B.E. (MECHATRONICS)

2018 Regulations, Curriculum & Syllabi

(Candidates admitted during Academic Year 2018-2019)

Stay Ahead

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

An Autonomous Institution Affiliated to Anna University - Chennai • Approved by AICTE • Accredited by NAAC with "A+" Grade

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CONTENTS

VISION OF THE DEPARTMENT

To prepare students to achieve academic excellence in Mechatronics education with a practically oriented curriculum, research and innovative product development.

MISSION OF THE DEPARTMENT

1. To provide pedagogical expertise to disseminate technical knowledge.
2. To foster continuous learning and research by establishing state of the art facilities.
3. To provide exposure to latest technologies through industry-institute interaction.
4. To nurture the innovation to develop interdisciplinary projects.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I. Graduates possess adequate knowledge on mechanical, electronics and electrical engineering to solve problems pertaining to mechatronics

II. Graduates are capable of integrating and using systems or devices incorporating information technologies and modern engineering tools for product design, development and manufacturing

III. Graduates aspire for higher studies and can reveal professional interaction and work effectively on multi-disciplinary teams along with professional and ethical responsibility

PROGRAM OUTCOMES

Engineering Graduates will be able to:

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

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

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

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

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6. 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.

PO7. 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.

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

PO9. Individual and Team Work: Function effectively as an individual, and as a member or

leader in diverse teams, and in multidisciplinary settings.

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

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

PO12. 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.

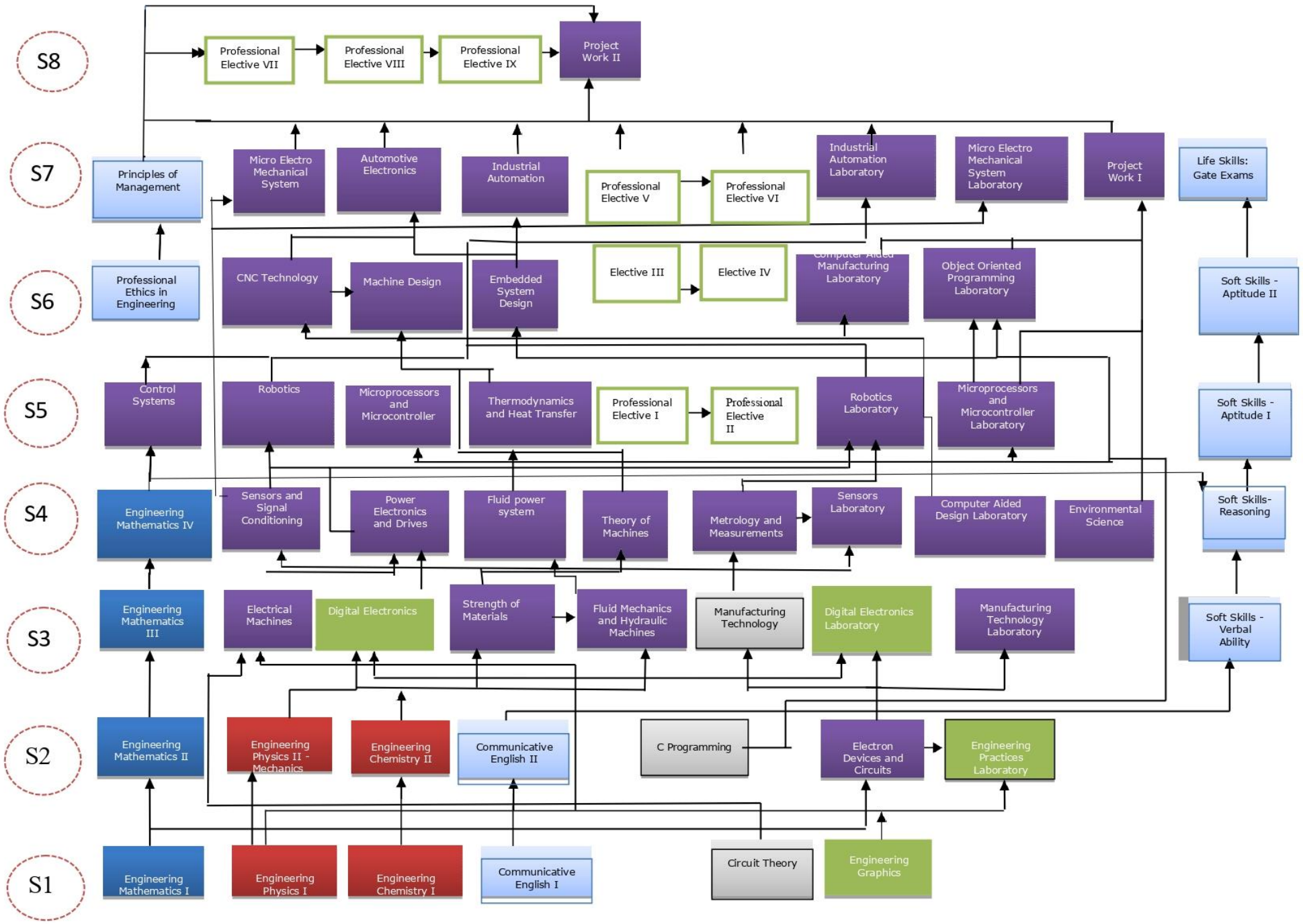
PROGRAM SPECIFIC OBJECTIVE (PSO)

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

PSO2: Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

MAPPING OF PEOs AND POs

POs	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2
PEO1	X	X											X	X
PEO2			X	X	X		X						X	X
PEO3						X		X	X	X	X	X		X


S8
Professional Elective VII
Professional Elective VIII
Professional Elective IX
Project Work II
S7
Principles of Management
Micro Electro Mechanical System
Automotive Electronics
Industrial Automation
Professional Elective V
Professional Elective VI
Industrial Automation Laboratory
Micro Electro Mechanical System Laboratory
Project Work I
Life Skills: Gate Exams
S6
Professional Ethics in Engineering
CNC Technology
Machine Design
Embedded System Design
Elective III
Elective IV
Computer Aided Manufacturing Laboratory
Object Oriented Programming Laboratory
Soft Skills - Aptitude II
S5
Control Systems
Robotics
Microprocessors and Microcontroller
Thermodynamics and Heat Transfer
Professional Elective I
Professional Elective II
Robotics Laboratory
Microprocessors and Microcontroller Laboratory
Soft Skills - Aptitude I
S4
Engineering Mathematics IV
Sensors and Signal Conditioning
Power Electronics and Drives
Fluid power system
Theory of Machines
Metrology and Measurements
Sensors Laboratory
Computer Aided Design Laboratory
Environmental Science
Soft Skills- Reasoning
S3
Engineering Mathematics III
Electrical Machines
Digital Electronics
Strength of Materials
Fluid Mechanics and Hydraulic Machines
Manufacturing Technology
Digital Electronics Laboratory
Manufacturing Technology Laboratory
Soft Skills - Verbal Ability
S2
Engineering Mathematics II
Engineering Physics II - Mechanics
Engineering Chemistry II
Communicative English II
C Programming
Electron Devices and Circuits
Engineering Practices Laboratory
S1
Engineering Mathematics I
Engineering Physics I
Engineering Chemistry I
Communicative English I
Circuit Theory
Engineering Graphics

DEPARTMENT OF MECHATRONICS

Minimum Credits to be Earned : 162

I SEMESTER

Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CIA	SEE	Total	
18MA101	ENGINEERING MATHEMATICS I	3	1	0	4	4	40	60	100	BS
18MC102	ENGINEERING PHYSICS I	2	0	2	3	4	50	50	100	BS
18MC103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
18MC104	CIRCUIT THEORY	2	0	2	3	4	50	50	100	ES
18HS101	COMMUNICATIVE ENGLISH I	1	0	2	2	3	100	0	100	HSS
18MC106	ENGINEERING GRAPHICS	1	0	4	3	5	100	0	100	ES
Total		**11**	**1**	**12**	**18**	**24**				

II SEMESTER

Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CIA	SEE	Total	
18MA201	ENGINEERING MATHEMATICS II	3	1	0	4	4	40	60	100	BS
18MC202	ENGINEERING PHYSICS II - MECHANICS	3	1	0	4	4	40	60	100	ES
18MC203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
18MC204	C PROGRAMMING	2	0	2	3	4	50	50	100	ES
	LANGUAGE ELECTIVE	1	0	2	2	3	100	0	100	HSS
18MC206	ELECTRON DEVICES AND CIRCUITS	2	0	2	3	4	50	50	100	ES
18MC207	ENGINEERING PRACTICE LABORATORY	0	0	2	1	2	100	0	100	ES
Total		**13**	**2**	**10**	**20**	**25**				

III SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
18MC301	ENGINEERING MATHEMATICS III	3	1	0	4	4	40	60	100	BS
18MC302	ELECTRICAL MACHINES	3	0	2	4	5	50	50	100	ES
18MC303	DIGITAL ELECTRONICS	3	0	0	3	3	40	60	100	PC
18MC304	STRENGTH OF MATERIALS	3	1	0	4	4	40	60	100	ES
18MC305	FLUID MECHANICS AND HYDRAULIC MACHINES	2	0	2	3	4	50	50	100	ES
18MC306	MANUFACTURING TECHNOLOGY	3	0	0	3	3	40	60	100	PC
18MC307	DIGITAL ELECTRONICS LABORATORY	0	0	2	1	2	100	0	100	PC
18MC308	MANUFACTURING TECHNOLOGY LABORATORY	0	0	2	1	2	100	0	100	PC
18GE301	SOFT SKILLS - VERBAL ABILITY	0	0	2	-	2	100	0	100	EEC
Total		**17**	**2**	**10**	**23**	**29**				
IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
18MC401	ENGINEERING MATHEMATICS IV	3	1	0	4	4	40	60	100	BS
18MC402	SENSORS AND SIGNAL CONDITIONING	3	0	0	3	3	40	60	100	PC
18MC403	POWER ELECTRONICS AND DRIVES	3	0	2	4	5	50	50	100	PC
18MC404	FLUID POWER SYSTEM	2	0	2	3	4	50	50	100	PC
18MC405	THEORY OF MACHINES	3	1	0	4	4	40	60	100	PC
18MC406	METROLOGY AND MEASUREMENTS	3	0	0	3	3	40	60	100	PC
18MC407	SENSORS LABORATORY	0	0	2	1	2	100	0	100	PC
18MC408	COMPUTER AIDED DESIGN LABORATORY	0	0	4	2	4	100	0	100	PC
18HS001	ENVIRONMENTAL SCIENCE	2	0	0	-	2	100	0	100	HSS
18GE401	SOFT SKILLS – BUSINESS ENGLISH	0	0	2	-	2	100	0	100	EEC
Total		**19**	**2**	**12**	**24**	**33**				

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
18MC501	CONTROL SYSTEMS	3	1	0	4	4	40	60	100	PC
18MC502	ROBOTICS	3	0	0	3	3	40	60	100	PC
18MC503	MICROPROCESSORS AND MICROCONTROLLERS	3	0	0	3	3	40	60	100	PC
18MC504	THERMODYNAMICS AND HEAT TRANSFER	3	1	0	4	4	40	60	100	PC
	PROFESSIONAL ELECTIVE I	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE II	3	0	0	3	3	40	60	100	PE
18MC507	ROBOTICS LABORATORY	0	0	4	2	4	100	0	100	PC
18MC508	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	0	0	2	1	2	100	0	100	PC
18GE501	SOFT SKILLS - APTITUDE I	0	0	2	-	2	100	0	100	EEC
Total		**18**	**2**	**8**	**23**	**28**				**-**

VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
18HS002	PROFESSIONAL ETHICS IN ENGINEERING	2	0	0	2	2	40	60	100	HS
18MC602	CNC TECHNOLOGY	3	0	0	3	3	40	60	100	PC
18MC603	MACHINE DESIGN	3	1	0	4	4	40	60	100	PC
18MC604	EMBEDDED SYSTEM DESIGN	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE III	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE IV	3	0	0	3	3	40	60	100	PE
18MC607	COMPUTER AIDED MANUFACTURING LABORATORY	0	0	2	1	2	100	0	100	PC
18MC608	OBJECT ORIENTED PROGRAMMING LABORATORY	0	0	4	2	4	100	0	100	PC
18GE601	SOFT SKILLS - APTITUDE II	0	0	2	-	2	100	0	100	EEC
Total		**17**	**1**	**10**	**22**	**28**				

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
18HS003	PRINCIPLES OF MANAGEMENT	2	0	0	2	2	40	60	100	HSS
18MC702	MICRO ELECTRO MECHANICAL SYSTEMS	3	0	0	3	3	40	60	100	PC
18MC703	AUTOMOTIVE ELECTRONICS	3	0	0	3	3	40	60	100	PC
18MC704	INDUSTRIAL AUTOMATION	3	0	0	3	3	40	60	100	PC
	PROFESSIONAL ELECTIVE V	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE VI	3	0	0	3	3	40	60	100	PE
18MC707	INDUSTRIAL AUTOMATION LABORATORY	0	0	2	1	2	60	40	100	PC
18MC708	MICRO ELECTRO MECHANICAL SYSTEM LABORATORY	0	0	2	1	2	60	40	100	PC
18MC709	PROJECT WORK I	0	0	6	3	6	60	40	100	EEC
Total		**18**	**0**	**10**	**23**	**28**				

VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
	PROFESSIONAL ELECTIVE VII	3	0	0	3	3	60	40	100	PE
	PROFESSIONAL ELECTIVE VIII	3	0	0	3	3	60	40	100	PE
	PROFESSIONAL ELECTIVE XI	3	0	0	3	3	60	40	100	PE
18MC804	PROJECT WORK II	0	0	18	9	18	60	40	100	EEC
Total		**9**	**0**	**18**	**9**	**18**	**-**	**-**	**-**	-

ELECTIVES										
LANGUAGE ELECTIVES										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
18HS201	COMMUNICATIVE ENGLISH II	1	0	2	2	3	100	0	100	HSS
18HSH01	HINDI	1	0	2	2	3	100	0	100	HSS
18HSG01	GERMAN	1	0	2	2	3	100	0	100	HSS
18HSJ01	JAPANESE	1	0	2	2	3	100	0	100	HSS
18HSC01	CHINESE	1	0	2	2	3	100	0	100	HSS
18HSF01	FRENCH	1	0	2	2	3	100	0	100	HSS
PHYSICS ELECTIVES										
18GE0P1	NANO MATERIALS SCIENCE	3	0	0	3	3	40	60	100	BS
18GE0P2	SEMI CONDUCTOR PHYSICS AND DEVICES	3	0	0	3	3	40	60	100	BS
18GE0P3	APPLIED LASER SCIENCE	3	0	0	3	3	40	60	100	BS
CHEMISTRY ELECTIVES										
18GE0C1	CORROSION SCIENCE AND ENGINEERING	3	0	0	3	3	40	60	100	BS
18GE0C2	ENERGY STORING DEVICES	3	0	0	3	3	40	60	100	BS
18GE0C3	POLYMER SCIENCE	3	0	0	3	3	40	60	100	BS
MATHEMATICS ELECTIVES										
18GE0M1	GRAPH THEORY AND COMBINATORICS	3	0	0	3	3	40	60	100	BS
18GE0M2	ALGEBRA AND NUMBER THEORY	3	0	0	3	3	40	60	100	BS
18GE0M3	MATHEMATICAL FINANCE AND QUEUEING THEORY	3	0	0	3	3	40	60	100	BS
ENTREPRENEURSHIPELECTIVES										
18GE0E1	ENTREPRENEURSHIP DEVELOPMENT I	3	0	0	3	3	40	60	100	PE
18GE0E2	ENTREPRENEURSHIP DEVELOPMENT II	3	0	0	3	3	40	60	100	PE

DISCIPLINE ELECTIVES										
18MC001	ENGINEERING MATERIALS AND METALLURGY	3	0	0	3	3	40	60	100	PE
18MC002	INDUSTRIAL ENGINEERING	3	0	0	3	3	40	60	100	PE
18MC003	FINITE ELEMENT ANALYSIS	3	0	0	3	3	40	60	100	PE
18MC004	DESIGN OF JIGS AND FIXTURES	3	0	0	3	3	40	60	100	PE
18MC005	DESIGN OF MATERIAL HANDLING SYSTEMS	3	0	0	3	3	40	60	100	PE
18MC006	DESIGN OF MECHATRONICS SYSTEM	3	0	0	3	3	40	60	100	PE
18MC007	NON-CONVENTIONAL MACHINING	3	0	0	3	3	40	60	100	PE
18MC008	COMPUTER INTEGRATED MANUFACTURING	3	0	0	3	3	40	60	100	PE
18MC009	ADVANCED MANUFACTURING	3	0	0	3	3	40	60	100	PE
18MC010	NON-DESTRUCTIVE TESTING	3	0	0	3	3	40	60	100	PE
18MC011	DESIGN FOR MANUFACTURING AND ASSEMBLY	3	0	0	3	3	40	60	100	PE
18MC012	PROCESS PLANNING AND COST ESTIMATION	3	0	0	3	3	40	60	100	PE
18MC013	VIRTUAL INSTRUMENTATION	3	0	0	3	3	40	60	100	PE
18MC014	MEDICAL MECHATRONICS	3	0	0	3	3	40	60	100	PE
18MC015	MODELLING OF INDUSTRIAL ROBOTS	3	0	0	3	3	40	60	100	PE
18MC016	FUZZY LOGIC & ARTIFICIAL NEURAL NETWORK	3	0	0	3	3	40	60	100	PE
18MC017	ARTIFICIAL INTELLIGENCE	3	0	0	3	3	40	60	100	PE
18MC018	OPTIMIZATION TECHNIQUES	3	0	0	3	3	40	60	100	PE
18MC019	MACHINE LEARNING	3	0	0	3	3	40	60	100	PE
18MC020	LINEAR INTEGRATED CIRCUITS	3	0	0	3	3	40	60	100	PE
18MC021	CONTROL SYSTEM AND DRIVES FOR ELECTRIC VEHICLES	3	0	0	3	3	40	60	100	PE
18MC022	PROCESS CONTROL	3	0	0	3	3	40	60	100	PE

18MC023	AD-HOC AND SENSOR NETWORK	3	0	0	3	3	40	60	100	PE
18MC024	INDUSTRIAL IOT	3	0	0	3	3	40	60	100	PE
18MC025	INDUSTRIAL DRIVES AND CONTROL	3	0	0	3	3	40	60	100	PE
18MC026	LEAN MANUFACTURING	3	0	0	3	3	40	60	100	PE
18MC027	GREEN MANUFACTURING	3	0	0	3	3	40	60	100	PE
18MC028	WIRELESS SENSOR NETWORKS	3	0	0	3	3	40	60	100	PE
18MC029	COMPUTATIONAL FLUID DYNAMICS	3	0	0	3	3	40	60	100	PE
OPEN ELECTIVES										
18MC0YA	INDUSTRIAL ROBOTICS	3	0	0	3	3	40	60	100	PE
18MC0YB	BASICS OF MECHATRONICS	3	0	0	3	3	40	60	100	PE
18MC0YC	MICRO ELECTRO MECHANICAL SYSTEMS	3	0	0	3	3	40	60	100	PE
18MC0YD	INDUSTRIAL DRIVES AND AUTOMATION	3	0	0	3	3	40	60	100	PE
ONE CREDIT COURSES										
18MC0XA	COMMUNICATION PROTOCOLS					-	100	0	100	EEC
18MC0XB	AC/DC DRIVES	-	-	-	1	-	100	0	100	EEC
18MC0XC	ADVANCED METROLOGY AND QUALITY CONTROL	-	-	-	1	-	100	0	100	EEC
18MC0XD	INDUSTRIAL HYDRAULICS	-	-	-	1	-	100	0	100	EEC
18MC0XE	DESIGN AND ASSEMBLY OF ELECTRONICS COMPONENTS IN PCB	-	-	-	1	-	100	0	100	EEC
18MC0XF	CNC SERVICING	-	-	-	1	-	100	0	100	EEC
ADDITIONAL ONE CREDIT COURSE										
18GE0XA	ETYMOLOGY	-	-	-	1	-	100	0	100	EEC
18GE0XB	GENERAL PSYCHOLOGY	-	-	-	1	-	100	0	100	EEC
18GE0XC	NEURO BEHAVIORAL SCIENCE	-	-	-	1	-	100	0	100	EEC

18GE0XD	VISUAL MEDIA AND FILM MAKING	-	-	-	1	-	100	0	100	EEC
18GE0XE	YOGA FOR HUMAN EXCELLENCE	-	-	-	1	-	100	0	100	EEC
18GE0XF	VEDIC MATHEMATICS	-	-	-	1	-	100	0	100	EEC
18GE0XG	HEALTH AND FITNESS	-	-	-	1	-	100	0	100	EEC
18GE0XH	CONCEPT, METHODOLOGY AND APPLICATIONS OF	-	-	-	1	-	100	0	100	EEC

	VERMI COMPOSTING									
18GE0XI	BLOG WRITING	-	-	-	1	-	100	0	100	EEC
18GE0XJ	INTER PERSONAL SKILLS	-	-	-	1	-	100	0	100	EEC
18GE0XK	COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT	-	-	-	1	-	100	0	100	EEC
18GE0XL	NATIONAL CADET CORPS	-	-	-	1	-	100	0	100	EEC
18GE0XM	NEW AGE INNOVATION AND ENTREPRENEURSHIP	-	-	-	1	-	100	0	100	EEC
18GE0XN	DISRUPTIVE INNOVATION BASED STARTUP ACTIVITIES	-	-	-	1	-	100	0	100	EEC
18GE0XO	SOCIAL PSYCHOLOGY	-	-	-	1	-	100	0	100	EEC
18GE0XP	FM RADIO BROAD CASTING TECHNOLOGY	-	-	-	1	-	100	0	100	EEC

SUMMARY OF CREDIT DISTRIBUTION

S. No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDIT	CREDITS in%	Range of Total Credits	
		I	II	III	IV	V	VI	VII	VIII			Min	Max
1	BS	10	7	4	4					25	15%	15%	20%
2	ES	6	11	11						28	17%	15%	20%
3	HSS	2	2				2			4	5%	5%	10%
4	PC			8	20	17	14	8		67	40%	30%	40%
5	PE					6	6	12		24	16%	15%	20%
6	EEC							3	9	12	7%	7%	10%
Total		18	20	23	24	23	22	23	9	162	100%	-	

BS - Basic Sciences
ES - Engineering Sciences
HSS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course
CA - Continuous Assessment
ES - End Semester Examination

18MA101 ENGINEERING MATHEMATICS I 3 1 0 4

Course Objectives

- Understand the concepts of vectors and Eigenvectors for different matrices to describe the stability of the linear systems in engineering fields.
- Exemplify the concepts of differentiation and integration to identify the area of 2D and 3D surfaces in engineering problems.
- Explain the concepts of analytic functions in complex domain to predict the nature of different engineering systems.

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems, reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PSO1. Analyze, design and develop electro mechanical system using contemporary tools.

Course Outcomes (COs)

1. Apply the principles of coordinate systems in the complex plane and characteristics of linear systems by Eigen values and Eigenvectors.
2. Analyse various types of functions and their differentiation techniques involved in engineering fields.
3. Apply different methods of integration to solve the engineering problems
4. Execute the suitable integration technique to calculate the area and volume of different surfaces.
5. Apply the concept of analytic function to estimate the integral in complex plane.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	-	-	-	-	2	-
2	2	2	-	-	-	-	-	-	-	-	-	-	3	-
3	2	2	-	-	-	-	-	-	-	-	-	-	2	-
4	1	2	-	-	-	-	-	-	-	-	-	-	2	-
5	1	2	-	-	-	-	-	-	-	-	-	-	3	-

UNIT I **9 Hours**

COMPLEX NUMBERS,VECTORS AND MATRICES

Complex plane, polar coordinates and polar form of complex numbers, powers and roots, fundamental theorem of algebra. Vector algebra in 2-D and 3-D space, dot product and cross product. Matrices: Eigen values and Eigenvectors, properties of eigenvalues and eigenvectors.

UNIT II **9 Hours**

CALCULUS

Limits and Continuity of Functions: Limits of functions, types of limits, evaluation of limits, continuity of functions, properties of continuous functions.

Derivatives: Derivatives, differentiability rules and properties, differentiation of transcendental functions, higher order derivatives, implicit differentiation, and differentiation of hyperbolic functions.

Integration: Anti-derivatives, Riemann Sum, indefinite and definite integration, Mean Value Theorem for definite integral, Fundamental Theorem of Calculus.

UNIT III **9 Hours**

INTEGRATION METOD

Basic integration formulas for algebraic and transcendental functions. Integration by special devices: integration by parts, rationalizing substitution or trigonometric substitution, partial fractions, reduction formulas, improper integrals, convergence tests.

UNIT IV **9 Hours**

APPLICATIONS OF DERIVATIVES AND INTEGRATIONS

Extreme values, points of inflection and curve sketching, Rolle's Theorem, Mean Value Theorem, optimization, indeterminate forms, L'Hôpital's Rule. Area between curves, volume of a general solid by slicing and cylindrical shell methods, volume of a solid of revolution, length of plane curves, area of a surface of revolution.

UNITV **9Hours**

COMPLEX ANALYSIS

Analytic Functions - Properties of Analytic Functions - Determination of Analytic Function using Milne-Thompson method. Cauchy's Integral Formula - Classification of Singularities - Cauchy's Residue TheorePSO1:

Total: 60 Hours

Reference(s)

1. Finney R. L., Weir PSO1: D., and Giordano F. R., *Thomas' Calculus*, 10th edition, Addison-Wesley, 2001.
2. Smith R. T. and Minton R. B., *Calculus*, 2nd edition, McGraw-Hill, 2002.
3. Kreyszig E., *Advanced Engineering Mathematics*, 8th edition, John Wiley & Sons, 1999.
4. Anton H., *Calculus with Analytic Geometry*, 5th edition, John Wiley & Sons, 1995.
5. Ayres F. J. R. and Mendelson E., *Schaum's Outline of Theory and Problems of Calculus*, 4th edition, McGraw-Hill, 1999.

18MC102 ENGINEERING PHYSICS I 2 0 2 3

Course Objectives

- Illustrate the Newtons laws of motion and wave motion with applications
- Understand the basic properties of electricity, magnetism and optics
- Differentiate the special theory of relativity and quantum physics from classical physics

Programme Outcomes (POs)

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

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

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

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Apply the Newton's three laws of motion to solve the real world problems involving elevator, at wood machine and acceleration of objects
2. Differentiate the physical characteristics of simple harmonic motion, wave motion and find the solutions for wave equations
3. Analyse the electric and magnetic elements using the fundamental laws and properties of electricity and magnetism.
4. Justify the characteristics of mirrors, lenses, microscopes and diffraction gratings using the concepts of physical and geometrical optics.
5. Conclude the wave and particle nature of matter with special theory of relativity and quantum physics

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	**2**	**1**	-	-	-	-	-	-	**2**	-	-	-	**3**	-
2	**2**	**1**	-	-	-	-	-	-	**2**	-	-	-	**2**	-
3	**2**	**2**	-	-	-	-	-	-	**2**	-	-	-	**2**	-
4	**2**	**2**	-	-	-	-	-	-	**2**	-	-	-	**2**	-
5	**2**	**1**	-	-	-	-	-	-	**2**	-	-	-	**2**	-

UNIT I 6 Hours

MECHANICS

Newtons laws of motion: Concept of force and its nature - Newtons first law and inertial framesdefinition of mass - Newtons second law-gravitational force and weight - Newtons third law. Applications of Newtons laws: particle in equilibrium, particle under net force - weighing a mass in an elevator, the atwood machine and acceleration of two objects connected by a cord

UNIT II 6 Hours

OSCILLATIONS AND WAVES

Fundamentals of simple harmonic motion -energy of simple harmonic oscillator - spring mass system time period of simple pendulum, compound pendulum and torsional pendulum - Dampedoscillations. Travelling wave motion - sinusoidal waves on strings - speed of a wave - reflection and transmission -

rate of energy transfer in wave motion

UNIT III **6 Hours**

ELECTRICITY AND MAGNETISM

Point charges - electric fields - Gauss law and its applications - electric potential - capacitance - energy stored in a capacitor. Concept and source of magnetic fields - Amperes theorem determination of magnetic field due to different current distributions - Faradays law self-induction and mutual induction - energy stored in an inductor

UNIT IV **6 Hours**

LIGHT AND OPTICS

Nature of light -laws of reflection and refraction -refractive index and Snells law - dispersion of light - total internal reflection - image formation: concave mirrors - convex mirrors - thin lenses –compound microscope -human eye. Conditions of interference -Youngs double slit experiment intensity distribution of interference - phase change due to reflection - diffraction-narrow slit diffraction - single slit and two slit - intensity distribution - diffraction grating - applications

UNITV **6Hours**

MODERN PHYSICS

Special theory of relativity - simultaneity and time dilation -twin paradox - length contraction - relativistic mass variation - space time graph. Black body radiation and Planck hypothesis - allowed energy levels - thermal radiation from different objects - photoelectric and Compton effect. Matter waves - de-Broglie hypothesis - wave nature of particles - Davission-Germer experiment 1 5 H

EXPERIMENT 1 **5 Hours**

Determination of resultant of system of concurrent coplanar forces-Parallelogramlaw of forces

EXPERIMENT 2 **5 Hours**

Determination of moment of inertia-Torsional pendulum

EXPERIMENT 3 **5 Hours**

Determination of wavelength of mercury spectral lines-spectrometer

EXPERIMENT 4 **4 Hours**

Determination of refractive index of solid and liquid-travelling microscope

EXPERIMENT 5 **3 Hours**

Determination of wavelength of laser-diffraction grating

EXPERIMENT 6 **4 Hours**

Determination of frequency of a tuning fork-Meldes apparatus

EXPERIMENT 7 **4 Hours**

Thickness of a thin wire using interference of light-Air wedge method

60 Hours

Reference(s)

1. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2011
2. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011
3. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, NewDelhi, 2017
4. H D Young and R A Freedman, Sears and Zemanskys University Physics with Modern Physics, Pearson education, 2016
5. R K Gaur and S L Gupta, Engineering Physics, Dhanpat Rai Publications, 2012

18MC103 ENGINEERING CHEMISTRY I 2 0 2 3

Course Objectives

a. Assess the purpose of alloying and heat treatment in the field of metallurgy applications
b. Identify the types of corrosion and its suitable prevention method
c. Classify polymers based on its properties and molding techniques
d. Interpret the properties and applications of lubricants
e. Classify polymers based on its properties and molding techniques

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
PO2. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO7. 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
PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1 Apply the alloying principle to improve the strength, durability, corrosion resistance, and flexibility of metals by combining with other elements
2 Apply heat treatment processes to improve material properties by understanding their transformation behaviours
3 Analyze the types of corrosion, factors influencing the corrosion rate, and identify corrosion control method for effective material protection
4 Assess the properties of addition and condensation polymeric materials used in electonic and automobile industries
5 Outline the properties and application of lubricants used in high speed - low load and low speed - high load machines

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	2	-	-	-	-	-	2	-
2	2	2	-	-	-	-	-	-	-	-	-	-	2	-
3	3	1	-	-	-	-	-	-	-	-	-	-	1	-
4	2	2	-	-	-	-	-	-	-	-	-	-	1	-
5	1	1	-	-	-	-	1	-	-	-	-	-	1	-

UNIT I 6 Hours

ALLOYS

Purpose of alloying - function and effects of alloying elements - classification of alloys. Composition - properties - uses of ferrous alloys (steel, cast iron and stainless steel) and non-ferrous alloys (aluminum, nickel, copper) - shape memory alloys.

UNIT II 7 Hours

HEAT TREATMENT

Fundamentals of simple harmonic motion -energy of simple harmonic oscillator - spring mass system time period of simple pendulum, compound pendulum and torsional pendulum - Dampedoscillations. Travelling wave motion - sinusoidal waves on strings - speed of a wave - reflection and transmission - rate of energy transfer in wave motion

UNIT III **7 Hours**

CORROSION SCIENCE

Corrosion - chemical and electrochemical corrosion - Pilling-Bedworth rule - types of oxide layer, oxygen absorption, hydrogen evolution mechanism - galvanic series. Types of electrochemical corrosion: Galvanic corrosion - differential aeration corrosion (pitting, pipeline and stress). Factors influencing corrosioPSO2: Corrosion control: Sacrificial anode - impressed current method.

UNIT IV **5 Hours**

POLYMER

Polymers - polymerization - functionality - degree of polymerization - classification of polymers. Types of polymerizatioPSO2: Structure, properties and applications of thermosetting (epoxy resin and Bakelite) and thermoplastics (poly vinyl chloride and PMMA). Rubber: SBR. Compounding of plastics (injection and extrusion).

UNITV **5Hours**

LUBRICANTS

Functions - properties (viscosity index, oiliness, carbon residue, aniline point, cloud and pour point) - classification: Grease (calcium based, sodium based and lithium based) - solid lubricants (graphite and molybdenum disulphide). Grading of lubricants. Hydraulic oils - Properties and applications - gas as a lubricant.

