and sniff sensors, RCC, VOICE recognition and synthesizers.

UNIT IV MACHINE VISION 9

Introduction – Image processing Vs image analysis, image Acquisition, digital Images – Sampling and Quantization – Image definition, levels of Computation.

Image processing Techniques: Data reduction – Windowing, digital conversion. Segmentation – Thresholding, Connectivity, Noise Reduction, Edge detection, Segmentation, Region growing and Region Splitting, Binary Morphology and grey morphology operations.

UNIT V FEATURE EXTRACTION 9

Geometry of curves – Curve approximation, Texture and texture analysis, Image resolution – Department h and volume, Color processing, Object recognition by features, Department h measurement, specialized lighting techniques. Segmentation using motion – Tracking. Image Data Compression, Real time Image processing, Application of Vision systems.

TEXT BOOK

1.Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, "Industrial Robotics:Technology, Programming and Applications", McGraw Hill Book Company, 2012

REFERENCES

1. Saeed B. Niku, Introduction to Robotics: Analysis, Systems, Applications, 2nd edition, Pearson Education India, PHI 2003 (ISBN 81-7808-677-8)
2. Ramesh Jam, RangachariKasturi, Brain G. Schunck, Machine Vision, Tata McGraw-Hill, 1991. 1st Edition.
3. Yoremkoren, Robotics for Engineers, McGraw-Hill, USA, 1987.
4. P.A. Janaki Raman, Robotics and Image Processing, Tata McGraw-Hill, 1991.

COURSE OUTCOMES (COs)	
CO1	To introduce the automation, robotics and its components
CO2	To explain the various methods of forward kinematics and reverse kinematics
CO3	To explain the various end effectors and sensors used in robot
CO4	To explain the machine vision technique
CO5	To explain the image processing technique and application of MV

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			M	M	H	M		H	M		M	H
	CO2	M		M	M	H	H				M		
	CO3		M		M	H	H		H	M			M
	CO4				M	H		M			M	L	
	CO5		H		M	H		M	H	L	M	M	L
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18PCMT702	**DESIGN OF MECHATRONICS SYSTEM**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Control system, Transducer Engineering				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the various Mechatronics system design approaches and its case studies				

UNIT I INTRODUCTION 9

Introduction to Mechatronics system – Key elements – Mechatronics Design process – Types of Design – Traditional and Mechatronics designs – Advanced approaches in Mechatronics - Man machine interface, industrial design and ergonomics, safety.

UNIT II REAL TIME INTERFACING 9

Introduction - Elements of data acquisition and control - Overview of I/O process – Overframing.Selection of interface cards--DAQ card-single channel-multichannal-RS232/422/485communication- IEEE 488 standard interface-GUI card-GPIB-Ethernet switch - Man machine interface

UNIT III CASE STUDIES ON DATA ACQUISITION AND CONTROL 10

Case studies on Data Acquisition: Introduction – Cantilever Beam Force Measurement system– Transducer calibration system for automotive applications – Strain gauge weighing system – Solenoid Force-Displacement calibration system.

Case studies on Data Acquisition and control: Introduction – pH control system – Dc-Icing Temperature Control system – Skip control of a CD player – Auto focus Camera, exposure control.

UNIT IV CASE STUDIES ON DESIGN OF MECHATRONIC PRODUCTS 9

Introduction–Fuzzy based Washing machine – Autofocus Camera, exposure control– Motion control using D.C.Motor & Solenoids – Engine management systems. – Controlling temperature of a hot/cold reservoir using PID- Control of pick and place robot – Part identification and tracking using RFID – Online surface measurement using image processing

UNIT V ADVANCED APPLICATIONS IN MECHATRONICS DESIGN 8

Introduction–Sensors for condition Monitoring – Mechatronic Control in Automated Manufacturing – Artificial intelligence in Mechatronics – Fuzzy Logic Applications in Mechatronics – Microsensors in Mechatronics

TEXT BOOKS:

1. Devdas shetty, Richard A. Kolk, "Mechatronics System Design", Thomson Learning Publishing Company, Vikas publishing house, 2001.

REFERENCES

1. Bolton, -Mechatronics - Electronic Control systems in Mechanical and Electrical Engineering-, 2nd Edition, Addison Wesley Longman Ltd., 1999.
2. Brian Morriss, Automated Manufacturing Systems - Actuators, Controls, Sensors and Robotics, Mc Graw Hill International Edition, 1995.
3. Bradley, D.Dawson, N.C. Burd and A.J. Loader, Mechatronics: Electronics in Products and Processes, Chapman and Hall, London, 1991.

COURSE OUTCOMES (COs)	
CO1	To learn various types of Design processes.
CO2	To understand the concept of Real time interfacing.
CO3	To learn the various case studies on Data Acquisition and control**.**
CO4	To learn the various case studies on Mechatronics Products.
CO5	To learn the concept of advance application in Mechatronics.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1				M	H						L	
	CO2	M			M	H		M					
	CO3				M	H							
	CO4				M	H			M				
	CO5				M	H							
3	Category	Professional Core(PC)											
4	Approval	47 th Meeting of Academic Council, July, 2018											

U18PCMT703	COMPUTER INTEGRATED MANUFACTURING	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – CNC Technology, Manufacturing Technology				
	Course Designed by – Dept of Mechatronics				
OBJECTIVES	To understand the various concepts of CAD,CAM and Computer Integrated Manufacturing				

UNIT I INTRODUCTION TO CAD AND ITS ELEMENTS 9

Principles of Computer hardware, Software and Operating System, application Programs, Data Handling and File Structures, Computer aid in Phases of design- Development of Design Database using CAD Systems- Conceptual Design Process Analysis Optimization- Detailed Design and Documentation.

UNIT II ELEMENTS OF CAD SYSTEMS AND DESIGN USING COMPUTERS 9

Elements of CAD Systems, Introduction to Graphic Hardware, Software, Details of 2D Software Packages-Layering, Drawing Primitives, Display Techniques, Editing, utilities, Scaling, Dimensioning, 3D Visualization, Geometric Modeling-Wireframe and Solid models.

UNIT III DESIGN USING COMPUTERS 9

Design of Gears, Couplings, Flywheels, Shafts Connecting Rods etc. Software for Vibration Problems Stress Analysis, Kinematic Analysis, Dynamic Analysis.

UNIT IV COMPUTER AIDED MANUFACTURING 9

Numerical Control- Modes- NC Elements- NC Machine Tools- CNC Machines- CNC Hardware Basics- CNC Tooling- CNC Machine Tools and Control System- Part Programming- Manual and Computer Aided- Turning Center Programming- Advanced Part Programming- Direct Numerical Control- Adaptive Control- Computer Aided Part Programming, APT, Introduction to Robotics, Group Technology, Computer Aided Process Planning, FMS.

UNIT V COMPUTER INTEGRATED MANUFACTURING 9

CIM as a Concept and a Technology- CASA/SME Model of CIM-Benefits- Communication Matrix in CIM- Fundamentals of Computer Communication n CIM, CIM Data Transmission Method, Serial , parallel, asynchronous, modulation, Demodulation, Simplex and Duplex- Types of Communications in CIM- Point to Point, Star and Multiplexing- CIM for Batch Production- Group Technology – FMS- Process Control in CIM- Characteristics of Manufacturing Process Data- Continuous, Analog, Discrete Binary and Pulse Data- ADC/DC Multiplexers, Process Monitoring Through Computer- Types of Computer Process Control- Preplanned, Direct Digital Control (DDC)- Regular Control and Feed Forward Control, Requirements of Control Programming Interrupt, Real Time Clock Input.

TEXT BOOK:

1. Radhakrishnan P. CAD/CAM/CIM, 3rd Edition, New central Book Agency, 2008.

REFERENCES

1. Rao P.N. CAD/CAM, Principles and Application, Tata McGraw Hill, 2005.2nd Edition.
2. Mikell P.Groover, Automation, Production Systems and CIM, 4th Edition, Prentice Hall of India,2001.
3. Chris McMahon and Jimmy Browne, CAD/CAM, Pearson Education, 2001.2nd Edition.

COURSE OUTCOMES (COs)	
CO1	To introduce the CAD and its element.
CO2	To explain the elements of cad systems and design using computers.
CO3	To explain the various component design using computer.
CO4	To explain the computer aided manufacturing.
CO5	To explain the computer integrated manufacturing.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1				M	H						L	
	CO2	M			M	H		M					
	CO3				M	H							
	CO4				M	H			M				
	CO5				M	H							
3	Category	Professional Core(PC)											
4	Approval	47th Meeting of Academic Council, July, 2018											

U18EEMT7P1	**PROJECT WORK-I**	**L**	**T**	**P**	**C**
	Total Contact Hours –18 periods per week	0	0	6	3
	Prerequisite – Professional Courses				
	Course Designed by – Department of Mechatronics.				

OBJECTIVES

Every project work shall have a guide who is the member of the faculty of the institution. The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or a design problem.

COURSE OUTCOMES (COs)

CO1	Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion.
CO2	This final report shall be typewritten form as specified in the guidelines.
CO3	The continuous assessment shall be made as prescribed in the regulations.
CO4	The student can able to design the components they required
CO5	Understand the different fabrication processes.
CO6	Will gain confidence to face industrial environment.

Mapping of Course Outcomes with Program outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H							M			L	
	CO2	H						H	M	H		L	
	CO3			H	H	H		H				L	
	CO4					M		H		M		L	
	CO5					M							
	CO6						M	H	M				

3	Category	Humanities and Social studies (HS)	Basic Sciences &Maths (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Seminar/ Internship (PR)	

									√	
4	Approval	47th Academic Council, July 2018								

U18PCMT7L1	**ROBOTICS LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite –Microcontroller & PLC Lab, Sensor & Instrumentation Lab				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To impart knowledge on building robots and practice exercises on Robot				

LIST OF EXPERIMENTS

1. Study of different types of robots based on configuration and application.
2. Study of different type of links and joints used in robots
3. Study of components of robots with drive system and end effectors.
4. Determination of maximum and minimum position of links.
5. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
6. Estimation of accuracy, repeatability and resolution.
7. Robot programming exercises

(Point-to-point and continuous path programming)

LIST OF EQUIPMENT (for a batch of 30 students)

S.No	Name of the Equipment/components	No. of Items
1	Any one type of robot configuration with at least five degree of freedom.	1 set
2		10 licenses
3	Robot programming software inclusive of computer system.	5 each
4	Models of different types of end effectors drive systems Links and Joints.	5 each
	Models of different configuration robots	

COURSE OUTCOMES (COs)	
CO1	To understand different types of robots based on configuration and application
CO2	To study of different type of links and joints used in robots
CO3	To study about various end effectors used in robots
CO4	To learn about the different types of drive system

CO5	Verification of transformation (Position and orientation) with respect to gripper and world coordinate system

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)
(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			M	M	H	M		H	M		M	
	CO2	M		M	M	H	H				M		
	CO3		M		M	H	H		H	M			
	CO4				M	H		M			M	L	
	CO5		H		M	H		M	H	L	M	M	
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18PCMT7L2	**SIMULATION AND PROGRAMMING LAB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	1
	Prerequisite –Control System, Instrumentation and control Lab				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	• To Write motion control programs • To design and Configure graphical screens for HMI (Human Machine Interface) in LabVIEW and MATLAB.				

LIST OF EXPERIMENTS

1. Programming exercises using loops and charts.
2. Programming exercises using clusters and graphs
3. Programming exercises using case and sequence structures, file input/output, string operations.
4. Creating virtual instrumentation for simple applications
5. Closed loop response of level control loop.
6. Closed loop response of flow control loop.
7. Closed loop response of temperature control loop.
8. Closed loop response of pressure control loop

LIST OF EQUIPMENT (for a batch of 60 students)

1. LAB VIEW Software – 10 licenses
2. MAT LAB Software - 10 licenses

COURSE OUTCOMES (COs)	
CO1	Use different sensors and actuators to control various industrial parameters: temperature, pressure, level and flow.

CO2	Write program for LabVIEW to interface and control various actuators.
CO3	Simulate and create virtual instruments.
CO4	Analyze the findings of experimental observations in both written and oral format.
CO5	Present the findings of experimental observations in both written and oral format.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			M	M	H	M		H	M		M	
	CO2	M		M	M	H	H				M		
	CO3		M		M	H	H		H	M			
	CO4				M	H		M			M	L	
	CO5		H		M	H		M	H	L	M	M	
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

18MCAB713	**BEHAVIORAL AND INTERPERSONAL SKILLS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite –				
	Course Designed by –				

Behavioral and Interpersonal skills (non-verbal skills / behaviours, non-aggression**)**

Each individual has behavior patterns that are shaped by the context of his or her past. Most often, adapting the behaviour to the changing context of the reality a person lives in becomes difficult which may lead to the reduction in personal effectiveness and natural self-expression. The main focus of this course is to equip the students with useful approaches to help in the deeper understanding of self and help individuals empower themselves to be the source of their own growth and development. The course will help students to learn effective communication skills, Group and team building skills and will help them learn the goal setting process and thus become more effective in achieving their goals.