FURTHER READING

Biogas production, its benefits and disadvantages. Polymers in automobiles. Pollution of water in India in a decade.

EXPERIMENT 1 **2 Hours**

Instruction about safety rules, reagent handling and precautions need to be followed in lab

EXPERIMENT 2 **4 Hours**

Estimation of copper in brass alloy

EXPERIMENT 3 **4 Hours**

Estimate the amount of iron present in the given solution using spectrophotometer by thiocyanate method

EXPERIMENT 4 **4 Hours**

Determination of hardenability using Jominy end quench test

EXPERIMENT 5 **4 Hours**

Determination of corrosion percentage by weight loss method

EXPERIMENT 6 **4 Hours**

Thermalstability of polymer using thermogravimetry analysis

EXPERIMENT 7 **4 Hours**

Determination of molecular weight of a polymer by viscosity measurement method

EXPERIMENT 8

Comparison of viscosity for liquid lubricants by Ostwald viscomete

60 Hours

Reference(s)

1. P. C. Jain and Monica Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publisher, New Delhi, 2013.
2. G.E.Dieter, Mechanical Metallurgy, McGraw Hill, 2007.
3. William D Callister Jr., Materials science and engineering: An introduction, 7th Edition, John Wiley&sons Inc.,New York,2007.
4. B.R. Puri, L. R. Sharma, M.S. Pathania, Principles of Physical Chemistry, 41st Edition, Vishal Publishing Co., (2004)
5. R. Gowariker, N.V. Viswanathan, J. Sreedhar, Polymer Science,1st Edition, New age

International Publishers, New Delhi, 2014.

6. R. Mukhopadhy and S. Datta, Engineering Chemistry, New Age International Pvt. Ltd, New Delhi, 2010

18MC104 CIRCUIT THEORY 2 0 2 3

Course Objectives

- To understand the basic concepts of electrical circuits and machines
- To examine the speed control methods of DC motor
- To illustrate the construction and operation of three phase systems

Programme Outcomes (POs)

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

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

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

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6. 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.

PO7. 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.

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

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

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

PO12. 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

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

PSO2: Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Apply fundamental laws for electric circuits to understand basic components resistors, inductors, and capacitors
2. Analyze concepts AC circuits to compute RMS, peak factor, and star to delta transformation
3. Analyze the performance and characteristics of electromagnetic fields to verify point, line, and disc charges
4. Implement concepts of three-phase systems, their advantages, and effect power, voltage, and current in star and delta configurations
5. Assess series and parallel resonance circuits to analyse Q factor and bandwidth

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	-	2	1	1	3	3	3	-	2	3	-
2	2	2	2	-	1	1	1	1	1	1	-	1	1	1
3	3	3	2	-	2	2	2	3	3	3	-	2	3	1
4	2	2	2	-	2	1	1	2	2	2	-	2	2	1
5	1	2	1	-	3	2	2	1	1	1	-	3	1	1

UNIT I **6 Hours**

DC CIRCUITS

Definition of voltage, current, power, energy, resistor, inductor and capacitor - Ohms statement, illustration and limitations- Kirchoffs laws statement and illustration - current and voltage division technique - resistance in series and parallel - problems, mesh and nodal analysis.

UNIT II **6 Hours**

AC CIRCUITS

Generation of single phase alternating emf - RMS value, average value, peak factor and form factor, analysis of pure resistive, inductive and capacitive circuits J operator - Representation of alternating quantities in rectangular and polar forms - star to delta transformation - simple problems

UNIT III **6 Hours**

ELECTROMAGNETIC FIELD THEORY

Gauss And Stokes Theorem - Maxwell equations and significance. Electric Charge - Coulombs law - Electric field and potential - Electric field due to a point charge, electric dipole - line of charge and charge disc

UNIT IV **6 Hours**

THREE PHASE SYSTEM

Advantage of 3 phase system - phase sequence - Interconnection of three phase - Star and Delta connection - Voltage current and power in star and delta connection

UNITV **6Hours**

RESONANCE AND COUPLED CIRCUITS

Series and parallel resonance - Q factor and bandwidth - Resonant frequency of a tank circuit - Basics of magnetic circuits - Simple and Composite magnetic circuits - Self and Mutual inductances - Coefficient of Coupling - Coupled circuits - Dot convention - Coupled circuits in Series and Parallel

FURTHER READING

Voltage Regulator - BLDC Motor -SMPS-Autotransformer-Ac Servomotor

EXPERIMENT 1 **5 Hours**

Identification of basic Electronic components such as Resistor, Capacitor, and Inductor and measuring the fundamental characteristics

EXPERIMENT 2 **5 Hours**

Residential house wiring using switches, fuse, indicator, lamp and energy meter, Fluorescent lamp wiring, Stair case wiring

EXPERIMENT 3 **5 Hours**

Verify KCL and KCL using simple circuits

EXPERIMENT 4 **5 Hours**

Implement star to delta and delta to star transformation circuits

EXPERIMENT 5 **5 Hours**

Measurement of electrical quantities voltage, current, power

EXPERIMENT 6 **5 Hours**

Apply the voltage division and current division techniques for series and parallel connections of lamp loads.

60 Hours

Reference(s)

1. Smarjith Ghosh, Fundamentals of Electrical and Electronics Engineering, Prentice Hall (India) Pvt. Ltd., 2010
2. R. Muthusubramanian, S. Salivahanan, Basic Electrical and Electronics Engineering, Tata McGraw-Hill Education, Reprint 2012
3. William H. Hayt, Jack E. Kemmerly, and Steven PSO1: Durbin, Engineering Circuit Analysis, Eighth Edition, Tata McGraw Hill, 2013
4. Charles K. Alexander, Fundamentals of Electric Circuits, Fifth Edition, Tata McGraw Hill Publishing Co Ltd, 2013.
5. Mahmood Nahvi, Joseph A Edminister, Electric Circuits, Fifth Edition, Tata McGraw Hill Publishing Company Limited, 2017.
6. S P Ghosh, A K Chakraborty, Network Analysis and Synthesis, Tata McGraw Hill Education Private Limited, 2010.

18HS101 COMMUNICATIVE ENGLISH I 1 0 2 2

Course Objectives

- Read and understand the main points on familiar matters regularly encountered in work, school, or leisure
- Listen and respond in most common situations where English is spoken
- Write simple connected texts on topics which are familiar or of personal interest
- Describe experiences and events, hopes and ambitions and briefly give reasons and explanations for opinions and plans

Programme Outcomes (POs)

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

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

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Apply appropriate grammar and vocabulary that aligns with the expectations of the Competitive exam level.
2. Analyze the general meaning of non-routine letters within your work area, and find key details in short reports of a predictable nature.
3. Construct straightforward, routine letters of a factual nature, and select relevant information to make notes on routine matters, such as taking or placing orders.
4. Use simple presentations or demonstrations and demonstrate understanding by summarizing key points.
5. Resolve predictable requests from a visitor, outline routine requirements, and offer advice within your job area on simple matters.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	3	3	-	-	1	-
2	-	-	-	-	-	-	-	-	3	3	-	-	1	-
3	-	-	-	-	-	-	-	-	3	3	-	-	1	-
4	-	-	-	-	-	-	-	-	3	3	-	-	1	-
5	-	-	-	-	-	-	-	-	3	3	-	-	1	-

UNIT I 9 Hours

GRAMMAR

Tenses Future continuous, Past continuous, Past perfect, Past simple, Past tense responses, Present perfect continuous, Present perfect/past simple Reported speech Adverbs intensifiers Comparatives and superlatives Conditionals 2nd and 3rd Connecting words expressing cause and effect, contrast Phrasal verbs Prepositions of place Simple passive - Wh-questions in the past Question tags Will and going to, for prediction.

UNIT II 9 Hours

READING

Understanding short real-world notices, messages Detailed comprehension of factual material; skimming and scanning skills - Interpreting visual information Reading for detailed factual information Reading for gist and specific information - Grammatical accuracy and understanding of text structure - Reading and information transfer

UNIT III **9 Hours**

WRITING

Internal communication including note, message, memo or email - arranging / rearranging appointments, asking for permission, giving instructions - Business correspondence including letter, fax, email apologising and offering compensation, making or altering reservations, dealing with requests, giving information about a product.

UNIT IV **9 Hours**

LISTENING

Listening for specific information Listening for numbers and letters Note completion Listening for gist listening to monologues (presentations, lectures, announcements and briefings) listening to interacting speakers (telephone conversations, face-to-face conversations, interviews and discussions).

UNITV **9Hours**

SPEAKING

Exchanging personal and factual information expressing and finding out about attitudes and opinions organise a larger unit of discourse Turn-taking, negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing and/or disagreeing, suggesting, speculating, comparing and contrasting, and decision-making. 1.Goodbye party for Miss Pushpa T S - Nissim Ezekiel 2.Our Casuarina Tree - Toru Dutt 3.Palanquin Bearers - Sarojini Naidu 4.The Tyger - William Blake 5.Ode on a Grecian Urn - John Keats

45 Hours

Reference(s)

1. Alexander Garrett, Cambridge BEC Preliminary Students Book with Answers, Cambridge University Press, 2016.
2. Lan Wood, Anne Williams and Anna Cowper. Pass Cambridge BEC Preliminary, Second Edition, New Delhi, 2014.
3. Norman Whitby. Cambridge Business Benchmark. Pre-Intermediate to Intermediate, Students Book. South Asian Edition, 2018

18MC106 ENGINEERING GRAPHICS 1 0 4 3

Course Objectives

- To provide knowledge on fundamentals of engineering drawings and conic sections.
- To impart skill on orthographic projections of points and lines
- To familiarize on projection of planes and simple solids
- To provide knowledge on section of solids and development of surfaces of simple solids
- To impart skill on conversion of isometric view to orthographic projection and vice versa

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
PO4. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO9.Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12. 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.
PSO1: Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Apply the engineering drawing concepts as per industrial standards.
2. Construct orthographic projections of points and lines
3. Create projection of planes and simple solids
4. Develop section of solids and surfaces
5. Demonstrate the conversion of orthographic to isometric and vice versa

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	-	-	-	-	-	-	-	1		-	2	-
2	2	-	-	1	-	-	-	-	2	1	-	-	2	-
3	1	-	-	1	-	-	-	-	2	1	1	1	2	-
4	1	-	-	1	-	-	-	-	2	1	1	1	2	-
5	1	-	-	1	-	-	-	-	2	1	1	1	2	-

UNIT I 12 Hours

FUNDAMENTALS OF ENGINEERING DRAWINGS

Definition of voltage, current, power, energy, resistor, inductor and capacitor - Ohms statement, illustration and limitations- Kirchoffs laws statement and illustration - current and voltage division technique - resistance in series and parallel - problems, mesh and nodal analysis.

UNIT II 15 Hours

PROJECTION OF POINTS

Principles of projection, projection of points in four quadrants, first angle projection of straight lines - perpendicular to one plane, parallel and inclined to both planes.

UNIT III **16 Hours**

PROJECTION OFPLANES AND SOLIDS

Projection of simple planes and projection of simple solids parallel, perpendicular and inclined to one plane using change of position method.

UNIT IV **16 Hours**

SECTION OFSOLIDS AND DEVELOPMENT OF SURFACES

Section of Solids - simple position with cutting plane parallel, perpendicular and inclined to one plane. Development of surfaces - simple and truncated solids

UNITV **16Hours**

ORTHOGRAPHIC PROJECTIONS AND ISOMETRIC VIEW

Orthographic projections and isometric view of components used in engineering applications

75 Hours

Reference(s)

1. K Venugpoal, Engineering Drawing and Graphics, Third edition, New Age International,2005
2. Basant Agrawal, Mechanical drawing, Tata McGraw-Hill Education, 2008
3. Engineering Drawing Practice for Schools & Colleges, Bureau of Indian StandardsSp46,2008
4. PSO2: D. Bhatt and V. PSO1: Panchal, Engineering Drawing, Charotar Publishing House Pvt.Limited, 2008
5. K.V. Natarajan, AText Book of Engineering Graphics, Dhanalakshmi Publishers, 2013

18MA201 ENGINEERING MATHEMATICS II 3 1 0 4

Course Objectives

- Understand the concepts of partial derivatives and multiple integrals to define the area, volume and extreme values of various surfaces in engineering fields.
- Classify the sequences and series in linear systems is convergent or divergent.
- Formulate the real time engineering problem into mathematical model using ordinary differential equation and solve it by appropriate method.

Programme Outcomes (POs)

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

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

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Apply the concepts of partial differentiation to evaluate various parameters in signals and systems and characterize maxima and minima of functions for optimization problems.
2. Apply multiple integral concepts to calculate the area and volume by appropriate vector integral theorems.
3. Analyse the convergence and divergence of sequences and series by various tests.
4. Apply mathematical concepts to construct first-order differential equations derived from real-time phenomena and solve them using appropriate analytical methods
5. Execute the appropriate method to solve the second order differential equations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	-	-	-	-	2	-
2	1	2	-	-	-	-	-	-	-	-	-	-	2	-
3	2	1	-	-	-	-	-	-	-	-	-	-	2	-
4	2	1	-	-	-	-	-	-	-	-	-	-	2	-
5	2	1	-	-	-	-	-	-	-	-	-	-	2	-

UNIT I **9 Hours**

PARTIAL DIFFERENTIATION

Tenses Future continuous, Past continuous, Past perfect, Past simple, Past tense responses, Present perfect continuous, Present perfect/past simple Reported speech Adverbs intensifiers Comparatives and superlatives Conditionals 2nd and 3rd Connecting words expressing cause and effect, contrast Phrasal verbs Prepositions of place Simple passive - Wh-questions in the past Question tags Will and going to, for prediction.

UNIT II **9 Hours**

MULTIPLE INTEGRALS

Sequences and series, convergence and divergence of series, absolute convergence, conditional convergence, test for convergence and divergence. Power series for functions, interval of convergence, Taylor and Maclaurin series, Taylor s Theorem with remaind

UNIT III **9 Hours**

SEQUENCES AND SERIES

Internal communication including note, message, memo or email - arranging / rearranging appointments, asking

for permission, giving instructions - Business correspondence including letter, fax, email apologising and offering compensation, making or altering reservations, dealing with requests, giving information about a product.

UNIT IV **9 Hours**

FIRST ORDERDIFFERENTIAL EQUATIONS

Listening for specific information Listening for numbers and letters Note completion Listening for gist listening to monologues (presentations, lectures, announcements and briefings) listening to interacting speakers (telephone conversations, face-to-face conversations, interviews and discussions).

UNITV **9Hours**

SECOND ORDER DIFFERENTIAL EQUATIONS

Second order homogeneous and non-homogeneous equations with constant coefficients, variation of parameters, method of undetermined coefficients, series solutions of differential equations, applications

45 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley, 2001
2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.Kreysgiz E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999.
3. Ray Wylie and C Louis Barrett Advanced Engineering Mathematics, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, 2003. 4. Peter V. O Neil , Advanced Engineering Mathematics, Seventh Edition , Cengage Learning India Private Limited, 2012. 5. Glyn James, Advanced Engineering Mathematics, Third Edition,Wiley India, 2014.

18MC202 ENGINEERING PHYSICS II - MECHANICS 3 1 0 4

Course Objectives

- To impart knowledge in crystallography and the crystal growth methods
- To understand the properties of conductors and semiconductors
- To familiarise basic concepts of force and system of forces in real world environment
- To analyse the properties of surface and friction between the surfaces

Programme Outcomes (POs)

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

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

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Analyze the seven crystal systems, planes, and stacking sequences in metallic crystal structures
2. Find the characteristics of conducting and semiconducting materials in terms of the crystal lattice, charge carriers and energy band diagrams
3. Apply the conceptual knowledge to solve problems of particles and rigid bodies in two dimensions under equilibrium conditions
4. Outline the properties of surfaces and solids using the parallel and perpendicular axis theorems
5. Differentiate the two types of friction and analyse the equilibrium of bodies on an inclined plane

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	-	-	-	-	2	-
2	2	1	-	-	-	-	-	-	-	-	-	-	2	-
3	3	2	-	-	-	-	-	-	-	-	-	-	2	-
4	2	2	-	-	-	-	-	-	-	-	-	-	2	-
5	2	2	-	-	-	-	-	-	-	-	-	-	2	-

UNIT I 8 Hours

CRYSTALPHYSICS

Lattice - unit cell - Bravais lattice - lattice planes - miller indices - d-spacing in cubic lattice - calculation of number of atoms per unit cell - atomic radius - coordination number - packing density for SC, BCC, FCC and HCP structures- crystal growth: Bridgman and Czochralski techniques -X- ray diffraction methods

UNIT II 8 Hours

CONDUCTING AND SEMICONDUCTING MATERIALS

Conductors: Classical free electron theory -electrical and thermal conductivity -Wiedemann-Franz law -success and drawbacks of classical free electron theory -quantum theory - Fermi level -Fermi distribution function Semiconductors: Elemental and compound semiconductors -intrinsic semiconductor - Fermi level - electrical conductivity - band gap -extrinsic semiconductor -variation of Fermi level with temperature and impurity concentration -Hall Effect -applications of Hall Effect -solar cell -I-V characteristics

UNIT III 10 Hours

EQUILIBRIUM OFPARTICLES AND RIGID BODIES

Sequences and series, convergence and divergence of series, absolute convergence, conditional convergence, test for convergence and divergence. Power series for functions, interval of convergence,

Taylor and Macular in series, Taylor s Theorem with remainder.

UNIT IV **10Hours**

PROPERTIES OF SURFACES AND SOLIDS

Determination of area, volume and mass of centroid - Pappus and Guldinus theorem -moment of inertia of plane and area - Parallel axis theorem - perpendicular axis theorem - product of inertia -mass moment of inertia - radius of gyration

UNITV **9Hours**

FRICTION

Frictional force - laws of Coulomb friction - angle of friction - cone of friction - equilibrium of bodies on an inclined plane - ladder friction - wedge friction - belt friction - rolling resistance

EXPERIMENT 1 **4 Hours**

Virtual fabrication of silicon cantilever using Intelli FAB MEMS software

EXPERIMENT 2 **4 Hours**

Determination of standard electrode potential of Zinc/Copper/silver using calomel as reference electrode.

EXPERIMENT 3 **4 Hours**

Determination of pH of an unknown solution using pH sensor.

EXPERIMENT 4 **4 Hours**

Estimate the amount of ferrous iron present in the given sample solution using potentiometer.

EXPERIMENT 5 **4 Hours**

Construct a battery (using scrap metal/ other sources) exhibiting valid output and compare it with the existing commercial batteries based on cost and output. (Marks awarded based on battery output)

EXPERIMENT 6 **0 Hours**

Conduct metric titration of mixtures of acid using a conductivity cell

EXPERIMENT 7 **0 Hours**

Estimate the amount of Prussian Blue dye in the given solution using spectrophotometer by thiocyanate method.

EXPERIMENT 8 **0 Hours**

Analysis of NPK fertilizer compounds by using IR Spectroscopy

65 Hours

Reference(s)

1. Charles Kittel, Introduction to Solid State Physics, 8th Edition, Wiley, India Pvt limited New Delhi 2012
2. Arthur Beiser, Shobjit Mahaja and S Rai Choudhury, Concepts of Modern Physics, 6th Edition, Tata McGraw Hil Education Pvt Ltd New Delhi, 2010
3. M.PSO2: Avadhanalu, P.G. Kshirsagar, A Text Book of Engineering Physics S. Chand Company New Delhi 2018
4. F.P. Beer, and Jr. E.R Johnston, Vector Mechanics for Engineers Statics and Dynamics, Tata McGraw-Hill Publishing Company, New Delhi, 2007
5. PSO2: H. Dubey, Engineering Mechanics - Statics and Dynamics, Tata McGraw-Hill Education Private Limited, New Delhi, 2013
6. D. P. Sharma, Engineering Mechanics, Dorling Kindersley (India) Pvt. Ltd., New Delhi, 2010

18MC203 ENGINEERING CHEMISTRY - II 2 0 2 3

Course Objectives

- Identify the importance of micro system and substrate materials for MEMS
- Summarize the terminologies of electrochemical reactions and explain the function of batteries and chemical sensors
- Characterize the chemical compounds using suitable analytical techniques

Programme Outcomes (POs)

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

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

PSO1. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Apply the concept of atomic/molecular theory in microsystems and their fabrication
2. Analyze MEMS substrate materials, emphasizing silicon properties, crystal structure, and compounds for microfabrication applications.
3. Predict the suitable sensing method for the detection of ionic and gaseous chemical substances
4. Analyze the characteristics and performance of primary, secondary, and modern batteries to determine their suitability for effecient utilization
5. Select the suitable analytical method for the identification of functional group and determination of metals

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	-	-	-	-	-	-	-	-	-	2	-
2	2	1	-	-	-	-	-	-	-	-	-	-	2	-
3	3	2	-	-	-	-	-	-	-	-	-	-	2	-
4	2	2	-	-	-	-	-	-	-	-	-	-	2	-
5	2	2	-	-	-	-	-	-	-	-	-	-	1	-

UNIT I 6 Hours

CHEMISTRYFOR MICROSYSTEMS

Introduction - atomic structure of matter - ions and ionization - molecular theory of matter - intermolecular forces - doping of semiconductors - the diffusion theory

UNIT II 6 Hours

MATERIALS FOR MEMS

Introduction - substrates and wafers - active substrate materials. Silicon as a substrate material: The ideal substrate for MEMS - single crystal silicon and wafers - crystal structure - Miller indices - mechanical properties of silicoPSO2: Silicon compounds (silicon dioxide, silicon carbide, and silicon nitride and polycrystalline silicon).

UNIT III 6 Hours

CHEMICAL SENSORS

Electrode potential: Single and standard electrode potential - half-cell reactions. Cells: Cell representation, types (electrochemical and electrolytic cells), Types of electrodes. Sensor: Definition classification of chemical sensors - electrochemical devices: pH sensors, pellistors, NPK sensor, solid electrolyte sensor for sensing oxygen.

UNIT IV 6 Hours

BATTERIES

Batteries: Difference between cell and battery - characteristics and types. Construction, working and applications of primary battery: Alkaline - secondary battery: Lead acid - modern battery: Lithium battery. Environmental and safety issues in disposal of batteries.

UNITV **6Hours**

INSTRUMENTAL METHODS

Beer-Lamberts law. Principle, instrumentation (block diagram only) and applications: Ultra violet spectroscopy - infrared spectroscopy - atomic absorption spectroscopy - colorimetry (estimation of transition metals) - thermogravimetric analyzer (TGA)

FURTHER READING

Energy resources: Renewable (solar and wind) and nonrenewable (fossil fuels). Fuel cells.

EXPERIMENT 1 **4 Hours**

Virtual fabrication of silicon cantilever using Intelli FAB MEMS software

EXPERIMENT 2 **4 Hours**

Determination of standard electrode potential of Zinc/Copper/silver using calomel as reference electrode.

EXPERIMENT 3 **4 Hours**

Determination of pH of an unknown solution using pH sensor.

EXPERIMENT 4 **4 Hours**

Estimate the amount of ferrous iron present in the given sample solution using potentiometer.

EXPERIMENT 5 **4 Hours**

Construct a battery (using scrap metal/ other sources) exhibiting valid output and compare it with the existing commercial batteries based on cost and output. (Marks awarded based on battery output)

EXPERIMENT 6 **6 Hours**

Conduct metric titration of mixtures of acid using a conductivity cell

EXPERIMENT 7 **6 Hours**

Estimate the amount of Prussian Blue dye in the given solution using spectrophotometer by thiocyanate method.

EXPERIMENT 8 **2 Hours**

Analysis of NPK fertilizer compounds by using IR Spectroscopy

60 Hours

Reference(s)

1. Tai-Ran Hsu, MEMS and Microsystems, Tata McGraw Hill Eduction Pvt. Ltd, New Delhi, 2010
2. P. C. Jain and Monica Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publisher, New Delhi, 2013.
3. William D Callister Jr., Materials science and engineering: An introduction, 7th Edition, John Wiley&sons Inc.,New York,2007.
4. B.R. Puri, L. R. Sharma, M.S. Pathania, Principles of Physical Chemistry, 41st Edition, Vishal Publishing Co., (2004)
5. R. Gowariker, N.V. Viswanathan, J. Sreedhar, Polymer Science,1st Edition, New age International Publishers, New Delhi, 2014.
6. R. Mukhopadhy and S. Datta, Engineering Chemistry, New Age International Pvt. Ltd, New Delhi, 2010

18MC204 C PROGRAMMING 2 0 2 3

Course Objectives

- To learn the basics of computer organisation
- To study the basics of C primitives, operators and expressions.
- To understand the different primitive and user defined data types

Programme Outcomes (POs)

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

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

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

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

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations

PO7. 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.

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

PO12. 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.

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

PSO2: Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Apply problem solving techniques and number conversions in real time applications
2. Implement programs using operators and expressions
3. Apply decision making and branching in C program
4. Execute programs using Arrays and strings.
5. Apply the concepts of structures and functions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	3	-	3	-	-	-	-	-	-	2	2	1
2	3	2	3	-	3	-	-	-	-	-	-	2	2	1
3	2	2	3	2	3	-	-	-	-	-	-	2	2	1
4	1	2	3	2	3	-	1	-	-	-	2	2	2	1
5	1	2	3	2	3	-	1	-	-	-	2	2	2	1

UNIT I 6 Hours

INTRODUCTION TO COMPUTERS

Introduction to computers - Characteristics of Computers - Evolution of Computers - Computer

Generations - Basic Computer Organization - Number System - Problem Solving Techniques - Features of a Good Programming Language.

UNIT II **6 Hours**

INTRODUCTION TO C PROGRAMMING

Overview of C-Structure of C program-Keywords-Constants- Variables-Data types-Type conversion Operators and Expressions: Arithmetic-Relational-Logical-Assignment- Increment and Decrement Conditional-Bitwise -Precedence of operators-Managing I/O operations-Formatted I/O-Unformatted I/O

UNIT III **6 Hours**

CONTROL STATEMENTS

Decision Making and Branching: simple if statement-if else statement-nesting of if else Statement Switch Statement. Decision Making and Looping: while statement-do while statement-for statement Nested for statement Jump Statements: go to-break-continue-return statement.

UNIT IV **6 Hours**

ARRAYS AND STRINGS

Arrays: Introduction, one dimensional array, declaration - Initialization of one dimensional array, two dimensional arrays, initializing two dimensional arrays, multi dimensional arrays. Strings: Declaring and initializing string variables- Reading strings from terminal - writing string to screen - String handling functions.

UNITV **6Hours**

STRUCTURES AND FUNCTIONS

Structures and Unions: Introduction-defining a structure- declaring structure variables-accessing structure members- structure initialization-Unions-Enumerated data type User Defined Functions: Elements of user defined functions -Definition of functions-return values and their types- function calls-function declaration-categories of function -call by value and call by reference-recursion-Pre-processor directives and macros

EXPERIMENT 1 **3 Hours**

Write a C program to perform arithmetic operations on integers and floating point numbers

EXPERIMENT 2 **3 Hours**

Write a C program to implement ternary operator and relational operators

EXPERIMENT 3 **3 Hours**

Write a C program to find the greatest of three numbers using if-else statement

EXPERIMENT 4 **3 Hours**

Write a C program to display the roots of a quadratic equation with their types using switch case

EXPERIMENT 5 **3 Hours**

Write a C program to generate pyramid of numbers using for loop

EXPERIMENT 6 **3 Hours**

Write a C program to perform Matrix Multiplication

EXPERIMENT 7 **4 Hours**

Write a C program to check whether the given string is Palindrome or not

EXPERIMENT 8 **4 Hours**

Design a structure to hold the following details of a student. Read the details of a student and display them in the following format Student

Details: roll no, name, branch, year, section, cgpa.

NAME:
ROLL NO:
BRANCH:
YEAR:
SECTION:
CGPA:

60 Hours

Reference(s)

1. Pradeep K. Sinha, Priti Sinha, Computer Fundamentals, BPB publications, 2008
2. Ashok. PSO2: Kamthane, Computer Programming, Second Edition, Pearson Education, 2012
3. E.Balagurusamy, Programming in ANSI C, Tata McGraw-Hill, 2012
4. Herbert Schildt, C -The complete Reference, Tata McGraw-Hill, 2013
5. Byron Gottfried, Programming with C, Schaum's Outlines, Tata Mcgraw-Hill, 2013

18MC206 ELECTRON DEVICES AND CIRCUITS 2 0 2 3

Course Objectives

- To understand the characteristics, operations, and application of solid state devices like diode, BJT, FET, MOSFET and various optoelectronic devices
- To understand various applications of electronic devices.

Programme Outcomes (POs)

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

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

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

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6. 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.

PO7. 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.

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

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

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

PO12. 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.

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Analyze the characteristics of PN junction diodes including diffusion, drift currents, and biasing conditions.
2. Apply DC analysis techniques to BJT circuits and biasing for amplifier circuits
3. Compare the different amplifier configurations (CE, CB, CC) based on their voltage gain, input/output impedence, and other small signal characteristics
4. Analyze the significance of pinch-off voltage in JFETs and threshold voltage in MOSFETs, and find the channel length modulation in MOSFETs
5. Demonstrate the operation and applications of various display devices LEDs, LCDs, photo transistors, opto-couplers, solar cells, and CCDs

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2		2	1	1	3	3	3		2	3	
2	2	2	2	-	1	1	1	1	1	1	-	1	1	-
3	3	3	2	-	2	2	2	3	3	3	-	2	3	-
4	2	2	2	-	2	1	1	2	2	2	-	2	2	-
5	1	2	1	-	3	2	2	1	1	1	-	3	1	-

UNIT I **6 Hours**

SEMICONDUCTOR DIODES

Semiconductor material and Properties, PN junction diode, Current equations, Diffusion and drift current densities, forward and reverse bias characteristics, Switching Characteristics - Zener diodes

UNIT II **6 Hours**

BIPOLAR JUNCTIONTRANSISTOR

Device structure and physical operation, current voltage characteristics, the BJT as an amplifier and a switch, DC Analysis of BJT Circuits, Biasing BJT Amplifier Circuit

UNIT III **6 Hours**

BJT AMPLIFIERS

Small Signal operations and models, trans conductance, input resistances, voltage gain, hybrid pi model, T-model, Small Signal equivalent circuit, Early effect, Single stage BJT amplifiers CE, CB, CC, Comparison

UNIT IV **6 Hours**

FIELD EFFECTTRANSISTOR

JFETs Drain and Transfer characteristics,-Current equations-Pinch off voltage and its significance MOSFET- Characteristics- Threshold voltage -Channel length modulation, D-MOSFET, E-MOSFET Current equation - Equivalent circuit model and its parameters

UNITV **6Hours**

DISPLAY DEVICES

LED, LCD, Photo transistor, Opto Coupler, Solar cell, CCD

EXPERIMENT 1 **3 Hours**

Volt-Ampere characteristics of diode and zener diode

EXPERIMENT 2 **3 Hours**

Volt-Ampere characteristics of Transistor and MOSFET

EXPERIMENT 3 **3 Hours**

Volt-Ampere characteristics of SCR

EXPERIMENT 4 **3 Hours**

Experimental verification of half and full wave rectifiers with and without filter

EXPERIMENT 5 **3 Hours**

Design and verification of series voltage regulator

EXPERIMENT 6 **3 Hours**

Design and implementation of CE amplifier

EXPERIMENT 7 **3 Hours**

Design and implementation of class B push pull amplifier

EXPERIMENT 8 **3 Hours**

Design and implementation of RC Phase shift and we in bridge oscillator

EXPERIMENT 9 **3 Hours**

Design and implementation of multi vibrator circuits using transistor

EXPERIMENT 10 **3 Hours**

Design of audio amplifier using any one type of power amplifier

60 Hours

Reference(s)

1. Jacob. Millman, Christos C.Halkias, Electronic Devices and Circuits, 3rd Edition, Tata McGraw Hill Publishing Limited, New Delhi, 2010.
2. David A. Bell, Electronic Devices and Circuits, 5th Edition, Oxford University Press, 2009.
3. Allen Mottershead, Electronic Devices and Circuits-An Introduction, Prentice Hall of India Private Limited, New Delhi, 2003
4. N.P.Deshpande, Electronic Devices and Circuits, 1st Edition, Tata McGraw Hill Publishing Limited, New Delhi, 2013.
5. R.L.Boylestad and Louis Nashelsky, Electronic Devices and Circuits, 9th Edition, Pearson/Prentice Hall, 2013.
6. Thomas L Floyd, Electronic Devices, Prentice Hall of India, New Delhi, 2011.

18MC207 ENGINEERING PRACTICE LABORATORY 0 0 2 1

Course Objectives

- To provide hands on training for fabrication of components using carpentry, sheet metal and welding equipment / tools.
- To gain the skills for making turning, facing operations using suitable Lathe.
- To develop the skills for making wood/sheet metal models using suitable tools

Programme Outcomes (POs)

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

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

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

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

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

PO12. 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.

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Fabricate simple components using carpentry tools
2. Make the machining process and measure the dimensions using Vernier Caliper
3. Prepare corner joint, Butt joint, Lap joint using welding equipment/tools.
4. Make simple models using wood and sheet metal
5. Develop an object using different sheets.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	-	1	3	-	-	1	-	-	1	1	2	-
2	2	-	-	1	2	-	-	3	-	-	1	1	1	-
3	3	-	-	1	1	-	-	2	-	-	1	1	2	-
4	2	-	-	1	2	-	-	2	-	-	1	1	1	-
5	2	-	-	1	1	-	-	1	-	-	1	1	2	-

EXPERIMENT 1 2 Hours

For the given wire, plate measure the dimensions using screw gauge and Vernier caliper

EXPERIMENT 2 3 Hours

Perform turning, facing operations on given work piece to produce the stepped diameter on the MS rod. Measure the dimensions using Vernier caliper

EXPERIMENT 3 3 Hours

Perform turning, facing, chamfering operations on given work piece to produce tapered diameter on the MS rod. Measure the dimensions using Vernier caliper

EXPERIMENT 4 2 Hours

Perform drilling, reaming, tapping operation on the given work piece

EXPERIMENT 5 4 Hours

Make lap joint, Corner joint, Butt joint using Arc and gas welding methods on the given two plates

EXPERIMENT 6 **6 Hours**

Develop a rectangular tray, hopper, cylinder using the sheet metal operations

EXPERIMENT 7 **4 Hours**

Making of Pen Stand, Teapoy using carpentry power tools

EXPERIMENT 8 **2 Hours**

Use hand grinder to make a square plate from the given object and make a hole of multiple diameters

EXPERIMENT 9 **4 Hours**

Fabrication of a simple component using thin and thick plates to make a Book rack

Total **30 Hours**

18MC301 ENGINEERING MATHEMATICS III 3 1 0 4

Course Objectives

- Aimed to provide basic knowledge on periodic, Non periodic functions and their representations using Fourier series and Fourier transforms respectively
- Assess the electrical and mechanical potentials using Laplace transform techniques through partial differential equations
- Predict the changes in the manufacturing process using the concepts of statistics

Programme Outcomes (POs)

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

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

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Represent the periodic motions of mechanical appliances with the help of Fourier series
2. Demonstrate the non periodic vibrations and their properties using Fourier Transforms
3. Formulate a function in frequency domain for which the function defined in time domain through the techniques of Laplace transforms
4. Find the position of a moving particle which are depending on more than one Parameter, using partial differential equations
5. Summarise and analyse the properties of the parameters of any mechanical process with the help of Statistics

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
2	2	3	-	-	-	-	-	-	-	-	-	-	2	-
3	3	1	-	-	-	-	-	-	-	-	-	-	2	-
4	3	2	-	-	-	-	-	-	-	-	-	-	2	-
5	2	2	-	-	-	-	-	-	-	-	-	-	2	-

UNIT I 10 Hours

FOURIER SERIES

Definition of periodic function, Eulers formula, Functions having points of discontinuity, Change of intervals, Odd and Even functions, Expansion of odd or even periodic functions, Half range sine and cosine series, Elements of harmonic analysis

UNIT II 9 Hours

FOURIER TRANSFORMS

Fourier Transform and Inverse Fourier Transform, Sine and Cosine Transforms and Properties, Transforms of Simple Functions, Convolution Theorem, Parseval s Identity

UNIT III 9 Hours

LAPLACE TRANSFORM

Laplace Transform, Existence Condition, Transforms of Standard Functions, Unit step function, Unit impulse function, Properties, Transforms of Derivatives and Integrals, Initial and Final Value Theorems, Laplace transform of Periodic Functions, Inverse Laplace transforms. Applications to ordinary differential equations

UNIT IV 10 Hours

APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATION

Classification of Second Order Quasi Linear Partial Differential Equations, Fourier Series Solutions of One Dimensional Wave Equation, One Dimensional Heat Equation, Steady State Solution of Two Dimensional Heat Equation, Fourier Series Solutions in Cartesian Coordinates

UNITV **7Hours**

BASIC STATISTICS

Mean, Median, Mode, Variance, Standard Deviation, Covariance, Correlation and Regression

Total: 60 Hours

Reference(s)

1. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley, 1993
2. Johnson Richard A. and Bhaltacharyya Gouri K., Statistics, Principles and Methods, 3rd Edition, John Wiley, 1996
3. O'Neil Peter V., Advanced Engineering Mathematics, 4th Edition, PWS-Kent, 1995
4. James Glyn, Advanced Modern Engineering Mathematics, Addison-Wesley, 1993 5.
5. Grewal.B.S, Higher Engineering Mathematics, Khanna Publishers, 43 rd Edition, New Delhi, 2016

18MC302 ELECTRICAL MACHINES 3 0 2 4

Course Objectives

- To understand the working principle and performance characteristics of DC Generator and DC Motor
- To understand the working principle of induction motor and synchronous machines
- To Impart knowledge on special electrical machines

Programme Outcomes (POs)

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

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

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

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6. 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.

PO7. 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.

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

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

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

PO12. 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.

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Implement the circuit model of DC Machines with working principles for starting and controlling the speed.
2. Compute the transformer parameters using the per unit system to compute voltage regulation and efficiency.
3. Analyze the slip-torque characteristics of induction motors to find the operating point and suitable starting methods.
4. Apply the excitation principles of synchronous motor to power factor correction in industries
5. Select the appropriate special machine based on its characteristics for constructing modern tools in industry

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2	-	2	1	1	3	3	3	-	2	3	-
2	2	2	2	-	1	1	1	1	1	1	-	1	1	-
3	3	3	2	-	2	2	2	3	3	3	-	2	3	-
4	2	2	2	-	2	1	1	2	2	2	-	2	2	-
5	1	2	1	-	3	2	2	1	1	1	-	3	1	-

UNIT I **8 Hours**

DC MACHINES

Introduction-Constructional Features-Motoring and generation principle -Emf And Torque equation - Circuit Model- Methods of Excitation and magnetisation characteristics - Starting and Speed Control - Universal Motor

UNIT II **10 Hours**

TRANSFORMERS

Introduction -Ideal Transformer - Accounting For Finite Permeability And Core Loss - Circuit Model Of Transformer - Per Unit System - Determination Of Parameters Of Circuit Model Of Transformer – Voltage Regulation - Nameplate Rating - Efficiency - Three Phase Transformers -Auto Transformers

UNIT III **9 Hours**

INDUCTION MACHINES

Three phase induction motors: Constructional details - Types of rotors - Principle of operation - Slip - Slip-torque characteristics - Condition for maximum torque - Losses and efficiency - Starters - Single Phase induction motors: Double field revolving Theory -Types-Applications

UNIT IV **10 Hours**

SYNCHRONOUS MACHINES

Constructional details - Types of rotors, operating characteristics - Emf equation - Synchronous reactance - Armature reaction - Voltage regulation - EMF, MMF, methods - Synchronous motor: Principle of operation - Torque equation - Starting methods - V and inverted V curves.

UNITV **8Hours**

SPECIAL MACHINES

Special machines - reluctance motor, repulsion motor, hysteresis motor, stepper motor, servo motor, BLDC. Dynamic, regenerative and plugging

FOR FURTHER READING

Phasor Diagram of Transformer, Blocked rotor test of induction motor, power factor correction using synchronous motor, Analysis of mechanical characteristics of special machines.

EXPERIMENT 1 **4 Hours**

Load test on DC shunt motor.

EXPERIMENT 2 **4 Hours**

Load test on DC series motor

EXPERIMENT 3 **5 Hours**

Load characteristics of separately excited DC generator

EXPERIMENT 4 **5 Hours**

Load characteristics of separately excited DC generator

EXPERIMENT 5 **4 Hours**

O C and S C test on single phase transformer

EXPERIMENT 6 **5 Hours**

Load test on three phase Induction motor.

EXPERIMENT 7 **4 Hours**

Load test on 1 phase Induction motor.

75 Hours

Reference(s)

1. D.P.Kothari and J.J.Nagrath, Electric Machines, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2017
2. A.E.Fitzgerald, Charles Kingsley and Stephen D. Umans, Electric Machinery, Tata McGrawHill Publishing Company Ltd, New Delhi, 2003
3. Stephen J. Chapman, Electric Machinery Fundamentals, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017
4. P. S. Bhimbhra, Electrical Machinery, Khanna Publishers, New Delhi, 2011.
5. B.L.Theraja and A.K.Theraja, A Text Book of Electrical Technology - Volume II, S.Chand and Company Ltd, New Delhi, 2014

18MC303 DIGITAL ELECTRONICS 3 0 0 3

Course Objectives

- To understand the fundamentals of digital logic
- To understand the various number systems and codes
- To design various combinational and sequential circuits
- To study the basics about synchronous and asynchronous circuits

Programme Outcomes (POs)

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

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

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

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

PSO2: Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Use the Boolean algebra and simplification techniques to design and minimize logic circuits.
2. Design and analyze combinational circuits such as adders, subtractors, multiplexers, and encoders for efficient data processing.
3. Develop sequential circuits using flip-flops and state diagrams through state minimization and assignment techniques.
4. Outline the different memory types and implement combinational logic using PLDs, PLA, PAL, and FPGA.
5. Design synchronous and asynchronous sequential circuits while addressing potential hazards, and use VHDL to model and simulate digital systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	-	-	-	-	-	-	-	-	-	1	1
2	1	2	3	-	-	-	-	-	-	-	-	-		1
3	2	1	3	-	-	-	-	-	-	-	-	-	1	1
4	1	1	2	-	-	-	-	-	-	-	-	-	1	2
5	2	2	3	-	2	-	-	-	-	-	-	-	2	2

UNIT I 9 Hours

LOGIC GATES AND MINIMIZATION CIRCUITS

Basic digital circuits AND - OR - NAND - NOR - EX-OR - EX-NOR operations - universal building block construction using logic gates - Boolean Algebra- Simplification of Boolean functions - special forms of Boolean functions - minterm (SOP) - maxterm (POS) - K Map representation of logic functions - simplification of logic functions using K Map - Don't care conditions ,Quine-McCluskey method of minimization.

UNIT II 9 Hours

COMBINATIONAL CIRCUITS

Half and Full Adders - Half and Full Subtractors - Code converters Encoder - Decoder – Multiplexer Demultiplexer - Binary/ BCD adders, subtractors - Carry look ahead adder - parity checker - parity generators - Magnitude comparator

9 Hours

UNIT III

SEQUENTIAL CIRCUITS

General model of sequential circuits - flip-flops - latches - level triggering, edge triggering – master slave configuration - Mealy/Moore models - state diagram - state table - State minimization - State assignment - Excitation table and maps - shift registers - Ring counter

UNIT IV **9 Hours**

MEMORY DEVICES

Memory types and terminology - static and dynamic RAM - ECL RAM - Non Volatile RAM - Sequential Memories: Recirculation shift registers-First in first out memories - Magnetic core memories - magnetic disk memories - Programmable Logic Devices (PLD) - Programmable Logic Array (PLA) - Programmable Array Logic (PAL) - Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using ROM, PLA, PAL

UNITV **9Hours**

SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS AND VHDL

Design of synchronous sequential circuits - parity checker - sequence detector - Asynchronous sequential logic: Race conditions and Cycles - Hazards in combinational circuits. Introduction to VHDL -Behavioral, Data Flow and Structural Model - Operators - Data objects - Data types, Attributes - Test Benches - Simple programs

FOR FURTHER READING

Memory types and terminology - static and dynamic RAM - ECL RAM - Non Volatile RAM --First in first out memories - Magnetic core memories - magnetic disk memories- Magnetic tape and Bubble memories

Total: 45 Hours

Reference(s)

1. PSO1: Morris Mano, Michel D. Ciletti, Digital Design, Pearson Education, New Delhi, 6th edition,2018
2. Ronald J. Tocci Neal S. Widmer and Gregory L. Moss, Digital Systems: Principles and Applications, Prentice Hall of India, New Delhi, 12th Edition, 2018
3. A. Anand Kumar, Fundamentals of Digital Circuits, PHI Learning Pvt. Ltd. 2014.
4. Thomas L. Floyd, Digital Fundamentals, Pearson Education Inc, New Delhi,10th Edition, 2006
5. Donald P.Leach and Albert Paul Malvino, Digital Principles and Applications, Tata McGrawHill Delhi, 8th Edition 2015
6. Charles H.Roth. Fundamentals of Logic Design, Thomson Learning, 7th Edition,2013

18MC304 STRENGTH OF MATERIALS 3 1 0 4

Course Objectives

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To determine the stresses and understand their behaviour on beams, shafts and thin cylinders
- To assess the deflections in beams, columns and springs
- To compute the power transmitted by shafts and stain energy stored in deformed bodies

Programme Outcomes (POs)

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

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

PO3: Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration

PO6. 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.

PSO2: Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Identify the stress-strain relationship to determine the deformation of a composite bar in a structural engineering application.
2. Make use of Mohr's circle to determine the stresses under bending and shear loading in an engineering design scenario.
3. Examine the shear force and bending moment distributions in loaded beams for the design and safety of structural components.
4. Compute the strain energy stored and find the deflection of beams for the analysis and design of structural elements.
5. Determine the parameters of shafts and springs to design mechanical systems, such as power transmission devices and suspension systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1	-		1	-	-	-	-	-	-	-	1
2	2	3	2	-	-	2	-	-	-	-	-	-	-	2
3	1	3	2	-	-	1	-	-	-	-	-	-	-	2
4	1	3	2	-	-	1	-	-	-	-	-	-	-	2
5	2	3	2	-	-	2	-	-	-	-	-	-		2

UNIT I 9 Hours

STRESS, STRAIN AND DEFORMATION OFSOLIDS

Rigid bodies and deformable solids - Simple stresses and strains - Stress-strain curve for ductile materials - Deformation of axially loaded member - Composite bars - Thermal stresses - Elastic constants - Relationship between elastic constants - Volumetric strains

UNIT II 9 Hours

STRESSES IN BEAM

Stresses on inclined planes - Principal stresses and principal planes - Mohr's circle of stress - Theory of simple bending - Bending stress distribution - Load carrying capacity - Proportioning of sections -

Shear stress distribution - Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses - Thick cylinders - Lame's equation - Shrink fit

UNIT III **9 Hours**

TRANSVERSE LOADING ON BEAMS

Beams and its types - Transverse loading on beams - Shear force and bending moment in beams: cantilever, simply supported beam and overhanging beam - Determination of maximum bending moment - Point of contra flexure

UNIT IV **9 Hours**

STRAIN ENERGY AND DEFLECTION

Strain energy - Resilience and proof resilience - Strain energy stored in the member due to gradually applied load, suddenly applied load and impact load - Stress strain diagram showing ductile and brittle behaviour of materials - Elastic curve - Governing differential equation - Double integration method for computation of slope and deflection of determinant beams - Deflection in columns - Long column - Euler's Theory - Short column - Empirical formulae

UNITV **9Hours**

TORSION IN SHAFTS AND SPRINGS

Theory of Torsion - Stresses and Deformations in Solid and hollow circular shafts - Power transmitted to shaft - Shaft in series and parallel - Stepped shafts - Deflection in shafts fixed at the both ends - Closed and open coiled helical springs - springs in series and parallel - Stresses in helical springs - Deflection of helical springs - Leaf springs

FOR FURTHER READING

Bending stress distribution of flitched beams - Stresses in compound cylinders - Stress-strain curve for brittle materials

Total: 60 Hours

Reference(s)

1. Rattan, S. S., Strength of Materials, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2012
2. Egor. P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2002
3. Ferdinand P. Beer, E. Russell Johnston, Jr., John T. Dewolf and David F. Mazurek, Mechanics of Materials, McGraw-Hill Education, New York, 2015.
4. Bansal. R. K., A Textbook of Strength of Materials, Laxmi Publications Pvt. Ltd., New Delhi, 2018
5. Subramanian, R., Strength of Materials, Oxford University Press, Oxford Higher Education Series, 2016.
6. https://onlinecourses.nptel.ac.in/noc17_ce22/preview

18MC305 FLUID MECHANICS AND HYDRAULIC MACHINES 2 0 2 3

Course Objectives

- To understand the fluid properties and its application
- To acquire knowledge on kinematics and dynamics of internal flows of fluids
- To carry out the dimensional and model analysis of systems using Newtonian fluid
- To understand the concepts of hydraulic machines

Programme Outcomes (POs)

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

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

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

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

PO7. 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.

PSO2: Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Examine the dynamic behavior of fluid motion in engineering systems.
2. Evaluate the characteristics of internal fluid flow and identify the losses occurring within the fluid path.
3. Utilize dimensional and model analysis techniques to predict the performance of hydraulic machines.
4. Apply principles of fluid mechanics to assess the performance of hydraulic turbines.
5. Analyze the operation of dynamic and positive displacement pumps.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-	2	-	-	-	-	-	-	-	-	-	-
2	3	2	2	2	-	-	1	-	-	-	-	-	2	-
3	2	2	3	2	-	-	-	-	-	-	-	-	3	-
4	2	2	3	2	-	-	1	-	-	-	-	-	2	2
5	2	2	3	2	-	-	1	-	-	-	-	-	2	2

UNIT I 6 Hours

FLUID PROPERTIES

Fluid - Fluid Mechanics - Properties of fluids - Types of fluid Capillarity and Surface Tension - Two dimensional Continuity equation, Bernoulli equation, energy equation, momentum equation and moment of momentum equation.

UNIT II 6 Hours

INTERNAL FLUID FLOWAND FRICTIONAL LOSSES

Types of Fluid flow - Flow in circular pipe, - Darcy Weisbach equation - Chezy's formula -Minor losses in pipes - Flow through syphon - Flow through pipes in series and in parallel

UNIT III **6 Hours**

DIMENSIONAL ANALYSIS

Dimensional analysis - Rayleigh's Method, Buckingham's Pi Theorem - Similitude - Types of Similarities - Dimensionless parameters - Model laws

UNIT IV **6 Hours**

HYDRAULIC TURBINES

Turbines- definition - Classification, Types of Heads and Efficiencies Construction and working principle - Pelton Wheel - Francis Turbine, Kaplan Turbine - specific speed - Characteristic curve for hydraulic turbines - Governing of turbines

UNITV **6Hours**

HYDRAULIC PUMPS

Types of Pumps - Construction and Working - Centrifugal pump, Reciprocating Pump, Jet Pumps, Gear Pump -Definitions of Head and Efficiencies - Minimum speed - Priming and Cavitation - Slip - Characteristic curves. Slip - Indicator diagram (Description only)

FOR FURTHER READING

Pressure Measurement - Types of manometer - Lift and drag in air foils - Propeller Turbine - Air vessel - Pitot Tube

EXPERIMENT 1 **3 Hours**

Determination of fluid properties for the given samples

EXPERIMENT 2 **3 Hours**

Determination of coefficient of discharge by selecting a simple flow and efficient flow measuring device to measure the flow of water in a closed pipe

EXPERIMENT 3 **3 Hours**

Measurement of discharge of a pipe flow using a vertically oriented flow measuring device and identifying the significant parameters

EXPERIMENT 4 **3 Hours**

Measure the discharge of open channel flow using V notch or trapezoidal notch

EXPERIMENT 5 **3 Hours**

Measure and Comparison of major losses in two pipes in which the water flowing inside them

EXPERIMENT 6 **3 Hours**

Selection of suitable pump for domestic application and determining its optimum performance parameters.

EXPERIMENT 7 **3 Hours**

Selection of a non rotary positive displacement pump and determining its optimum performance parameters

EXPERIMENT 8 **3 Hours**

Determine the efficiency and characteristics of Impulse turbine

EXPERIMENT 9 **3 Hours**

Determine the efficiency and characteristics of Kaplan Turbine

EXPERIMENT 10 **3 Hours**

Design an experiment to verify the various fluid laws

60 Hours

Reference(s)

1. R. K. Bansal, A textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications, New Delhi, 2018
2. Bruce R. Munson , Donald F. Young, Theodore H. Okiishi and Wade W. Huebsch, Fundamentals of Fluid Mechanics, John Wiley and Sons (Asia) Pvt. Ltd., New Delhi, 2012.
3. Pijush K. Kundu and Ira PSO1: Cohen, Fluid Machines, Academic Press, Burlington, USA, 2010
4. Yunus A. Cengel and John PSO1: Cimbala, Fluid Mechanics Fundamentals and Application, Tata McGraw-Hill Publishing Company Ltd, New Delhi 2013

5. John F. Douglas, J. PSO1: Gasiorek, John Swaffield and Lynne Jack, Fluid Mechanics, Pearson Education, New Delhi, 2008.
6. S. K. Som , Gautam Biswas and S. Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw-Hill Publishing Company Ltd, New Delhi 2017

18MC306 MANUFACTURING TECHNOLOGY 3 0 0 3

Course Objectives

- To understand working principle of conventional and non-conventional casting, welding and metal working processes
- To study the working of machining processes including non-conventional types
- To learn about the production methods of thermo and thermosetting plastics

Programme Outcomes (POs)

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

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

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6. 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.

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Select appropriate casting and molding techniques to manufacture components based on material properties and production requirements in industrial
2. Apply the principles of welding, brazing, soldering, and adhesive bonding for assembling components in automotive, aerospace, and manufacturing applications.
3. Choose the suitable metal forming processes, such as forging, rolling, extrusion, or drawing, to manufacture components in a sheet metal industry.
4. Identify the appropriate machine tool for specific machining operations to achieve desired precision and efficiency in manufacturing processes.
5. Examine the appropriate non-conventional machining method to process complex shapes or hard-to-machine materials in advanced manufacturing applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2	-	-	-	1	-	-	-	-	-	-	1	-
2	3	3	-	-	-	2	-	-	-	-	-	-	2	-
3	3	2	-	-	-	1	-	-	-	-	-	-	1	-
4	3	2	-	-	2	2	-	-	-	-	-	-	2	-
5	1	2			2	1	-	-	-	-		-	1	-

UNIT I 9 Hours

CASTING PROCESSES

Introduction to Foundry - Procedure to make sand mould, types of cores, moulding tools, machine moulding - pattern, sand testing, - casting defects and remedies. Introduction to Plastics - Moulding of Thermoplastics - Injection moulding -Plunger and screw machines -Blow moulding -Rotational moulding -Film blowing - -Thermoforming - Compression moulding -Transfer moulding

UNIT II 9 Hours

JOINING PROCESSES

Types of Metal Joining Process - Introduction to welding process - Principle of arc and gas welding - Tools and equipment - Filler and flux materials - Flame types - Weld defects - Safety in welding - Special welding processes: resistance welding, Friction welding, TIG welding, MIG welding -Brazing

and soldering - Adhesive bonding.

UNIT III **9 Hours**

METAL FORMING THEORY

Introduction to hot and cold working - Forging: open and close die, upsetting - Rolling: high roll mills and shape rolling - Extrusion: forward and backward, tube extrusion - Drawing of wires, rods and tubes - Sheet metal work: Shearing, bending and drawing operations - Powder metallurgy (basics only)

UNIT IV **9 Hours**

MACHINE TOOLS

Cutting tools & materials, cutting fluids, metal cutting theory, Merchants circle, constructional features of machine tools: Universal milling machine, shaping machine, cylindrical grinding machine, capstan and turret lathe - Basics of CNC machine.

UNITV **9Hours**

NON CONVENTIONAL MACHINING

General principles and applications - Water jet machining (WJM), Abrasive Jet Machining (AJM)Electro Discharge Machining (EDM), Electro Chemical Machining (ECM) and Laser Beam Machining (LBM), Ultrasonic Machining (USM).

FOR FURTHER READING

Additive Manufacturing, Laser Beam welding, Automated Melding system

Total: 45 Hours

Reference(s)

1. J. P. Kaushish, Manufacturing Processes, Prentice Hall of India Learning Private Limited, New Delhi, 2014
2. P. PSO2: Rao, Manufacturing Technology - Vol I and II, Tata McGraw-Hill Publishing Company
Limited, New Delhi, 2013.
3. D. K. Singh, Fundamentals of Manufacturing Engineering, ANE Books, New Delhi, 2008
4. Roy A. Lindberg, Processes and Materials of Manufacture, Prentice Hall of India Learning. Ltd., New Delhi, 2009
5. T. R. Mishra, Non-Conventional Machining, Narosha Publishing House, New Delhi, 2012
6. Mikell P. Groover, Automation, Production System and Computer Integrated Manufacturing, Pearson Education, New Delhi, 2015.

18MC307 DIGITAL ELECTRONICS LABORATORY 0 0 2 1

Course Objectives

- To design and implement the digital circuits
- To gain expertise in digital systems and simulation of digital circuits with ICs

Programme Outcomes (POs)

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

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

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

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

PSO2: Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Compute and implement combinational circuits, including adders, subtractors, code converters, and parity checkers, using logic gates and ICs.
2. Develop and test sequential circuits, such as counters and flip-flops, and implement these using programmable devices like ROMs and PLAs.
3. Create and simulate digital circuits using VHDL at the data abstraction level, enhancing skills in digital system modeling and verification.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	1	1	-	-	-	-	-	-	-	-	1	1
2	-	-	1	2	-	-	-	-	1	-	-	-	1	2
3	-	-	1	2	-	-	-	-	2	-	-	-	2	3
4	-	-	1	1	-	-	-	-	-	-	-	-	1	1
5	-	-	1	2	-	-	-	-	1	-	-	-	1	2

EXPERIMENT 1 **3 Hours**

Design and implementation of Adders and Subtract or using logic gates

EXPERIMENT 2 **3 Hours**

Design and implementation of code converters using logic gates

(i) BCD to excess-3 code and vice versa

(ii) Binary to gray and vice-versa

EXPERIMENT 3 **3 Hours**

Design and implementation of 4 bit binary adder/ subtract or and BCD adder

EXPERIMENT 4 **3 Hours**

Design and implementation of 4 bit binary adder/ subtract or and BCD adder

EXPERIMENT 5 **3 Hours**

Design and implement a 16 bit odd/even parity generator and checker using ICs

EXPERIMENT 6 **3 Hours**

Design and implement a multiplexer and DE multiplexer using ICs

EXPERIMENT 7 **3 Hours**

Design and implement an encoder and decoder using ICs

EXPERIMENT 8 **3 Hours**

Design and implement a synchronous counter

EXPERIMENT 9 **3 Hours**

Design a sequential circuit using ROMs and PLAs

EXPERIMENT 10 **3 Hours**

Design flip flops (JK,SR,D and T) VHDL using data level of abstraction

30 Hours

Reference(s)

1. PSO2: Nagrath, Electronics: Analog and Digital, Prentice Hall of India Pvt. Ltd, New Delhi, 2009
2. Anant Agarwal, Joffrey H. Lang, Foundations of Analog and Digital Electronic Circuit, Elsevier, 2006

18MC308 MANUFACTURING TECHNOLOGY LABORATORY 0 0 2 1

Course Objectives

- To operate conventional machine tools such as lathe, milling machine, shaping machine, drilling machine, gear hobbing machine, surface grinding machine and tool and cutter grinder
- To correlate the theory, course on machining processes
- To measure various linear dimensions

Programme Outcomes (POs)

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

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO7. 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.

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

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

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Classify various machine tools and their functions, while performing hands-on measurement of linear dimensions using precision instruments in a laboratory
2. Demonstrate the operation of conventional machine tools for drilling and welding processes to fabricate and assemble components.
3. Create machine parts according to the required design specifications using appropriate machining techniques.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	-	-	-	2	-	1	-	1	-	1	-	1	-
2	2	-	-	-	2	-	2	-	2	-	1	-	1	-
3	3	-	-	-	2	-	1	-	3	-	1	-	1	-
4	3	-	-	-	2	-	1	-	1	-	1	-	1	-
5	2	-	-	-	2	-	2	-	2	-	1	-	1	-

EXPERIMENT 1 **3 Hours**

Machining a cotter pin whose diameter is continuously varying throughout its length

EXPERIMENT 2 **3 Hours**

Making a model of screw used in Vernier caliper

EXPERIMENT 3 **3 Hours**

Practicing to make models like table, chair, rack, teapoy, stool, etc. using arc welding equipment

EXPERIMENT 4 **3 Hours**

Fabrication of a pin and hole with push fit assembly using centre lathe

EXPERIMENT 5 **3 Hours**

Preparing the shaft/key/coupling assembly by selecting suitable machining operations and to list the sequence of operations.

EXPERIMENT 6 **3 Hours**

Machining a spur gear with n number of teeth with 2 mm module by selecting suitable machine tool.

EXPERIMENT 7 **3 Hours**

Grinding of single point cutting tool in the 10 mm MS square rod with standard nomenclature using tool and cutter grinding machine

EXPERIMENT 8 **3 Hours**

Grinding of single point cutting tool in the 10 mm MS square rod with standard nomenclature using tool and cutter grinding machine

EXPERIMENT 9 **3 Hours**

Producing a square bar from the given shaft with minimum material wastage by selecting suitable machining operations

30 Hours

Reference(s)

1. Central Machine Tool Institute (CMTI), Machine Tool Design Handbook, Tata McGraw-Hill Publishing Company Ltd, Bangalore, 2017
2. Geoffery Boothroyd and Winston A. Knight, Fundamentals of Machining and Machine Tools,CRC Press, Taylor and Francis Group, Indian Edition, 2008.
3. Heinrich Gerling and Karl H. Heller, All About Machine Tools, New Age International (P) Limited Publishers, Noida, 2008
4. Steve F. Krar, Arthur R. Gill and Peter Smid, Technology of Machine Tools, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2010

18GE301 SOFT SKILLS - VERBAL ABILITY 2 0 0 0

Course Objectives

- To help students gain adequate proficiency in vocabulary
- To help students become proficient in basic writing skills related to workplace communication
- To read and understand unabridged text

Programme Outcomes (POs)

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

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

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

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Take up verbal ability part of the placement tests with confidence
2. Write with confidence in professional and workplace communication
3. Distinguish fact from opinion by reading passages from a text

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	-	2	-	-	1	-
2	-	-	-	-	-	-	-	-	-	-	3	-	1	-
3	-	-	-	-	-	-	-	-	2	-	-	-	1	-
4	-	-	-	-	-	-	-	-	-	2	-	-	1	-
5	-	-	-	-	-	-	-	-	-	-	3	-	1	-

UNIT I 15 Hours

INTRODUCTION

Synonyms - Antonyms - Word Groups - Verbal Analogies - Etymology - Critical Reasoning - Cloze Test - One Word Substitution - Idioms and Phrases - Text & Paragraph Completion

UNIT II 15 Hours

BASICS OF VERBAL APTITUDE

Sentence Formation - Paragraph Formation - Change of Voice - Change of Speech - Reading Comprehension - Sentence Equivalence - Jumbled Sentences - Spotting Errors -Homophones Homonyms - Commonly Mispronounced/Misspelt Words

Total: 30 Hours

Reference(s)

1. Murphy, Raymond. English Grammar in Use A Self-Study Reference and Practice Book for Intermediate Learners of English. IV EditioPSO2: United Kingdom: Cambridge University Press. 2012.
2. Lewis, NormaPSO2: Word Power Made Easy. New York: Pocket Books. 1991.
3. Barron's The Official Guide for New GMAT Review, New Jersey: John Wiley & Sons, Inc.

2015

18MC401 ENGINEERING MATHEMATICS IV 3 1 0 4

Course Objectives

- Recognize and develop a mathematical model representing all important characteristics of the physical system.
- Identify and solve any type of mathematical equations by numerical methods.
- Predict and control the process by control charts.

Programme Outcomes (POs)

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

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

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Compute the solution of nonlinear equations and to construct a mathematical model for the given data.
2. Assess the values of one and two dimensional partial differential equations like vibration of strings, heat distribution in a rod and plate
3. Identify the error committed by the numerical calculation of any type of mathematical models and able to rectify the errors
4. Predict the outcome of any mechanical process using the concepts probability and probability distributions.
5. Justify and validate the mathematical model for a mechanical process with the help of hypothesis testing

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	-	-	-	-	-	-	-	-	-	-	2	-
2	3	2	-	-	-	-	-	-	-	-	-	-	2	-
3	3	1	-	-	-	-	-	-	-	-	-	-	2	-
4	2	1	-	-	-	-	-	-	-	-	-	-	2	-
5	3	2	-	-	-	-	-	-	-	-	-	-	2	-

UNIT I 10 Hours

NUMERICAL SOLUTIONS OF NON LINEAR EQUATIONS, INTERPOLATION AND ORDINARY DIFFERENTIAL EQUATIONS.

Single and multi-variable nonlinear equations by Newton s method, convergence of fixed point iterations. Curve fitting: Least squares approximation, Normal equations. Polynomial interpolation and cubic spline interpolatioPSO2: Single step method: Runge-Kutta method, Multi-step methods, Finite

Difference Methods.

UNIT II 10 Hours

NUMERICAL SOLUTIONS OF INTEGRATIONS AND PARTIAL DIFFERENTIAL EQUATIONS.

Integration using Simpson s and Trapezoidal rules. Classification of partial differential equations, solutions of Laplace s and Poisson s equations, Solutions of parabolic and hyperbolic equations

UNIT III 6 Hours

ERROR ANALYSIS

Errors, Truncation and round off errors, measurement errors, Chebychev s Polynomial and data

filtering.