The broader objective of this course is to make the students aware about the different facets of self and to help them learn skills to strengthen their inner capacities. So that they are able to understand themselves, think and act effectively, to be able to communicate in an effective manner and to learn to lead and to form an effective team. The specific objectives, however, are as following.

To help the students to understand their real self by recognizing differentaspects of their self-concept that will lead to an increased self-confidence.

To train the students for communicating effectively in both formal as well as in informal settings.

To help the students to understand the importance of non-verbal aspects of effective communication.

To help the students to understand Emotion and emotional intelligence, Managing ones' own emotional reservoirs, effective dealing with emotions at work

To facilitate the students in understanding the formation and function of group and team and to help them to learn the skills of a successful leader.

To help the students in understanding and practicing the goal setting process by recognizing the importance of each step involved in goal setting. The activities involved are designed to facilitate their career goal decision making.

The activities to achieve the above objectives can be suggested as follows.

Motivational lectures

Group Discussions/activities

Case Study

Games/Stimulation Exercises

Role-Playing
Mindfulness training.

U18MCAB714	**NATURE - NATURE CLUB**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite –				
	Course Designed by –				

Nature club (bird watching, recognizing plants at institute/at home, recognizinglocal animals, appreciating biodiversity

Impart knowledge and inculcate the habit of taking interest and understanding biodiversity in and around the college campus. The students should be encouraged to take interest in bird watching, recognizing local plants, herbs and local animals. The students should be encouraged to appreciate the difference in the local biodiversity in their hometown, in the place of their study and other places they visit for vacation/breaks etc.

Following activities must be included.

Identify a tree fruit flower peculiar to a place or having origin from the place.

Making high resolution big photographs of small creatures (bees, spiders, ants. mosquitos etc.) especially part of body so that people can recognize (games on recognizing animals/plants).

Videography/ photography/ information collections on specialties/unique features of different types of common creatures.Search and explore patents and rights related to animals, trees etc. Studying miracles of mechanisms of different body systems.

U18EEMT8P2	**PROJECT WORK-II**	**L**	**T**	**P**	**C**
	Total Contact Hours –18 periods per week	0	0	18	9
	Prerequisite – Professional Courses				
	Course Designed by – Department of Mechanical Engineering				
OBJECTIVES					

Every project work shall have a guide who is the member of the faculty of the institution. The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or a design problem.

COURSE OUTCOMES (COs)

CO1	Each student shall finally produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion.
CO2	This final report shall be typewritten form as specified in the guidelines.
CO3	The continuous assessment shall be made as prescribed in the regulations.
CO4	The student can able to design the components they required
CO5	Understand the different fabrication processes.
CO6	Will gain confidence to face industrial environment.

Mapping of Course Outcomes with Program outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H							M			L	
	CO2	H						H	M	H		L	
	CO3			H	H	H		H				L	
	CO4					M		H		M		L	
	CO5					M							
	CO6						M	H	M				

3	Category	Humanities and Social studies (HS)	Basic Sciences &Maths (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Seminar/ Internship (PR)	
									√	

4	Approval	47th Academic Council, July 2018

The objective of this project is to provide opportunity for the students to implement their skills acquired in the previous semesters to undergo learning in research oriented areas, collecting survey and documents on the growing fields in technology

The students as an individual will choose one topic which will be the topic of his project work in the final semester. Every project work shall have a guide who will be the faculty of the institution.

The topic chosen may be related to small machine elements (Example- screw jack, coupling, machine vice, cam and follower, governor etc) attachment to machine tools, tooling (jigs, fixtures etc), small gear box, automotive appliances, agricultural implements, simple heat exchangers, small pumps, hydraulic/pneumatic devices etc.

The student is required to collect literature survey regarding the selected topic to be extended in the next semester. He has to demonstrate its working apart from submitting the project report. The report should contain study material, literature and whatever further deemed important related to his work.

	COMPREHENSION	**L**	**T**	**P**	**C**
U18EEMT8C1	Total Contact Hours : Test will be conducted at the end of the semester	0	0	1	1
	Prerequisite – All the courses up to seventh semester				
	Course Designed by – Department of Mechatronics				

OBJECTIVES

- To provide a complete review of Mechatronics topics covered up to seventh semesters, so that a comprehensive understanding is achieved.
- It will also help students to face job interviews, competitive examinations and also to enhance the employment potential.
- To provide overview of all topics covered and to assess the overall knowledge level up to seventh semester.

18MCAB815	**INNOVATION - PROJECT BASED – SC., TECH, SOCIAL, DESIGN & INNOVATION**	**L**	**T**	**P**	**C**
	Total Contact Hours - 30	0	0	2	0
	Prerequisite –				
	Course Designed by –				

Project based – Sc., Tech, Social, Design & Innovation

Many students, when they enter engineering, are full of enthusiasm to understand new areas, to build systems and to experiment and play with them. This enthusiasm is to be tapped and to direct it to exploration and sustained pursuit by the student which may result in development of a working system, a prototype, or a device or material, etc. They are not required or even expected to produce research or an innovation.

Students may be encouraged to take up projects which are aimed at providing solutions to societal problems, reduce drudgery and improving efficiency in rural work, green technologies, utilization of rural and urban waste, sanitation and public health, utilizing non -conventional energy sources, technologies for the benefit of the differently able people and technologies ready to be implemented in the Institute.

Two types of activities may be undertaken under this

Exposure to social problems (which are amenable to technological solutions)

Design & Innovation (to address above problems)

After this students be encouraged to undertake technology projects of social relevance

ELECTIVES

PROFESSIONAL ELECTIVE –I

U18PEMT011	**COMMUNICATION ENGINEERING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Fundamentals of Electronic Circuits and Devices				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To study about the analog and digital communication and also study about the real time application and Satellite communication.				

Unit I Analog Communication 9

AM – Frequency Spectrum – Vector Representation – Power Relations – Generation Of AM – DSB, DSB/SC, SSB, VSB AM Transmitter & Receiver; FM and PM – Frequency Spectrum – Power Relations : NBFM & WBFM, Generation Of FM and DM, Amstrong Method & Reactance Modulations : Fm & Pm Frequency.

Unit II Digital Communication 9

Pulse Modulations – Concepts of Sampling and Sampling theorems, PAM, PWM, PPM, PTM, Quantization and Coding: DCM, DM, Slope Overload Error. ADM, DPCM, OOK SYSTEMS – ASK, FSK, PSK, BSK, QPSK, QAM, MSK, GMSK, Applications Of Data Communication.

Unit III Source Codes, Line Codes & Error Control 9

Primary Communication – Entropy, Properties, BSC, BEC, Source Coding: Shaum, Fao, Huffman Coding: Noiseless Coding Theorum, BW – SNR Trade Off Codes: NRZ, RZ, AMI, HDBP, ABQ, MBnbcodes: Efficiency Of Transmissions, Error Control Codes And Applications: Convolutions & Block Codes.

Unit IV Multiple Access Techniques 9

SS&MA Techniques: FDMA, TDMA, CDMA, SDMA Application In Wire And Wireless Communication: Advantages (Merits):

Unit V Satellite, Optical Fiber – Power line, Scada 9

Orbits: Types Of Satellites: Frequency Used Link Establishment, Ma Techniques Used In Satellite Communication, Earth Station; Aperture Actuators Used In Satellite – Intelsat And Insat: Fibers – Types: Sources, Detectors Used, Digital Filters, Optical Link: Power Line Carrier Communications: Scada.

TEXT BOOKS:

1. Taub & Schiling "Principles of Communication Systems" Tata McGraw Hill 2007.
2. J.Das "Principles of Digital Communication" New Age International, 1986.

REFERENCES:

1. Kennedy and Davis "Electronic Communication Systems" Tata McGraw hill, 4th Edition, 1993.
2. Sklar "Digital Communication Fundamentals and Applications"Pearson Education, 2001.
3. Bary le, Memuschmidt, Digital Communication, Kluwer Publication, 2004.
4. B.P.Lathi "Modern Digital and Analog Communication Systems" Oxford University Press, 1998.

COURSE OUTCOMES (COs)	
CO1	To learn basics about Analog Communication.
CO2	To learn about transducers in Digital Communication.
CO3	To learn about Source Codes, Line Codes & Error Control.
CO4	To learn about Multiple Access Techniques
CO5	To understand the Satellite, Optical Fiber – Power line, Scada
Mapping of Course Outcomes(COs) with Programme Outcomes (POs)	

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1					H							
	CO2	M			M				H				
	CO3				M	H		M					
	CO4								H		M	M	
	CO5				M	H							
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

U18PEMT012	**MECHANICS OF SOLIDS AND FUNDAMENTALS OF FLUIDS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 60	3	0	0	3
	Prerequisite – Engineering Mathematics				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To understand the basics concepts of various mechanism in solids and fundamentals about fluids				

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 12

Concept of stress-strain- Hooke's law- Tension- Compression and shear- Stress strain diagram, poisson's relation-Volumetric strain- Elastic constants and their relation- Stress in simple and composite bars subjected to axial loading and temperature- State of stress at a point-Principle plane- Principle stress-Normal and longitudinal stresses on a given plane-Mohr's circle of stresses.

UNIT II TRANSVERSE LOADING ON BEAMS, SHEAR FORCE AND BENDING MOMENT 12

Types of Beams- Transverse loading on beams shear force and Bending moment in beams – Cantilever-Simply supported, overhanging beam subjected to concentrated load and UDL – Maximum bending moment and point of contra flexure-Theory of simple bending and assumption – Derivation of formulae M/I = F/Y = E/R and its applications to engineering – Leaf spring.

UNIT III TORSION, SPRINGS AND COLUMNS 12

Theory of torsion and assumption – Torsion of circular shafts- solid & hollow – strain energy in torsion- Power transmission- Strength and stiffness of shafts- Types of springs- Stiffness stresses and deflection in helical spring- Columns – Buckling and stiffness due to axial loads – Euler, Rankin and Empirical formulae for columns with different conditions.

UNIT IV FLUID FLOW CONCEPTS AND DYNAMICS OF FLUIDS 12

Flow characteristics- Concepts of system and control volume –Continuity equation – Application of control volume to continuity – Energy Equation – Euler's Equation – Bernoulli equation and Momentum Equation – simple problems.

UNIT V DIMENSIONAL ANALYSIS AND FLOW THROUGH CIRCULAR CONDUITS 12

Dimension and units, Buckingham's Π theorem- Boundary layer concepts- Boundary layer thickness- Darcy-Weisbach equation- Friction factor and Moody diagram-Commercial pipes- Minor losses- Flow though pipes in series and in parallel.

TEXT BOOKS

1. Ramamurtham.S and Narayanan.R, "Strength of material", DhanpatRai Pvt. Ltd., New Delhi, 2001.
2. Bansal.R.K, "Strength of Material", Laxmi publications Pvt. Ltd., New Delhi, 6th Edition,2017.
3. Kumar.K.L, "Engineering Fluid Mechanics", Eurasla publishers Home Ltd., New Delhi, 1995.
4. Bansal.R.K, "Fluid Mechanics and Hydraulic Machines",Laxmi publications (P) Ltd., New Delhi, 1995.
5. Popov.E.P, "Mechanics of Materials", Prentice Hall, 1982.
6. Timoshenko.S.P and Gere .M.J, "Mechanics of Materials", C.B.S. publishers, 1986.

REFERENCE

1. Ferdinand P. Beer and Russell Johnston.E, "Mechanics of Materials", SI metric Edition McGraw Hill, 1992
2. R.K.Rajput,"Strength of Materials:Mechanics of Solids,S.Chand,2006.
3. Srinath.L.N, "Advanced Mechanics of Solids",Tata McGraw Hill Ltd., New Delhi.
4. Ramamurthan.S, "Fluid Mechanics and Hydraulics", DhanpatRai and Sons, Delhi, 1988.

Fox R.W and Mc. Donald .A.T, "Introduction to fluid Mechanics", 5th Ed. John Wiley and Sons, 1999

COURSE OUTCOMES (COs)	
CO1	To understand the different types of beams and bending moment and shear force
CO2	To learn the power transmission and strain energy and stiffness and buckling
CO3	To learn the flow characteristic fluid continuity, Euler's equation
CO4	To learn the principles of dimensional analysis
CO5	To learn the various applications of solids and fluids mechanism

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	H	M		L	H	L						
	CO2	H	M		L	H	L						
	CO3	H	M		L	H	L						
	CO4	H	M		L	H	L						
	CO5	H	M		L	H	L						
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

U18PEMT013	VIRTUAL INSTRUMENTATION	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Fundamentals of computing and programming, Design of Mechatronics System.				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the Virtual Instrument. To study of LABVIEW software and about image processing				

UNIT I INTRODUCTION TO VIRTUAL INSTRUMENTS 9

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

UNIT II LABVIEW GRAPHICAL PROGRAMMING 9

LabVIEW – graphical user interfaces- controls and Indicators – 'G' programming –data types –data flow programming –Editing Debugging and Running a Virtual Instrument –Graphical programming palettes and tools – Front panel objects – Function and Libraries.