UNIT IV **10 Hours**

PROBABILITY THEORY

Probability. Random variables, probability densities and distributions, mean and variance of a distributioPSO2: Conditional probability. Bayes theorePSO1: Binomial, Poisson and normal distributions.

UNITV **9Hours**

DATA ANALYSIS

Data Sampling, Random Sampling, Reliability of Data, Testing of Hypothesis, Confidence Interval, Quality Control.

Total: 60 Hours

Reference(s)

1. Greenberg Michael D., Advanced Engineering Mathematics, Prentice-Hall International Inc, 1998.
2. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley, 1993.
3. Johnson Richard A. and Bhaltacharyya Gouri K., Statistics, Principles and Methods, 3rd Edition, John Wiley, 1996.
4. Sankara Rao. K, Numerical Methods for Scientists and Engineers, Eastern Economy Edition, New Delhi.
5. Milton J. S. and Arnold Jesse C., Introduction to Probability and Statistics: Principles and Applications for Engineering and The Computing Sciences, McGraw Hill Inc, 3rd Edition, 1995.

18MC402 SENSORS AND SIGNAL CONDITIONING 3 0 0 3

Course Objectives

- To recall the basic laws governing the operation of electrical instruments and the measurement techniques
- To discuss about units, standards, error analysis and characteristics of measurement systems
- To select a suitable sensor and signal conditioning circuit for a particular applications

Programme Outcomes (POs)

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

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

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

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PSO2: Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Outline the various calibration techniques and signal types for sensors.
2. Compare the different sensors associated in measuring motion, proximity and ranging sensors signals
3. Construct the working principle and characteristics of force, magnetic and heading sensors
4. Select the basic principles of various pressure temperature, optical and smart sensors
5. Outline the need for signal conditioning system and their purpose

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	-	2	-	1	-	-	-	-	-	-	-	-	2
2	3	1	2	-	1	-	-	-	-	-	-	-	-	2
3	3	-	1	-	1	-	-	-	-	-	-	-	-	2
4	3	1	1	-	1	-	-	-	-	-	-	-	-	2
5	3	-	2	-	-	-	-	-	-	-	-	-	-	3

UNIT I 9 Hours

SCIENCE OF MEASUREMENT

Basics of Measurement - Classification of errors - Error analysis - Static and dynamic characteristics of transducers - Performance measures of sensors -Classification of transducers - Sensor calibration techniques -Sensor Output Signal Types

UNIT II 9 Hours

MOTION, PROXIMITY AND RANGING SENSORS

Motion Sensors - Potentiometers, Resolver, Encoders - Optical, Magnetic, Inductive, Capacitive, LVDT - RVDT - Synchro - Microsyn, Accelerometer - GPS, Bluetooth, Range Sensors - RF beacons, Ultrasonic Ranging, Reflective beacons, Laser Range Sensor (LIDAR).

UNIT III 9 Hours

FORCE, MAGNETIC AND HEADING SENSORS

Strain Gage, Load Cell, Magnetic Sensors - types, principle, requirement and advantages: Magneto resistive - Hall Effect -Current sensor Heading Sensors - Compass, Gyroscope, Inclinometers

UNIT IV **9 Hours**

OPTICAL, PRESSURE AND TEMPERATURE SENSORS

Photo conductive cell, photo voltaic, Photo resistive, LDR - Fiber optic sensors - Pressure - Diaphragm, Bellows, Piezoelectric - Tactile sensors, Temperature - IC, Thermistor, RTD, Thermocouple. Acoustic Sensors - flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors

UNITV **9Hours**

SIGNAL CONDITIONING SYSTEM

Wheatstone and Schering bridges - Amplification - Filtering - V/I, I/V and I/P converters - Sample and Hold circuits - D/A converter (R -2R ladder and weighted resistor types) - A/D converter (Dual slope, successive approximation and flash types) - Data logging - Display devices: CRO, LED and LCD

FOR FURTHER READING

Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors - applications - Automobile, Aerospace, Robotics and Manufacturing

Total:45 Hours

Reference(s)

1. A.K.Sawhney and P.Sawhney, A Course on Mechanical Measurement Instrumentation and Control, Dhanpat Rai and Co, New Delhi, 2011
2. E. O. Doeblin, Measurement Systems: Applications and Design, Tata McGraw-Hill Publishing Company Limited, 2003
3. C. Sujatha and Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons, Canada, 2001
4. Hans Kurt TÃƒÂ¶nshoff (Editor), Ichiro, Sensors in Manufacturing, Volume 1, Wiley-VCH 2001.
5. Richard Zurawski, Industrial Communication Technology Handbook 2nd edition, CRC Press, 2015
6. https://nptel.ac.in/courses/112103174/3

18MC403 POWER ELECTRONICS AND DRIVES 3 0 2 4

Course Objectives

- To obtain the switching characteristics of different types of power semiconductor devices
- To determine the operation, characteristics and performance parameters of converters
- To understand the concept of DC and AC drives

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PO6. 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.
PO7. 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.
PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO12. 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.
PSO2: Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Analyze the construction and characteristics of power semiconductor devices for protecting equipment from the overvoltage and current.
2. Apply phase control techniques in power electronics equipment for stabilizing voltage and current.
3. Implement Pulse Width Modulation (PWM) techniques in inverters to eliminate harmonics and achieve efficient AC to DC power conversion.
4. Select suitable electrical drives and control DC motors with rectifiers and choppers to achieve optimal efficiency.
5. Execute slip power recovery schemes in AC motors with static rotor resistance control to improve power factor

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1	-	1	3	3	1	1	3	-	1	-	3
2	3	3	3	-	3	3	3	2	2	2	-	2	-	2
3	3	3	3	2	3	3	3	2	2	2	-	2	-	3
4	2	2	2	-	2	2	2	3	1	1	-	3	-	2
5	2	2	2	-	2	2	2	3	1	1	-	3	-	3

UNIT I **9 Hours**

POWER SEMICONDUCTOR DEVICES

Construction, Operation, Characteristics of Power Diode - SCR - TRIAC - Power transistor,MOSFET and IGBT - di/dt and dv/dt protection

UNIT II **9 Hours**

CONVERTERS AND CHOPPERS

Phase Control - Single Phase and Three phase uncontrolled and controlled rectifiers with R and RL load, Choppers, Time ratio control, Types, Buck-boost chopper-four quadrant operation, cyclo converters

UNIT III **9 Hours**

INVERTERS

Single phase and three phase (both 120 Ã‚Â° and 180 Ã‚Â° modes.) voltage source inverters - PWM techniques: Sinusoidal PWM modified sinusoidal PWM and multiple PWM - Current source inverters - Harmonics elimination technique

UNIT IV **9 Hours**

SOLID STATE DC DRIVES

Types of electrical drives - selection of drives - heating and cooling curves - Four quadrant operation of hoist -Ward Leonard control system - Control of DC drives using rectifiers and choppers

UNITV **9Hours**

SOLID STATE AC DRIVES

Control of three phase induction motors using stator voltage and frequency control - variable frequency drive - static rotor resistance control - Slip power recovery schemes - Static Kramer control method - Static Scherbius control method - Power factor correction

FOR FURTHER READING

Sepic, pi, T converters, UPS-PV power conversion, Application of Closed Loop control method, Permanent magnet brushless DC motor drive

EXPERIMENT 1 **3 Hours**

Characteristics of SCR

EXPERIMENT 2 **3 Hours**

Characteristics of IGBT

EXPERIMENT 3 **3 Hours**

Single phase half wave uncontrolled rectifiers with R, RL load

EXPERIMENT 4 **3 Hours**

Single phase half wave controlled rectifiers with R, RL load

EXPERIMENT 5 **3 Hours**

Single phase half wave controlled rectifiers with R, RL load and feedback diode

EXPERIMENT 6 **3 Hours**

Single phase uncontrolled rectifiers with R, RL load

EXPERIMENT 7 **3 Hours**

Single phase controlled rectifiers with R, RL load

EXPERIMENT 8 **3 Hours**

Three phase uncontrolled rectifiers with R, RL load

EXPERIMENT 9 **3 Hours**
Three phase controlled rectifiers with R, RL load
EXPERIMENT 10 **3 Hours**
Single phase PWM inverter

Total: 75 Hours

Reference(s)

1. Muhammad H. Rashid, Power Electronics - Circuits, Devices and Applications, Prentice Hall of India Learning. Ltd., New Delhi, 2004
2. G. K. Dubey, Fundamentals of Electrical Drives, Wiley Eastern Ltd., New Delhi, 2007
3. S. K. Pillai, A First Course on Electrical Drives, New Age International Pvt. Ltd., New Delhi, 2012.
4. PSO1: D. Singh and K. B. Khanchandani, Power Electronics, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008
5. Vedam Subrahmaniam, Electric Drives (concepts and applications), Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2007
6. P. S. Bhimbra, Power Electronics, Khanna Publishers, New Delhi, 2012

18MC404 FLUID POWER SYSTEM 2 0 2 3

Course Objectives

- To gain knowledge on properties of fluid and various types of losses in fluid
- To understand the construction and working principle of various components used in hydraulic and pneumatic systems
- To design hydraulic and pneumatic circuits for various applications using software and hardware tools

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
PO3.Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PSO1.Analyze, design and develop electro mechanical system using contemporary tools
PSO2.Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation

Course Outcomes (COs)

1. Apply the concept of fluid power system to determine head losses and pump power.
2. Select suitable hydraulic pumps and suitable actuators used in hydraulic system
3. Determine the hydraulic valvess for the fluid power application.
4. Choose the components to design a pneumatic system
5. Design the hydraulic and pneumatic circuits for a given application using various methods.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	-	1	-	1	-	-	-	-	-	-	-	3	2
2	3	-	2	-	1	-	-	-	-	-	-	-	2	2
3	3	-	1	-	1	-	-	-	-	-	-	-	2	2
4	3	-	2	-	1	-	-	-	-	-	-	-	3	2
5	1	-	3	-	3	-	-	-	-	-	-	-	3	3

UNIT I 6 Hours

FLUID POWER SYSTEMS

Introduction to fluid power History Pascals law - Comparison between various type of energy medium - Advantages - Drawbacks - Applications of fluid power system in various sectors. Hydraulic fluids: Properties and functions. Filtration system - Darcys equation: Frictional losses. Losses in valves and fittings - Determination of head losses & pump power in a hydraulic circuit.

UNIT II 6 Hours

HYDRAULIC PUMPS AND ACTUATORS

Positive and non-positive displacement pumps - Pumping theory and classification - Construction and working principle of Gear, Vane and Piston pumps - Variable Displacement Pumps (Vane and Piston), Pump performance curves - Hydraulic cylinders: Construction & Working principle - Single acting, Double acting, Double rod cylinder and Telescopic cylinder. Hydraulic motors: Gear, Vane and Piston motors

UNIT III 6 Hours

HYDRAULIC VALVES

Directional Control Valves: Check valve - Pilot operated check valve - methods of valve actuation - working principle of 2/2, 3/2, 4/2 ,4/3 and 5/2 DCV - Shuttle valve. Pressure control Valves: Pressure relief valves - Pressure reducing valve - Unloading valves - Counterbalance valves - Flow control valves - Proportional and Servo valves: Mechanical type.

UNIT IV **6 Hours**

PNEUMATICS SYSTEM

Introduction - Properties of air - gas laws - Compressors: Piston compressor, Screw compressor and Vane compressor. Fluid conditioners: Air filters, Air pressure regulators, Air lubricators, Pneumatic silencers, After coolers and Air dryers. Pneumatic actuators: Pneumatic cylinders, Rotary air motors and Performance curves

UNITV **6Hours**

DESIGN OF HYDRAULIC AND PNEUMATIC CIRCUITS

Fluid power Symbols - Basic circuit - Meter in and Meter Out Circuit - Counter Balance Circuit - Pipe Sizing Calculations. Sequential circuit design for simple applications: Step counter method, Cascade methods & Karnaugh Veitch map method

FOR FURTHER READING

Servo pumps - variable displacement hydraulic Motors-Pneumatic valves. Introduction to Hydraulic Accessories, Pressure switch, Pressure and Flow sensors - Accumulators

EXPERIMENT 1 **3 Hours**

Identification of fluid power system components.

EXPERIMENT 2 **3 Hours**

Drawing the standard symbols of Fluid Power System components.

EXPERIMENT 3 **3 Hours**

Actuation of a single acting cylinder using limit switch and push button in a kit and simulation software

EXPERIMENT 4 **3 Hours**

Actuation of a double acting cylinder using limit switch in a kit and simulation software

EXPERIMENT 5 **3 Hours**

Simulation of fluid power circuits with logic controls (AND valve and OR valve).

EXPERIMENT 6 **3 Hours**

Design of PLC circuits using to actuate the double acting cylinder of Hydraulic lift

EXPERIMENT 7 **3 Hours**

Actuation of meter in, meter out, synchronizing and quick exhaust circuit in a simulation software

EXPERIMENT 8 **3 Hours**

Design of pneumatic circuit for a drilling operation and simulate the operation in a simulation software (use step counter method).

EXPERIMENT 9 **3 Hours**

Design of hydraulic circuit for a pick and place operation using cascade method and simulate the operation

EXPERIMENT 10 **3 Hours**

Design of fluid power circuit using Karnaugh Veitch method and simulate the operation in a simulation software.

Reference(s)

1. Anthony Esposito, Fluid Power with Applications, Pearson Education New Delhi, 2015
2. S. R. Majumdar, Oil Hydraulics, Tata McGraw Hill Publishing Company Pvt Ltd. New Delhi,2014
3. James L. Johnson, Introduction to Fluid Power, Delmar Thomson Learning, 2013
4. S. R. Majumdar, Pneumatic systems - Principles and maintenance, Tata McGraw Hill
5. Publishing Company Pvt Ltd. New Delhi, 2014.
6. Andrew Parr, Hydraulics and Pneumatics, Jaico Publishing House, 2015
7. https://nptel.ac.in/courses/112105047

18MC405 THEORY OF MACHINES 3 1 0 4

Course Objectives

- To learn various mechanisms and find their velocity and acceleration
- To perform force analysis and balancing of reciprocating engines
- To understand the function of flywheel and to determine basic parameters of flywheel
- To determine gear ratio for simple, compound, reverted and epicyclic gear train

Programme Outcomes (POs)

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

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

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

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

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

PO12. 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.

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

PSO2: Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Demonstrate the mobility of a given planar mechanism.
2. Apply vector mechanics principles to draw the velocity and acceleration diagram of planar mechanisms.
3. Analyze the static and dynamic forces in different parts of reciprocating engine for a mechanism design.
4. Implement the concept of balancing of masses in rotating shafts to determine its effects on vibration
5. Compute speed and torque ratio of major gear trains

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	-	1	-	-	-	-	-	-	-	1	2	2
2	2	2	-	-	-	-	-	-	-	1	-	1	3	2
3	2	2	-	-	-	-	-	-	-	1	-	1	3	2
4	2	2	-	-	-	-	-	-	-	1	-	1	3	2
5	2	2	1	-	-	-	-	-	-	1	-	1	3	2

UNIT I 9 Hours

BASICS OF MECHANISMS

Basic concepts of mechanisms: link, pair, chain, mechanism, machine and structure, degree of freedom, mobility of mechanism - Kutzbach criterion, Grashof's law - Inversions of mechanisms:

Four bar and slider crank Mechanical advantage, Transmission angle, Description of some common mechanisms: Straight line generators, dwell mechanisms, ratchets and escapements, universal joint - Gyroscope and Mechanical Governors(Basics only) - Industrial robotic arms

UNIT II **9 Hours**

KINEMATICS OF MECHANISMS

Displacement, velocity and acceleration - Graphical method of velocity (relative velocity method) and acceleration diagrams for simple mechanisms - Coriolis component of acceleration

UNIT III **9 Hours**

KINETICS OF MECHANISMS

Static force analysis: Applied and constraint forces, Free body diagrams, Static equilibrium conditions: Two, three and four members - Static force analysis of simple mechanisms - The principle of superposition - Dynamic force analysis: Inertia force and Inertia torque, D'Alembert's principle, Dynamic Analysis in Four bar mechanism

UNIT IV **9 Hours**

BALANCING AND VIBRATION

Balancing Single Rotating mass by a single mass rotating in the same plane and two masses rotating in different planes - Several masses rotating in the same plane and different planes - Vibration and its effects - Types of vibration: Longitudinal, Transverse and torsional-free, forced and damped vibrations (basic only)

UNITV **9Hours**

GEARS AND GEAR TRAINS

Law of toothed gearing Involutes and cycloidal tooth profiles Spur gear terminology and definitions Gear tooth action Interference and undercutting Problems Helical, bevel, worm, rack and pinion gears(Basics only) - Introduction to gear correction gear trains Speed ratio, train value, Parallel axis gear trains, Epicyclic gear trains - Determination of gear speeds and torque using tabular method

FOR FURTHER READING

Cams, dynamic analysis of reciprocating engine

Total:60 Hours

Reference(s)

1. 1. S. S. Rattan, Theory of Machines, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2014
2. 2. R. L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2009
3. Sadhu Singh, Theory of Machines, Prentice Hall of India Learning, New Delhi, 2012
4. Kenneth J. Waldron and Garny L. Kinzel, Kinematics, Dynamics and Design of Machinery, John Wiley and Sons (Asia) Pvt. Ltd., New Delhi, 2007
5. R. S. Khurmi, J. K. Gupta, Theory of Machines, Eurasia Publishing House Pvt. Ltd., New Delhi, 2005
6. https://onlinecourses.nptel.ac.in/noc19_me29/preview

18MC406 METROLOGY AND MEASUREMENTS 3 0 0 3

Course Objectives

- To familiarize the important terms connected to measurement and understand various techniques used in linear, angular, form, power, flow and temperature measurements
- To impart knowledge on fits, tolerances and gauges design

Programme Outcomes (POs)

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

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

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

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PSO2: Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Apply the principles of metrology to identify and correct measurement errors, ensuring accurate and reliable results in engineering applications.
2. Select suitable linear and angular measuring instruments and techniques and perform precise measurements using advanced tools.
3. Select appropriate comparators and gauges, and find the dimensional variations in engineering components.
4. Apply appropriate methods for gear and thread measurement, and select suitable tools to assess surface roughness, gear tooth variations, and thread errors.
5. Identify the device used to measure the Force,Torque, Power and temperature for industrial applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	-	-	-	-	-	-	-	-	-			2
2	3	2	-	1	2	-	-	-	-	-	-	-	-	2
3	2	2	-	1	2	-	-	-	-	-	-	-	-	2
4	3	2	-	2	2	-	-	-	-	-	-	-	-	2
5	2	2	-	2	2	-	-	-	-	-	-	-	-	1

UNIT I 9 Hours

BASICS OF METROLOGY

Introduction to metrology ÃƒÂ¢?? Precision and accuracy ÃƒÂ¢?? Terms associated with measurement: sensitivity, readability, reliability and repeatability - Errors in Measurements: systematic and random errors - Correction and calibration - Types of standards - Concepts of interchange ability and selective assembly

UNIT II 9 Hours

LINEAR AND ANGULAR MEASUREMENTS

Linear measuring instruments - Classification - Vernier calliper - Micrometer - Limit gauges - gauge design -Angular measuring instruments: bevel protractor, clinometers, angle gauges, spirit levels, slip

gauges and sine bar - Autocollimator - Laser interferometers - Machine vision - Nano-measurements

UNIT III **9 Hours**

COMPARATORS AND GAUGES

Comparators: mechanical, mechanical optical comparators, electrical comparators and pneumatic comparators - Limits, fits and tolerances - Tolerance grades - Types of fits - GO and NO GO gauges: plug and snap gauges - Taylor's principle - Design of GO and NO GO gauges - Filler gauges

UNIT IV **9 Hours**

FORM MEASUREMENT

Gear measurement: gear tooth vernier, constant chord method - Measurement of lead and run out - Backlash checking - Parkinson gear tester - Thread measurement: two wire and three wire methods - Errors in threads - Surface roughness parameters: Ra, Ry, Rz and RMS values - Surface roughness symbols

UNITV **9Hours**

MEASUREMENT OF POWER, FLOW AND TEMPERATURE

Force - Torque - Power - Measurement of power: mechanical, pneumatic, hydraulic and electrical - Flow measurement: venturimeter, orifice meter, rotameter, Pitot tube - Temperature measurement: Liquid in glass Thermometers, Pressure Thermometers, Pyrometer and electrical resistance thermometer

FOR FURTHER READING

Basic concept of CMM - Application of CMM - 3D Scanner

Total:60 Hours

Reference(s)

1. Jain, R. K.,Engineering Metrology, Khanna Publishers, New Delhi, 2018
2. Bewoor, A. K. and Kulkarni, V. A., Metrology and Measurement, Tata McGraw-Hill
3. Publishing House, New Delhi, 2009.
4. Venkateshan, S. P., Mechanical Measurements, John Wiley and Sons, New Delhi, 2015
5. Backwith, Marangoni and Lienhard, Mechanical Measurements, Pearson Education, New
6. Delhi, 2013
7. https://onlinecourses.nptel.ac.in/noc18_me62/preview

18MC407 SENSORS LABORATORY 0 0 2 1

Course Objectives

- The purpose of this course is to acquire knowledge about LabVIEW programming and to study the interfacing of different sensors with LabVIEW.

Programme Outcomes (POs)

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

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

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PSO2.Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Design a LabVIEW program to obtain a required measurement data for temperature
2. Carryout a design procedure to obtain a required measurement data for force
3. Demonstrate appropriate design procedure to obtain a required measurement data for displacement
4. Carryout an appropriate design procedure, suitable for signal conversion to interface with computer.
5. Design the LabVIEW program to control the speed and position of servomotor

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	-	3	-	3	-	-	-	-	-	-	-	-	2
2	3	-	3	-	1	-	-	-	-	-	-	-	-	2
3	3	-	3	-	2	-	-	-	-	-	-	-	-	1
4	3	-	3	-	2	-	-	-	-	-	-	-	-	2
5	3	-	3	-	1	-	-	-	-	-	-	-	-	2

EXPERIMENT 1 **3 Hours**

In automobiles, temperature of the radiator has to be monitored regularly. Normally RTD's are used to monitor the coolant temperature because of its linearity property. Develop a suitable program to measure the temperature of RTD.

EXPERIMENT 2 **3 Hours**

Temperature measurement plays a vital role in milk processing industries. Because of high accuracy and stability, thermocouples are mostly preferred. Develop a suitable program to measure the temperature of J, K and E Type thermocouples

EXPERIMENT 3 **3 Hours**

Electronics produced by the telecommunications industry- out of all the devices thermistors are used in cellular phones. Thermistors help to regulate the temperature from inside a mobile device. This is important with the accepted use of rechargeable lithium-ion battery packs. Thermistors are also an important part of the protective circuitry. Develop a suitable program to measure the temperature of using thermistor

EXPERIMENT 4 **3 Hours**

Aerospace products require a continuous measure of weight and pressure on a near constant basis. These critical operations require the highest standard of accuracy. In which load cell are mostly preferred. Develop a suitable program to measure the force measurement using load cell

EXPERIMENT 5 **3 Hours**

Accurate and precise measurements of ligament strain, e.g. in the human knee, are still one of the most challenging tasks in biomechanical engineering. In order to measure the movement of knee joints and their reaction under mechanical load strain gauges are used. Develop a suitable program to measure the strain value using strain gauge.

EXPERIMENT 6 **3 Hours**

LVDTs are mostly used to measure spool position in a wide range of servo valve applications. Develop a suitable program to measure the displacement using LVDT.

EXPERIMENT 7 **3 Hours**

Vibration Measurement using Accelerometer and Frequency spectrum analysis, calculation of velocity and displacement using accelerometer

EXPERIMENT 8 **3 Hours**

Analog to Digital Conversion

EXPERIMENT 9 **3 Hours**

Digital to Analog Conversion

EXPERIMENT 10 **3 Hours**

Speed and Position Control of Servo Motor

30 Hours

Reference(s)

1. LabVIEW: Basics I & II Manual, National Instruments, Bangalore, 2011.
2. A. K. Sawhney and P. Sawhney, A Course on Mechanical Measurement Instrumentation and Control, Dhanpat Rai and Co, New Delhi, 2011

18MC408 COMPUTER AIDED DESIGN LABORATORY 0 0 4 2

Course Objectives

- To provide knowledge and skills to draw orthographic projections of simple components using geometric modelling software
- To provide knowledge on three dimensional model of simple mechanism and animation using CAD software

Programme Outcomes (POs)

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

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

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

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

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6. 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.

PO7. 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.

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

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

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

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

PO12. 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.

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

PSO2: Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Sketch the orthographic projections of simple components using geometric modelling software
2. Construct three dimensional assembly models of machine and robotic components using CAD Software

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	-	-	3	-	-	-	-	-	-	-	3	-
2	2	2	3	2	3	2	2	2	2	3	2	3	3	3

EXPERIMENT 1 **4 Hours**

Create an orthographic view of machine components from the given isometric drawings.

EXPERIMENT 2 **4 Hours**

Construct a three dimensional assembly model of bearing

EXPERIMENT 3 **4 Hours**

Construct a three dimensional assembly model of bearing

EXPERIMENT 4 **8 Hours**

Generate a three dimensional shaft and coupling assembly model by considering tolerance in each Component.

EXPERIMENT 5 **8 Hours**

Create a three dimensional assembly model of Piston and Connecting Rod.

EXPERIMENT 6 **8 Hours**

Build a three dimensional assembly model of power drive system

EXPERIMENT 7 **4 Hours**

Create a three dimensional assembly model of two wheeler suspension system

EXPERIMENT 8 **4 Hours**

Construct a three dimensional assembly model of control valve

EXPERIMENT 9 **4 Hours**

Generate a three dimensional assembly model of Jig/fixture

EXPERIMENT 10 **8 Hours**

Create a three dimensional assembly model of Cartesian robot and animate its working using modelling software.

EXPERIMENT 11 **4 Hours**

Prepare technical documents for Cartesian robot Assembly by using 3D Via software

Total: 60 Hours

Reference(s)

1. Prof Sham Tickoo, Prabhakar Singh,Creo Parametric 2.0 for Engineers and Designers, Dreamtech press publication,New Delhi, 2013

2. Fumihiko Kimura, Geometric Modelling: Theoretical and Computational Basis towardsAdvanced CAD Applications,Springer publications, Newyork, 2001

18HS001 ENVIRONMENTAL SCIENCE 2 0 0 0

Course Objectives

- Understand the interdisciplinary and holistic nature of the environment
- Identify the significance of natural resources and environment on the quality of life and stimulate the quest for sustainable development
- Assess the socio-economic, political and ethical issues in environmental science

Programme Outcomes (POs)

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

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

PO7. 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

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

PSO2: Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Explain the importance of interdisciplinary nature of environment studies, uses and exploitation of natural resources
2. Analyze the different types of ecosystems and biodiversity, its values and also role of professionals in protecting the environment from degradation
3. Impact the existing environmental challenges related to pollution and its management
4. Select suitable strategies for sustainable management of components of environmental science
5. Correlate the impacts of population and human activities on environment

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	-	-	-	-	2	-	-	-	-	-	-	1
2	1	1	-	-	-	-	2	-	-	-	-	-	1	-
3	2	2	-	-	-	-	1	-	-	-	-	-	1	-
4	1	-	-	-	-	-	1	-	-	-	-	-	1	-
5	2	-	-	-	-	-	1	-	-	-	-	-	1	-

UNIT I 6 Hours

NATURAL RESOURCES

Forest resources: Use - over exploitation - deforestation - case studies. Water resources: Use - over utilization of surface and ground water - conflicts over water. Mineral resources: Use - exploitation - environmental effects of extracting and using mineral resources - case studies. Food resources: Effects of modern agriculture - fertilizer-pesticide problems (eutrophication, blue baby syndrome, bio magnification). Energy resources: renewable (solar, wind, and hydro).

UNIT II 6 Hours

LINEAR AND ANGULAR MEASUREMENTS

Concept of an ecosystem: Structure and function of an ecosystem - producers - consumers - decomposers - food chains - food webs and ecological pyramids - Types of ecosystem: Introduction – characteristic features: desert ecosystePSO1: Biodiversity - value of biodiversity - threats to biodiversity -endangered and endemic species - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity

UNIT III **6 Hours**

ENVIRONMENTAL POLLUTION

Pollution: Definition - causes - effects - control measures of air pollution - water pollution: (Sewage water treatment by activated sludge and trickling filter process) - noise pollution- thermal pollutioPSO2: Disaster management: causes - effects - control measures of floods earthquake

UNIT IV **7 Hours**

SOCIAL ISSUES AND ENVIRONMENT

Sustainable development: Definition - Unsustainable to sustainable development - solid waste management - causes - effects - 5R Principles (landfills, incineration, composting). Water conservation - rain water harvesting - watershed management. Climate change - global warming - acid rain - ozone layer depletioPSO2: E-waste.

UNITV **5 Hours**

HUMAN POPULATION AND ENVIRONMENT

Force - Torque - Power - Measurement of power: mechanical, pneumatic, hydraulic and electrical - Flow measurement: venturimeter, orifice meter, rotameter, Pitot tube - Temperature measurement: Liquid in glass Thermometers, Pressure Thermometers, Pyrometer and electrical resistance thermometer

FOR FURTHER READING

Human rights:Biomedical waste -Identification of adulterants in food materials

Total:30 Hours

Reference(s)

1. Anubha Kaushik, C.P. Kaushik, Environmental Science and Engineering, 4th Multi Colour Editions, New Age International Publishers, New Delhi, 2014
2. Raven, P.H., Hassenzahl, D.PSO1: & Berg, L.R. 2012. Environment. 8th editioPSO2: John Wiley & Sons
3. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014
4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press
5. 5. A. K. De, Environmental Chemistry, 7th Edition, New age international publishers, New Delhi, 2014

18GE401 SOFT SKILLS-BUSINESS ENGISH 0 0 2 0

Course Objectives

- To acquire command of both the receptive skills (Listening, Reading) and the productive skills (Writing and Speaking) of English language
- To understand and make effective use of English language in business contexts

Programme Outcomes (POs)

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

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

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Listen, Read, Speak, and Write Business English at the level of independent users
2. Appear for the Business English Certificate (BEC) Vantage level examination conducted by the Cambridge Assessment English

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	-	1	-	-	-	1	-
2	-	-	-	-	-	-	-	-	-	2	-	-	1	-

UNIT I 15 Hours

LISTENING AND READING

Listening for writing short answers - filling gaps in sentences - identifying topic, context and function identify different functions of language in business situations - identify prompts -identify paraphrases of required information Scanning - reading for gist - understanding sentence structure - error identification identify paraphrases - cohesive words and phrases - understand the importance of analysing the distractors - identify grammatical and semantic relationships

UNIT II 15 Hours

WRITING AND SPEAKING

Business emails - notes - memos to colleagues or friends - giving instructions - explaining a development - asking for comments - requesting information - agreeing to requests - explaining apologising - reassuring - complaining - describing - summarising - recommending - persuading turn - taking - sustaining interaction - initiating - responding - giving personal information - talking about present circumstances, past experiences and future plans - expressing opinion - speculating organising a larger unit of discourse - giving information - expressing and justifying opinions speculating - comparing and contrasting - agreeing and disagreeing

I 15 Hours

LISTENING AND READING

Listening for writing short answers - filling gaps in sentences - identifying topic, context and function identify different functions of language in business situations - identify prompts -identify paraphrases of required information Scanning - reading for gist - understanding sentence structure - error identification identify paraphrases - cohesive words and phrases - understand the importance of analysing the distractors - identify grammatical and semantic relationships

II 15 Hours

WRITING AND SPEAKING

Business emails - notes - memos to colleagues or friends - giving instructions - explaining a development - asking for comments - requesting information - agreeing to requests - explaining apologising - reassuring - complaining - describing - summarising - recommending - persuading turn - taking - sustaining interaction - initiating - responding - giving personal information - talking about present circumstances, past experiences and future plans - expressing opinion - speculating organising a larger unit of discourse - giving information - expressing and justifying opinions speculating - comparing and contrasting - agreeing and disagreeing

Total:60 Hours

Reference(s)

1. 1. Whitehead, Russell and Michael Black. Pass Cambridge BEC Vantage Self - study Practice Tests with Key, Heinle - a part of Cengage Learning, Delhi, 2003.

18MC501 CONTROL SYSTEMS 3 1 0 4

Course Objectives

- To describe feedback control and basic components of control systems
- To understand the various time domain and frequency domain tools for analysis and design of linear control systems
- To study the methods to analyze the stability of systems from transfer function forms
- To describe the methods of designing compensators

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
PO2. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PSO2: Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Develop a mathematical model of a physical system and compute the transfer function using Block diagram reduction technique and Signal flow graph.
2. Analyze the performance of first and second order system and compute the steady state error for different test signals
3. Analyze the frequency domain response and determine the phase margin and gain margin using bode plot, polar plot and Nyquist plot.
4. Analyse the cascade compensation and design a lag, lead and lag-lead series compensator using bode plot
5. Check the system controllability and observability using state space approach

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2	2	-	-	-	-	-	-	-	-	-	3
2	1	2	3	2	-	-	-	-	-	-	-	-	-	2
3	1	3	3	-	-	-	-	-	-	-	-	-	-	3
4	1	2	3	1	-	-	-	-	-	-	-	-	-	2
5	1	2	1	2	-	-	-	-	-	-	-	-	-	3

9 Hours

UNIT I

SYSTEMS REPRESENTATION

Basic elements in control systems - open loop and closed loop with applications - Transfer functions of mechanical, electrical and analogous systems - Block diagram reduction - signal flow graphs

UNIT II **10 Hours**

TIME RESPONSE ANALYSIS

Time response - Time domain specifications -Types of test inputs I and II order system response - Steady state error, error constants - Stability concept and definition - Characteristic equation - Location of poles - Routh Hurwitz criterion - Root locus techniques: construction

UNIT III **9 Hours**

FREQUENCY RESPONSE ANALYSIS

Bode plots - Polar plot - Nyquist stability criterion - Correlation between frequency domain and time domain specifications - stability analysis using frequency response methods.

UNIT IV **9 Hours**

COMPENSATOR AND CONTROLLER DESIGN

Realization of basic compensators - cascade compensation in time domain and frequency domain - feedback compensation - Design of lag, lead, lag-lead series compensator (using Bode plot)- Introduction to P, PI, PID controllers.

UNITV **8Hours**

STATE SPACE ANALYSIS

State equation - Solutions, Realization, Controllability, Observability - State space to transfer function conversion.

FOR FURTHER READING

Tachometer - Synchro - Need for time & frequency domain analysis and its applications - Impacts of stability and its important methods - Application of compensation

Total: 60 Hours

Reference(s)

1. Norman S. Nise, Control System Engineering, Wiley India Edition New Delhi, 2018
2. J. Nagrath and PSO1: Gopal, Control System Engineering, New Age International Publisher, New Delhi, 2008
3. Rao V Dukkipatti, Control Systems, Narosa Publications,New Delhi, 2005
4. PSO1: Gopal, Digital Control and State Variable Methods, Tata McGraw Hill,New Delhi, 2003 5. K. Ogata, Modern Control Engineering, Pearson Edition 5th Edition, London, 2010
6. https://nptel.ac.in/courses/108106098/

18MC502 ROBOTICS 3 0 0 3

Course Objectives

 To acquire knowledge on the fundamentals of robotic systems

Programme Outcomes (POs)

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

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

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

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PSO1: Analyze, design and develop electro mechanical system using contemporary tools

PSO2: Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Interpret fundamental terminology used in robotics
2. Classify major types of end effectors and controls used in robot
3. Apply fundamental transformation matrix for kinematic solution and sensors used in robotics
4. Determine major robot work cell design and robot applications for manufacturing and assembly sectors
5. Compare micro and nano robots and its application

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	2	-	-	-	-	-	-	-	-	-	-	-	3
2	-	-	2	-	1	-	-	-	-	-	-	-	-	3
3	-	-	1	-	2	-	-	-	-	-	-	-	1	3
4	-	-	2	-	-	-	-	-	-	-	-	-	2	2
5	-	2	-	-	1	-	-	-	-	-	-	-	2	1

UNIT I **9 Hours**

INTRODUCTION TOROBOTICS

Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robots-Simple problems- Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systems- Hydraulic, Pneumatic and Electric system

UNIT II **10 Hours**

END EFFECTORS AND ROBOT CONTROLS

Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers-Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple

Problems - Robot controls-Point to point control, Continuous path control, Intelligent robot-Control system for robot joint-Control actions-Feedback devices-Encoder, Resolver, LVDT-Motion Interpolations-Adaptive control

UNIT III **8 Hours**

Robot kinematics-Types- 2D, 3D Transformation-Scaling, Rotation, Translation- Homogeneous coordinates, multiple transformation-Simple problems. Denavit- Hartenberg convention, Forward and inverse kinematics solution for SCARA configured robot

UNIT IV **9 Hours**
ROBOT CELL DESIGN AND APPLICATIONS

Robot work cell design and control-Sequence control, Operator interface, Safety monitoring devices in Robot-Mobile robot working principle, actuation using software. Introductions-Robot applications - Material handling, Machine loading and unloading, assembly, Inspection, Welding, Spray painting and underwater robot

UNITV **9Hours**
SERVICE AND FIELD ROBOTICS

History of service robotics - Present status and future trends - Need for service robots – applications examples and Specifications of service and field Robots.Non conventional industrial robots

FOR FURTHER READING

Medical robot, Nuclear material handling robot, Robots for thermal and chemical plants, Autonomous Vehicles, Application of collaborative robots

Reference(s)

1. S.R. Deb, Robotics Technology and flexible automation, 2nd Edition, Tata McGraw-Hill Education, 2017
2. Mikell P Groover & Nicholas G Odrey, Mitchell Weiss, Roger N Nagel, Ashish Dutta, Industrial Robotics, Technology programming and Applications, 2nd Edition, Tata McGrawHill Education, 2017.
3. Richard D. Klafter, Thomas .A, Chri Elewski, Michael Negin, Robotics Engineering an Integrated Approach, PHI Learning, 2009.
4. Francis PSO2: Nagy, Andras Siegler, Engineering foundation of Robotics, Prentice Hall Inc., 1986
5. Carl D. Crane and Joseph Duffy, Kinematic Analysis of Robot manipulators, Cambridge University press, 2008 6. NPTEL - https://nptel.ac.in/courses/112105249/

18MC503 MICROPROCESSORS AND MICROCONTROLLER 3 0 0 3

Course Objectives

- To give an emphasis on the hardware features of Microprocessor and Microcontroller with their functions
- To provide essential knowledge on various operating modes of I/O ports Timers/Counters, control registers and various types of interrupts
- To design and verify the various interfacing techniques for various applications

Programme Outcomes (POs)

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

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

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

PO5.Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PSO1: Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Analyze the internal hardware architecture and instruction of 8085 microprocessor
2. Analyse the hardware architecture and instruction of 8086 microprocessor
3. Develop an interfacing circuit using various interfacing device with Microprocessor 8085
4. Analyse the hardware architecture and instruction of microcontroller 8051, ATMEGA and arduino
5. Apply the microprocessor and microcontroller used for various industrial application

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	-	-	-	-	-	-	-	-	-	1	-
2	2	1	2	-	2	-	-	-	-	-	-	-	2	-
3	2	2	2	-	2	-	-	-	-	-	-	-	2	-
4	2	1	2	-	2	-	-	-	-	-	-	-	2	-
5	3	1	2	-	-	-	-	-	-	-	-	-	1	-

UNIT I **9 Hours**

INTEL 8085 MICROPROCESSOR

Introduction - Organization of 8085: Architecture, Internal Register Organization and Pin Configuration - Instruction Set of 8085 - addressing modes - instruction and machine cycles with states and timing diagram

UNIT II **9 Hours**

8085 INTERFACING DEVICES

Programmable peripheral Interface (8255) - Programmable interval timer (8253) - Programmable communication interface (USART) - Programmable interrupt controller - Programmable DMA Controller (8257).

UNIT III **9 Hours**

8051 ARCHITECTURE

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

UNIT IV **9 Hours**

MSP430 MICROCONTROLLER

Introduction to MSP Microcontroller, MSP430 Architecture - Functions, Interrupts and Low- Digital Inputs and Outputs - analog inputs and outputs - Timer - Communications.

UNITV **9Hours**

APPLICATIONS OF MICROCONTROLLER

Interfacing of Keyboards(4x4 & 8) - Interfacing of Display Devices(LED, LCD, 7 Segment LED) - DC Motor control - Stepper motor control - Servo Motor control - Traffic light control - Closed loop process control.

FOR FURTHER READING

Designing real time clock, detecting power failure, detecting presence of objects using 8253. Microcontroller System Design - Testing the Design, Look up Tables.

Total: 45 Hours

Reference(s)

1. Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085 6/e, Penram International Publishing (India) Pvt. Ltd., 2013
2. Douglas V Hall., Microprocessor and Interfacing: Programming and Hardware, McGraw Hill Inc., New Delhi, Second Edition 2002.
3. Davies, John H. MSP430 microcontroller basics. Elsevier, 2008.
4. Muhammad Ali Mazidi and Janice Gillipie mazidi, The 8051 Microcontroller and Embedded System, Pearson Education Asia, 2011.
5. Kenneth J Ayala, The 8051 Microcontroller Architecture Programming and Application, Thomson Delmar New Delhi, 2014
6. Krishna Kant, Microprocessor and Microcontroller Architecture, Programming and System Design using 8085, 8086, 8051 and 8096, PHI, 2007

18MC504 THERMODYNAMICS AND HEAT TRANSFER 3 1 0 4

Course Objectives

- To enlighten the knowledge of students about the fundamentals of thermodynamics and heat transfer

Programme Outcomes (POs)

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

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

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

PSO2: Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Apply fundamental thermodynamic properties and laws for engineering problems
2. Analyze various thermodynamic process and solve steady flow energy equation for engineering system
3. Apply the concept of entropy and evaluate efficiency for major thermodynamic gas power cycles
4. Apply fundamentals of heat transfer and evaluate overall heat transfer coefficient of a system
5. Evaluate the convection and radiation heat transfer coefficient for an engineering system

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	-	-	-	-	-	-	-	-	-	-	-	3
2	3	3	-	-	-	-	-	-	-	-	-	-	-	3
3	3	3	-	1	-	-	-	-	-	-	-	-	-	3
4	3	3	-	3	-	-	-	-	-	-	-	-	-	3
5	3	1	-	3	-	-	-	-	-	-	-	-	-	3

UNIT I **9 Hours**

INTRODUCTION TO THERMODYNAMICS

Thermodynamic systems. Temperature and the zeroth law of thermodynamics. Thermodynamic scales. Ideal gas. Simple, compressible pure substances: gases and steaPSO1: Numerical problems

UNIT II **9 Hours**

FIRST LAW OF THERMODYNAMICS

Expansion work. Friction work. Internal energy. Heat. Enthalpy. Specific heats of gasses. Adiabatic,

isothermal, isochoric and isobaric processes. Polytropic processes. First law of thermodynamics. Open and closed systems, steady flow energy equation- Numerical problems

UNIT III **9 Hours**

SECOND LAW OF THERMODYNAMICS

Entropy and irreversibilities. Second law of thermodynamics. Thermal engine. Carnot's efficiency. Isentropic processes and isentropic efficiencies for thermal engines. Gas turbine: Brayton cycle. Steam turbine: Rankine cycle. Steam compression refrigeration systems. Numerical problems.

UNIT IV **9 Hours**

CONDUCTION

General differential equation for conduction heat transfer. Conduction in a flat wall. Conduction in a cylindrical wall. Thermal resistance. Overall heat transfer coefficient. Numerical problems

UNITV **9Hours**

CONVECTION AND RADIATION

Free and forced convection mechanisPSO1: Interior and exterior convectioPSO2: Convection over flat surfaces. Convection over cylinders. Electromagnetic spectrum and radiation physics. Kirchoff's law. Black-body radiatioPSO2: Numerical problems

FOR FURTHER READING

Reversibility- S.I and C.I engines- Conduction through Plane Wall, Cylinders and Spherical system, Grey body radiation -Shape Factor Algebra - Electrical Analogy- Convective Mass Transfer Correlations

Total: 45 Hours

Reference(s)

1. P. K. Nag, Engineering Thermodynamics, Edition 5, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2013
2. Yunus A. Cengel and Michael A. Boles, Thermodynamics - An Engineering Approach in SI Units, Tata McGraw Hill Publishing Company, New Delhi, 2017
3. C. P. Kothandaraman and S. Subramanya, Fundamentals of Heat and Mass Transfer, New Age International Publishers, New Delhi, 2012
4. T. D. Eastop and McConkey, Applied Thermodynamics for Engineering Technologists, Pearson, New Delhi, 2004
5. C. P. Kothandaraman, S. Domkundwar and A. V. Domkundwar, A course in Thermal Engineering, Dhanpatrai and Co. Pvt. Ltd., New Delhi, 2016
6. NPTEL - https://nptel.ac.in/courses/112105123/1

18MC507 ROBOTICS LABORATORY 0 0 4 2

Course Objectives

- To model forward and inverse kinematics for major robotic configuration
- To simulate pick and place operation using an industrial robot

Programme Outcomes (POs)

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO11. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PSO1: Analyze, design and develop electro mechanical system using contemporary tools

PSO2: Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Carry out forward and inverse kinematics using simulation software
2. Demonstrate pick and place operation using six axis industrial robot
3. Generate program for forward and inverse kinematics solutions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	3	-	-	-	-	-	1	-	1	3
2	-	-	-	-	2		-	-	-	-	-	-	3	2
3	-	-	-	-	1	-	-	-	-	-	-	-	2	3

EXPERIMENT 1 **6 Hours**

Visualization of Denavit- Hartenberg parameters

EXPERIMENT 2 **6 Hours**

Simulation of forward kinematics of 3R robot

EXPERIMENT 3 **6 Hours**

Simulation of forward kinematics of 3P robot

EXPERIMENT 4 **6 Hours**

Simulation of Forward kinematics of PRP configured robot

EXPERIMENT 5 **6 Hours**

Simulation of Forward and inverse kinematics of SCARA robot

EXPERIMENT 6 **6 Hours**

Generate a program in CpROG environment for pick and place operation

EXPERIMENT 7 **6 Hours**

Generate a program for forward kinematics numerical solution for 3 degrees of freedom robot manipulator

EXPERIMENT 8 **6 Hours**

Generate a program for forward kinematics numerical solution for 5 degrees of freedom robot manipulator

EXPERIMENT 9 **6 Hours**

Develop a continuous motion program using 6 axis industrial robot for spray painting

EXPERIMENT 10 **6 Hours**

Develop a point to point motion program using 6 axis industrial robot for pick and place operation **6 Hours**

60 Hours

Reference(s)

1. Mikell P. Groover, Mitchell Weiss, Roger PSO2: Nagel and Nicholas G. Odrey, Industrial Robotics
Technology, Programming and Applications, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2017
2. K. S. Fu, R. C. Gonzalez and C. S. G. Lee, Robotics Control, Sensing, Vision, and Intelligence, Tata McGraw-Hill Publishing Company Limited, India, 2017

18MC508 MICROPROCESSORS AND MICROCONTROLLER LABORATORY 0 0 2 1

Course Objectives

- To focus the implementation of arithmetic operations using microprocessors and microcontroller
- To simulate embedded C programs
- To implement various on-chip and off-chip interfacing and algorithms

Programme Outcomes (POs)

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

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

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

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PSO 1: Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Implement the arithmetic and logical operations using microcontrollers and microprocessors
2. Carry out the digital and analog hardware interface for microcontroller-based systems
3. Generate an embedded C program to control stepper and DC motor

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	3	-	3	-	-	-	-	-	-	-	1	-
2	2	2	3	-	2	-	-	-	-	-	-	-	2	-
3	2	3	3	-	3	-	-	-	-	-	-	-	2	-

EXPERIMENT 1 **3 Hours**

Perform the basic arithmetic operations using Embedded C in Microprocessor 8085 and 8086

EXPERIMENT 2 **3 Hours**

Perform the search operation for finding the number (largest, smallest) in the array using Embedded C in Microprocessor 8085 and 8086.

EXPERIMENT 3 **3 Hours**

Execute code conversions like HEX to ASCII and Vice versa using Embedded C in Microprocessor

8085 and 8086

EXPERIMENT 4 **3 Hours**

Perform the basic arithmetic operations using Embedded C in Microcontroller 8051.

EXPERIMENT 5 **3 Hours**

Implement the search operation for finding the number (largest, smallest) in the array using Embedded C in Microcontroller 8051.

EXPERIMENT 6 **3 Hours**

Execute code conversions like HEX to ASCII and Vice versa using Embedded C in Microcontroller 8051.

EXPERIMENT 7 **3 Hours**

Perform the different mode of operation using Embedded C by interfacing the Programmable Peripheral Interface with the Microprocessor 8085 and Microcontroller 8051

EXPERIMENT 8 **3 Hours**

Perform the controlling operation to the stepper motor using Embedded C by interfacing the stepper motor with the Microprocessor 8085 and Microcontroller 8051.

EXPERIMENT 9 **3 Hours**

Perform the controlling operation of DC motor using Embedded C by interfacing the DC motor controller with the Microprocessor 8085 and Microcontroller 8051.

EXPERIMENT 10 **3 Hours**

Conversion of Analog to digital and vice versa using embedded C with Microprocessor 8085 and Microcontroller 8051. **3 Hours**

30 Hours

Reference(s)

1. Ramesh Gaonkar, Microprocessor Architecture, Programming and Applications with the 8085 6/e, Penram International Publishing (India) Pvt. Ltd., 2013.
2. Douglas V Hall., Microprocessor and Interfacing: Programming and Hardware, McGraw Hill Inc., New Delhi, Second Edition 2002.
3. Muhammad Ali Mazidi and Janice Gillipie mazidi, The 8051 Microcontroller and Embedded System, Pearson Education Asia, 2011
4. Kenneth J Ayala, The 8051 Microcontroller Architecture Programming and Application, Thomson Delmar New Delhi, 2014
5. Krishna Kant, Microprocessor and Microcontroller Architecture, Programming and System Design using 8085, 8086, 8051 and 8096, PHI, 2007.

18GE501 SOFT SKILLS - APTITUDE I 0 0 2 0

Course Objectives

- Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical Values.
- It will provide a lot of activities and examples for a student to learn and develop these life skills

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Explain various concepts of number systems and their techniques in solving the percentage, average and age problems.
2. Analyse the profit and loss of real time situations and the relation between ratio, proportion and variation
3. Apply different techniques to find the distance, speed and time of various moving objects.
4. Understand the concepts of coding, sequences and series, data interpretation and critical reasoning to solve real time logical reasoning problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
4	2	-	-	-	-	-	-	-	-	-	-	-	-	-

EXPERIMENT 1 **2 Hours**

NUMBER SYSTEMS

Introduction - Definition - Classification on Numbers- Power cycles and remainders - Short cut process- Concept of Highest Common Factor-Concept of Least Common Multiple- Divisibility Number of zeros in an expression.

EXPERIMENT 2 **2 Hours**

PERCENTAGE

Introduction - Definition and Utility of Percentage - Importance of base/denominator for percentage calculations-Concept of percentage values through additions-Fraction to percentage conversion table.

EXPERIMENT 3 **3 Hours**

AVERAGES AND AGES

Introduction-Average of different groups-Addition or removal of items and change in average - Replacement of some of the items.

EXPERIMENT 4 **3 Hours**

RATIO, PROPORTIONS AND VARIATION

Introduction- Ratio- Properties-Dividing a given number in the given ratio-Comparison of ratios - Proportions-Useful results on proportion- Continued proportion-Relation among the quantities more than two-Variation.

EXPERIMENT 5 **2 Hours**

PROFIT AND LOSS

Gain/Loss and percentage gain or percentage loss-Multiplying equivalents to find sale price-Relation among cost price, sale price, gain/loss and percentage gain or percentage loss-An article sold at two different selling price-Two different articles sold at same selling price-Percentage gain or percentage loss on selling price-Percentage gain or percentage loss on whole property.

EXPERIMENT 6 **2 Hours**

TIME AND WORK

Introduction-Basic concepts-Concepts on working with different efficiencies-Pipes and Cisterns Work Equivalence (Man Days) -Alternative approach.

EXPERIMENT 7 **2 Hours**

TIME, SPEED AND DISTANCE

Definition-Basics of Time, Speed and Distance - Relative speed-Problems based on Trains-Problems based on Boats and Streams-Problems based on Races-Time taken with two difference modes of transport-Time and distance between two moving bodies.

EXPERIMENT 8 **3 Hours**

CODING AND DECODING

Introduction-Description of Coding method-Coding patterns - Concepts of Coding and Decoding Problems involving Coding and Decoding methods.

EXPERIMENT 9 **2 Hours**

SEQUENCE AND SERIES

Introduction-Sequences of real numbers - Number and Alphabet series-Description of Number and Alphabet series-Analogy-Odd man out-Power series.

EXPERIMENT 10 **3 Hours**

DATA SUFFICIENCY

Introduction to Data Sufficiency - Overview of the wide variety of Data Sufficiency problems - Basic introduction on how to determine what information is sufficient to solve a given problem - Common pitfalls to avoid.

EXPERIMENT 11 **3 Hours**

DIRECTION

Introduction to Direction - sense test - Overview of the wide variety of Direction problems-Direction Plotting diagrams.

EXPERIMENT 12 **3 Hours**

CRITICAL REASONING

Introduction-Basic concept of critical reasoning- Weaken the argument-Strengthen the argument-Flaw in the argument-Evaluate the conclusion.

30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.
2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd, India
3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.
6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

18HS002 PROFESSIONAL ETHICS IN ENGINEERING 2 0 0 2

Course Objectives

- To understand Human Values and ethical theory.
- To understand codes of ethics, work place responsibilities, rights, engineering experimentation, global issues and contemporary ethical issues.
- To understand personal ethics, legal ethics, cultural ethics and engineers responsibility.

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Articulate engineering ethics theory with sustained lifelong learning.
2. Adopt a good character and follow high professional ethical life.
3. Contribute to shape a better character by following ethical actions.
4. Confront and resolve moral issues occurred during technological activities.
5. Resolve moral and ethical problems through exploration and assessment by established experiments.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	-	-	-	-	-	-	3	-	-	2	-	-	-
2	-	-	-	-	-	-	-	2	-	-	2	-	-	-
3	-	-	-	-	-	-	-		-	-	3	-	-	-
4	-	-	-	-	-	-	-	2	-	-	2	-	-	-
5	-	-	-	-	-	-	-	2	-	-	2	-	-	-

UNIT I 6 Hours

COURSE INTRODUCTION - NEED, BASIC GUIDELINES AND ANALYSIS

Importance of Human Values & Ethics in 21st Century -Understanding the theory of basic human values and ethics Openness to change -Self-enhancement Conservation; Self-transcendence -Schwartz Value Survey: Self – Assessment

UNIT II 6 Hours

EMBRACING THE COMMON ETIQUETTE

Altruism – Integrity -Freedom -Justice -Honesty -Truthfulness -Responsibility –Compassion

UNIT III **6 Hours**

CONTINUOUS HAPPINESS AND PROSPERITY

An overview on basic Human Aspirations - Understanding and living in harmony at various levels of life - Embracing self-love and wellness -Understanding harmony in the family and society

UNIT IV **6 Hours**

UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS

Reflection on growing global multifold problems: poverty, pollution, hunger, disease, unemployment, caste system, child labour, gender equality, politics and violence. Understanding the challenges in cultural, personal, social, political, and economic environment

UNITV **6Hours**

UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS CO-EXISTENCE

Understanding the harmony in the Nature - Holistic perception of harmony at all levels of existence - Practice Exercises and Case Studies will be taken up in Practice Sessions

Total: 30 Hours

Reference(s)

1. Martin, G. (2011). The Little Book of Ethics: A Human Values Approach. Australia: G.P. Martin.
2. Gupta, PSO2: L. (2002). Human Values for The 21St Century. India: Anmol Publications Pvt. Limited.
3. Mishra, A. (2017). Happiness Is All We Want. India: Bloomsbury Publishing.
4. Universal Human Values. (2023). (n.p.): Booksclinic Publishing.
5. A Textbook On Professional Ethics and Human Values. (2007). India: New Age International (P) Limited

18MC602 CNC TECHNOLOGY 3 0 0 3

Course Objectives

- To understand the construction and principle of CNC machines
- To generate simple programs for CNC turning and machining centres

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Interpret the evolution and working principle of CNC machine tools with its relevant applications
2. Illustrate the basic structure, construction, working and control of CNC machines over conventional units.
3. Generate real time program for producing desired products using CNC machines.
4. Explain the different tooling and work holding device of CNC
5. Explain the maintenance and troubleshooting techniques

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3				1								2	
2	2				3								3	
3	3				1								1	
4	1				3								3	
5	2				1								1	

UNIT I **9 Hours**

INTRODUCTION TO CNC MACHINE TOOLS

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

UNIT II **9 Hours**

STRUCTURE OF CNC MACHINE TOOL

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

UNIT III **9 Hours**

CNC PROGRAMMING

Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, parametric programming, machining cycles, programming for machining, generation of CNC codes from CAM packages, CNC controllers

UNIT IV **9 Hours**

TOOLING AND WORK HOLDING DEVICES

Introduction to cutting tool materials Carbides, Ceramics- Cubic Boron Nitride, Polycrystalline Cubic Diamond- insert selection codes - PMK, NSH, qualified, semi qualified and preset tooling, tooling system for Machining centre and Turning centre, work holding devices for rotating and fixed work parts, economics of CNC

UNIT V **9 Hours**

CNC MAINTENANCE AND TROUBLE SHOOTING

Warnings-Check operation, Replacement, Parameters, Daily Maintenances - Caution, Note, Alarms, Maintenance Parts, Parameters. Trouble shooting-Causes and Remedies for failures - Machine position, Reference Position, Manual operation, Automatic operation, Jog Operation, Feed rate, Spindle Speed, LCD Display, Abnormal Servo System

FOR FURTHER READING

CNC Program generation from CAD models, geometric modeling for NC machining & machining of free-form surfaces, CNC controller & motion control in CNC system. Application of CNC and recent advances in CNC machines, maintenance of CNC machine tools, CNC trainer

Total: 45 Hours

Reference(s)

1. HMT, Mechatronics, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2017
2. Warren S.Seamers, Computer Numeric Control, Fourth Edition Thomson Delmar, 2002
3. P. N. Rao and N. K. Tiwari, Numerical Control and Computer Aided Manufacturing, Tata McGraw-Hill Publishing company, New Delhi 2012
4. Tilak Raj, CNC technology & programming, Dhanpat Rai publishing company(p) ltd., N Delhi,2014
5. P. Radhakrishnan, Computer Numerical Control Machine & Computer Aided Manufacturing, New Academic Science Limited,England 2014
6. M. Adithan & B. S. Pabla, CNC Machines, New Age International Publishers , Delhi, 2018

18MC603 MACHINE DESIGN **3 1 0 4**

Course Objectives

- To learn the different standards used in machine design
- To design the various machine elements subjected to simple and variable loads

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Compute the stresses for various loads and apply the theories of failure to design the machine components
2. Design shaft, keys and couplings based on power transmission capability
3. Analyse the forces acting on bolts in eccentric loading, welded joints and design the elements
4. Design a flywheel for an IC engine and calculate stresses in springs for different end conditions
5. Compute static, dynamic load carrying capacity for a bearings and select the suitable bearings.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1										2	
2	1	2	3										3	
3	2	2	3										2	
4	2	3	2										3	
5	2	3	2										1	

UNIT I **9 Hours**

STEADY STRESSES AND VARIABLE STRESSES IN MACHINE ELEMENTS

Machine Design: Design process - procedure & requirements of machine elements - Standards in design - Factor of safety. Design against static load: Application of Principal stresses and theories of failure in designing machine elements. Design against Fluctuating Load: Endurance limit - S-N Curve - Design for finite and Infinite life (Reversed load only) - Stress concentration: Factors - Reduction of stress concentration

UNIT II **9 Hours**

DESIGN OF SHAFT, KEYS AND COUPLINGS

Design of shaft: Shaft materials - Selection of preferred sizes - Solid shaft design based on strength, torsional rigidity and A.S.M.E code. Key: types - stresses developed - Design of Square and Flat key. Couplings: Types - applications - Design of Muff coupling, clamp coupling, rigid flange coupling and bushed-pin flexible coupling

UNIT III **9 Hours**

DESIGN OF THREADED JOINTS AND WELDED JOINTS

Threaded Joints: Types - bolt of uniform strength - terminology of screw threads - ISO Metric screw thread - materials - Design of eccentrically loaded bolted joints in shear and eccentric load perpendicular to axis of bolt. Welded Joints: welding symbols - standards - types - stress relieving of welded joints - Conditions for maximum shear in parallel and transverse fillet weld. Design of butt, parallel and transverse fillet welds against static load.

UNIT IV **9 Hours**

DESIGN OF SPRINGS AND FLYWHEEL

Springs: types - terminology of helical spring - styles of end - spring materials- Wahl's stress factor - Design of helical springs for static and variable loads - Design of helical torsion springs - nipping in leaf springs - design of semi-elliptic leaf spring. Flywheel: Functions - materials - types - stresses in rimmed flywheel - design of rimmed flywheel based on constructing turning moment diagram

UNIT V **9 Hours**

DESIGN OF BEARINGS

Bearings - classifications - Rolling contact bearings: Types - static and dynamic load carrying capacity - Stribeck's equation - equivalent bearing load - Selection of deep drove ball bearing from manufacturer's catalogue. Sliding contact bearings: lubricants - types - modes of lubrication - types - petroff's equation - Mckee's analysis - Design of hydrostatic thrust and full hydrodynamic bearings based on different parameters

FOR FURTHER READING

Manufacturing considerations in design - Design of cotter joint - design of levers - Fatigue failure - Notch sensitivity - Soderberg and Goodman lines - Design for infinite life (Fluctuating load) - Impact stresses - CastiglianoÃƒÂ¢??s theorem - Design of belleville spring

Total: 60 Hours

Reference(s)

1. V. B. Bhandari, Design of Machine Elements, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2017
2. J. E. Shigley and C. R. Mischke, Mechanical Engineering Design, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2017
3. R. C. Juvinall and K. M. Marshek, Fundamentals of Machine Component Design, John Wiley and Sons, New Delhi, 2018.
4. R. L. Norton, Design of Machinery, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2007
5. Faculty of Mechanical Engineering, PSG College of Technology, Design Data, M/s.Kalaikathir Achchagam, Coimbatore, 2014
6. https://nptel.ac.in/courses/112105125

18MC604 EMBEDDED SYSTEM SESIGN 3 0 2 4

Course Objectives

- To impart knowledge on the Building Blocks of Embedded System,Various Embedded Development Strategies, Bus Communication in processors, Input/output interfacing and processor scheduling algorithms
- To understand Real time operating system

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Analyse the internal hardware parts of embedded systems architecture
2. Implement an embedded system for a given Networking application
3. Execute the various Embedded Development Strategies
4. Analyse various processor scheduling algorithms
5. Analyse the basics of Real time operating system application

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1											2
2	2	1	2											2
3	1	3	2											3
4	2	2	2											2
5	1	2	1											1

UNIT I **8 Hours**

INTRODUCTION TO EMBEDDED SYSTEMS

Embedded Systems - Overview - Structural units, selection of processor - memory devices - Memory management methods - Timer and Counting devices, Watchdog Timer, Real Time Clock

UNIT II **10 Hours**

EMBEDDED NETWORKING

Introduction - I/O Ports - Communication protocols : RS232, RS422, RS 485, CAN Bus - Serial Peripheral Interface (SPI) - Inter Integrated Circuits (I2C).

UNIT III **9 Hours**

EMBEDDED FIRMWARE DEVELOPMENT

Embedded Product Development Life Cycle- Objectives, Different Phases Of EDLC, Modelling of EDLC; Data Flow Graph, State Machine Model, Sequential Program Model, V Model

UNIT IV **9 Hours**

EMBEDDED SYSTEM DESIGN

Introduction to basic concepts of RTOS-Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing

UNIT V **9 Hours**

EMBEDDED SYSTEM APPLICATION

Line Follower robot, Linear conveyor control system, Temperature monitoring and control system

FOR FURTHER READING

Real Time Application, Device control using Mobile, Security Alert system, Automatic Car Control system, Mobile operating Land Rover

1 **2 Hours**

EXPERIMENT 1

Study of ARM evaluation system

2 **3 Hours**

EXPERIMENT 2

Interfacing ADC and DAC

3 **3 Hours**

EXPERIMENT 3

Interfacing LED and PWM

4 **4 Hours**

EXPERIMENT 4

Interfacing real time clock and serial port

5 **3 Hours**

EXPERIMENT 5

Interfacing keyboard and LCD through communication protocols

6 **2 Hours**

EXPERIMENT 6

Interfacing EPROM and interrupt

7 **3 Hours**

EXPERIMENT 7

Interrupt performance characteristics of ARM and FPGA

8 **3 Hours**

EXPERIMENT 8

Flashing of LEDS

9 **4 Hours**

EXPERIMENT 9

Interfacing stepper motor and temperature sensor

10 **3 Hours**

EXPERIMENT 10

Implementing zigbee protocol with ARM.

Total: 75 Hours

Reference(s)

1. Peckol, Embedded system Design, John Wiley & Sons,2010
2. Lyla B Das, Embedded Systems-An Integrated Approach, Pearson, 2013
3. Shibu. K.V, Introduction to Embedded Systems, Tata McGraw Hill, 2017
4. Raj Kamal, Embedded System-Architecture, Programming, Design, Tata McGraw Hill, 2013
5. C.R.Sarma, Embedded Systems Engineering, University Press (India) Pvt. Ltd, 2013
6. Han-Way Huang, Embedded system Design Using C8051, Cengage Learning, 2009.