UNIT III LABVIEW BASIC PROGRAMMING 9

FOR Loops, WHILE loops, Shift Registers, CASE structure, formula nodes-Sequence structures- Arrays and Clusters- Array operations – Bundle, Unbundle – Bundle/Unbundle by name, graphs and charts – string and file I/O – High level and Low level file I/Os – attribute nodes local and global variables.

UNIT IV BASICS OF DAQ 9

Basics of DAQ Hardware and Software – Concepts of Data Acquisition and terminology – Installing Hardware, Installing drivers -Configuring the Hardware – addressing the hardware in LabVIEW- Digital and Analog I/O function – Buffered I/O – Real time Data Acquisition.

UNIT V COMMUNICATION 9

Simple programs in VI- Advanced concepts in LabVIEW- TCP/IP VI's, Synchronization – other elements of Virtual Instrumentation – Bus extensions – PXI - Computer based instruments - Image acquisition – Motion Control.

TEXT BOOKS

1. Garry M. Johnson "Lab VIEW Graphical Programming", Tata McGraw-Hill, 5th Edition, 2009
2. Lisa.K.Wills, "LabVIEW for Everyone" Prentice Hall of India, 2009.

REFERENCES

1. Labview Basics I and II Manual, National Instruments, 2009
2. Barry Paton, "Sensor, Transducers and Lab VIEW", Prentice Hall, 2007.

COURSE OUTCOMES (COs)	
CO1	To introduce the virtual instrumentation
CO2	To learn about LABVIEW
CO3	To learn array operation
CO4	To learn basic DAQ hardware and software

CO5	To learn image acquisition												
Mapping of Course Outcomes(COs) with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			H			M						
	CO2			H									
	CO3		M		H								
	CO4					M	H						
	CO5							H	H				
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

U18PEMT014	PROCESS AUTOMATION	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Control system				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To obtain the mathematical models for first order and higher order real-time systems and also understand the concept of self-regulation and to get adequate knowledge about the characteristics of various controller modes and controller tuning methods				

UNIT I INTRODUCTION **9**

Need for process control - Continuous and batch process - Mathematical model of first order level:pressure and thermal processes, interacting and non-interacting systems - Servo and regulator operation - self-regulation

UNIT II CONTROLLER CHARACTERISTICS **9**

Basic control actions - Characteristics of On-Off, proportional, integral and derivative control modes - Composite control modes: P+I, P+D and P+I+D control modes - Selection of control mode for different processes typical control schemes for level, flow, pressure and temperature processes.

UNIT III TUNING OF CONTROLLERS AND MULTI-LOOP CONTROL 9

Optimum controller settings - Evaluation criteria-IAE, ISE and ITAE decay ratio - Tuning of

controllers by process reaction curve method, damped oscillation method Ziegler-Nichol's tuning,feed forward control - ratio control, cascaded control, averaging control, inferential and split rangecontrol.

UNIT IV FINAL CONTROL ELEMENT 9

Pneumatic and electric actuators - Valve positioner - Control valve characteristics - Type of valves:globe, butterfly, diaphragm, ball valves and control valve sizing cavitation and flashing in controlvalves - Response of control valves - Electric and electro pneumatic valves - Selection of controlvalves

UNIT V SELECTED UNIT OPERATIONS 6

Distillation column control of top and bottom product compositions reflux ratio. Case study: controlof CSTR, control of heat exchanger, Steam boiler: drum level control and combustion control.

TEXT BOOKS

1. George Stephanopoulos, Chemical Process Control, Prentice Hall of India learning Pvt. Ltd.,

New Delhi, 2012

REFERENCE

1. Donald P. Eckman, Automatic Process Control, Wiley-India Pvt. Ltd., New Delhi, 2009
2. Dale E. Seborg, D. A. Mellichamp and Thomas F Edgar, Process Dynamics and Control, Wiley-India, 2010.
3. Peter Harriott, Process Control, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2008
4. S B Thakore and B I Bhatt, Introduction to Process Engineering and Design, Tata McGraw-Hill PublishingCo. Ltd., New Delhi, 2008.
5. B. Wayne Bequette, Process Control: modeling, design, and simulation, Prentice Hall of IndiaLearning Pvt.Ltd., New Delhi, 2008

COURSE OUTCOMES (COs)		
CO1	Solve the mathematical models for first order real time systems.	
CO2	Understand the characteristics of various control modes and the concept of various control schemes	
CO3	Understand the various controller tuning methods to tune the controller.	
CO4	Know the construction, characteristics and applications of different type of actuators.	

CO5	Learn about final control elements used in process control												
Mapping of Course Outcomes(COs) with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M	L		M	H	L	L					
	CO2		L										
	CO3				H	M	M						
	CO4	M				H	L						
	CO5	M	L		M	H	H	L					
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

PROFESSIONAL ELECTIVE-II

U18PEMT021	**CONSUMER ELECTRONICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Electronics				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To understand the operation of audio, video systems. To learn the operation of various memory devices and various switching systems. Able to conduct experiments on electrical machines and analyze the experimental data				

UNIT I AUDIO SYSTEM 9

Hi-Fi systems, stereophonic sound system, public address systems, Acoustics, Quadraphonic sound systems, Graphics Equalizer, Electronic tuning, Digital sound recording on tape and disc..

UNIT II VIDEO SYSTEMS 9

B & W TV, colour TV and HD TV systems, Electric cameras, VCR, VCP, Block diagram and principles of working of cable TV and DTH, cable TV using internet.

UNIT III MEMORY DEVICES 10

CD systems, Memory diskettes, Discs and drums vide monitoring audio, video recording media & Systems.

UNIT IV SWITCHING SYSTEMS 9

Dolby noise reduction digital and analog recording. Switching Systems: Switching systems for telephone exchange, PAB EPRABX, modular telephones, Telephone message recording concepts, remix controlled systems.

UNIT V HOME APPLIANCES 8 Electronic toys, microwave oven, Refrigerators, washing machines, calculator, data organizers

TEXT BOOKS

1. Gulati.R.R, Monochrome and color television, New age publisher.2nd Edition
2. Encyclopedia of video & TV / Focal press

REFERENCES

1. Complete Satellite & cable Television R.R Gulati New age International Publisher.
2. Handbook of Electronics & Telecommunication.

COURSE OUTCOMES (COs)	
CO1	To learn various sound systems like stereophonic, Quadraphonic, recording
CO2	To learn various video systems like cameras, VCR, VCP, TV etc
CO3	To study various memory devices like CD, HDD etc
CO4	To learn switching system in telephone exchange
CO5	To study the home appliances like oven, Refrigerators, washing machines

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l

2	CO1					H		M					H
	CO2	M			M					H	H		
	CO3						M		H				
	CO4					H				L	L		M
	CO5				M					L	H		
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

U18PCMT022	DIMENSIONAL METROLOGY	L	T	P	C
	Total Contact Hours -45	3	0	0	3
	Prerequisite – Engineering Physics				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce concept of metrology and measurement, measurement systems, metrological equipments.				

UNIT I BASICS OF MEASUREMENT & METROLOGY 9

Measurement & Metrology – Introduction, uses, acts and applications of measurement, codification of measurement – Accuracy, precision and reliability – Evolution of standards – metric systems – fundamental & Practical Criteria – metrological, communication and computational considerations – Rounding of numerical values. Measurements and Tolerances – Geometric Dimensioning and Tolerance – Statistics and metrology – probability and acceptance sampling.

UNIT II MEASUREMENT INSTRUMENTS 9

Measurement with scales and scaled Instruments – steel rule – role of error – calipers – types and applications.Vernier Instruments – Vernier Caliper, Department h gauge, Height gauge – height master – Three elements of measurements. Micrometer Instruments – Principle, Types, applications. Development and use of gauge blocks – Calibration, applications, combining gauge blocks.

UNIT III MEASUREMENT METHODS 9

Measurement by comparison – Dial Indicator – Principle, selection, use and Calibration – Accessories and attachments – constructive use of Error. High – Amplification comparators – Electronic measurement – applications – advantages of multiple scales. Pneumatic measurement – Principles, applications and advantages of pneumatic comparators – Calibration – Role of error, Calibration Procedure.

UNIT IV OPTICAL MEASUREMENT METHODS 9

Optical Flats and Optical alignment – light waves as standards – measurement with optical flats, applications of optical flat measurement – principles of optical metrology – Alignment Telescope – Straightness measurement – Optical squares and squareness measurement – Sight level – Plumbness, optical polygons – Angles, Jig Transit – Planes, Theodolite Angles and planes. Reference planes-Flatness, Perpendicularity and modern reference planes. Angle measurement-Basic geometry function, sign bars and plates and mechanical angle measurements.

UNIT V SURFACE MEASUREMENT METHODS 9

Surface Measurement – surface Evaluation, stylus method, Numerical values for surface Assessment, surface Texture specimens, surface Evaluation, other methods, Roundness measurement. Coordinate measuring machines – types, operational details and metrological features – coordinate systems. Non-contact type measurement – Principles of microscope, applications, optical comparator, profile projector, machine vision systems, Laser measurement.

TEXTBOOKS

1. Connie Dotson, Ronger Harlow and Richard L. Thomson, "Fundamentals of Dimensional metrology", 5th Edition, 2009. Thomson Asia Pvt. Ltd. Singapore. ISBN 981-243-685-5.

REFERENCES

1. R.K. Jain, "Engineering Metrology", Khanna Publishing, 2002.
2. Connie Dotson,"Dimensional Metrology", 1st Edition,2012.
3. Raghavendra,"Engineering Metrology and Measurements",Oxford Higher Education,2013.
4. Gaylor, Shotbolt and Sharp, "Metrology for Engineers, O.R. Cassel, London, 1993.
5. Thomas, "Engineering Metrology", Butthinson& Co., 1984.

COURSE OUTCOMES (COs)	
CO1	To explain the concept of metrology and measurement and various terms used in the metrology
CO2	To understand the vernier caliper, micrometer and gauge block
CO3	To explain the measurement by comparison
CO4	To explain the optical metrology
CO5	To explain the surface measurement

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l

2	CO1	H			M	H		M			M		M
	CO2			M									
	CO3	M			H						M		
	CO4					H		H					H
	CO5												
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

U18PEMT023	**TEXTILE MECHATRONICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Manufacturing Technology				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To study about the basics processes involved in textile technology				

UNIT I INTRODUCTION TO TEXTILE TECHNOLOGY AND SPINNING 9

History of textile technology and its advancements, introduction to textile fibers, overview of

textile manufacturing, Introduction to automation in textile industries.

Spinning process flow chart – Objectives and process variables of textile spinning machineries:Mixing, Blow room, Carding, Draw frame, Combing, Speed frame, Ring frame, rotor spinning.

UNIT II BASICS OF WEAVING 9

Weaving process flowchart – Objectives and process variables in weaving preparatory: Winding,Warping, Sizing and beaming. Objectives and process variables in weaving: drawing in,knotting, denting and weaving.

UNIT –III BASICS OF PROCESSING 9

Objectives and process variables in processing machines: Singeing, Desizing, Scouring,

Bleaching, Mercerizing, Dyeing, Printing, Finishing.

UNIT-IV AUTOMATION IN SPINNING MACHINERY 9

Machinery material flow and its variation controls – Feeders & Stop motions – Auto levelers –Safety switches – Production and quality monitors – Full doff and pre-set length monitors. Data acquisition system for spinning preparatory, ring spinning – rotor spinning.

UNIT-V AUTOMATION IN WEAVING MACHINERY 9

Yarn cleaner controls – Knotter / splicer carriage controls – Warping machine monitors and

controls – sizing machine monitors and controls – Auto reaching / drawing in and knotting

machine monitors and controls – Data acquisition system in weaving preparatory and weaving – humidification systems .CAD / CAM / CIM in spinning, Weaving, Dyeing, Printing, Apparel production – Electronics data interchange - Robotics in textile industries

TEXTBOOKS

1. Chattopadhyay R. (Ed), "Advances in Technology of Yarn Production", NCUTE, IIT Delhi,

2002.

2. Oxtoby E "Spun Yarn Technology" butter worth‟s, London, New Edition 2002.

3. Lord P.R. and Mohammed M.H., "Weaving – Conversion of Yarn to Fabric", Merrow

Publication, 2001.

REFERENCES

1. Krishna Kant, "Computer – Based Industrial Control", PHI Learning Pvt Ltd, 2nd edition,

New Delhi, 2011.

2. Venkatachalam. A and Ashok Kumar L, "Monograph on ― Instrumentation & Textile

Control Engineering" – 2005.

3. Berkstresser G A, Buchanan D R and Grady P, "Automation in the Textile Industry from

Fibers to Apparel", The Textile Institute, UK, 1995.

COURSE OUTCOMES (COs)	
CO1	To know the evolution of textile technology and manufacturing with textile fibers
CO2	To describe various process and machines involved in spinning
CO3	To learn the various process and machines involved in weaving.