0 0 2 1

18MC607 COMPUTER AIDED MANUFACTURING LABORATORY

Course Objectives

- To provide knowledge on modelling and creating toolpath of machine components using computer aided manufacturing softwares
- To impart part programming knowledge on CNC lathe.
- To expose part programming knowledge on CNC milling machine
- To study the working of wire cut EDM for cutting various shapes.
- To impart knowledge on developing the prototype by additive manufacturingprocess

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Formulate the tool path for circular and prismatic parts using machining programs
2. Create the part program for the machining component using CNC lathe.
3. Create the part program for the machining component using CNC milling
4. Demonstrate the the wire cut EDM for producing intricate shapes
5. Demonstrate the component using additive manufacturing process

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2								1				2	
2					2				2				3	
3					2				2				1	
4	2				2				2				3	
5					2				2				1	

1 **4 Hours**

EXPERIMENT 1

To make a protected type flange coupling to transmit the power from dia 20mm shaft.

2 **4 Hours**

EXPERIMENT 2

To manufacture the Vee block component as per the dimensions shown below.

3 **4 Hours**

EXPERIMENT 3

To fabricate a frame support as shown in figure.

4 **4 Hours**

EXPERIMENT 4

To machine a logo of Bannari amman Institute of Technology

5 **4 Hours**

EXPERIMENT 5

To make a profile of shaft support as per the dimensions given in the figure

6 **4 Hours**

EXPERIMENT 6

To make an injection molding die for Ball point pen case using CNC milling

7 **4 Hours**

EXPERIMENT 7

Reverse engineering of pump components like impeller, Shaft, Casing, Centre line support using 3D scanner and printer

8 **2 Hours**

EXPERIMENT 8

Redesign and make an extruder assembly of a 3D printer to hold three filaments using design for additive manufacturing principles

Total: 30 Hours

Reference(s)

1. Koren Y, Computer Control of Manufacturing systems, McGraw Hill, 2006
2. S.K.Sinha,CNC Programming, McGraw Hill,2007
3. Wego Wang, Reverse Engineering Technology,CRC Press,2004

0 0 4 2

18MC608 OBJECT ORIENTED PROGRAMMING LABORATORY

Course Objectives

- To understand the concepts of Object Oriented Programming
- To study the concepts of objects and classes
- To familiarize the concepts of functions and constructors, use them to create real-time applications

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Understand the characteristics and data types of C++ language
2. Understand the Objects and Classes of C++ language
3. Develop efficient programs using operator overloading
4. Demonstrate the concepts of polymorphism to large scalesoftware
5. Apply the concepts of files streams to real-world problems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1		3									
2	2	1	1		3									
3	2	2	2		3									3
4	3	2	3		-									
5	1	2	3		3									3

1 **5 Hours**

EXPERIMENT 1

Introduction to OOPS concepts, datatypes

2 **5 Hours**

EXPERIMENT 2

Program to implement Matrix addition, subtraction. Multiplication and division

3 **5 Hours**

EXPERIMENT 3

Implement the concept of type conversion, the precedence of operators

4 **5 Hours**

EXPERIMENT 4

Simple C Programs to check whether the entered number is positive or negative using if-else statement and realize a calculator operation Switch statement

5 **5 Hours**

EXPERIMENT 5

Simple C Programs to print the first 50 odd/even numbers and pyramid pattern printing using

a) for loop
b) while loop
c) do-while loop

6 **5 Hours**

EXPERIMENT 6

Write a C program for constructor and destructor concept

7 **5 Hours**

EXPERIMENT 7

Program to implement the concepts of function overloading and operator overloading and method overriding.

8 **5 Hours**

EXPERIMENT 8

Write a C program to Multiple, Multilevel, Hybrid, Hierarchical Inheritance

9 **5 Hours**

EXPERIMENT 9

Implement the concept of class using static data member and static member functions.

10 **5 Hours**

EXPERIMENT 10

Write a C program to file handling (file reader, file writer) random access file using Write, Read, Rename, and Remove commands

11 **5 Hours**

EXPERIMENT 11

Write a C program to store the information (name, roll, and marks) of 50 students using class and display the number of students who got A grade (100-85), B grade (85-70), C grade (70-66), D grade (55-45) and failed in the periodical exam.

12 **5 Hours**

EXPERIMENT 12

Write a C program to design Log-In screen, check username and password and to display the corresponding message on successful login/failed login.

Total: 60 Hours

Reference(s)

1. D.S.Malik, C++ Programming, Thomson, USA, 2011.
2. Robert Lafore, Object Oriented Programming in-C++,4th Edition, Galgotia Publication, Pearson India, New Delhi, 2008
3. K.R. Venugopal, Raj Kumar and T.Ravishankar, Mastering C++, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2006
4. https://nptel.ac.in/courses/106105151/

18GE601 SOFT SKILLS-APTITUDE II **0 0 2 0**

Course Objectives

- Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values. It will provide a lot of activities and examples for a student to learn and develop these life skills.

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.

Course Outcomes (COs)

1. Apply the concepts of probability, Sets, Permutation and Combinations in estimating data for real time problems.
2. Understand the concept of logarithms, progressions and Simple and Compound interest to solve various practical problems.
3. Analyse objects involving cubes and cuboids in determining the number of sides colored.
4. Interpret various data from graphs and tables to determine ratio, percentage and averages.
5. Apply the logical reasoning skills for identifying age, relations, visual relations and puzzles.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3													
2	2													
3	3													
4	2													
5	3													

1 **2 Hours**

PERMUTATION AND COMBINATION

Definition-Fundamental rules-Theorems on Permutation-Theorems on Combination

2

PROBABILITY

Concept and Importance of Probability-Underlying factors for real Life estimation of probability-Basic facts about probability-Some important consideration while defining event.

3 **2 Hours**

SYLLOGISM AND VENN DIAGRAM

Concepts on Syllogisms-Venn diagram-Interpretation-Venn diagram-solving.

4 **2 Hours**

SIMPLE INTEREST AND COMPOUND INTEREST

Introduction-Definition - Effect of change of P, R, T on simple interest-Amount-Amount becomes N times the principle-Repayment of debt in equal installments-Rate and time are numerically equal- Compound Interest-Conversion period-Basic formula-Special cases-To find the principle / Time /Rate- Difference between Compound Interest and Simple Interest-Equal annual installment to pay the borrowed amount.

5 **2 Hours**

MIXTURES AND ALLIGATION

Definition-Alligation rule-Mean value (cost price) of the mixture-Some typical situations where allegation can be used.

6 **2 Hours**

CUBE AND LOGARITHM

Introduction-Basic Concepts of Cube and Cuboid-Problems involving cubes and cuboids of various dimensions-Problems involving coloured cubes and cuboids - Basic concepts of Logarithm-Laws of Logarithms including change of base-Common logarithm (base 10) - Properties of Logarithms to solve equations involving logarithmic expressions.

7 **2 Hours**

DATA INTERPRETATION

Introduction-Ratio-Percentage-Average-Tables - Graphs and Charts.

8 **2 Hours**

PROGRESSION AND LOGICAL REASONING

Arithmetic progression-Geometric progression-Harmonic progression-Theorems related with progressions.

9 **4 Hours**

PROBLEM ON AGES

Introduction-Basic concept-Usage of Percentage and Averages -Applications.

10 **4 Hours**

ANALYTICAL REASONING

Introduction-Basic concept-Non-verbal Analytical Reasoning -Arrangements.

11 **2 Hours**

BLOOD RELATION

Introduction-Basic concept-Kinds of relation-Tree diagram -Relations

12 **2 Hours**

VISUAL REASONING

Introduction-Basic concepts-Odd man out-Next series-Mirror image and water image

13 **2 Hours**

SIMPLIFICATIONS

Introduction-Basic concepts-Arithmetic operations-Equation solving methods-Puzzles.

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.
2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd, India.
3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.
6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications

18HS003 PRINCIPLES OF MANAGEMENT 2 0 0 2

Course Objectives

- To develop cognizance about importance of management principles.
- Extract the functions and responsibilities of managers.
- To Study and understand the various HR related activities.
- Learn the application of the theories in an organization.
- Analyze the position of self and company goals towards business.

Programme Outcomes (POs)

g. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Students will be able to understand the basic concepts of Management.
2. Have some basic knowledge on planning process and its Tools & Techniques.
3. Ability to understand management concept of organizing and staffing.
4. Ability to understand management concept of directing.
5. Ability to understand management concept of controlling.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1							2		2		3			
2							2		2		3			
3							2		2		3			
4							2		2		3			
5							2		2		3			

UNIT I **6 Hours**

INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

Definition of Management Science or Art Manager Vs Entrepreneur-types of managers- Managerial roles and skills-Evolution of Management Scientific, Human Relations, System and Contingency approaches Types of Business organization- Sole proprietorship, partnership, Company-public and private sector enterprises-Organization culture and Environment Current Trends and issues in Management.

UNIT II **6 Hours**

PLANNING

Nature and purpose of planning-Planning process-Types of planning-Objectives-Setting objectives-Policies- Planning premises - Strategic Management- Planning Tools and Techniques-Decision making steps and process.

UNIT III **6 Hours**

ORGANISING

Nature and purpose Formal and informal organization Organization chart Organization Structure Type - Line and staff authority Departmentalization delegation of authority Centralization and decentralization Job Design-Human Resource Management HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management.

UNIT IV **6 Hours**

DIRECTING

Foundations of individual and group behaviour-Motivation-Motivation theories- Motivational techniques-Job satisfaction-Job enrichment-Leadership-types and theories of leadership-Communication-Process of communication-Barrier in communication Effective communication-Communication and IT.

UNIT V **6 Hours**

CONTROLLING

System and process of controlling-Budgetary and non-Budgetary control techniques-Use of Computers and IT in Management control-Productivity problems and management-Control and Performance-Direct and preventive control-Reporting.

Total: 30 Hours

Reference(s)

1. Robbins, S. (2017). Management, (13th ed.), Pearson Education, New Delhi.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, Fundamentals of Management, Pearson Education,7th Edition, 2011.
3. Robert Kreitner and Mamata Mohapatra, Management, Biztantra, 2008.
4. L. M. Prasad, Principles and Practice of Management. 7th Edition, Sultan Chand & Sons, 2007.
5. P. C. Tripathi and P. N. Reddy, Principles of Management, Fourth Edition, Tata McGraw Hill, 2008

3 0 0 3

18MC702 MICRO ELECTRO MECHANICAL SYSTEM

Course Objectives

- To comprehend the physical effects on miniaturisation through scaling laws
- To gain knowledge on principles of micro fabrication and micro manufacturing
- To be able to design and analyse MEMS-based sensors and actuators

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. Analyze, design and develop electro mechanical system using contemporary tools
n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Retrieve the scaling laws used in conceptual design of microsystems
2. Summarize the working principles of micro sensors and actuators
3. Use photolithography and its allied processes to fabricate MEMS devices
4. Select a suitable micro manufacturing technique for the fabrication of a specific MEMS device
5. Outline the principles of microsystem packaging and design

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2											2	
2	2	1			2								2	1
3	2	1	1		2								2	
4	2	1	1		2								3	
5	2	1	3											

UNIT I **9 Hours**

MICROSYSTEMS AND MINIATURIZATION

Introduction to Microsystems and microelectronics - Applications of micro system in automotive , bio medical,aerospace - telecommunication industries. Trimmer's scaling vector and scaling laws - scaling in geometry- scaling in rigid body dynamics- scaling in electrostatic forces-scaling in electricity

UNIT II **9 Hours**

MICRO SENSORS AND ACTUATORS

Microsensors- Types of micro sensors - Micro accelerometer, Pressure sensors and thermal sensors. Micro actuation techniques - piezoelectric crystals -Shape memory alloys - bimetallics - conductive polymers. Micro motors - micro grippers - Microfluidic devices - Micro pumps - micro valves - valve less micro pumps

UNIT III **9 Hours**

MICRO FABRICATION

Clean room technology, Micro Fabrication processes: Photolithography - X Ray and UV, Ion implantation, Diffusion - Oxidation - Chemical Vapor Deposition - Physical Vapor Deposition - D.C. Sputtering

UNIT IV **9 Hours**

MICROMACHINING

Processes for bulk micromachining - Wet vs dry etching - Chemical etching of Silicon - etchant systems and etching process - Reactive ion etching (RIE) and Deep reactive ion etching (DRIE) - mask layout design. Processes for Surface micromachining -Limitations of Bulk and surface micromachining - LIGA

UNIT V **9 Hours**

MICROSYSTEMS DESIGN AND PACKAGING

Design Considerations- design challenges, selection of materials, manufacturing, signal transduction, electromechanical system, packaging, Mechanical design thermo mechanical loading, thermomechanical stress analysis, dynamic analysis and interfacial fracture analysis Micro system packaging: Materials die level, device level - system level - packaging techniques - die preparation - surface bonding - wire bonding - sealing

FOR FURTHER READING

Optical MEMS: Micro mirrors, optical switches, RF-MEMS: RF resonators for filters, frequency sources, Power MEMS: micro power sources, batteries and solar cells vs. MEMS based devices, energy harvesting, NEMS -sensors.

Total: 45 Hours

Reference(s)

1. Tai Ran Hsu, MEMS and Microsystems Design and Manufacture, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2017
2. Mohamed Gad-el-Hak, The MEMS Handbook, CRC Press Publishers, India, 2002
3. Chang Liu, Foundations of MEMS, Pearson Education, New Delhi, 2011
4. James J. Allen, Micro Electro Mechanical System Design, CRC Press Publishers, India, 2005.
5. Marc J Madou Fundamentals of microfabrication, Third Edition, CRC Press Publishers, 2011
6. MEMS and Microsystems (NPTEL Course) https://nptel.ac.in/courses/117105082/

18MC703 AUTOMOTIVE ELECTRONICS 3 0 0 3

Course Objectives

- The purpose of this course is to study the basics of electronics, emission controls and its importance in automobiles
- To study the various sensors and actuators used in automobiles for improving fuel economy and emission control
- To study the various blocks of control units used for control of fuel, ignition and exhaust systems

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Represent the importance of emission standards in automobiles and understand the need for starting and charging system in automobiles
2. Summarize the electronic fuel injection/ignition components and their function
3. Choose a sensors/ transducer for measuring mechanical quantities, temperature and appropriate actuators
4. Determine the electronic engine control systems problems with appropriate diagnostic tools
5. Interpret the need for vehicle chassis and safety system

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3					3	2							
2	3					1	1							
3	3					1	1							
4	3					2	1							
5	3					1	1							

UNIT I **8 Hours**

VEHICLE NORMS, CHARGING AND STARTING SYSTEM

Evolution of electronics in automobiles - emission laws - introduction to Euro I, Euro II, Euro III, Euro IV, Euro V, Euro VI standards - Equivalent Bharat Standards. Charging systems: Working and design of charging circuit diagram - Alternators - Requirements of starting system - Starter motors and starter circuits

UNIT II **9 Hours**

IGNITION AND INJECTION SYSTEM

Ignition systems: Ignition fundamentals - Electronic ignition systems - Programmed Ignition - Distribution less ignition - Direct ignition - Spark Plugs. Electronic fuel Control: Basics of combustion - Engine fueling and exhaust emissions - Types of exhaust: hot end and cold end.- Electronic control of carburetion - Petrol fuel injection - Diesel fuel injection

UNIT III **8 Hours**

SENSORS AND ACTUATORS

Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall Effect, Throttle angle, temperature, exhaust gas oxygen sensors - study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator and vacuum operated actuator.

UNIT IV **10 Hours**

ENGINE CONTROL SYSTEM

Control modes for fuel control - Engine control subsystems - Ignition control methodologies - Different ECU's used in the engine management - block diagram of the engine management system. In vehicle networks: CAN standard, format of CAN standard - Diagnostics systems in modern automobiles

UNIT V **10 Hours**

CHASSIS AND SAFETY SYSTEM

Traction control system - Cruise control system - Electronic control of automatic transmission Antilock-braking system - Electronic suspension system - Working of airbag and role of MEMS in airbag systems - Centralized door locking system - Climate control of cars - Introduction to driverless car

FOR FURTHER READING

Power Train Control, Safety System Control (Brake System (ASR, ESP) and Airbag-Seat Belt Tensioners), Steering System Control, Bharat IV & V Ã¢?? Emission Standard, Security System (Centralized Remote Door Locking, Immobilizer).

Total: 45 Hours

Reference(s)

1. Tom Denton, Automobile Electrical and Electronics Systems, Routledge Publishers, United Kingdom, 2017
2. William Ribbens, Understanding Automotive Electronics, Newnes Publishers, India, 2013.
3. BOSCH Automotive Handbook, Bentley Publishers, USA, 2005
4. Barry Hollembeak, Automotive Electricity, Electronics and Computer Controls, Delmar Publishers, USA, 2001
5. Ronald. K. Jurgon, Automotive Electronics Handbook, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 1999

18MC704 INDUSTRIAL AUTOMATION 3 0 0 3

Course Objectives

- To understand the need of automation in various industrial sectors
- To learn about the various technology developments such as PLC, SCADA and DCS in industrial automation
- To understand the basics of communication with its protocol.

Programme Outcomes (POs)

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

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

n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Outline the need of automation in industries
2. Illustrate different instructions available in PLC for various applications
3. Implement supervisory control and data acquisition systems for particular applications
4. Integrate the distributed control system and to differentiate the DCS over other automation systems
5. Select the proper communication buses and its protocol for industrial applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		2											1
2	3		1											3
3	3		1											3
4	3		2											3
5	3		1											3

UNIT I **9 Hours**

BASICS OF AUTOMATION

Automation in Production System-Principles and Strategies of Automation-Basic Elements of an Automated System-Advanced Automation Functions-Levels of Automation-Flow lines, Transfer Mechanisms-Fundamentals and Analysis of Transfer Lines, Fundamentals of IoT

UNIT II **9 Hours**

PROGRAMMABLE LOGIC CONTROLLER

PLC Architecture - Processor Memory Organization: Program Files, Data Files- Programming Languages- Wiring Diagrams and Ladder Logic Programs- Instructions: Simple Instructions, Timer, Counter, Program Control, Data Manipulation, Math Instructions - Selection of PLC

UNIT III **9 Hours**

SUPERVISORY CONTROL AND DATA ACQUISITION

Elements of SCADA-Functionalities of SCADA-Architecture: Hardware, Software: Development, Runtime mode functions-Tools: Tag database-Recipe database- Alarm Logging-Trends: Real Time, Historical Trends-Security and User Access Management-Management Information System-Report Function.

UNIT IV **9 Hours**

DISTRIBUTED CONTROL SYSTEM

Evolution of DCS - Types of Architecture - Local Control Unit - Communication Facilities - Operator and Engineering Interfaces - Operator Displays - Process Interfacing issues.

UNIT V **9 Hours**

COMMUNICATION PROTOCOLS

Introduction - Communication Hierarchy, Communication System Requirements - Network Topologies - Communication Modes HART Networks and OSI models- Communication buses - Fieldbus, Modbus, Profibus - Device net - CAN network - System Operation and Troubleshooting.

FOR FURTHER READING

24 Hour Clock Design, Automatic Control of Warehouse Door, Automatic Lubrication of Supplier Conveyor Belt, Automatic Stacking Process.

Total: 45 Hours

Reference(s)

1. M. P. Groover, Automation, Production Systems and Computer Integrated Manufacturing, Fourth Edition, Pearson Education, UK, 2016
2. Webb J.W, Programmable Controller Principles and applications, Fifth Edition, Morrill Publishing Co, USA, 2002
3. Petruzella, FD, Programmable Logic Controllers, Fifth Edition, McGraw-Hill, New York, 2016.
4. Stuart A. Boyer, SCADA: Supervisory Control and Data Acquisition, Fourth Edition, ISA Publication, Europe, 2009
5. Lucas M.P, Distributed control systems, Van Nostrand Reinhold Company, Newyork, 1986

18MC707 INDUSTRIAL AUTOMATION LABORATORY

0 0 2 1

Course Objectives

- To provide a clear view on Programmable Logic Controllers (PLC) and Supervisory Control and Data Acquisition (SCADA).
- To learn the various methods involved in automatic control and monitoring

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. Analyze, design and develop electro mechanical system using contemporary tools
n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Understand the use of RS Logix software in PLC
2. Develop the PLC program for the implementation of logic gates
3. Develop the PLC program for various applications like traffic light control, bottle filling, cylinder actuation and elevator control
4. Understand the use of wonderware intouch SCADA software to develop a SCADA screen to display the process parameters such as temperature, pressure, humidity and level.
5. Develop a SCADA screen for receipe database, alarm logging and security access management

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		1		1								3	2
2	3		3		1								1	2
3	3		3		2								2	2
4	3		2		2								2	2
5	3		2		1								3	2

1 **3 Hours**

EXPERIMENT 1

Implementation of logic gates using RS Logix software

2 **3 Hours**

EXPERIMENT 2

Two way and four way traffic light control system using PLC

3 **3 Hours**

EXPERIMENT 3

Bottle filling process using PLC

4 **3 Hours**

EXPERIMENT 4

Automate the cylinder sequencing process using PLC

5 **3 Hours**

EXPERIMENT 5

Select the suitable I/O module for control of elevator using PLC

6 **3 Hours**

EXPERIMENT 6

Design a SCADA screen to display the plant information such as temperature, pressure and humidity using historical trends

7 **3 Hours**

EXPERIMENT 7

Design a SCADA screen for automatic level monitoring system

8 **3 Hours**

EXPERIMENT 8

Design a SCADA screen for recipe database

9 **3 Hours**

EXPERIMENT 9

Design a SCADA screen for alarm logging

10 **3 Hours**

EXPERIMENT 10

Design a SCADA screen for security access management

Total: 30 Hours

Reference(s)

1. Petruzella Frank D., Programmable Logic Controllers, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2010
2. Webb, John W. Programmable Logic Controllers: Principles and Application, Fifth edition, Prentice Hall of India, New Delhi, 2004.
3. Bolton , Programmable Logic Controllers, Sixth Edition Newnes, ,2015

0 0 2 1

18MC708 MICRO ELECTRO MECHANICAL SYSTEM LABORATORY

Course Objectives

- To study the micro level model, simulate and analyse the same
- To perform the static and thermo mechanical analysis
- To virtually fabricate a micro device using etching and additive manufacturing process

Programme Outcomes (POs)

b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling 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.
m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Create a mask layout of MEMS devices
2. Analyze the electro mechanical performance of created MEMS devices
3. Generate an appropriate procedure, to fabricate the MEMS devices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		3		2	3	2							1	
2		3		2	2	2							2	
3		2		3	3	2							3	

1 **3 Hours**

EXPERIMENT 1

Development of a mask to form circular hole in a flat structure using direct and indirect methods.

2 **3 Hours**

EXPERIMENT 2

Virtual fabrication of comb drive used in micro accelerometer

3 **3 Hours**

EXPERIMENT 3

Transient analysis for a bimorph cantilever in a periodically changing magnetic field

4 **3 Hours**

EXPERIMENT 4

Virtual fabrication of die through an anisotropic etching process.

5 **3 Hours**

EXPERIMENT 5

Static analysis of piezoelectric beam.

6 **3 Hours**

EXPERIMENT 6

Thermo ElectroMechanical Analysis of Piezoelectric pump.

7 **3 Hours**

EXPERIMENT 7

Sub harmonic analysis of a cantilever beam

8 **3 Hours**

EXPERIMENT 8

Design of micro accelerometer and perform g-displacement analysis.

9 **3 Hours**

EXPERIMENT 9

Design of microbolometer and perform temperature-voltage analysis.

10 **3 Hours**

EXPERIMENT 10

Design of pressure sensor and perform pressure analysis.

Total: 30 Hours

Reference(s)

1. Chang Liu, Foundations of MEMS, Pearson Education, New Delhi, 2011.
2. James J. Allen, Micro Electro Mechanical System Design, CRC Press Publishers, India, 2005
3. Intellisuite Tutorial http://www.intellisense.com/upload/20121217020748597 5.pdf

18MC707 PROJECT WORK I **0 0 6 3**

Course Objectives

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Identify technical ideas, strategies and methodologies
- Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project
- Test and validate through conformance of the developed prototype and analysis the cost effectiveness
- Prepare report and present oral demonstrations

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
f. 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. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change
m. Analyze, design and develop electro mechanical system using contemporary tools
n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness
5. Prepare report and present oral demonstrations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		3	2			2	1						2	3
2	2	2	1	3		2					2	2	2	3
3			3	2	2			2			2	2	2	3
4		1		2	3	1	2	2					2	3
5									3	3		2	2	3

Total: 45 Hours

18MC804 PROJECT WORK II **0 0 18 9**

Course Objectives

- Formulate a real world problem, identify the requirement and develop the design solutions.
- Identify technical ideas, strategies and methodologies
- Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project
- Test and validate through conformance of the developed prototype and analysis the cost effectiveness
- Prepare report and present oral demonstrations

Programme Outcomes (POs)

a. Apply the knowledge of mathematics, science, and engineering fundamentals to the solution of engineering problems.
b. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

f. 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. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
l. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the context of technological change.
m. Analyze, design and develop electro mechanical system using contemporary tools
n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness
5. Prepare report and present oral demonstrations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		3	2			2	1						2	3
2	2	2	1	3		2					2	2	2	3
3			3	2	2			2			2	2	2	3
4		1		2	3	1	2	2					2	3
5									3	3		2	2	3

18HS201 COMMUNICATIVE ENGLISH II 1 0 2 2

Course Objectives

- Read and understand ideas of complex text on both concrete and abstract topics
- Listen and understand technical discussions in his/her field of specialisation
- Produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options
- Interact with a degree of fluency and spontaneity that makes regular interaction without strain

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Use appropriate grammar and vocabulary that is expected at the BEC Vantage exam level.
2. Understand the general meaning of non-routine letters, and of a report of predictable / unpredictable topic
3. Write simple reports of factual nature and factual non-routine letters
4. Ask for factual information and understand the answer; and take/pass on workplace messages
5. Express opinions and present arguments to a limited extent; and give simple, prepared presentations on familiar topics

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									1					
2									2					
3									3					
4										1				
5										2				

UNIT I **9 Hours**

GRAMMAR3

Tenses - Future continuous, Future perfect, Future perfect continuous, Past perfect, Past perfect continuous - Adjectives and adverbs - Mixed conditionals - Modals - can't have, needn't have - Modals of deduction and speculation - Narrative tenses - Passives - Phrasal verbs, extended - Relative clauses - Reported speech - Will and going to, for prediction - Wish - Would expressing habits, in the past.

UNIT II **9 Hours**

READING

Scanning and reading for gist - Understanding text structure - Reading for gist and specific information - Vocabulary and structure - Understanding sentence structure and error identification

UNIT III **9 Hours**

WRITING

A message, memo or email, Giving instructions, explaining a development, asking for comments, requesting information, agreeing to requests - Business correspondence: explaining, apologising, reassuring, complaining, short report: describing, summarising - proposal: describing, summarising, recommending, persuading.

UNIT IV **9 Hours**

LISTENING

Listening for and noting specific information - Listening to identify topic, context, Function - Following the main points and retrieving specific information from the text.

UNIT V **9 Hours**

SPEAKING

Giving personal information: Talking about present circumstances, past experiences and future plans, expressing opinions, speculating - Organising a larger unit of discourse: Giving information and expressing and justifying opinions - Turn-taking: negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing/disagreeing, suggesting, speculating, comparing and contrasting, and decision- aking. 1.A Horse and Two Goats - R K Narayan 2.My Lord the Baby - Rabindranath Tagore 3.Twist in the Tale - Jeffery Archer.4.The Third and Final Continent - Jhumpa Lahiri

5. The Gift of the Magi - O Henry

Total: 45 Hours

Reference(s)

1. Guy Brook-Hart, "BEC Vantage: Business Benchmark Upper-Intermediate- Student's Books" 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Ian Wood, Paul Sanderson, Anne Williams with Marjorie Rosenberg, "Pass Cambridge BEC Vantage- Student's Book" 2nd Edition, Cengage Learning, New Delhi, 2014
3. Michael Handford, Martin Lisboa, Almut Koester, Angela Pitt, "Business Advantage - Student's Book Upper-Intermediate" Cambridge University Press, New Delhi, 2014.
4. Cambridge Examinations Publishing, "Cambridge BEC VANTAGE - Self-study Edition", Cambridge University Press, UK, 2005.

18HSH01 HINDI **1 0 2 2**

Course Objectives

- To help students acquire the basics of Hindi
- To teach them how to converse in Hindi on simple day- to -daysituations
- To teach them how to converse in Hindi on simple day- to -daysituations

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Construct simple sentences and use vocabulary required for day- to -day conversation
2. Distinguish and understand the basic sounds of Hindi language
3. Appear for Hindi examinations conducted by Dakshina Bharat Hindi Prachar Sabha

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				
4										2				
5										2				

UNIT I **9 Hours**

Hindi Alphabet: Introduction - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu & Visarg -Table of Alphabet -Vocabulary.

UNIT II **9 Hours**

Nouns: Genders (Masculine & Feminine Nouns)- Masculine & Feminine - Reading Exercises.

UNIT III **9 Hours**

Pronouns and Tenses: Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences - Interrogative Sentences.

UNIT IV **9 Hours**

Classified Vocabulary: Parts of body - Relatives - Spices - Eatables - Fruit & Vegetables - Clothes - Directions - Seasons - Professions.

UNIT V **9 Hours**

Speaking: Model Sentences and Rhymes - Speaking practice for various occasions

Total: 45 Hours

Reference(s)

1. Hindi Prachar Vahini-1 by Dakshin Bharat Hindi Prachar Sabha Chennai
2. B.R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People,Vee Kumar Publications(P)Ltd., New Delhi,2009

18HSG01 GERMAN **1 0 2 2**

Course Objectives

- To help students appear for the A1 level Examination
- To teach them how to converse fluently in German in day-to-dayscenarios

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. listen and identify individual sounds of German
2. use basic sounds and words while speaking
3. read and understand short passages on familiar topics
4. use basic sentence structures while writing
5. understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

Introduction to German language: Alphabet - Numbers - Greetings - Days and Seasons- Working with Dictionary.

UNIT II **9 Hours**

Nouns - articles - Speaking about one self - Listening to CD supplied with the books, paying special attention to pronunciation

UNIT III **9 Hours**

Regular & Irregular verbs - Personal pronouns - family - Introduction to types of sentences

UNIT IV **9 Hours**

Question words-Types of Questions - Nominative case- Verb Conjugation - country - nationalities

UNIT V **9 Hours**

Verbs - to be & to have - conjugation - Hobbys - Framing basic Questions and answers

Total: 45 Hours

Reference(s)

1. Kursbuch and Arbeitsbuch, NETZWERK A1 DEUTSCH ALS FREMDSPRACHE, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2015
2. Langenscheidt Eurodictionary - German - English / English - German, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2009
3. Grundkurs, DEUTSCH Lehrbuch Hueber Munichen, 2007.

18HSJ01 JAPANESE **1 0 2 2**

Course Objectives

- To train students for N5 Level Examination
- To teach them use basic Japanese sentences in day-to-day conversation
- To make students familiar with the Japanese cultural facets and social etiquettes

Programme Outcomes (POs)
Course Outcomes (COs)

1. Recognise and write Japanese alphabet
2. Speak using basic sounds of the Japanese language
3. Apply appropriate vocabulary needed for simple conversation in Japanese language
4. Apply appropriate grammar to write and speak in Japanese language
5. Comprehend the conversation and give correct meaning

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										3				
3										2				
4										2				
5										2				

UNIT I **9 Hours**

Introduction to Japanese - Japanese script- Pronunciation of Japanese(Hiragana)- (Katakana) Long vowels - Pronunciation of in,tsu,ga - Letters combined with ya,yu,yo - Daily Greetings and Expressions - Numerals. N1 wa N2 desu - N1 wa N2 ja arimasen - S ka N1 mo - N1 no N2 - san - Kore - Sore - Are - Kono N - Sono N - Ano N - Sou desu - Sou ja Arimasen - S1 ka - S2 ka - N1 no N2 - Sou desu ka - Koko - Soko - Asoko - Kochira - Sochira Achira - N1 wa N2 (place) desu - Doko - Dochira - N1 no N2 - Ko - So - A - Do (Demonstrative words) - O kuni Kanji10 - Technical Japanese Vocabulary (30 Numbers)

UNIT II **9 Hours**

Introduction to time - Ji - Fun - Pun - Introduction of verbs - V Masu - V Masen - V Mashita - V Masendeshita N (Time) Ni V - N1 Kara - N2 Made - N1 to N2 - S Ne - N (Place) e Ikimasu - Kimasu - Kaerimasu - Doko (e) Mo Ikimasen - Ikimasendeshita - N (Vechile) de Ikimasu - Kimasu - Kaerimasu - N (Person / Animal) to V - Itsu - S Yo N o (transitive) - N o Shimasu - Nani o Shimasuka - Nan and Nani - N (place) de V - V Masenka - V Mashou - o - Kanji 10 - Technical Japanese Vocabulary (30 Numbers) .