CO4	To study the various stages of automation scopes in spinning and weaving.												
CO5	To learn the role of computers in automated textile manufacturing												
Mapping of Course Outcomes(COs) with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1		H	H									
	CO2		H	M									
	CO3		H	L	M	H							
	CO4		H										
	CO5		H		H	L							
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

U18PEMT024	**PLANT LAYOUT AND MATERIAL HANDLING**	**L**	**T**	**P**	**C**
	Total Contact Hours – 45	3	0	0	3
	Prerequisite –Manufacturing Technology				
	Course Designed by – Department of Mechanical Engineering				

OBJECTIVES

To equip students with adequate knowledge for running an organization and to understand the integration of material handling systems.

COURSE OUTCOMES (COs)

CO1		Understand the procedures for systematic integration of organization.
CO2		Will understand various techniques and tools of layout planning.
CO3		Students will be able to get knowledge on industrial layouts.
CO4		Understand material handling systems
CO5		Learn the concepts of industrial building
CO6		Learn the concepts of industrial utilities

	Mapping of Course Outcomes with Program outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low	

UNIT I **8**

Plant Location: Factors to be considered – influence of location on plant layout, selection of plant site, Consideration in facilities planning and layout. Equipments required for plant operation, Capacity, serviceability and flexibility and analysis in selection of equipments, space requirements, and man power requirements.

UNIT II **8**

Plant layout: Need for layout, types of layout, factors influencing product, process. Fixed and combination layout: tools and techniques for developing layout, process chart, flow diagram, string diagram, template and scale models – machine data. Layout planning procedure. Visualization of layout, revision and improving existing layout, balancing of fabrication and assembly lines.

UNIT III **10**

Importance and scope. Principles of material handling. Planning, operating and costing Principles, types of material handling systems, factors influencing their choice. Assembly practices: Manufacturing and assembly, process planning, selective assembly.

UNIT IV **12**

Industrial building and utilities: Centralized electrical, pneumatic water line systems. Types of buildings, lighting, heating, air conditioning and ventilation utilities - planning and maintenance, waste handling, statutory requirements. Packing and storage materials: Importance of Packaging, layout for Packaging – Packaging machinery – wrapping and Packing materials, cushion materials.

UNIT V **7**

Motion analysis, flow analysis, graphic analysis, safety analysis, equipment cost analysis, palletization analysis, analysis of operation, material handling surveys.

TEXT BOOKS :

1. Agarwal, Plant layout and material handling, Jain brothers publication.
2. Sharma S.C, Plant layout and material handling, Khanna publishers.

REFERENCES :

1. Oberman. Ya, Material handling, Mir publishers.1980
2. Sharma S.C, Material Management And Material Handling, Khanna Publishers.1995.
3. Shubin J A, Plant layout, P H I publications.1965
4. https://books.google.com/.../**Plant_Layout_and_Material_Handling**.html?...

1	COs/POs	a	b	c	d	e	f	G	H	i	J	K	l
2	CO1	H											
	CO2	H		H				L					
	CO3	H		H		M	M			L		L	
	CO4	H		H									
	CO5	H					M		M				
	CO6	H		H									

3	Category	Humanities and Social studies (HS)	Basic Sciences &Maths (BS)	Engg Sciences (ES)	Professional Core (PC)	Core Elective (CE)	Non-Major Elective (NE)	Open Elective (OE)	Project/ Seminar/ Internship (PR)	
						√				

4	Approval		38th Meeting of Academic Council, July 2018	

PROFESSIONAL ELECTIVE –III

U18PEMT031	**NEURAL NETWORK & FUZZY LOGIC**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Dept of Mechatronics				
OBJECTIVES	To introduce the neural network, associative memories and fuzzy logic system				

UNIT I INTRODUCTION TO NEURAL NETWORKS 9

Introduction, Humans and Computers, Organization of the Brain, Biological Neuron, Biological and Artificial Neuron Models, Characteristics of ANN, McCulloch-Pitts Model, Historical Developments, Potential Applications of ANN. Essentials of Artificial Neural Networks. Artificial Neuron Model, Operations of Artificial Neuron, Types of Neuron Activation Function, ANN Architectures, Classification Taxonomy of ANN – Connectivity, Learning Strategy . (Supervised, Unsupervised, Reinforcement), Learning Rules.

UNIT II FEED FORWARD NEURAL NETWORKS: 9

Single Layer Feed Forward Neural Networks- Introduction, Perceptron Models: Discrete, Continuous and Multi-Category, Training Algorithms: Discrete and Continuous Perceptron Networks, Limitations of the Perceptron Model. Multilayer Feed forward Neural Networks-Credit Assignment Problem, Generalized Delta Rule, Derivation of Backpropagation (BP) Training, Summary of Backpropagation Algorithm, Kolmogorov Theorem, Learning Difficulties and Improvements.

UNIT III ASSOCIATIVE MEMORIES `9

Paradigms of Associative Memory, Pattern Mathematics, Hebbian Learning, General Concepts of Associative Memory, Bidirectional Associative Memory (BAM) Architecture, BAM Training Algorithms: Storage and Recall Algorithm, BAM Energy Function. Architecture of Hopfield Network: Discrete and Continuous versions, Storage and Recall Algorithm, Stability Analysis.

UNIT IV CLASSICAL & FUZZY SETS 9

Introduction to classical sets - properties, Operations and relations; Fuzzy sets, Membership, Uncertainty, Operations, properties, fuzzy relations, cardinalities, membership functions. Fuzzy Logic System Components.Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods.

UNIT V APPLICATIONS 9

Neural network applications: Process identification, control, fault diagnosis. Fuzzy logic applications: Fuzzy logic control and Fuzzy classification.

TEXT BOOKS

1. S. Rajasekharan and G. A. Vijayalakshmipai, "Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications", PHI Publication, 2004.

REFERENCES:

1. Simon Haykin, "Neural Networks- A comprehensive foundation", Pearson Education, 2001.2nd Edition.

2. S.N.Sivanandam, S.Sumathi,S. N. Deepa "Introduction to Neural Networks using MATLAB 6.0", TMH, 2006.

3. James A Freeman and Davis Skapura, Neural Networks Pearson Education, 2002.

4. Timothy J. Ross, " Fuzzy Logic With Engineering Applications", McGraw-Hill Inc. 1997.3rd Edition.

5.John Yen and Reza Langan, "Fuzzy Logic: Intelligence, Control and Information", Pearson Education,2004.

COURSE OUTCOMES (COs)	
CO1	To learn basics of neural networks.
CO2	To learn about feed forward neural network.
CO3	To learn about associative memories
CO4	To learn about classical and fuzzy sets.
CO5	To learn about application of neural networks and fuzzy logic.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l

2	CO1			H			M						
	CO2			H							H	H	
	CO3		M		H								
	CO4					M	H					H	
	CO5							H	H			H	
3	Category	Professional Elective(PE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

U18PEMT032	COMPOSITE MATERIALS AND STRUCTURE	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Engineering Mathematics, Engineering Physics				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To make the student understand the analysis of composite laminates under different loading conditions and different environmental conditions				

UNIT I MICROMECHANICS 10

Introduction – advantages and application of composite materials – types of reinforcements and matrices – micro mechanics – mechanics of materials approach, elasticity approach- bounding techniques – fiber volume ratio – mass fraction – density of composites. effect of voids in composites.

UNIT II MACROMECHANICS 10

Generalized Hooke's Law – elastic constants for anisotropic, orthotropic and isotropic materials – macro mechanics – stress-strain relations with respect to natural axis, arbitrary axis – determination of in plane strengths of a lamina – experimental characterization of lamina. failure theories of a lamina. hygrothermal effects on lamina.

UNIT III LAMINATED PLATE THEORY 10

Governing differential equation for a laminate. stress – strain relations for a laminate. different types of laminates. in plane and flexural constants of a laminate. hygrothermal stresses and strains in a laminate. failure analysis of a laminate. impact resistance and interlaminar stresses. netting analysis

UNIT IV FABRICATION PROCESS AND REPAIR METHODS 8

Various open and closed mould processes, manufacture of fibers, importance of repair and different types of repair techniques in composites – autoclave and non-autoclave methods.

UNIT V SANDWICH CONSTRUCTIONS 7

Basic design concepts of sandwich construction – materials used for sandwich construction – failure modes of sandwich panels – bending stress and shear flow in composite beams.

TEXT BOOKS

1. Autar K Kaw, 'Mechanics of Composite Materials', CRC Press, 1997.
2. MadhujiMukhapadhyay, Mechanics of Composite Materials and Structures, University Press, 2004

REFERENCE

1. Agarwal, B.D., and Broutman, L.J., "Analysis and Performance of Fibre Composites," John Wiley and sons. Inc., New York, 1995.
2. Lubin, G., "Handbook on Advanced Plastics and Fibre Glass", Von Nostrand Reinhold Co., New York, 1989.
3. Calcote, L R. "The Analysis of laminated Composite Structures", Von – Nostrand Reinhold Company, New York 1998.
4. Allen Baker, "Composite Materials for Aircraft Structures", AIAA Series, II Edition, 1999.

COURSE OUTCOMES (COs)	
CO1	To learn the basics of composite materials.
CO2	To learn about macro mechanics
CO3	To learn about micromechanics
CO4	To learn about laminate plate theory
CO5	To learn about fabrication process and repair methods.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1		H			H							
	CO2						M						
	CO3		H	L	L	H							
	CO4				M		M						
	CO5			L	H	M							
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

U18PEMT033	UNDERWATER ROBOTICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Transducer				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	The course should enable the students to demonstrate knowledge and understanding of Underwater robotic systems in operation and their applications.				

UNIT 1: INTRODUCTION TO UNDERWATER ROBOTICS 8

Robotics in Water - Basics Representation of Underwater Robot - Types and Classification of Underwater Robotics - Differentiating Aerial and Underwater Robotics - why it is called an perfect engineering product - Overview about Environmental Factors affecting object in water

UNIT 2: CONTROL OF THE UNDERWATER ROBOTICS 10

Control System and Types of Control Systems in Underwater Robotics - Sensors Connected with the Underwater Robotics - Introduction to Underwater Manipulators - Applications of Underwater Vehicles APPLICATION DEVELOPMENT - ASSIGNMENT (1 HOUR)

UNIT 3: ENGINEERING CONCEPTS IN UNDERWATER ROBOTICS 8

Introduction to Fluid Dynamics - Studying of FD Model - Computation Fluid Dynamics on Water Bodies Introduction to Hydraulics - Hydraulics Acting on an Object - Hydraulics as Underwater Pressure Compensator Introduction to Pressure Dynamics - Buoyancy Concept - Studying various Polymers in Buoyancy and Pressure Calculations Introduction to Electrical Power Driven Systems - Studying Different Types - PLC and HMI Interface Systems an Overlook - Electrical Archaeology of Systems ANALYSIS & DEVELOPMENT MODULES - ASSISGNMENT (2 HOURS)

UNIT 4: AUTONOMOUS UNDERWATER SYSTEM 8

Introduction to AUVS - Development of AUV / ROV in Market - Case Study on AUV Control System Basics - Case Study on Subsea Manipulator - Case Study on Technologies Used

UNIT 5: APPLICATIONS OF UNDERWATER ROBOTICS 8

Case Studies and procedure for design of under water robots

TEXTBOOK

1. GianlucaAntonelli “Underwater Robots (Springer Tracts in Advanced Robotics)”, Springer; 3rd ed. 2014 edition

REFERENCES

1. GianlucaAntonelli, Underwater Robots: Motion and Force Control of Vehicle-Manipulator Systems (Springer Tracts in Advanced Robotics), Springer; 3rd ed. 2014 edition

2. Steven W. Moore, Harry Bohm, and Vickie, "Underwater Robotics: Science, Design & Fabrication" MATE Center,2013

COURSE OUTCOMES (COs)	
CO1	Select the components for design of underwater robotics.
CO2	Design, configuration and operation of platforms, both autonomous underwater vehicles (AUVs) and Remotely Operated Vehicles (ROVs).
CO3	Use and interpretation of sensor data for control applications
CO4	Know the procedure of Maneuvering simulations of underwater robots.
CO5	Software architectures for maritime robots.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1					H		M					
	CO2	M			M						H		
	CO3						M		H				
	CO4					H					L		
	CO5				M						H		
3	Category	Professional Elective(PE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

U18PEMT034	**BUILDING AUTOMATION**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Nil				
	Course Designed by – Department of Mechatronics				

OBJECTIVES	Provide the student with an advanced knowledge base and understanding of the design, simulation and safety of Building Automation System (BAS).

UNIT 1 INTRODUCTION **9**

Introduction to Building Automation System, Features, Characteristics, Drawbacks of Building Automation system.Various Systems of Building Automation – Building Management System, Energy Management System, Security System, Safety System, Video Management System.