UNIT III **9 Hours**

N (tool/means) de V - Word/Sentence wa Go de Nani desu ka - N (person) Ni Agemasu, etc - N (person) Ni Moraimasu etc - Mou V Mashita - Introduction to Adjectives - N wa Na adj (Na) desu - N wa II adj (II) desu - Na adj Na n - II adj (II) N - Totemo - Amari - N wa Dou desuka - N1 wa Donna N2 desuka - S1 Ga S2 - Dore N ga Arimasu - Wakarimasu - N Ga Sukidesu - Kiraidesu - Jozu desu - Heta desu - Donna N - Yoku - Daitai - Takusan - Sukoshi - Amari - Zenzen - S1 kara S2 - Doushite - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

UNIT IV **9 Hours**

N ga Arimasu - Imasu - N1 (place) Ni N2 ga Arimasu - Imasu - N1 (thing/person/place) no N2 (position) - N1 ya N2 - Word (s) desuka - Chirisosu wa Arimasuka - Saying numbers - Quantifier (period) Ni kai V - Quantifier Dake - N dake - Past tense of Noun sentences and Na adjective sentences - Past tense of ii adjective sentences - N1 wa N2 yori adjective desu - N1 to N2 to dochira ga adjective desu ka - N1/N2 no houga adjective desu - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

UNIT V **9 Hours**

N ga hoshi desu - V masu form tai desu - N (place) e V masu form - N Ni - ikimasu - kimasu - kaerimasu N ni V - N o V - dou ko ka - nani ka - go chuu mon - Verb conjugation - Verb groups - Verb te form - V te form kudasai - V te form imasu - V masu from mashouka - S1 ga S2 - N ga V - V te form mo ii desu - V te form wa ikemasen - V te form imasu Shrimasen - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

Total: 45 Hours

Text Book(s)

1. Japanese for Everyone: Elementary Main Textbook 1-2, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

Reference(s)

1. Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

18HSC01 CHINESE **1 0 2 2**

Course Objectives

- To help students appear for HSK Level 1 Exam
- To help students acquire the basics of Chinese language
- To teach the students how to converse in Chinese in various situations

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. listen and identify individual sounds of Chinese
2. use basic sounds and words while speaking
3. read and understand short passages on familiar topics
4. use basic sentence structures while writing
5. understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

Hello

1. Initials and Finals of Chinese b,p,m,f,d,,n,l,g,k,h,j,q,x
2. Tones Four
3. Chinese Syllables
4. Tone S

UNIT II **9 Hours**

Thank you - Initials and Finals of Chinese - The Neutral Tone - Rules of Tone Marking and Abbreviation

UNIT III **9 Hours**

1. What"s your name - In the school; -In the classroom; -In the school - The Interrogative Pronoun
2 The Sentence
3 Interrogative Sentences with

UNIT IV **9 Hours**

She is my Chinese teacher - In the library
The Interrogative Pronouns
The Structural Particle
The interrogative Particle

UNIT V **9 Hours**

Her daughter is 20 years old this year -
1. The Interrogative Pronoun
2. Numbers below 100
3. Indicating a Change
The Interrogative Phrase

Total: 45 Hours

18HSF01 FRENCH **1 0 2 2**

Course Objectives

- To prepare the students for DELF A1 Examination
- To teach them to converse fluently in French in day-to-day scenarios

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. To help students acquire familiarity in the French alphabet & basic vocabulary
2. listen and identify individual sounds of French
3. Use basic sounds and words while speaking
4. Read and understand short passages on familiar topics
5. Understand and use basic grammar and appropriate vocabulary in completing languagetasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1										2				
2										2				
3										3				
4										2				
5										3				

UNIT I **9 Hours**

ENTRER EN CONTACT

La langue francaise, alphabets, les numeros, les jours, les mois. Grammaire Les verbes s'appeler,etre, avoir, les articles definis, indefinis Communication - Saluer, s'informer sur quelqu'un, demander de se presenter Lexique - Les alphabets, les nationalites, l'age, les pays, les couleurs, les jours de la semaine, les mois de l'annee, les professions

UNIT II **9 Hours**

PARTAGER SON LIEU DE VIE

Les francais et leur habitat, des habitations insolites Grammaire - Verbes - Conjugaison : Present (Avoir / etre / ER, IR, RE : Regulier et Irregulier) - Adjectifs les propositions de lieu Communication - Chercher un logement, d'ecrire son voisin, s'informer sur un logement Lexique - L'habitat, les pieces, l'equipement, la description physique

UNIT III **9 Hours**

VIVRE AU QUOTIDIEN

Grammaire - Articles contractes, verbes vouloir, pouvoir, devoir, adjective interrogative, future proche Communication- Exprimer ses gouts, parler de ses loisirs, justifier un choix, exprimer une envie Lexique - le temps libre et les loisirs, les saisons, les activites quotidiennes, le temps (le matin, le soir, la nuit)

UNIT IV **9 Hours**

COMPRENDRE SON ENVIRONNEMENT - OUVRIR -Ãƒ?Ã‚, LA CULTURE

Grammaire - Verbes - Finir, Sortir, les adjectifs demonstratifs, le passe compose, l imparfait | Communication - Propose quelqu un de faire quelque chose, raconteur une sortie au passe parler un film |Lexique - Les sorties, la famille, art, les vetements et les accessoires

UNIT V **9 Hours**

GOUTER A LA CAMPAGNE

Grammaire La forme negative, les verbes acheter, manger, payer, articles partitifs, le pronom en de quantite | Communication Accepter et refuse rune invitation, donner des instructions, commander au restaurant | Lexique Les services et les commerces, les aliments, les ustensiles, argent

Total: 45 Hours

Reference(s)

1. Saison A1, Methode de francais
2. Hachette FLE

18GE0P1 NANOMATERIALS SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on Nanoscience
- Explore different techniques of producing nanomaterials
- Create expertise on the applications of nanomaterials in various fields

Course Outcomes (COs)

1. Summarize the origin and advance of nanomaterials and its classification
2. Compare the different types of methods adopted for synthesizing nanomaterials
3. Analyze the characterization techniques for analyzing nanomaterials
4. Explain the physical properties exhibited by nanomaterials
5. Organize the nanomaterials developed for advanced technological applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1												
2	2	2												
3	3	1												
4	1	1												
5	2	3												

UNIT I **9 Hours**

NANO SCALE MATERIALS

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future - classification of nanostructures, nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties -differences between bulk and nanomaterials and their physical properties.

UNIT II **9 Hours**

NANOMATERIALS SYNTHESIS METHODS

Top down processes - mechanical milling, nanolithography and types based on radiations - Bottom up process - physical method: physical vapour deposition, RF sputtering, CVD- chemical method: colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self-organization.

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes-structure, synthesis and electrical properties -applications- fuel cells - quantum efficiency of semiconductor nanomaterials

UNIT V **9 Hours**

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- organic LED: basic processes, carrier injection, excitons, optimization - organic photovoltaic cells- particulate and geometrical nanomagnets-magneto resistance.

Total: 45 Hours

Reference(s)

1. Willam A. Goddard, Donald W.Brenner, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, 2012
2. Charles P. Poole Jr and. Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2007
3. Guozhong Cao, Y. Wang, "Nanostructures and Nanomaterials-Synthesis, Properties & Applications", Imperials College Press, 2011.
4. T. Pradeep, "NANO: The Essentials Understanding Nanoscience and Nanotechnology", McGraw - Hill Education (India) Ltd, 2012
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley and Sons Ltd, 2006
6. Viswanathan B, Aulice Scibioh M, "Fuel cells: Principles and Applications", University Press, 2009.

3 0 0 3

18GE0P2 SEMI CONDUCTOR PHYSICS AND DEVICES

Course Objectives

- Impart knowledge in physical properties of semiconducting materials
- Analyze the factors affecting the operation of semiconductor devices
- Apply the physics of semiconductors to develop semiconductor devices

Programme Outcomes (POs)

Course Outcomes (COs)

1. Exemplify the band gap, drift and diffusion current densities due to carrier transport in semiconductors
2. Analyze the energy band diagram in thermal equilibrium and space charge width of PN junction
3. Illustrate the operation of Bipolar Junction transistor at different modes and different configurations
4. Illustrate the operation of metal oxide field effect transistor and their memory devices
5. Represent the working mechanism of opto-electronic devices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	1	2												
3	1	1												
4	1	1												
5	2	1												

UNIT I **9 Hours**

ENERGY BANDS AND CARRIER TRANSPORT PROPERTIES

Energy Bands: Formation of energy bands - doping effects - energy levels - electron and hole concept in semiconductor. Carrier transport: Carrier drift-drift current density - conductivity- diffusion current density - total current density

UNIT II **9 Hours**

P-N JUNCTION

Basic structure and fabrication process of p-n junction - current - voltage characteristics - energy band diagram - equilibrium Fermi levels - depletion region - junction breakdown phenomena - zener - avalanche breakdown.

UNIT III **9 Hours**

BIPOLAR JUNCTION TRANSISTOR

The basic transistor action - operation in the active mode - current gain - static characteristics - carrier distribution in emitter, base and collector region - modes of operation - current - voltage characteristics of common base and emitter configuration - frequency response and switching of bipolar transistor

UNIT IV **9 Hours**

MOSFET

The ideal MOS diode - basic fundamentals and characteristics - types - CMOS and BiCMOS - CMOS inverter - MOSFET on insulator - thin film transistor (TFT) - silicon on insulators (SOI) devices - MOS Memory structures - DRAM and SRAM

UNIT V **9 Hours**

PHOTONIC DEVICES

Radiative transitions and optical absorption-light emitting diodes-organic LED - infrared LED - semiconductor laser - temperature effect - photo detector - photo diode - silicon and compound semiconductor solar cells - efficiency

Total: 45 Hours

Reference(s)

1. Donald A Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill, 2012
2. S. M. Sze and M. K. Lee, "Semiconductor Devices, Physics and Technology", John-Wiley & Sons, 2015
3. Ben. G. Streetman and S. K. Banerjee , "Solid State Electronic Devices", Pearson Education Ltd, 2015
4. C. Kittel, "Introduction to Solid State Physics", John-Wiley & Sons, 2012
5. J. Millman and C. Halkias, "Electronic Devices and Circuits", Tata McGraw Hill, 2010
6. Hagen Klauk, "Organic Electronics: Materials, Manufacturing and Applications", Wiley-VCH, 2006

18GE0P3 APPLIED LASER SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on laser science
- Explore different strategies for producing lasers
- Create expertise on the applications of lasers in various fields

Programme Outcomes (POs)
Course Outcomes (COs)

1. Illustrate the transition mechanisms and the components of a laser system
2. Compare the different types of lasers based on pumping method, active medium and energy levels
3. Compute the rotation of earth, velocity and distance using lasers and apply the same for day today applications
4. Analyze the role of lasers in surgical and endoscopy applications
5. Apply the laser techniques in industrial applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1												
2	1	2												
3	2	1												
4	1	1												
5	1	2												

UNIT I **9 Hours**

LASER FUNDAMENTALS

Introduction - principle - absorption and emission of light - thermal equilibrium - Einstein's prediction - Einstein's relations - A and B coefficients - condition for large stimulated emission - spontaneous and stimulated emission in optical region - light amplification - condition for light amplification - population inversion. Components of lasers - pumping methods - pumping mechanisms - optical resonator

UNIT II **9 Hours**

LASER BEAM CHARACTERISTICS AND TYPES

Characteristics of laser - Classification of lasers - principle, construction, working, energy level diagram and applications of molecular gas laser (CO2 laser) - liquid laser (dye laser) - excimer laser - Solid state laser (Nd:YAG laser) - semiconductor laser (homojunction laser).

UNIT III **9 Hours**

LASERS IN SCIENCE

Introduction - Harmonic generation (SHG) - Stimulated Raman emission - lasers in chemistry - laser in nuclear energy - lasers and gravitational waves - rotation of the earth - measurement of distance - Light detection And Ranging (LIDER) - velocity measurement – holography

UNIT IV **9 Hours**

LASERS IN MEDICINE AND SURGERY

Light induced biological hazards: Eye and skin - Eye laser surgery - photocoagulations - homeostasis - dentistry - laser angioplasty - different laser therapies - advantages & disadvantages - laser endoscopy.

UNIT V **9 Hours**

LASERS IN INDUSTRY

Applications in material processing: laser welding - hole drilling - laser cutting. Lasers in electronics industry: information storage - bar code scanner. Lasers in defence: laser based military weapons - laser walls.

Total: 45 Hours

Reference(s)

1. K. Thiyagarajan and A. K. Ghatak, "LASERS: Fundamentals and Applications", Springer, USA, 2015
2. M. N. Avadhanulu, "An Introduction to Lasers Theory and Applications", S. Chand Publisher, 2013
3. W. Koechner, M. Bass, "Solid State Lasers: a graduate text", Springer Verlag, New York, 2006
4. K. P. R. Nair, "Atoms, Molecules and Lasers", Narosa Publishing House, 2009
5. K. R. Nambiar, "Lasers: Principles Types and Applications", New Age International Publications, 2006
6. A. Sennaroglu, "Solid-State Lasers and Applications", CRC Press, 2006.

3 0 0 3

18GE0C1 CORROSION SCIENCE AND ENGINEERING

Course Objectives

- Understand the loss incurred due to corrosion in different sectors and terminologies related to corrosion
- Identify forms and types of corrosion with suitable mechanism
- Apply various methods of corrosion control, corrosion testing and monitoring

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
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

Course Outcomes (COs)

1. Explain if corrosion can occur under specific operating conditions in a given equipment or construction and indicate regions of immunity, corrosion and passivity of a metal
2. Compare different corrosion types on metals when exposed to air, water and at high temperatures (> 100 C)
3. Identify the corrosion mechanism on steel, iron, zinc and copper metal surfaces
4. Calculate the rate of corrosion on metals using electrochemical methods of testing
5. Propose the correct materials, design and operation conditions to reduce the likelihood of corrosion in new equipment and constructions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2						1							
3	1	3												
4	2	2												
5	3	3					1							

UNIT I **9 Hours**

CORROSION

Importance of corrosion - spontaneity of corrosion - units of corrosion rate (mdd and mpy) - direct and indirect damage by corrosion - importance of corrosion prevention in industries - Pilling Bedworth ratio and its significance - passivation - area relationship in both active and passive states of metals - Pourbaix digrams of Mg, Al and Fe and their advantages and disadvantages

UNIT II **7 Hours**

TYPES OF CORROSION

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion. Catastrophic oxidation corrosion

UNIT III **9 Hours**

MECHANISM OF CORROSION

Hydrogen embrittlement - corrosion fatigue - filiform corrosion - fretting damage and microbes induced corrosion. Corrosion mechanism on steel, iron, zinc and copper metal surfaces

UNIT IV **10 Hours**

CORROSION RATE AND ITS ESTIMATION

Rate of corrosion: Factors affecting corrosion. Electrochemical methods of polarization: Tafel extrapolation polarization and linear polarization. Weight loss method - testing for intergranular susceptibility and stress corrosion. Non destructive testing methods: Visual testing - liquid penetrant testing - magnetic particle testing and eddy current testing

UNIT V **10 Hours**

CORROSION CONTROL METHODS

Fundamentals of cathodic protection - types of cathodic protection(sacrificial anodic and impressed current cathodic protection). Stray current corrosion, problems and its prevention. Protective coatings: Metal coatings: Hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of suitable design for corrosion control

FOR FURTHER READING

Corrosion issues in supercritical water reactor (SCWR) systems

Total: 45 Hours

Reference(s)

1. Mouafak A. Zaher, "Introduction to Corrosion Engineering", CreateSpace Independent Publishing Platform, 2016.
2. E.McCafferty, "Introduction to Corrosion Science", Springer; 2010 Edition, January 2010.
3. R. Winstone Revie and Herbert H. Uhlig, "Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering", 4th Edition, John Wiley & Science, 2008.
4. Mars G. Fontana, "Corrosion Engineering", Tata McGraw Hill, Singapore, 2008
5. David E.J. Talbot (Author), James D.R. Talbot, "Corrosion Science and Technology", Second Edition (Materials Science & Technology), CRC Press; 2nd Edition, 2007.
6. http://corrosion-doctors.org/Corrosion-History/Eight.htm

18GE0C2 ENERGY STORING DEVICES 3 0 0 3

Course Objectives

- Understand the concept, working of different types of batteries and analyze batteries used in electric vehicles
- Identify the types of fuel cells and to relate the factors of energy and environment
- Analyze various energy storage devices and fuel cells

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Explain the parameters required for operation of a cell to evaluate the capacity of energy storage devices
2. Identify the electrodes, electrolyte and cell reactions of different types of primary, secondary batteries and infer the selection criteria for commercial battery systems with respect to commercial applications
3. Differentiate fuel cells based on its construction, production of current andapplications
4. Compare different methods of storing hydrogen fuel and its environmental applications
5. Relate energy and environmental based on the importance and types of renewable energy for sustainable development

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1												
2	2	3												
3	3	1												
4	2	2												
5	3	3												

UNIT I **6 Hours**

BASICS OF CELLS AND BATTERIES

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of lithium and lead acid battery - charge efficiency- charge rate - charge retention - closed circuit voltage, open circuit voltage current density - cycle life - discharge rate-over charge- over discharge

UNIT II **10 Hours**

BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES

Primary batteries - zinc-carbon, magnesium, and mercuric oxide - recycling/safe disposal of used cells. Secondary batteries - introduction, cell reactions, cell representations and applications - lead acid, nickel-cadmium and lithium ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide, lithium anode cell, photogalvanic cells. Battery specifications for cars and automobiles

UNIT III **10 Hours**

TYPES OF FUEL CELLS

Importance and classification of fuel cells - description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells, phosphoric acid, solid oxide, molten carbonate and direct methanol fuel cells

UNIT IV **10 Hours**

HYDROGEN AS A FUEL

Sources and production of hydrogen - electrolysis - photocatalytic water splitting - methods of hydrogen storage- high pressurized gas - liquid hydrogen type - metal hydride - hydrogen as engine fuel - features, application of hydrogen technologies in the future - limitations

UNIT V **9 Hours**

ENERGY AND ENVIRONMENT

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy. Solar Cells: First, second, third and fourth generation solar cell - photobiochemical conversion cell

Total: 45 Hours

Reference(s)

1. M. Aulice Scibioh and B. Viswanathan, Fuel Cells: Principles and Applications, University Press, India, 2009
2. F. Barbir,PEM fuel cells: Theory and practice, Elsevier, Burlington, MA, Academic Press, 2013
3. M. R. Dell Ronald and A. J. David, Understanding Batteries, Royal Society of Chemistry, 2001
4. J. S. Newman and K. E. Thomas-Alyea, Electrochemical Systems, Wiley, Hoboken, NJ, 2012
5. Shripad T. Revankar, Pradip Majumdar, Fuel Cells: Principles, Design, and Analysis, CRC Press, 2016
6. Thomas B. Reddy, Linden's Handbook of Batteries, 4th Edition, McGraw Hill Professional, 2010

18GE0C3 POLYMER SCIENCE **3 0 0 3**

Course Objectives

- Explain the properties of different polymers with its mechanism
- Select the appropriate polymerization techniques to synthesize the polymers and its processing
- Identify suitable polymers for various industrial applications

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

Course Outcomes (COs)

1. Illustrate the types of mechanism of polymerization reactions and analyze the natural and synthetic polymers
2. Identify the suitable polymerization techniques to synthesize the high quality polymers
3. Characterize the polymers to identify the structural, thermal ,mechanical and electrical features for specific applications
4. Apply the polymer processing methods to design polymer products
5. Identify and analyze the polymers used in electronic and biomedical applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	1	2												
3	2	2												
4	1	1	2											
5	1	3	2											

UNIT I **10 Hours**

POLYMERS AND ELASTOMERS

Classification of polymers - Mechanism: Addition polymerization - free radical, cationic, anionic and co-ordination (Ziegler-Natta) polymerization - copolymerization - condensation polymerization (nylon-6,6) -ring opening polymerization (nylon-6). Elastomers: Natural rubber and synthetic rubber: styrene - butadiene rubber (SBR), butyl, neoprene, thiocol rubbers. High performance polymers: polyethers, polyether ether ketone (PEEK), polysulphones and polyimides

UNIT II **8 Hours**

POLYMERIZATION TECHNIQUES

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) - solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - emulsion polymerization (SBR) - advantages and disadvantages of bulk and emulsion polymerization. Melt solution and interfacial poly-condensation

UNIT III **8 Hours**

CHARACTERIZATION AND TESTING

Characterization of polymers by Infrared Spectroscopy (IR) and Nuclear Magnetic Spectroscopy (NMR) - Thermal properties: TGA and DSC - Testing tensile strength - Izod impact - Compressive strength - Rockwell hardness - Vicot softening point. Test for electrical resistance, dielectric constant, dissipation factor, arc resistance and dielectric strength - water absorption

UNIT IV **9 Hours**

POLYMER PROCESSING

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendering. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plastics fabrication: hand-layup - filament winding and pultrusion

UNIT V **10 Hours**

SPECIALITY POLYMERS

Preparation and properties of heat resistant and flame retardant polymers. Polymers for electronic applications: liquid crystalline, conducting and photosensitive polymers. Polymer for biomedical applications: artificial organs, controlled drug delivery, hemodialysis and hemofiltration

FOR FURTHER READING

Biodegradable polymers

Total: 45 Hours

Reference(s)

1. V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, "Polymer Science", New Age International (P) Ltd., New Delhi, 2015
2. Joel R. Fried, "Polymer Science and Technology", Prentice Hall of India (P). Ltd., 2014
3. F. W. Billmeyer,"Text Book of Polymer Science", John Wiley & Sons, New York, 2007
4. Barbara H. Stuart, "Polymer Analysis", John Wiley & Sons, New York, 2008
5. George Odian , "Principles of Polymerization", John Wiley & Sons, New York, 2004
6. R. J. Young and P. A. Lovell, "Introduction to Polymers", CRC Press, New York, 2011

3 0 0 3

18MC001 ENGINEERING MATERIALS AND METALLURGY

Course Objectives

- To provide knowledge on classification, microstructure, heat treatment and testing methods for metals
- To understand the types and properties of non metallic materials

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Apply phase rule to binary alloy systems and infer their microstructures through metallography
2. Classify ferrous and non-ferrous materials by composition and investigate their microstructures, properties and applications
3. Design a temperature profile of heat treatment process that improves mechanical properties such as hardness and toughness of materials
4. Predict the failure mechanisms in metals, ceramics and polymers.
5. Determine mechanical behavior of materials through standard testing methods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3		1									1	
2	2	3		1										
3	2	3		1									2	
4	2	3		1										
5	2	3		1	2									

UNIT I **9 Hours**

PHASE DIAGRAMS AND METALLOGRAPHY

Alloys, Solid solutions Phase diagram, phase rule, lever rule, Binary phase diagram (Isomorphous, eutectic, peritectic, eutectoid reactions) - Iron-Carbon phase diagram: Metallography, microstructure

UNIT II **9 Hours**

ENGINEERING METALS AND ALLOYS

Classification of Engineering materials: Ferrous metals, Plain carbon steel (low carbon, medium carbon and high carbon steels), microstructure/composition, properties, applications Alloy steels, effect of alloying additions on steels, stainless steels, HSLA, maraging, tool steels - Cast iron (grey, white, malleable, spheroidal cast iron), microstructure, properties, applications. Non-ferrous metals (Ni, Cu, Ti, Al, Mg, Zn alloys), microstructure/composition, properties, and applications, Bearing materials

UNIT III **9 Hours**

HEAT TREATMENT PROCESSES

Purpose of heat treatment Annealing (stress relief, recrystallization, spheroidizing) and Normalizing Hardening and Tempering, Isothermal transformation diagrams (T-T-T diagrams), Cooling curves superimposed on TTT diagrams (martensite and bainite phase formation) Hardenability, Jominy end quench test, Case hardening processes, carburizing, nitriding, carbonitriding, cyaniding, flame hardening, induction hardening.

UNIT IV **9 Hours**

FAILURE

Fracture - Ductile, Brittle, Mechanisms of ductile and brittle fracture, fracture toughness, Impact, Ductile to Brittle transition. Fracture in ceramics and polymers, Crack Initiation and Propagation, Griffith Theory

UNIT V **9 Hours**

MECHANICAL PROPERTIES AND TESTING

Elastic and plastic deformation, slip and twinning Tensile test, stress-strain behavior of ductile and brittle materials - Stress-strain behavior of elastomers. Viscoelasticity - Compression test - Hardness and testing methods - Impact test - Fatigue test, S-N curve, endurance limit, factors affecting fatigue - Creep test, creep curves

FOR FURTHER READING

Introduction to Super alloys, Shape memory alloys, Composites, Importance of surface properties of materials (corrosion and wear).

Total: 45 Hours

Reference(s)

1. Sydney H. Avner, Introduction to Physical Metallurgy, Tata McGraw-Hill Publishing Company Pvt Ltd., New Delhi, 2nd Edition, 2017
2. William D.Callister, Material Science and Engineering, John Wiley and Sons, Singapore, 9th Edition, 2013
3. Kenneth G.Budinski and Michael K.Budinski, Engineering Materials,Prentice Hall of India Learning. Ltd.,New Delhi, 2010.
4. V. Raghavan, Materials Science and Engineering, Prentice Hall of India Learning. Ltd., New Delhi, 2009
5. O.P.Khanna, Material Science and Metallurgy, Dhanpat Rai Publications (P) Ltd, New Delhi, 2013
6. https://onlinecourses.nptel.ac.in/noc19_mm01/preview

18MC002 INDUSTRIAL ENGINEERING 3 0 0 3

Course Objectives

- To understand the use of forecasting, control of inventory, process of routing and scheduling for improving productivity
- To build and solve linear programming problem
- To analyse deterministic and probabilistic models of problems related to networks and queuing

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Explain the ways of improving productivity by job design, work study, ergonomics, forecasting techniques and following safety.
2. Explain inventory control techniques and the need for material requirement planning.
3. Solve sequencing of jobs with two and more machines and also compute the characteristics of single server queuing models
4. Formulate linear programming problems and find the optimum solution.
5. Construct the network model and identify the critical path of deterministic and probabilistic models

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	1											1
2	2	2	1											2
3	1	2	3											1
4	2	3	1											1
5	2	3	1											2

UNIT I **9 Hours**

PRODUCTION PLANNING AND CONTROL

Productivity - Productivity index -Productivity measurement - Job design - Job standard - Work study - Method study - Operation process chart - Motion study - Motion econoomy - SIMO chart - Work measurement - PMTS - Ergonomics - Industrial safety: losses due to accidents, causes, preventive measures - Forecasting - Types - Accuracy of forecast -Sales forecasting techniques - Time series method: simple moving average, weighted moving average, exponential smoothing

UNIT II **9 Hours**

INVENTORY CONTROL

Inventory control - Purpose - Inventory costs - EOQ - Deterministic models - Shortage model - Classification: ABC analysis, FSN analysis - Material Requirement Planning (MRP)

UNIT III **9 Hours**

SCHEDULING AND QUEUING

Introduction -Rules - Factors affecting - Master schedule - Gantt chart - Sequencing problem: Models with n jobs with 2 machines Models with n jobs with 3 machines - Queuing models - Queuing systems and structures - Notation - Parameter - Poisson input - Exponential service - Constant rate service - Infinite population - Single server models

UNIT IV **9 Hours**

LINEAR PROGRAMMING

Introduction - Formulation - Graphical method, Simplex method Artificial Variable techniques: Big M method - Transportation Problems: North West corner method, Least cost method, Vogel's approximation method - MODI method - Assignment problems with Hungarian algorithm

UNIT V **9 Hours**

NETWORK MODELS

Network models - Shortest route - Minimal spanning tree - Maximum flow models - Project network - CPM and PERT networks - Critical path scheduling

FOR FURTHER READING

Simulation Process - Stochastic Simulation - Monte Carlo Sampling Process, Random Process Generatiion - Simulation of Queuing System

Total: 45 Hours

Reference(s)

1. T. R. Banga, N. K. Agarwal and S. C. Sharma, Industrial Engineering and Management Science, Khanna Publishers, Delhi, 1996
2. Prem Kumar Gupta and D. S. Hira, Operations Research, S. Chand and Co., New Delhi, 2014.
3. S. B. Srivastava, Industrial Management, I. K. International Publishing House Pvt. Ltd., New Delhi, 2012
4. Hamdy A. Taha, Operation Research: An introduction, Pearson Publications., New Delhi, 2010
5. Frederick S. Hiller and Gerald J. Liberman, Operations Research: Concepts and cases, Tata McGraw-Hill Publishing Company Pvt Ltd., New Delhi, 2010.

18MC003 FINITE ELEMENT ANALYSIS 3 0 0 3

Course Objectives

- To impart basic knowledge in finite element method.
- To provide knowledge in 1D elements and 2D elements
- To study heat conduction problems using finite element method
- To provide knowledge on higher order and isoparametric elements

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Apply the numerical methods to formulate the simple finite element problems.
2. Apply one dimensional finite element method to solve bar,beam and truss type problems
3. Apply finite element method for plane stress, plane strain and axisymmetric conditions.
4. Identify temperature distribution of one and two dimensional heat transfer problems using one and two dimensional finite elements .
5. Apply the numerical methods to formulate the higher order and isoperimetric problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1										1	
2	2	1	1										1	
3	2	3	1										1	
4	2	3	1										1	
5	3	2	2										1	

UNIT I **10 Hours**

INTRODUCTION

Relevance and scope of finite element methods -Basic concepts of Finite Element Analysis- strain vs displacement relations - stresses and equilibrium - natural and essential boundary conditions - Rayleigh Ritz - Galerkin method- FEM procedure - Discretisation of domain-element shapes, types, size, location and numbers.

UNIT II **10 Hours**

ONE-DIMENSIONAL ELEMENTS

Coordinate system types-global, local and natural. shape function of 1D bar element -Finite element formulation - stiffness matrix, load vector, boundary condition and assembly of global equation-1D bar element.

UNIT III **8 Hours**

TWO-DIMENSIONAL ELEMENTS

Two node truss element- problems in 2D truss -Introduction to beam element- Shape function for linear triangular element-Finite element formulation- Constant Strain Triangular (CST) element -plane stress, plane strain - axisymmetric elements - problems

UNIT IV **9 Hours**

HEAT TRANSFER APPLICATIONS

Shape function for 1D and 2D triangular element heat conduction - stiffness matrix, load vector and assembly of global equation for 1D and 2D triangular element heat conduction, heat generation with convective boundary conditions for linear element

UNIT V **8 Hours**

HIGHER ORDER AND ISOPARAMETRIC ELEMENT

Selection of order of polynomial-linear, simplex, complex and multiplex elements. Mesh refinement methods and convergence requirements. Iso, Sub and Super parametric element. Shape functions for a 2-D four noded and eight noded Isoparametric rectangular element using natural coordinate system - problems. Gaussian quadrature method-problems.

FOR FURTHER READING

Steps for structural and thermal analysis of machine elements using FEM packages. Nodal Analysis in FEM packages

Total: 45 Hours

Reference(s)

1. Daryl L Logan, A First Course in the Finite Element Method, Cengage Learning, 2010
2. S. S. Rao, Finite Element Method in Engineering, Elsevier India, 2005.
3. David V. Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi,2005.
4. Robert D. Cook, s. David , Malkucs Michael E. Plesha, Concepts and Applications of Finite Element Analysis, John Wiley, New Delhi,2007
5. T. R. Chandrupatla and A. D. Belegundu, Introduction to Finite Elements Engineering, Pearson Education, New Delhi, 2002.
6. https://nptel.ac.in/courses/112104116/

18MC004 DESIGN OF JIGS AND FIXTURES 3 0 0 3

Course Objectives

- To understand design principles for designing the jigs and fixtures
- To impart knowledge on locating and clamping principles for designing jigs and fixtures
- To introduce the different types of jigs and fixtures for producing the part

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Assess the design aspects of jigs and fixtures and relate with an application.
2. Identify the suitable locators and clamps for jigs, fixtures.
3. Design a suitable jig for producing a part for the given component
4. Design a suitable fixture for the given component producing a part.
5. Generate a suitable die design for given simple components using different operations

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	1										1	
2	3	1	1										2	
3	2	1	3										2	
4	2	2	3										2	
5	2	1	3										3	

UNIT I **8 Hours**

INTRODUCTION

Objectives, Challenges and Requirements, Production and Inspection Devices. Jigs and Fixtures - Differences, Design principles, Advantages, Essential Features, Materials used. Introduction to Limits, Fits and Tolerances, International Tolerance Grades, Geometric Dimensioning and Tolerance- Scope of Jigs and Fixtures

UNIT II **8 Hours**

LOCATION AND CLAMPING

Location - Principles, Basic rules, Degrees of Freedom, 3-2-1 Principle, Locating Methods, Types of Locators, Standard Parts. Clamping - Principles, Types of Mechanical Actuation Clamps, Pneumatic, Hydraulic, Magnetic, Vacuum, Electrostatic clamping, Epoxy Resin Clamping. Factors considered for Design of Jigs and Fixtures

UNIT III **10 Hours**

JIGS

Jigs - Elements, Construction, Types and Materials for Jig Elements. Drill bushes - Types, Special Bushes, Bush Clearance. Automatic drill jig, Rack and pinion operated, Indexing, Air operated Jig components - Design of Jigs for given components.