UNIT 2 BUILDING MANAGEMENT SYSTEM **9**

Introduction, HVAC, Sensors & Transducers – Temperature, Pressure, Level, Flow, RH. Meaning of Analog & Digital Signals, Valves and Actuators, Valve & Actuator Selection, Various Controllers, Concept of Controller IOs, Std Signals, Signal Compatibility between Controller & Field Devices. AHU – Concept, Components, Working Principle.AC Plant Room – Concept, Components, Refrigeration Cycle Working Principle, Chiller Sequencing, AC Plant Sequencing. Feedback Control Loops, Heat – Types, Heat Transfer Principles, Measurement of Heat Transfer. Psychrometry– Concept, ASHRAE Psychrometric Chart, Meaning of Various Terms – DBT, WBT, ST, RH, DPT, Sensible & Latent Cooling & Heating, Numericals. Job IO Summary Calculation, Controller Sizing, AI to DI Conversion, Cable Selection, Earthing – Meaning, Importance, Panel Earthing, EMI & Tackling EMI.Logic Examples, CL Programming.

UNIT 3 ENERGY MANAGEMENT SYSTEM **9**

Concept, Energy Meters, Types, Meter Networking, Monitoring Energy Parameters, Analysis of Power Quality – Instantaneous Power, Active Power, Reactive Power, Power Factor, Voltage, Current. Effect of Power Quality on Energy Consumption, Energy Reports, Energy Conservation, Importance of Energy Saving.

UNIT 4 SAFETY SYSTEMS **9**

Introduction, Fire –Meaning, Fire Development Stages, Fire Sensors & Detectors, Detector Placement, Detectors Required For Various Applications. Fire Extinguishing Principles, Fire Extinguishers & Its Classification. Fire Alarm System – Controllers, Components, Features, Concept of Fire Loop & Fire Devices, 2-Wire & 4-Wire Loops, Working Principle, System Description, Pre-alarm, Alarm, Trouble, Fault, Differences, Cable Selection, Installation Guidelines Best Installation Practices, Logic Example. NFPA and IS2189 Stds, System Programming.

UNIT 5 INTEGRATED SYSTEMS 9

Introduction, Integration of Building Management System, Energy Management System, Safety System, Security Systems & Video Management, Benefits of Integrated Systems, Challenges, Future Prospects of Integrated Systems

TEXT BOOK

1. Reinhold A. Carlson Robert A. Di Giandomenico, 'Understanding Building Automation Systems: Direct Digital Control, Energy Management, Life Safety, Security Access Control, Lighting, Building', 1 st edition (R.S. Means Company Ltd), (1991)

REFERENCE

1. Smart Buildings by Jim Sinopoli, Butterworth-Heinemann imprint of Elsevier,2nd ed., 2010.
2. Understanding Building Automation Systems (Direct Digital Control, Energy Management, Life Safety, Security, Access Control, Lighting, Building Management Programs) by Reinhold A. Carlson, Robert A. Di Giandomenico, pub.by R.S. Means Company, 1991.
3. Intelligent Building Systems by Albert Ting-Pat So, WaiLok Chan, Kluwer Academic publisher,3rd ed., 2012.
4. Design of Special Hazards and Fire Alarm Systems by Robert Gagnon, Thomson Delmar Learning; 2nd edition, 2007.
5. HVAC Controls and Systems by Levenhagen, John I.Spethmann, Donald H., McGraw-Hill Pub.
6. HVAC Control in the New Millennium by Hordeski, Michael F, Fairmont press, 2001.
7. Process Control- Instrument Engineers Handbook by Bela G. Liptak, Chilton book co.

COURSE OUTCOMES (COs)	
CO1	Select and evaluate the different transducers, actuators, AC, refrigeration systems in modern Buildings
CO2	Identify the importance and techniques of energy conservations in BAS for simple applications
CO3	Design and installation methods of safety sensors for simple application
CO4	Know the procedure for integrated and secure smart building techniques
CO5	Identify and describe the basic mechanical components and controls in an HVAC control system

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1					H		M					
	CO2	M			M						H		
	CO3						M		H				
	CO4					H					L		
	CO5				M						H		
3	Category	Professional Elective(PE)											

4	Approval	47th Meeting of Academic Council, July, 2018

PROFESSIONAL ELECTIVE-IV

U18PEMT041	**DIGITAL SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Engineering Mathematics				
	Course Designed by – Department of Mechatronics Engineering				
OBJECTIVES	To learn the operation of various DSP devices. To understand the Design Algorithm of various filters				

UNIT I CLASSIFICATION OF SIGNALS 9

Characterization and classification of signals – examples of signals – continuous versus discrete – analog versus digital – advantages of digital signal processing compared with analog processing- Sampling of Analog Signals – Aliasing. Linear Time Invariant Systems (LTIS) – Linearity – Time Invariant – Causality – stability – Response of CT – LTI System using Convolution Integral Response of DT – LTI system using convolution SUM – Finding Impulse Response of LTI using Laplace Transform – Z – Transform & its Properties- Finding Impulse Response of DT – LTI system using Z – transform.

UNIT II FAST FOURIER TRANSFORM 9

Fourier series analysis, Spectrum of C.T. signals, Fourier Transform and Laplace Transform in signal analysis. Spectrum of D.T. signals, Discrete Time Fourier Transform (DTFT), Discrete Fourier Transform (DFT) – Introduction to radix – 2 FFT – DIT & DIF radix 2 FFT.

UNIT III FIR FILTER DESIGN 9

FIR Filters: Design of Filters – Frequency selective filters – Linear filtering – Structures for FIR – Design of FIR Filters – using windows – Frequency Sampling – Linear phase FIR Filters.

UNIT IV DIGITAL FILTER DESIGN 9

Review of design of analogue Butter worth and Chebyshev Filters, Frequency transformation in analogue domain – design of IIR digital filters using impulse invariance technique – Design of digital filters using bilinear transform – Pre warping – Frequency transformation in digital domain – Realization using direct, cascade and parallel forms.

UNIT V DSP PROGRAMMING *9*

Effect of Number representation on Quantization – Overflow – Need for scaling – truncation error – coefficient Quantization error – limit cycle oscillations. Multichannel – Multi –

dimensional – typical applications of DSP – Introduction to Programmable DSP – Instruction set of TMS 320C50.

TEXT BOOKS

1. Sanjith K. Mitra "Digital Signal Processing", Tata McGraw–Hill, New Delhi, 3rd Edition, 2007.

REFERENCES

1. Allan V.Oppenheim& Donald W. Schafer, "Digital Signal Processing", PHI of India, 1989.
2. Texas Instruments, User Guide TMS 320C50.
3. Ludemann L.C. "Fundamentals of Digital Signal Processing", John Wiley Inc., 1992.
John G. Proakis and Dimitris G. Manolakis, "Digital Signal Processing, Algorithms and Application", PHI of India Ltd., New Delhi 3rd Edition 2000.

COURSE OUTCOMES (COs)	
CO1	To learn about Characterization and classification of signals
CO2	To learn about Discrete Fourier Transform (DFT)
CO3	To study about Various design method of FIR Filters
CO4	To study about Various design method of IIR Filters
CO5	To Study about Various Digital Signal Processors

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1					H		M					
	CO2	M			M			H					
	CO3						M		H				
	CO4					H		M			L		
	CO5				M		H		M	H			
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

U18PEMT042	UNCONVENTIONAL MACHINING PROCESSES	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Manufacturing Technology, Engineering Chemistry				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	The students are trained to demonstrate different unconventional machining processes and know the influence of difference process parameters on the performance and their applications				

UNIT I INTRODUCTION **6**

Unconventional machining Process – Need – classification – Brief overview.

UNIT II MECHANICAL ENERGY BASED PROCESSES **9**

Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining - Ultrasonic Machining.(AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR- Applications.

UNIT III ELECTRICAL ENERGY BASED PROCESSES **9**

Electric Discharge Machining (EDM)- working Principle-equipments-Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing – Wire cut EDM – Applications.

UNIT IV CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES **11**

Chemical machining and Electro-Chemical machining (CHM and ECM)-Etchants – Maskant - techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications. Principles of ECM- equipments-Surface Roughness and MRR Electrical circuit-Process Parameters- ECG and ECH - Applications.

UNIT V THERMAL ENERGY BASED PROCESSES **10**

Laser Beam machining and drilling (LBM), plasma Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types - Beam control techniques – Applications.

TEXT BOOKS

1. Vijay.K. Jain “Advanced Machining Processes” Allied Publishers Pvt. Ltd., New Delhi, 2007
2. Pandey P.C. and Shan H.S. “Modern Machining Processes” Tata McGraw-Hill, New Delhi, 2007.

REFERENCES

1. Benedict. G.F. "Nontraditional Manufacturing Processes", Marcel Dekker Inc., New York, 1987.
2. McGeough, "Advanced Methods of Machining", Chapman and Hall, London, 1998.
3. Paul De Garmo, J.T.Black, and Ronald.A.Kohser, "Material and Processes in Manufacturing" Prentice Hall of India Pvt. Ltd., 8thEdition, New Delhi , 2001.

COURSE OUTCOMES (COs)	
CO1	To learn about various unconventional machining processes
CO2	To understand the basic mechanical machining processes
CO3	To understand the basics of electrical discharge machine and related parameters
CO4	To learn the important concepts of chemical machining processes
CO5	To study about the electro chemical machining process and the various parameters associated to it.

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1					H	L	M					
	CO2	H			H						M		
	CO3			M			H		M				
	CO4					H							
	CO5			M	L						M		
3	Category	Professional Elective(PE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

U18PEMT043	**COGNITIVE ROBOTICS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Robotics & Machine Vision System				
	Course Designed by – Dept of Mechatronics				

OBJECTIVES	To understand the cognitive mechanisms adopted by the robot

UNIT 1: CYBERNETIC VIEW OF ROBOT COGNITION AND PERCEPTION 6

Introduction to the Model of Cognition,Visual Perception,Visual Recognition,Machine Learning,Soft Computing Tools and Robot Cognition

UNIT 2: MAP BUILDING 12

Introduction, Constructing a 2D World Map,Data Structure for Map Building,Explanation of the Algorithm, An Illustration of Procedure Traverse Boundary,An Illustration of Procedure Map Building ,Robot Simulation, Execution of the Map Building Program

UNIT 3: RANDOMIZED PATH PLANNING 9

Introduction, Representation of the Robot's Environment, Review of configuration spaces, Visibility Graphs, Voronoi diagrams, Potential Fields and Cell Decomposition, Planning with moving obstacles, Probabilistic Roadmaps, Rapidly exploring random trees, Execution of the Quad tree-Based Path Planner Program

UNIT 4: SIMULTANEOUS LOCALIZATION AND MAPPING (SLAM) 12

Problem Definition, Mathematical Basis, Example: SLAM in Landmark Worlds, Taxonomy of the SLAM Problem, Extended Kalman filter, Graph-Based Optimization Techniques, Particle Methods Relation of Paradigms

UNIT 5:ROBOT PROGRAMMING PACKAGES 6

Robot Parameter Display, Program for Bot Speak, Program for Sonar Reading Display, Program for Wandering Within the Workspace, Program for Tele-operation, A Complete Program for Autonomous Navigation

TEXT BOOKS:

1.Patnaik, Srikanta, "Robot Cognition and Navigation An Experiment with Mobile Robots",Springer-Verlag Berlin and Heidelberg,2007.

2.Howie Choset, Kevin LynchSeth Hutchinson, George Kantor, Wolfram Burgard, Lydia Kavraki, and Sebastian Thrun, "Principles of Robot Motion-Theory, Algorithms, and Implementation", MIT Press, Cambridge,2005.

REFERENCES:

1.Sebastian Thrun, Wolfram Burgard, Dieter Fox, "ProbabilisticRobotics", MIT Press, 2005.

2.Margaret E. Jefferies and Wai-Kiang Yeap,"Robotics and Cognitive Approaches to Spatial Mapping", Springer-Verlag Berlin Heidelberg 2008

COURSE OUTCOMES (COs)	
CO1	To learn the basic concepts of cognitive processes.
CO2	To learn about the map building methods.
CO3	To study about the path planning procedure
CO4	To study about the SLAM technique
CO5	To study about the Programming packages

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M			H	H	M			H	H	M	H
	CO2					H					H		
	CO3		M		H	H		M		H	H		M
	CO4				M	H				M	H		
	CO5					H					H		
3	Category	Professional Elective(PE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

U18PEMT044	**INDUSTRIAL AUTOMATION**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Applied Hydraulics and Pneumatics, Transducer Engineering				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the basic concepts and components of sensors, switching elements .To learn the automation concepts based on industrial applications				

UNIT I INTRODUCTION-ACTUATORS AND SENSORS 9

Actuators: Types of motion Conversion- Electric Linear actuators-Electric Rotary Actuators- Fluid Power Linear Actuators-Fluid power Rotating Actuators

Sensors: Binary Position Sensors-Pneumatic Position Sensors-Comparison between different position sensors-Point sensors for variables other than position

UNIT II SWITCHING THEORY 10

Binary Elements-variables-basic logic gates-Basic theorems-K Map- Practical examples of switching systems –Timers-counters-Schmitt triggers-encoders-parity detector-binary comparator

UNIT III SEMI FLEXIBLE AUTOMATION 8

Drum Programmers-Programmable Timers and Limit Switches-Card and Tape recorders-Matrix boards-Programmable counters.

UNIT IV FLEXIBLE AUTOMATION 9

PLC construction-Programming PLC- Ladder diagrams for PLC-PLC vs. Relay-PLC applications-Microcomputer architecture-Ramping a step motor-Assembly language Programming.

UNIT V ASSEMBLY AUTOMATION 9

Non Vibratory Feeding and orientation Devices-Vibratory feeding and orienting Devices-Parts Transfer-NC systems-Robot grippers-Robot Sensors-Robot Programming

TEXT BOOK:

1. David W.Pessen, Industrial Automation – Circuit design and components, Willey, India Edition, 2011.

REFERENCES :

1. David W.Pessen, Industrial Automation: Circuit design and components, Wiley indiaPvt.Ltd, 2011.

2. Saeed B. Niku, Introduction to Robotics: Analysis, Systems, Applications, 2nd edition, Pearson Education India, PHI 2003 (ISBN 81-7808-677-8)

3. Ramesh Jam, RangachariKasturi, Brain G. Schunck, Machine Vision, Tata McGraw-Hill, 1991. 1st Edition.

4. Yoremkoren, Robotics for Engineers, McGraw-Hill, USA, 1987.

COURSE OUTCOMES (COs)	
CO1	To introduce the actuators ,Sensors and its components
CO2	To explain the various methods of Switching theory
CO3	To explain the various miscellaneous switching elements
CO4	To explain the programmable controllers and Microcomputers

CO5	To introduce assembly automation

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1					H		M					
	CO2	H			M						H		
	CO3			L			H		L				
	CO4					H					M		
	CO5			L	M						H		
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

PROFESSIONAL ELECTIVE-V

	DIGITAL IMAGE PROCESSING	**L**	**T**	**P**	**C**
U18PEMT051	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Robotics & Machine vision system				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the basic concepts of Digital Image Processing and various techniques used to resolve the images				

UNIT I FUNDAMENTALS 8

What is Digital image processing, Examples (Briefly), Components of Image Processing System, Light and electromagnetic spectrum, Image Sensing and Acquisition, Simple Image Formation Model, Image Sampling and Quantization:- Representing Digital Images, Spatial and Grey level Resolution, Basic Relationship Between Pixels.

UNIT II IMAGE ENHANCEMENT IN SPATIAL DOMAIN 9

Background, some Basic Grey Level Transformation:- Image Negatives, Log negatives, Piecewise – Linear Transformation Functions:- Contrast stretching, Grey level Slicing, Bit Plane Slicing, Histogram processing: - Histogram Equalization, Histogram Specification, Local Enhancement.

UNIT III IMAGE ENHANCEMENT IN FREQUENCY DOMAIN 9

Two dimensional DFT and its Inverse, Filtering the frequency domain, Basics of filtering in frequency domain, smoothing and sharpening filters. Color Image Processing:- Color Fundamentals and Color Models.

UNIT IV IMAGE COMPRESSION 9

Fundamentals, Coding Redundancy, Interpixel Redundancy Psycho-Visual Redundancy, Image Compression Models, Error Free Compression, Variable – Length Coding, Huffman Coding, Arithmetic Coding, Run-length coding, Lossy Compression, Transform coding, JPEG.

UNIT V IMAGE SEGMENTATION 10

Detection of Discontinuous, Edge linking and Boundary Detection:- Local Processing, Thresholding:- Basic Global Thresholding, Region Based Segmentation:- Region Growing, Region Splitting and Merging, Use of Motion In Segmentation.

TEXTBOOKS:

1. Digital image processing by Rafael C. Gonzale Z, Richard E.Words, Pearson Education, Asia,3rd Edition, 2008.

REFERENCES

1. Fundamental of Digital Image Processing by Anil. K. Jain, Prentice Hall of India Publishing Ltd., New Delhi, 2002. 7th Edition

COURSE OUTCOMES (COs)	
CO1	To learn Fundamentals of Digital Images and the ways to represent it
CO2	To learns the various ways of representing image enhancement in spatial domain
CO3	To learn the concept of image enhancement in frequency domain
CO4	To study about the image compression techniques
CO5	To learn the various methods to specify image boundaries

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l

2	CO1				M	H							
	CO2	L				H							
	CO3				M	H							
	CO4	L			M	H							
	CO5				M	H							
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

	RAPID PROTOTYPING	**L**	**T**	**P**	**C**
U18PEMT052	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Computer Integrated Manufacturing				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To study about prototyping principles and tools used for prototyping and to learn about the applications of rapid prototyping				

UNIT I INTRODUCTION TO RAPID PROTOTYPING 7

Introduction: Need for time compression in product development, Product development-conceptual design – development- detail design-prototype- tooling.

UNIT II RP SYSTEMS CLASSIFICATIONS 9

Classification of RP systems, Stereo lithography systems- Principle- process parameters-process details-machine details, Applications.

Direct Metal Laser Sintering (DMLS) system - Principle process parameters process details-machine details, Applications.

UNIT III RP SYSTEM MANUFACTURING TECHNIQUES 9

Fusion Deposition Modeling - Principle- process parameters-process details-machine details, Applications.Laminated Object Manufacturing - Principle process parameters process details machine details, Applications.

UNIT IV DESIGN 3-DIMENSIONAL PRINTERS 10

Solid Ground Curing - Principle- process parameters-process details-machine details, Applications.3-Dimensional Printers - Principle- process parameters-process details-machine details, Applications, and other Concept Modelers like Thermo jet printers, Sander's model maker, JP system 5, Object Quadra system.

UNIT V APPLICATIONS OF RP SYSTEMS 10

Laser Engineering Net Shaping (LENS), Ballistic Particle Manufacturing (BPM)-Principle. Introduction to rapid tooling and rapid manufacturing, software for RP- STL files, Magics, Mimics Application of Rapid prototyping in Medical field.

TEXTBOOKS:

1. Pham D.T & Dimov.S.S, Rapid manufacturing, Springer-Verlag, London, 2001
2. **C. K. Chua ,K.F. Leong , C.S. Lim, Rapid Prototyping: Principles and Applications (Book & CD Rom),3rd edition, 16 Dec 2008**

REFERENCES

1. Terry Wohlers, Wohlers Report 2000, Wohlers Assosiates, USA, 2000.
2. M. Adithan ,Rapid Prototyping,2015

COURSE OUTCOMES (COs)	
CO1	To learn the basic concepts of product development
CO2	To learn about the various types of RP systems and their applications
CO3	To study about the different types of RP modeling systems and their applications
CO4	To understand the types of solid curing process and its applications
CO5	To learn about the different types 3-Dimensional Printers and their applications

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			H			M						
	CO2			H		H				M	H	H	
	CO3		M		H	H		H					
	CO4	M	H			M	H					H	
	CO5	L						H	H	M		H	
3	Category	Professional Elective(PE)											
4	Approval	47th Academic Council, July 2018											

U18PEMT053	INTERNET OF THINGS FOR MECHATRONICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Problem Solving and Python Programming				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To understand the basics of Internet of Things , To understand different applications of Internet of Things ,To understand the fundamental aspects of IoT.				

UNIT I INTRODUCTION TO INTERNET OF THINGS 9

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.

UNIT II SENSORS IN IOT 10

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.

UNIT III INTERFACING METHODOLOGIES 8

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).

UNIT IV HARDWARE & SOFTWARE PLATFORMS **9**

Hardware Platforms - Intel Galileo, Edison, Arduino, Beaglebone Black & Raspberry Pi.
Software Platforms - Intel XDK, Node-RED, VISUINO, Fritzing, 123dCircuits, Scratch

UNIT V APPLICATIONS OF IoT 9

Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring

TEXT BOOK

1.Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, "Industrial Robotics:Technology, Programming and Applications", McGraw Hill Book Company, 2012

REFERENCES

1. Saeed B. Niku, Introduction to Robotics: Analysis, Systems, Applications, 2nd edition, Pearson Education India, PHI 2003 (ISBN 81-7808-677-8)
2. Ramesh Jam, RangachariKasturi, Brain G. Schunck, Machine Vision, Tata McGraw-Hill, 1991. 1st Edition.

3. Yoremkoren, Robotics for Engineers, McGraw-Hill, USA, 1987.
4. P.A. Janaki Raman, Robotics and Image Processing, Tata McGraw-Hill, 1991.

COURSE OUTCOMES (COs)	
CO1	To Introduce The Introduction to Internet of Things
CO2	To Explain the Sensors in IoT
CO3	To explain the Interfacing Methodologies
CO4	To explain the Hardware & Software platforms
CO5	To explain the applications of IoT

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			M	M	H	M		H	M		M	H
	CO2	M		M	M	H	H				M		
	CO3		M		M	H	H		H	M			M
	CO4				M	H		M			M	L	
	CO5		H		M	H		M	H	L	M	M	L
3	Category	Professional Core(PC)											
4	Approval	47th Academic Council, July 2018											

U18PEMT054	**VETRONICS**	**L**	**T**	**P**	**C**
	Total Contact Hours -45	3	0	0	3
	Prerequisite –				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce all types of Vetronics and their applications in Engineering.				

UNIT I FUNDAMENTALS OF VEHICLE ENGINEERING 6

Engine – Types – Modern Engines –Advanced GDI, Turbo-charged engines transmissions, Chassis systems – Need for Avionics in Civil and Military aircraft and Space systems

UNIT II AUTOMOTIVE ENGINE CONTROL, MONITORING AND DIOGNASTICS SYSTEMS 9

Components of Electronic Engine Management– Engine control functions, Engine control modes, Fuel delivery systems, MPFI, Ignition Systems, Diagnostics – Compression ignition Engines – Emission control Management – Hybrid Power Plants – BAS

UNIT III AUTOMOTIVE TRANSMISSION AND SAFETY SYSTEMS 12

Transmission control – Autonomous cruise control – Braking control, ABS – Traction control, ESP, ASR – Suspension control – Steering control – Stability control– Parking Assist Systems– Safety Systems, SRS, Blind Spot Avoidance – Auto transmission electronic control, Telematics, Automatic Navigation, Future Challenges

UNIT IV AIRCRAFT MECHATRONICS 12

Fundamentals - components of an airplane and their functions - motions of a plane – Inertial Navigation – Sensors - Gyroscope- Principles , Gyro equations, Rate Gyros - Rate integration and free Gyro, Vertical and Directional Gyros, Laser Gyroscopes, Accelerometers. Direct reading compass, Types of actuation systems-Linear and non-linear actuation system, modeling of actuation systems, Performance testing equipments for sensors and actuation systems. measurement and control of Pressure , temperature fuel quantity, rpm, torque, engine vibration and power. Electrical Power requirement for Military and Civil standards. Satellite navigation - GPS -system description - basic principles -position and velocity determination

UNIT V MARINE MECHATRONIC SYSTEMS 6

Basics of Marine Engineering – Marine Propulsion Mechatronics elements in ships, submarines, Variable Buoyancy Systems

TOTAL NO .OF PERIODS: 45

REFERENCES

1. William B.Ribbens, “Understanding Automotive Electronics – 7th Edition, Butterworth, Heinemann Wobum, 2004..

2. Robert N Brady, Automotive Computers and Digital Instrumentation, Areston Book Prentice Hall, Eagle Wood Cliffs, New Jersey, 2000..

3. R.K. Jurgen, Automotive Electronics Handbook, McGraw Hill 2nd Edition. 2000

4. Collinson R.P.G. 'Introduction to Avionics', Chapman and Hall, 2002

5. Pallet, E.H.J. 'Aircraft Instruments & Integrated systems', McGraw-Hill, 2002

6. Myron Kyton, Walfred Fried, 'Avionics Navigation Systems', John Wiley& Sons, 2000

7. Pallett, E.H.J. 'Aircraft instruments, principles and applications', Pitman publishing Ltd., London, 1995

COURSE OUTCOMES (COs)	
CO1	To learn the basics of fundamentals of vehicle engineering
CO2	To study about the automotive engine control, monitoring and diognastics systems
CO3	To learn about the basic automotive transmission and safety systems
CO4	To study about The Aircraft Mechatronics
CO5	To learn about Marine Mechatronics Systems

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1				M	H							H
	CO2	M			M	H							
	CO3				M	H							M
	CO4				M	H							
	CO5				M	H							
3	Category	Open Elective(OE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

PROFESSIONAL ELECTIVE-VI

U18PEMT061	**EMBEDDED SYSTEM DESIGN**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3

	Prerequisite – Electron Devices & Circuits
	Course Designed by – Dept of Electronics and communication Engineering
OBJECTIVES	To study embedded hardware and embedded microcomputer systems

UNIT I REVIEW OF EMBEDDED HARDWARE 9

Gates – Timing diagram – Memory – Microprocessors Buses – Direct Memory Access – Interrupts – Built-in functions on the Microprocessor – Conventions used on Schematic – schematic. Interrupts Microprocessor Architecture – Interrupt basics – Shared data Problem – Interrupt latency.

UNIT II MICROCHIP PIC MICRO CONTROLLER 9

Introduction, CPU Architecture – Registers – Instruction sets addressing modes – Loop timing – Timers – Interrupts, Interrupt timing, I/O Expansion, I^2C Bus Operation Serial EEPROM, Analog to Digital converter, UART – Baud Rate – Data Handling – Initialization, special features- Serial Programming – Parallel Slave Port.

UNIT III EMBEDDED MICROCOMPUTER SYSTEMS 9

Motorola MC68H11 Family Architecture, Registers, Addressing modes Programs, Interfacing methods parallel I/O interface, parallel port interfaces, Memory Interfacing, High Speed I/O Interfacing, Interrupts – Interrupt service routine – Features of interrupts – Interrupt vector and Priority, Timing Generation and Measurements, Input capture, Output compare, frequency Measurement, Serial I/O devices RS 232, RS485.

UNIT IV SOFTWARE DEVELOPMENT 9

Round Robin, Round robin with Interrupts, function – Queue – Scheduling Architecture, Algorithms. Introduction to – Assembler – Compiler – Cross Compilers and Integrated Development Environment (IDE) Object Oriented Interfacing, Recursion, Debugging strategies, Simulators.

UNIT V REAL TIME OPERATING SYSTEMS 9

Task and Task States, Tasks and Data, Semaphores and Shared Data Operating System services – Message Queues – Timer function – Events – Memory Management, Interrupt Routines in an RTOS environment, Basic design using RTOS.

TEXT BOOKS :

1. Jonarthan W. Valvano "Embedded Microcomputer Systems", Real Time Interfacing", Thomson learning, 2001.3rd Edition.

REFERENCES :

1. David E. Simon, "An Embedded Software Primer", Pearson Education Asia, 2001.
2. John B Pitman, "Design with PIC Micro controllers", Pearson Education Asia, 1998.
3. Burns, Alan and Wellings, "Real – Time Systems and Programming Languages", second edition. Harlow: Addison Wesley – Longman, 1997.

4. Grehan Moore and Cyliax, "Real Time Programming: A guide to 32 bit Embedded Development", Addison Wesley – Longman, 1998.
5. Heath Steve, "Embedded Systems Design", Newnes, 1997.2nd Edition.

COURSE OUTCOMES (COs)	
CO1	To learn review of embedded hardware
CO2	To learn about microchip PIC micro controller
CO3	To learn embedded microcomputer systems
CO4	To learn about software development
CO5	To understand the real time operating systems

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			H			M						
	CO2			H							H	H	
	CO3		M		H								
	CO4					M	H					H	
	CO5							H	H			H	
3	Category	Open Elective(OE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

U18PEMT062	**TOTAL QUALITY MANAGEMENT**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Professional Courses				
	Course Designed by – Dept of Mechanical Engineering				

OBJECTIVES

1. To introduce to the student about the basic terms related to quality and concepts of quality management
2. To familiarize the student about the basic principles of total quality management
3. To acquaint the student with the basic statistical tools used in process control
4. To introduce to the student about the various tools used in implementing and checking total quality management
5. To familiarize the student about the different quality systems used in auditing the quality of a company/industry/organization

UNIT I **9**

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs – AnalysisTechniques for Quality Costs, Basic concepts of Total Quality Management, HistoricalReview, Principles of TQM, Leadership – Concepts, Role of Senior Management,Quality Council, Quality Statements, Strategic Planning, Deming Philosophy, Barriers toTQM Implementation.

UNIT II 9

Customer satisfaction – Customer Perception of Quality, Customer Complaints, ServiceQuality, Customer Retention, Employee Involvement – Motivation, Empowerment,Teams, Recognition and Reward, Performance Appraisal, Benefits, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, 5S, Kaizen, Supplier Partnership –Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development,Performance Measures – Basic Concepts, Strategy, Performance Measure.

UNIT III **9**

The seven tools of quality, Statistical Fundamentals – Measures of central Tendencyand Dispersion, Population and Sample, Normal Curve, Control Charts for variables andattributes, Process capability, Concept of six sigma, New seven Management tools.

UNIT IV **9**

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality FunctionDeployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality LossFunction, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA –Stages of FMEA.

UNIT V **9**

Need for ISO 9000 and Other Quality Systems, ISO 9000:2000 Quality System –Elements, Implementation of Quality System, Documentation, Quality Auditing, TS16949, ISO 14000 – Concept, Requirements and Benefits

TEXT BOOKS:

1. Dale H.Besterfiled, et al., “Total Quality Management”, Pearson Education, Inc.2003. (Indian reprint 2004). ISBN 81-297-0260-6.

REFERENCE BOOKS:

1. Evans. J. R. & Lindsay. W,M "The Management and Control of Quality", (5th Edition),South-Western (Thomson Learning), 2002 (ISBN 0-324-06680-5).
2. Feigenbaum.A.V. "Total Quality Management", McGraw-Hill, 1991.
3. Oakland.J.S. "Total Quality Management", Butterworth Hcinemann Ltd., Oxford,1989.
4. Narayana V. and Sreenivasan, N.S. "Quality Management – Concepts and Tasks",New Age International 1996.
5. Zeiri. "Total Quality Management for Engineers", Wood Head Publishers, 1991.
6. freecomputerbooks.com/**Total-Quality-Management**-and-Six-Sigma.htm

COURSE OUTCOMES (COs)	
CO1	By understanding about various quality terms, it will be helpful for the student to maintain quality in his/her organization
CO2	The student will be able to formulate new plans/procedures to be implemented to achieve the desired quality status by knowing about the various principles of quality management
CO3	The student will be able to analyze the periodical data in quality control using statistical tools
CO4	The total quality management tools will help the student to understand the procedures in measuring the quality of the organization/process and will also enable him/her to identify the parameters that are improving/depriving the quality
CO5	By knowing about the quality ISO systems, the student will be maintain processes/documentation properly so that the quality maintained by his/her organization gets recognized

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1			H			M						
	CO2			H							H	H	
	CO3		M		H								
	CO4					M	H					H	

	CO5							H	H			H	
3	Category	Open Elective(OE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

U18PEMT063	MICRO ELECTRONICS AND NANO ELECTRONICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Electronics Engineering & Basics Physics				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the various concepts about the micro electronics and nano electronics				

UNIT-I SEMICONDUCTOR PHYSICS 9

Introduction to semiconductor physics: Review of quantum mechanics, electrons in periodic lattices, E-k diagrams, Quasi-particles in semiconductors, electrons, holes and phonons. Boltzmann transport equation and solution in the presence of low electric and magnetic fields - mobility and diffusivity; carrier statistics; continuity equation, poisson's equation and their solution; high field effects: velocity saturation, hot carriers, avalanche breakdown, punch through and kirk effects.

UNIT-II SEMICONDUCTOR JUNCTIONS 9

Semiconductor junctions: Schottky, homo- and hetero-junction band diagrams and I-V characteristics, small signal switching models; two terminal and surface states devices based on semiconductor junctions. Bipolar transistor working, its charge control, and gummel poon model, structure of graded base, graded emitter transistor, hetro junction transistor.

UNIT-III MOS STRUCTURES 9

MOS structures: Semiconductor surfaces; the ideal and non ideal MOS capacitor band diagrams and CVs; Effects of oxide charges, defects and interface states; characterization of MOS capacitors: HF and LF CVs, avalanche injection; high field effects and breakdown. Long & short channel effects.

NANOELECTRONICS

UNIT-IV MOSFET 9

Shrink-down approaches: Introduction, CMOS scaling, the nanoscale MOSFET, finfets, vertical. MOSFETs, limits to scaling, system integration limits (interconnect issues etc.), resonant tunneling transistors, single electron transistors, new storage, optoelectronic, and spintronics devices.

UNIT-V CARBON NANOTUBE ELECTRONS **9**

Atoms-up approaches: Molecular electronics involving single molecules as electronic devices, transport in molecular structures, molecular systems as alternatives to conventional electronics, molecular interconnects; Carbon nanotube electronics, bandstructure& transport, devices, mems applications.

TEXTBOOKS:

1. Millman and Grabel, "Microelectronics", 2nd Ed. Tata McGraw-Hill (2004).
2. Hari Singh Nalwa, "Nanostructured Materials and Nanotechnology", Academic Press, 2002

REFERENCE:

1. Sedra A S and Smith K C, "Microelectronic Circuits" 4th Ed., New York, Oxford University Press, New York (1997).
2. Tocci R J and Widmer N S, "Digital Systems – Principles and Applications", 10th Ed., Pearson Education India, New Delhi (2001).
3. Cooper and Helfrick, "Modern Electronic Instrumentation and Measuring Techniques", 4th print Prentice Hall of India, New Delhi (1996).
4. Boylestad and Nashelsky, "Electronic Devices and Circuit Theory", 8th Ed, Pearson Education India, New Delhi (2002).
5. S.M. Kang & Y. Leblibici, "CMOS Digital Integrated Circuits-Analysis & Design", TMH, 3rd Ed. 2003.
6. A.Nabok, "Organic and Inorganic Nanostructures", Artech House, 2000.
7. C.Dupas, P.Houdy, M.Lahmani, Nanoscience: "Nanotechnologies and Nanophysics", Springer-Verlag Berlin Heidelberg, 2007.

COURSE OUTCOMES (COs)	
CO1	To introduce the semiconductor physics and quantum electronics
CO2	To explain the different types of junctions
CO3	To explain the MOS structure
CO4	To introduce and explain the nano electronics and its structure
CO5	To understand the concept of various application of micro electronics& Nano electronics

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l

2	CO1		M			H							
	CO2				M	H	M	L					M
	CO3				M	H							
	CO4				M	H							
	CO5				M	H							
3	Category	Professional Elective(PE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

U18PEMT064	**MODERN MANUFACTURING PROCESS**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite –Manufacturing Technology				
	Course Designed by – Dept of Mechatronics				
OBJECTIVES	To understand material removal by using various forms of energy and machining new materials and complex parts with high accuracy by using non-traditional machining				

UNIT I: INTRODUCTION 9

Need of Non-Traditional Machining Processes – Classification Based on Energy, Mechanism, source of energy, transfer media and process – Process selection Based on Physical Parameters, shapes to be machined, process capability and economics – Overview of all processes.

UNIT II : MECHANICAL PROCESS 9

Ultrasonic Machining: Principle- Transducer types – Concentrators – Abrasive Slurry – Process Parameters – Tool Feed Mechanism – Advantages and Limitations – Applications. Abrasive Jet Machining: Process- Principle – Process Variables – Material Removal Rate – Advantages and Limitations – Applications. Water Jet Machining: Principle – Process Variables – Advantages and Limitations – Practical Applications – Abrasive water jet machining process.

UNIT III : ELECTRICAL DISCHARGE MACHINING 9

Electrical Discharge Machining: Mechanism of metal removal – Dielectric Fluid – Flushing methods – Electrode Materials – Spark Erosion Generators – Electrode Feed System – Material Removal Rate – Process Parameters – Tool Electrode Design – Tool wear Characteristics of Spark Eroded Surfaces-

Advantages and Limitations – Practical Applications. Electrical Discharge Wire Cut and Grinding: Principle – Wire Feed System – Advantages and Limitations – Practical applications

UNIT IV : CHEMICAL AND ELECTRO CHEMICAL MACHINING 9

Chemical Machining: fundamentals, Principle –classification and selection of Etchant -chemical milling, Engraving, Blanking – Advantages and limitations – Applications. Electro Chemical Machining: Electro-chemistry of the process-Electrolytes – Electrolyte and their Properties – Material Removal Rate – Tool Material – Tool Feed System – Design For Electrolyte Flow – Process Variables – Advantages and Limitations – Applications – Electro Chemical Grinding: Honing, cutting off, Deburring and turning.

UNIT V : HIGH ENERGY MACHINING PROCESS 9

Electron Beam Machining: Principle –Generation and control of electron beam-Advantages and Limitations – Applications. Laser Beam Machining: Principle –Solid and Gas Laser Application – Thermal Features of LBM – Advantages and Limitations – Applications. Ion Beam Machining: Equipment – process characteristics – Advantages and Limitations – Applications. Plasma Arc Machining: Principle –Gas mixture– Types of Torches – Process Parameters – Advantages and Limitations – Applications. Ion Beam Machining – Principle – MRR – advantages, limitation, applications.

TEXT BOOKS:

1.P.CPandey And H.S. Shan, "Modern Machining Process", Tata McGraw – Hill Publishing Company Limited, New Delhi, 2007

2.V.K. Jain, "Advanced Machining Process", Allied Publishers Pvt Limited 2007

REFERENCES:

1. Amithaba Bhattacharyya, "New Technology", The Institution Of Engineers, India
2. HMT Bangalore, "Production Technology", Tata McGraw–Hill Publishing Company Limited, New Delhi, 2006.
3. Hassan El – Hofy "Advanced machining Processes" MC Graw-Hill, 2005.

COURSE OUTCOMES (COs)	
CO1	To learn the basic concepts of Non-Traditional Machining Processes
CO2	To learn about the various types of mechanical process and their applications
CO3	To study about the electrical discharge machining and their applications
CO4	To study about the chemical machining and their applications
CO5	To study about the electro discharge machining and their applications
Mapping of Course Outcomes(COs) with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low	

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1	M			H	H	M			H	L	M	
	CO2					H							
	CO3		M		H	H		M		H			
	CO4				M	H				M	L		
	CO5					H							
3	Category	Professional Elective(PE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

OPEN ELECTIVES

U18OEMT001	**MEMS & NANOTECHNOLOGY**	**L**	**T**	**P**	**C**
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Basic Electronics				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce the various concepts about the micro electronics mechanical system and Nano technology				

UNIT I INTRODUCTION TO MICRO SENSORS 9

Introduction: Historical background development of microelectronics, evolution of micro sensors, MEMS, emergence of micro machines.

Micro sensors: Introduction, thermal sensors, mechanical sensors, flow sensors and Introduction to SAW devices

UNIT II MEMS MANUFACTURING TECHNIQUES 9

MEMS materials and processing: Overview, metals, semiconductors, ceramic, polymeric and composite materials.

Microstereolithography: Introduction, Scanning Method, Projection Method, Applications. LIGA Process: Introduction, Basic Process and Application.

UNIT III MEMS FABRICATION TECHNIQUES 9

Micro System Fabrication Processes: Photolithography, Chemical Vapor Deposition, Etching, Bulk and Surface Micro Manufacturing

UNIT IV INTRODUCTION TO NANOTECHNOLOGY 9

Introduction to Nanotechnology: The nanoscale. Consequences of the nanoscale for technology and society. - Technologies for the Nanoscale, Top-down versus bottom-up assembly. Visualisation, manipulation and characterisation at the nanoscale, Proximal probe technologies. Self-assembly.

UNIT V NANOSCALE MANUFACTURING 9

Nanoscale Manufacturing: Nanomanipulation, Nanolithography - An introduction to tribology and its industrial applications - Nanoscale Materials and Structure, Nanocomposites, Safety issues with nanoscale powders - Applications, Applications in energy, informatics, medicine, etc

TEXTBOOKS:

1. **Mark Ratner & Daniel Ratner, Nano Technology, Pearson Education,2003.**
2. Tai – Ran Hsu, " MEMS & MICROSYSTEMS Design and Manufacturing", TATA McGRAW-HILL, 2002
3. S.M. Sze, Semiconductor Sensors, John Wiley & Sons, INC., 1994.

REFERENCE:

1. Marc J. Madou, "Fundamentals of Microfabrication", II Edition, CRC Press, 2002.
2. Mohamed Gad-el-Hak, The MEMS Handbook, CRC Press, 2002
3. M.Elwenspoek, R.Wiegerink, Mechanical Microsensors, Springer-Verlag Berlin Heidelberg, 2001.
4. David Ferry, Transport in Nanostructures, Cambridge University Press, 2000.2nd Edition.
5. S.Datta,Electron Transport in Mesoscopic Systems, Cambridge University Press, 1995.

COURSE OUTCOMES (COs)	
CO1	To introduce various micro sensors and emergence of micro machines.
CO2	To study about various materials for micro and Nano fabrication
CO3	To know various micro fabrication methods.
CO4	To understand the concept of Nano scale and technology
CO5	To learn Nano scale manufacturing
Mapping of Course Outcomes(COs) with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low	

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1				M	H	L						
	CO2				M	H	L						
	CO3				M	H	L						H
	CO4				M	H	L						
	CO5				M	H	L						
3	Category	Professional Elective(PE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

U18OEMT002	**NON-DESTRUCTIVETESTING**	**L**	**T**	**P**	**C**
	Total Contact Hours -45	3	0	0	3
	Prerequisite –Basic Electronics				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To introduce all types of NDT and their applications in Engineering.				

UNIT I NON-DESTRUCTIVE TESTING: AN INTRODUCTION, VISUAL INSPECTION & LIQUID PENETRANT TESTING 6

Introduction to various non-destructive methods, Comparison of Destructive and Non destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications.
Physical principles, procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods-water washable, Post – Emulsification methods, Applications

UNIT II EDDY CURRENT TESTING & ACOUSTIC EMISSION 10

Principles, Instrumentation for ECT, Absolute, differential probes, Techniques – High sensitivity techniques, Multi frequency, Phased array ECT, Applications. Principle of AET, Instrumentation, Applications - testing of metal pressure vessels, Fatigue crack detection in aerospace structures.

UNIT III MAGNETIC PARTICLE TESTING & THERMOGRAPHY 10

Principle of MPT, procedure used for testing a component, Equipment used for MPT, Magnetizing techniques, Applications. Principle of Thermography, Infrared Radiometry, Active thermography measurements, Applications – Imaging entrapped water under an epoxy coating, Detection of carbon fiber contaminants.

UNIT IV ULTRASONIC TESTING 10

Principle, Ultrasonic transducers, Ultrasonic Flaw detection Equipment, Modes of display A- scan, B-Scan, C- Scan, Applications, Inspection Methods - Normal Incident Pulse-Echo Inspection, Normal Incident Through-transmission Testing, Angle Beam Pulse-Echo testing, TOFD Technique, Applications of Normal Beam Inspection in detecting fatigue cracks, Inclusions, Slag, Porosity and Intergranular cracks - Codes, standards, specification and procedures and case studies in ultrasonics test.

UNIT V RADIOGRAPHY 9

Principle of Radiography, x-ray and gamma ray sources- safety procedures and standards, Effect of radiation on Film, Radiographic imaging, Inspection Techniques – Single wall single image, Double wall Penetration, Multiwall Penetration technique, Real Time Radiography - Codes, standards, specification and procedures and case studies in Radiography test. Case studies on defects in cast, rolled, extruded, welded and heat treated components - Comparison and selection of various NDT techniques

REFERENCES:

1. Baldev Raj, Jeyakumar,T., Thavasimuthu,M., "Practical Non Destructive Testing" Narosa publishing house, New Delhi, 2002

2. Krautkramer. J., "Ultra Sonic Testing of Materials", 1st Edition, Springer – Verlag Publication, New York, 1996.

3. Peter J. Shull "Non Destructive Evaluation: Theory, Techniques and Application" Marcel Dekker, Inc., New York, 2002

4. www.ndt.net

COURSE OUTCOMES (COs)	
CO1	To learn the basics of various non-destructive methods
CO2	To study about the Eddy Current Testing & Acoustic Emission
CO3	To learn about the basic Magnetic Particle Testing & Thermography
CO4	To study about The Ultrasonic Testing
CO5	To learn about t111.8485he Radiography

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l

2	CO1				M	H							H
	CO2	M			M	H							
	CO3				M	H							M
	CO4				M	H							
	CO5				M	H							
3	Category	Open Elective(OE)											
4	Approval	47th Meeting of Academic Council, July, 2018											

	BIO-MECHATRONICS	**L**	**T**	**P**	**C**
U18OEMT003	Total Contact Hours -45	3	0	0	3
	Prerequisite –Basic Electronics, Sensors Basics				
	Course Designed by – Department of Mechatronics				
OBJECTIVES	To know the principle, design and applications of various flow measurement assisted device for the human functional system				

UNIT I BIO MECHANICS AND SIGNAL PROCESSING 9

Cardiovascular biomechanics, Musculoskeletal and orthopedic biomechanics, human ergonomic, Rehabilitation. Bio-medical signals, Signal acquisition and signal processing-Isolation barriers, Bio-Image processing

UNIT II BIO SENSORS AND ACTUATORS 9

Introduction to Bio mechatronics, Electrodes - Types, - Measurement of blood pressure - Blood Gas analyzers: pH of blood, Smart actuators for biological applications

UNIT III MEDICAL MEASUREMENTS 9

Heart rate-Heart Sound-Pulmonary Function Measurements –Spirometer-Finger tip oximeter-ESR,GSR Measurements

UNIT IV SENSORY ASSIST DEVICES 9

Hearing aids-implants-Optical Prosthetics,Visual Neuroprosthesis-Sonar based Systems,Respiratory aids,Tactile devices for visually challenged

UNIT V ACTIVE AND PASSIVE PROSTHETIC LIMBS 9

Introduction to prosthetics, Passive Prosthetics-Walking Dynamics, Knee and Foot Prothesis, Active Prosthesis-Control of Prostheic arms and hands, Leg Mechanisms, Ankel-Foot Mechanisms, Prosthesis Suspension

TEXTBOOKS

1. Graham M. Brooker, "Introduction to Bio-Mechatronics", Sci Tech Publishing, 2012.

REFERENCES

1. Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, "Bio-Medical Instrumentation and Measurements", II edition, Pearson Education, 2009
2. Raymond Tong Kaiyu . "Bio-mechatronics in Medicine and Healthcare" Pan Stanford Publishing, CRC Press, 2011.

COURSE OUTCOMES (COs)	
CO1	To understand the basics of bio mechanics
CO2	To have adequate knowledge on sensors and actuator
CO3	To study about the medical instruments
CO4	To learn about the sensory assist devices
CO5	To know the concepts of active and passive prosthetic limbs

Mapping of Course Outcomes(COs) with Programme Outcomes (POs)

(H/M/L indicates strength of correlation) H-High, M-Medium, L-Low

1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1				M	H		M					
	CO2	M			M	H				H			
	CO3				M	H		M					
	CO4				M	H	H		L				
	CO5				M	H							

3	Category	Open Elective(OE)
4	Approval	47th Meeting of Academic Council, July, 2018

U18OEMT004	ARTIFICIAL INTELLIGENCE FOR ROBOTICS	L	T	P	C
	Total Contact Hours - 45	3	0	0	3
	Prerequisite – Robotic and Machine Vision				
	Course Designed by – Department of Mechatronics Engineering				
OBJECTIVES	To introduce the various concepts about the Artificial Intelligence				

UNIT I INTRODUCTION **9**

Intelligent Agents – Agents and environments - Good behavior – The nature of environments – structure of agents - Problem Solving - problem solving agents – example problems – searching for solutions – uniformed search strategies - avoiding repeated states – searching with partial information.

UNIT II PRINCIPLES OF DECISION-MAKING **9**

Crisp and Fuzzy Logic-Decision Trees-Case-based Reasoning-Bayesian Belief Networks-Path Planning-Voronoi Diagrams

UNIT III SEARCHING TECHNIQUES **9**

Motion Planning-Compute Cost-Optimal Path-First Search Program-Expansion Grid-Dynamic Programming-Computing Value-Optimal Policy-Constraint satisfaction problems (CSP) – Backtracking search and Local search for CSP – Structure of problems - Adversarial Search – Games – Optimal decisions in games – Alpha – Beta Pruning – imperfect real-time decision

UNIT IV NEURAL NETWORKS AND EXPERT SYSTEMS **9**

Evaluation and Search-Genetic Algorithms-Simulated Annealing-Particle Swarm Optimization-Neural Networks-Static Networks-Associative Networks-Cerebellar Model Articulation Controller-Expert Systems-Production Systems-Forward Chaining-Backward Chaining

UNIT V SLAM (Simultaneous Localization and Mapping) **9**

Localization-Planning-Fun with Parameters-SLAM-Graph SLAM-Implementing Constraints-Adding Landmarks-Matrix Modification-Untouched Fields-Landmark Position-Confident Measurements-Implementing SLAM

TOTAL: 45

TEXT BOOKS

1. Stuart Russell, Peter Norvig, “Artificial Intelligence – A Modern Approach”, 2nd Edition, Pearson Education / Prentice Hall of India, 2004.

2. Donald A.Waterman, ‘A Guide to Expert Systems’, Pearson Education.

Reference Books

1. Nils J. Nilsson, "Artificial Intelligence: A new Synthesis", Harcourt Asia Pvt. Ltd., 2000.

2. Elaine Rich and Kevin Knight, "Artificial Intelligence", 2nd Edition, Tata McGraw-Hill, 2003.

3. George F. Luger, "Artificial Intelligence-Structures And Strategies For Complex Problem Solving", Pearson Education / PHI, 2002**.**

4. Janakiraman, K. Sarukesi, 'Foundations of Artificial Intelligence and Expert Systems', Macmillan Series in Computer Science.

5. W. Patterson, 'Introduction to Artificial Intelligence and Expert Systems', Prentice Hall of India, 2003

COURSE OUTCOMES (COs)													
CO1	To learn pattern recognition												
CO2	To learn about game playing												
CO3	To learn knowledge representation												
CO4	To learn about knowledge representation using other logic												
CO5	To learn structural representation of knowledge												
Mapping of Course Outcomes(COs) with Programme Outcomes (POs) (H/M/L indicates strength of correlation) H-High, M-Medium, L-Low													
1	COs/POs	a	b	c	d	e	f	g	h	i	j	k	l
2	CO1		M			H							
	CO2				M	H	L				M		
	CO3				M	H							
	CO4				M	H	M	H			M		
	CO5				M	H							
3	Category	Open Elective(OE)											
4	Approval	47th Meeting of Academic Council, July, 2018											