UNIT IV **10 Hours**

FIXTURES

General Design Principles of Fixture. Types of Boring, Lathe, Milling and broaching fixtures - Setting Block. Grinding, Planning and Shaping fixtures. Inspection - Gauging, Measuring and Supplement fixtures. Welding, Assembly and Modular fixtures. Design of fixtures for given component

UNIT V **9 Hours**

DESIGN AND DEVELOPMENT OF DIES

Design and development of progressive and compound dies for Blanking and piercing operations. Bending dies. Development of bending dies-forming and drawing dies-Development of drawing dies. Design considerations in forging, extrusion, casting and plastic dies. Blank development for axisymmetric, rectangular and elliptic parts - Single and double action dies

FOR FURTHER READING

Design of Press tools - Press working terminologies and elements of dies and strip layout.

Total: 45 Hours

Reference(s)

1. Edward G. Hoffman, Jig and Fixture Design, Cengage Learning, New Delhi, 2014
2. C. Elanchezhian, Design of Jigs, Fixtures and Press Tools, Eswar Press, Chennai, 2010
3. P. H. Joshi, Jigs & Fixtures, Tata McGraw Hill publishing Co. Ltd. New Delhi 2012
4. Hiram E Grant, Jigs and Fixtures, Tata McGraw Hill publishing Co. Ltd., New Delhi, 2011
5. C. Donaldson, G. H. Lecain and V. C. Goold, Tool Design, Tata McGraw Hill publishing Co. Ltd., New Delhi, 2011
6. https://nptel.ac.in/courses/112105126/35

3 0 0 3

18MC005 DESIGN OF MATERIAL HANDLING SYSTEMS

Course Objectives

- To incorporate competency in system visualization and design
- To enable students to design a machine tool gearbox and material handling systems

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Choose the right material handling systems with safety and efficiency
2. Utilize the correct methods to design hoists.
3. Compare the different types of drives for material handling
4. Select the correct type of transportation methods for material handling
5. Analyze appropriate lifting mechanisms to improve material handling

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		1										3	
2	3		2										1	
3	3		2										2	
4	3		2										2	
5	3		3										2	

UNIT I **9 Hours**

MATERIALS HANDLING EQUIPMENT

Importance and principles of material handling. Types of intraplant transport facility and applications. Choice of material handling equipment - Surface and overhead equipment - general characteristics of surface and overhead equipment - AGV- AS/RS

UNIT II **9 Hours**

DESIGN OF HOISTS

Design of hoisting elements: Welded and roller chains - Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks - crane grabs - lifting magnets - Grabbing attachments - Design of arresting gear - Brakes: shoe, band and cone types

UNIT III **9 Hours**

DRIVES OF HOISTING GEAR

Hand and power drives - Traveling gear - Rail traveling mechanism - cantilever and monorail cranes - slewing, jib and luffing gear - cogwheel drive - selecting the motor ratings.

UNIT IV **9 Hours**

CONVEYORS

Types - description - design and applications of belt conveyors, apron conveyors and escalators pneumatic conveyors, screw conveyors and vibratory conveyors.

UNIT V **9 Hours**

ELEVATORS

Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks

FOR FURTHER READING

Occupational safety, Energy efficient machines and systems, Storage methods.

Total: 45 Hours

Reference(s)

1. Alexandrov, M., Materials Handling Equipment, MIR Publishers, Moscow, 1982
2. Boltzharol, A., Materials Handling Handbook, The Ronald Press Company, 1958.
3. Lingaiah. K. and Narayana Iyengar, Machine Design Data Hand Book, Vol. 1 & 2, Suma Publishers, Bangalore, 1983
4. P.S.G. Tech.,Design Data Book, Kalaikathir Achchagam, Coimbatore, 2012
5. Rudenko, N., Materials handling equipment, Elnvee Publishers, New Delhi, 1970.
6. Spivakovsy, A.O. and Dyachkov, V.K., Conveying Machines, Volumes I and II, MIR Publishers, 1985

18MC006 DESIGN OF MECHATRONICS SYSTEM 3 0 0 3

Course Objectives

- To study about mechatronics design process
- To study the data acquisition and control case studies
- To Understand about the application of mechatronics system

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Demonstrate the mechatronics design process, data acquisition and control through case studies
2. Analyze the various System modelling parameters available in mechatronics system.
3. Explain the aspects of real time interfacing in mechatronics system design
4. Implement the different design technology for various applications
5. Select the concept of micro mechatronics system and implementing in real time systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2												1
2	2	1	1											2
3	2	1	3											2
4	2	2	1											2
5	3	3	2											3

UNIT I **9 Hours**

INTRODUCTION TO MECHATRONICS SYSTEM

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

UNIT II **9 Hours**

SYSTEM MODELLING

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

UNIT III **9 Hours**

REAL TIME INTERFACING

Introduction-selection of interfacing standards Elements of Data Acquisition & control Systems- Over view of I/O process, General purpose I/O card and its installation, Data conversion process, Application Software- Labview Environment and its applications, Vim-Sim Environment & its applications -Man machine interface

UNIT IV **9 Hours**

CASE STUDIES ON MECHATRONIC SYSTEM

Introduction -Fuzzy based Washing machine - pH control system - Autofocus Camera, exposure control - Motion control using D.C.Motor & Solenoids - CNC related -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 **9 Hours**

MICRO MECHATRONIC SYSTEM

Introduction- System principle - Component design - System design - Scaling laws - Micro actuation - Micro robot - Micro pump - Applications of micro mechatronic components

FOR FURTHER READING

Mechatronics system design for Industrial robots for welding, painting and assembly, Industrial automation, Typical example of automated industries, application of visual inspection.

Total: 45 Hours

Reference(s)

1. Bishop, Robert H, Mechatronics Hand book,CRC Press, 2002.
2. Bradley, D.Dawson, N.C. Burd and A.J. Loader, Mechatronics: Electronics in Products and Processes, CRC Press 1991 , First Indian print 2010.
3. De Silva, Mechatronics: A Foundation Course, Taylor & Francis, Indian Reprint, 2013.
4. Devdas shetty, Richard A. Kolk, Mechatronics System Design, 2nd Edition ,Cengage Learning 2011.
5. Georg pelz, Mechatronic Systems: Modeling and simulation with HDL's, John wiley and sons Ltd, 2003

18MC007 NON-CONVENTIONAL MACHINING 3 0 0 3

Course Objectives

- To gather knowledge on the non-conventional machining processes
- To comprehend the use of unconventional machining, testing and inspection in manufacturing industries

Programme Outcomes (POs)

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

b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Apply non-conventional machining processes in the field of manufacturing industries
2. Analyze the source for defects in USM and AFF processes
3. Solve the issues related to material cutting and finishing by adopting appropriateprocess
4. Apply advanced machining processes in the field of production and testing
5. Apply high energy beam machining using laser and electron source in the field of fabrication and analysis

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2												
2	3	2												
3	2	2												
4	1	2												
5	2	3												

UNIT I **9 Hours**

MECHANICAL ADVANCED MACHINING PROCESSES

Abrasive Jet Machining (AJM) - Introduction - Abrasive Jet Machining Setup - Gas Propulsion System - Abrasive Feeder - Machining Chamber - AJM Nozzle - Abrasives; Parametric Analysis - Stand-off-Distance - Abrasive Flow Rate - Nozzle Pressure - Mixing Ratio; Process Capabilities – Applications

UNIT II **9 Hours**

ULTRASONIC MACHINING (USM)

Introduction - Ultrasonic Machining System - Mechanics of Cutting - Parametric Analysis - Process Capabilities - Applications; Abrasive Flow Finishing - Working Principle, Abrasive Flow Machining System - Machine - Tooling - Media; Process Variables; Process Performance; Analysis and Modeling of Abrasive Flow Machined Surfaces - Number of Active Grains - Wear of Abrasive Grains; Applications - Aerospace - Dies And Molds

UNIT III **8 Hours**

MAGNETIC ABRASIVE FINISHING (MAF)

Introduction - Working Principle of MAF - Material Removal (or Stock Removal) and Surface Finish - Bonded and Unbonded Magnetic Abrasives - Machining Fluid - Magnetic Flux Density; Analysis; Water Jet Cutting (WJC) - Introduction - WJM Machine - Process Characteristics, Process Performance, Applications

UNIT IV **9 Hours**

ABRASIVE WATER JET MACHINING (AWJM)

Working Principle - Pumping System - Abrasive Feed System - Abrasive Jet Nozzle - Catcher. Process Characteristics : Water Jet Pressure During Slotting - Water Flow Rate. Abrasive Flow Rate - Abrasive Particle Size - Abrasive Material. Cutting Parameters - Traverse Speed - Number of Passes - Stand-off-Distance - Visual Examination - Process Capabilities; EDM - R-C Pulse Generator, EDM Machine - Power Supply - Dielectric System - Electrodes - Servo system - Electrode Refeeding - Power Delivered to the Discharging Circuit.

UNIT V **10 Hours**

HIGH-ENERGY-BEAM MACHINING

Laser Beam Machining - Production of Lasers - Working Principle of Laser Beam Machining - Types of Lasers - Solid Lasers - Gas Lasers. Process Characteristics, Applications - Drilling - Cutting - Marking - Miscellaneous Applications; Electron Beam Machining - Working Principle - Electron Beam Machining System - Electron Beam Gun - Power Supply - Vacuum System And Machining Chamber - Process Parameters - Characteristics of the Process - Applications

FOR FURTHER READING

Electro chemical machining (ECM):Principle, applications, and process parameters and modelling

Total: 45 Hours

Reference(s)

1. P. N. Rao, Manufacturing Technology - Vol I and II, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2013.
2. T. R. Mishra, Non-Conventional Machining, Narosha Publishing House, New Delhi, 2012
3. D. K. Singh, Fundamentals of Manufacturing Engineering, ANE Books, New Delhi, 2008
4. J Paulo Davim, Traditional Machining Processes: Research Advances (Materials Forming, Machining and Tribology), Springer India, 2015
5. https://nptel.ac.in/syllabus/112104028/

3 0 0 3

18MC008 COMPUTER INTEGRATED MANUFACTURING

Course Objectives

- To understand the application of computers in various aspects of manufacturing viz., design, proper planning, manufacturing cost, layout & material handling system.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Explain the basics of automated system and CIM concepts
2. Explain the production and computerised process planning
3. Analyse the various techniques used in cellular manufacturing.
4. Apply flexible manufacturing system and Automated Guided Vehicle System in the field of production.
5. Recognize the Robot control systems and its applications in manufacturing

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3				1								2	
2	2				3								3	
3	3				1								1	
4	1				3								3	
5	2				1								1	

UNIT I **9 Hours**

INTRODUCTION TO CIM

Manufacturing Planning, Manufacturing Control- Introduction to CAD/CAM - Concurrent Engineering-CIM concepts - Computerised elements of cim system ÃƒÂ¢??Types of Production-Manufacturing Models and metrics - Mathematical models of Production performance - lean and just-in-time production, IoT and Cloud Manufacturing

UNIT II **9 Hours**

PRODUCTION PLANNING CONTROL AND COMPUTERISED PROCESS PLANNING

Process Planning - Aggregate Production Planning And The Master Production Schedule - Material Requirement Planning - Capacity Planning- Control Systems-Shop Floor Control-Inventory Control - Brief On Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.

UNIT III **10 Hours**

CELLULAR MANUFACTURING

Group Technology(GT), Part Families - Parts Classification And Coding - Opitz Part Coding System - Production Flow Analysis - Cellular Manufacturing - Composite Part Concept - Machine Cell Design And Layout - Quantitative Analysis In Cellular Manufacturing - Rank Order Clustering Method - Arranging Machines In A GT Cell

UNIT IV **9 Hours**

FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS)

Types Of Flexibility - FMS - FMS Components - FMS Application & Benefits - FMS Planning And Control - Quantitative Analysis In FMS - Simple Problems. Automated Guided Vehicle System (AGVS) - AGVS Application - Vehicle Guidance Technology - Vehicle Management & Safety.

UNIT V **8 Hours**

COMPUTER AIDED INSPECTION

Principles and interfacing, soft metrology -Application of lasers in precision measurements- laser interface, laser scanners, Coordinate measurement machine (CMM), Type of CMM & applications. Non contact CMM, Electro optical sensors for dimension, contact sensors for surface finish measurements. Image processing and its Metrology, Acoustical measurements

FOR FURTHER READING

Digital techniques in mechanical measurements

Total: 45 Hours

Reference(s)

1. Kant Vajpayee S, Principles Of Computer Integrated Manufacturing, Prentice Hall India, 2013
2. Rao. P, N Tewari &T.K. Kundra, Computer Aided Manufacturing, Tata McGraw Hill Publishing Company, 2000.
3. https://nptel.ac.in/syllabus/112104028/
4. https://www.me.iitb.ac.in/~ramesh/courses/ME338/non_trad.pdf

18MC009 ADVANCED MANUFACTURING 3 0 0 3

Course Objectives

- To understand the purpose of advanced machining, metal forming, welding and foundry processes in manufacturing industries
- To comprehend the use of modern testing and inspection equipment in manufacturing industries

Programme Outcomes (POs)

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

b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Apply advanced machining processes in the field of manufacturing industries
2. Analyze the source for defects in casting processes
3. Solve the issues related to material joining by adopting advanced welding processes
4. Apply advanced forming processes in the field of production and testing
5. Apply mechanism of chip formation in the processing of polymers, ceramics, and composites

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2												
2	1	1												
3	2	1												
4	3	3												
5	2	1												

UNIT I **10 Hours**

MACHINING PROCESSES

Introduction, Process principle, Material removal mechanism, Parametric analysis and applications of processes such as Abrasive water jet machining (AWJM), Electron beam machining (EBM), Wire Electrical Discharge Machining, Micromachining, Electro Chemical Discharge MAchining (ECDM), Environmentally Friendly Machining

UNIT II **8 Hours**

CASTING PROCESSES

Special techniques: CO2 moulding, shell molding, investment casting, pressure die casting, centrifugal casting, continuous casting

UNIT III **8 Hours**

WELDING PROCESSES

Metal joining, Details of electron beam welding (EBW), laser beam welding (LBW), ultrasonic welding (USW), advanced testing and inspection

UNIT IV **9 Hours**

METAL FORMING PROCESSES

Details of high energy rate forming (HERF) process, Electro-magnetic forming, explosive forming, Electro-hydraulic forming, Stretch forming, Contour roll forming - Special forming methods: hydro-forming, rubber pad forming

UNIT V **10 Hours**

RAPID PROTOTYPING

Tooling and Manufacturing, Classification of Rapid Prototyping (RP), Tooling (RT) and Manufacturing (RM) processes; Materials for RP/RT/RM; Operating principles, characteristics and analysis of current and developing RP/RT/RM processes - Case studies.

FOR FURTHER READING

Selection of RP/RT/RM processes based on the product requirements

Total: 45 Hours

Reference(s)

1. J. P. Kaushish, Manufacturing Processes, Prentice Hall of India Learning Private Limited, New Delhi, 2014
2. Mikell P. Groover, Automation, Production System and Computer Integrated Manufacturing, Pearson Education, New Delhi, 2015.
3. A. Ghosh, and A.K. Mallik, Manufacturing Science, Affiliated East-West Press Pvt. Ltd. New Delhi, 2010
4. P. N. Rao, Manufacturing Technology - Vol I and II, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2013
5. Rafiq I. Noorani, Rapid Prototyping : Principles and Applications, Wiley & Sons, 2006.
6. https://nptel.ac.in/syllabus/syllabus_pdf/112107078.pdf

18MC010 NON-DESTRUCTIVE TESTING 3 0 0 3

Course Objectives

- To understand the basic principles of various NDT methods
- To be aware of applications and limitations of the NDT techniques
- To know the different type of service and process defects.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Apply surface NDT techniques to carry out various inspection in accordance with the established procedures
2. Analyze eddy current testing procedures for non destructive testing
3. Apply principles of magnetism to investigate the service and processing defects
4. Choose right radiographic techniques and X-Rays for testing
5. Utilize ultrasonic testing as an NDT technique to investigate defects.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		1										2	
2	3		1										2	
3	3		1										2	
4	3		1										2	
5	3		1										2	

UNIT I **9 Hours**

VISUAL INSPECTION AND DYE PENETRANT TESTING

Introduction to NDT, Scope and advantages of NDT, Comparison of NDT with DT, classifications of NDT. Equipment used for visual inspection -Magnifying Glass Magnifying Mirror, Microscope, Borescope , endoscopes. Liquid penetration testing- Introduction, Principle, Equipment, Procedures, Characteristics of penetrants- developers Ã¢?? Evaluation Ã¢?? hazards Precautions, advantages, limitations and applications.

UNIT II **9 Hours**

EDDY CURRENT TESTING

Eddy Current Testing- Principle, Advantages, Disadvantages, Factors Affecting Eddy Current Response-Material Conductivity Permeability - Frequency- Geometry-Proximity (Lift off)-Faraday's Law, Lenz's law, Typical Applications, limitations ,Types of Probes.

UNIT III **9 Hours**

MAGNETIC PARTICLE TESTING

Principle of Magnetic Particle Testing-different methods to generate magnetic fields -Magnetic Particle Testing Equipment- Magnetic Particle Testing Procedures Method of De-Magnetization- Magnetic Particle Medium-Evaluation of Indications and Acceptance Standards- magnetic particle test-applications, advantages and limitations

UNIT IV **9 Hours**

RADIOGRAPHIC TESTING

X-Ray properties and atomic scattering, X-ray radiography principle, equipment & methodology - Type of Industrial Radiation sources and Application-Radiographic exposure Factors and Technique - X-Ray Equipment- Radiographic Procedure - Radiograph Interpretation, Radiography Image Quality-Indicators-Radiographic Techniques- Film Processing-Methods of Viewing Radiographs- Radiographic Testing Procedures for welds. Precautions against radiation hazards.

UNIT V **9 Hours**

ULTRASONIC TESTING

Introduction, Principle of operation Type of Ultrasonic Propagation- Ultrasonic probes. Types of Transducers -Ultrasonic Testing Techniques. Method for Evaluating Discontinuities-Ultrasonic Testing Procedures for different component- advantages and limitations,. Applications in inspection of castings, forgings, Extruded steel parts, bars, pipes, rails and dimensions measurements.

FOR FURTHER READING

Leak Testing, Acoustic Emission Testing, Defects

Total: 45 Hours

Reference(s)

1. J Prasad, C G K Nair, Non-Destructive Testing and Evaluation of Materials, Tata McGraw Hill Education Private Limited, 2017
2. American Metals Society, Non-Destructive Examination and Quality Control, Metals Hand Book, Vol.17, 9th Ed, Metals Park, OH, 1989
3. Bray, Don.E and Stanley, Roderic.K, Nondestructive Evaluation: A Tool in Design, Manufacturing, and Service. Revised, CRC Press New York, Edition, 1997
4. www.ndt-ed.org
5. https://nptel.ac.in/courses/112105125/

3 0 0 3

18MC011 DESIGN FOR MANUFACTURING AND ASSEMBLY

Course Objectives

- To understand the basic concepts and design guidelines that suite for different manufacturing processes
- To study the problems in design modifications of the product made through various manufacturing techniques.
- To study the importance of global issues related in design for environment

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
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.
m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Select the suitable tolerance refer to Indian standards and ASME Y 14.5
2. Select the casting with consideration to materials and surface properties
3. Construct parts based on machining considerations in manufacturing.
4. Demonstrate the DFMA tools for minimizing the effort and cost in manufacturing and assembly
5. Implement the environmental considerations in parts design and assembly.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	1			2							1	
2	3	1	1			1							2	
3	2	1	3			3							2	
4	2	2	3			3							2	
5	2	3	3			1							3	

UNIT I **9 Hours**

INTRODUCTION TO TOLERANCES

Tolerances: Limits and Fits, tolerance Chains and identification of functionally important dimensions. Dimensional chain analysis-equivalent tolerances method, geometric tolerancing for manufacture as per Indian Standards and ASME Y 14.5 standard, surface finish.

UNIT II **9 Hours**

FORM DESIGN OF CASTINGS

Materials choice - Influences of materials - Space factor - Size - Weight - Surface properties and production method on form design. Redesign of castings based on parting line considerations, Minimizing core requirements, redesigning cast members using Weldments.

UNIT III **9 Hours**

COMPONENT DESIGN - MACHINING CONSIDERATIONS

Design features to facilitate machining - Drills - Milling cutters - Keyways - Doweling procedures, Countersunk screws - Reduction of machined area - Simplification by separation - Simplification by amalgamation - Design for machinability - Design for economy

UNIT IV **9 Hours**

DFMA TOOLS

Rules and methodologies used to design components for manual, automatic and flexible assembly, traditional design and manufacture Vs concurrent engineering, DFA index, Poke-yoke, lean principles, six sigma concepts, design for manual assembly; design for automatic assembly.

UNIT V **9 Hours**

DESIGN FOR THE ENVIRONMENT

Introduction Environmental objectives Global issues Regional and local issues Basic DFE methods Design guidelines Example application Life cycle assessment Techniques to reduce environmental impact Design to minimize material usage Design for disassembly Design for Recyclability.

FOR FURTHER READING

Form design aspects in Forging and sheet metal components - machining considerations, redesign for manufacture, examples - Design for energy efficiency Design to regulations and standards

Total: 45 Hours

Reference(s)

1. A.K. Chitale and R. C. Gupta, Product Design and Manufacturing, PHI 2007
2. G. Boothroyd, P. Dewhurst and W. Knight, Product Design for Manufacture and Assembly, Marcell Dekker, 2002
3. R. Bryan, Fischer, Mechanical Tolerance stackup and analysis, Marcell Dekker, 2004
4. M. F. Spotts, Dimensioning and Tolerance for Quantity Production, Prentice Hall Inc., 2002
5. J.G. Bralla, Handbook of Product Design for Manufacturing, McGraw Hill Publications, 2000.
6. https://nptel.ac.in/courses/107103012/42.

3 0 0 3

18MC012 PROCESS PLANNING AND COST ESTIMATION

Course Objectives

- To understand the necessity of process plan & cost estimation in production activities
- To learn about the various process planning techniques and production cost estimation
- To gain knowledge on principles and analytical methods for solving cost components

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Explain the methods of process planning and the various steps involved in process selection.
2. Examine the various steps involved in process planning activities.
3. Estimate the factory administrative expenses
4. Apply the cost estimation procedure for solving problems in fabrication shops
5. Calculate machining time for basic production activities

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	2								1		2	
2	2	3	2								1		2	
3	2	1	1								2		1	
4	2	1	2								1		2	
5	2	1	1								2		1	

UNIT I **10 Hours**

INTRODUCTION

Introduction- methods of process planning-Drawing interpretation-Material evaluation- Importance of costing and estimation -methods of costing-elements of cost estimation-Aims of cost Estimation - Types of estimates - Estimating procedure

UNIT II **10 Hours**

PROCESS PLANNING ACTIVITIES

Process parameters calculation for various production processes-Selection jigs and fixtures selection of quality assurance methods - Set of documents for process planning-Economics of process planning-steps in process selection-Production equipment and tooling selection-CAPP-Variant -Generative

UNIT III **9 Hours**

PRODUCTION COST ESTIMATION

Types of estimates - Estimating procedure- Estimation labor cost, material cost- allocation of overhead charges- Depreciation - Calculation of depreciation cost - Analysis of depreciation - Computing Material cost, Direct labour cost, overhead cost, Factory and Administrative Expenses

UNIT IV **8 Hours**

ESTIMATION OF COST IN FABRICATION SHOPS

Estimation of Forging Shop- Estimation of Welding Shop- Estimation of Foundry Shop-Estimation in sheet metal shop-Shearing and forming-Illustrative examples.

UNIT V **8 Hours**

MACHINING TIME

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations ,Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding

FOR FURTHER READING

Processing planning in PCB manufacturing industry-Advanced softwares used for process planning and cost Estimation

Total: 45 Hours

Reference(s)

1. B. P. Sinha, Mechanical Estimating and Costing, Tata McGraw-Hill Publishing Company Limited, New Delhi,2012
2. Phillip F. Ostwalal and Jairo Munez, Manufacturing Processes and Systems, John Wiley and Sons Publishing Company, New York, 2016.
3. R. S. Russell and B. W. Tailor, Operations Management, Prentice Hall of India, New Delhi, 2012
4. V. Chitale and R. C. Gupta, Product Design and Manufacturing, Prentice Hall of India, New Delhi, 2012

18MC013 VIRTUAL INSTRUMENTATION 3 0 0 3

Course Objectives

- To understand the fundamentals of virtual instrumentation, and basic concept of Graphical programming with their functions in LabVIEW.
- To know the various types Interfaces and Protocol used in VI
- To describe the components of typical DAQ and various tools in VI with their application

Programme Outcomes (POs)

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Recall the fundamentals of virtual Instrumentation and compare conventional with traditional methods
2. Recognize the concept of graphical programming and LabVIEW with their functions
3. Identify the types of interfacing devices and protocol used in VI
4. Describe the functions and the interface requirements in Data acquisition system
5. Exemplify the types of VI tools with its application

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1			1		2									1
2			2		2									2
3			2		3									2
4			3		2									1
5			2		3									2

UNIT I **9 Hours**

INTRODUCTION TO VI

Virtual Instrumentation: Block diagram and architecture of a virtual instrument - Conventional Instruments versus Traditional Instruments - data-flow techniques, graphical programming in data flow.

UNIT II **9 Hours**

GRAPHICAL PROGRAMMING

Concepts of graphical programming - LabVIEW software - Concept of VIs and sub VI - Error Handling Techniques - Display types - Digital - Analog - Chart and Graphs. Timers and dialog controls - Loops - structures - Arrays - Clusters. Local and global variables - String and file I/O. State Machine Architecture - Design pattern : Producer/ Consumer pattern Ã¢?? Master/Slave pattern

UNIT III **9 Hours**

INSTRUMENT INTERFACES AND PROTOCOLS

RS232, RS422, RS485 and USB standards - IEEE 488 standard - Introduction to bus protocols of MOD bus and CAN bus. Electronic standards for signals - noise and EMI effects. Signal conditioning chassis and extension modules. Image acquisition cards and Motion Controllers

UNIT IV **9 Hours**

DATA ACQUISITION SYSTEM

Introduction to data acquisition on PC, Sampling fundamentals, ADCs, DACs, Calibration, Resolution, - analog inputs and outputs - Single-ended and differential inputs - Digital I/O, counters and timers, DMA, Data acquisition interface requirements - Parameters involved in selection of Data acquisition cards - Use of timer-counter and analog outputs on the universal DAQ card.

UNIT V **9 Hours**

VI TOOLS

Mathematical tools for statistical calculation - Signal processing tools- Fourier transforms, power spectrum - Windowing and filtering tools -Control system tools - PID controller Applications: CRO - function generator -Illustration and case study-Temperature controller.

FOR FURTHER READING

Introduction to LabVIEW NXG - LabVIEW NXG WebVI Projects - Simulation of a simple second order system - Controlling motion of servo and stepper motors- Controlling an ice cream-making process- Generation of HTML page.

Total: 45 Hours

Reference(s)

1. Jeffrey Travis, Jim Kring, LabVIEW for Everyone: Graphical Programming Made Easy and Fun (3rd Edition), Prentice Hall, 2012.
2. Sanjeev Gupta, Virtual Instrumentation using LabVIEW, TMH, 2013
3. Gary W. Johnson, Richard Jennings, Lab-view Graphical Programming, McGraw Hill Professional Publishing, 2011
4. Robert H. Bishop, Learning with Lab-view, Prentice Hall, 2013
5. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newness, 2010
6. https://nptel.ac.in/courses/108105062/10

18MC014 MEDICAL MECHATRONICS 3 0 0 3

Course Objectives

- To recall the human physiological system associated with biological signal acquisition using ECG, EEG, EMG and EOG machines
- To represent the principle function and working of different sensor, transducers, and electronics interfaces such as signal conditioning, recording system related to biomedicalfield
- To illustrate the functional blocks and operation of some advanced patient monitoring and diagnostic instruments

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
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
n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Interpret the biological behavior of human cell and to relate the resting and action potential associated with the principle of ECG, EEG, EMG and EOG Machines
2. Summarize the principle, working and application of different types of biomedical sensors and transducers
3. Represent the various signal conditioning, recording and display systems associated with the biomedical devices.
4. Elaborate the construction and working of different biomedical patient measurement and monitoring systems
5. Determine the need for various diagnostic instruments used in biomedical instrumentation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3					3	3							
2	3					1	1							1
3	3					2	2							1
4	3					2	2							1
5	3					1	1							1

UNIT I **9 Hours**

INTRODUCTION

Cell structure - electrode - electrolyte interface, electrode potential, resting and action potential - electrodes for their measurement, ECG, EEG, EMG and EOG - machine description - methods of measurement, failures and troubleshooting, Stem cells

UNIT II **9 Hours**

BIO MEDICAL SENSORS AND TRANSDUCERS

Basic transducer principles Types - resistive, inductive, capacitive, fiber-optic, photoelectric, chemical, active and passive transducers and their description and feature applicable for biomedical instrumentation Ã¢?? Bio, Nano sensors and application

UNIT III **9 Hours**

SIGNAL CONDITIONING, RECORDING AND DISPLAY

Input isolation, DC amplifier, instrumentation, charge amplifier, power amplifier, and differential amplifier - feedback, op-Amp-electrometer amplifier, carrier Amplifier - instrument power supply, basis of signal conversion and digital filtering, data reduction technique - time and frequency domain technique.

UNIT IV **9 Hours**

MEDICAL MEASUREMENT AND MONITORING SYSTEMS

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

UNIT V **9 Hours**

RECORDERS AND ADVANCED SYSTEMS

Oscillagraphic - galvanometric - thermal array recorder, photographic recorder, storage oscilloscopes, electron microscope. Biotelemetry, Diathermy, Audiometers, Dialyzers, Lithotripsy.

FOR FURTHER READING

Equipment failures and troubleshooting - ECG Analysis - Centralized patent monitoring system - Biotelemetry - Bio, Nano sensors and application.

Total: 45 Hours

Reference(s)

1. R. S. Khandpur, Handbook of Biomedical Instrumentation, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2011.
2. Cromwell, Weibell and Pfeiffer, Biomedical Instrumentation and Measurements, Prentice Hall of India Learning. Ltd., New Delhi, 2011
3. L. A. Geddes and Baker, L.E., Principles of Applied Bio-medical Instrumentation, John Wiley and Sons Publishing Company, New York, 1995
4. W. J. Tompkins, Biomedical Digital Signal Processing, Prentice Hall of India Learning. Ltd., New Delhi, 2000.

18MC015 MODELLING OF INDUSTRIAL ROBOTS 3 0 0 3

Course Objectives

- To impart knowledge on components of robot and types of endeffectors
- To understand kinematics, dynamics and programming of robot mechanisms
- To apply trajectory generation, motion analysis of robotic movements and robot vision.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Select the components and recognize the specifications of an Industrial Robot.
2. Apply forward and inverse kinematics and DH convention for predicting the position and orientation of serial manipulator.
3. Analyse the velocity kinematics and static force of serial manipulator robot.
4. Analyse the dynamics and plan the trajectory for industrial robot.
5. Create an algorithm for mobile robot control by applying suitable controlling techniques.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1		-									3
2	3	3	3		2									1
3	3	3	2		3									2
4	3	3	2		2									1
5	2	1	1		2									3

UNIT I **9 Hours**

ROBOTS AND END EFFECTORS

Robotics: A brief history, laws of Robotics, Differentiate serial and parallel manipulator - concept of workcell - selection of robot specification - classification of Industrial robot manipulator based on configuration - end-effector mechanism and types.

UNIT II **9 Hours**

KINEMATICS OF ROBOT MANIPULATOR

Representing position and rotation - Dot and Cross product - coordinate frames - rotation in plane - rotation in three dimension - Rotational transformation - Translational transformation - Euler angle, Roll, Pitch, Yaw angles Axis/angle representation - rigid motion - Homogeneous transformation - Denavit-Hartenberg convention - inverse and forward kinematics and problems

UNIT III **9 Hours**

VELOCITY ANALYSIS AND STATIC FORCE ANALYSIS

Representation of Linear and Angular Velocity of Manipulator Links Skew Symmetric matrix representation Velocity Forward Propagation Velocity / Manipulator Jacobian. Static Force Analysis: Force transformation of robotic manipulators - Force Jacobian - Singularity Analysis, Workspace Singularities.

UNIT IV **9 Hours**

ROBOT DYNAMICS AND TRAJECTORY PLANNING

Introduction, Lagrangian mechanics, Effects of moments of Inertia, Dynamic equation for two axis planar articulated robot - Trajectory planning, point to point, Continuous path motion

UNIT V **9 Hours**

MOBILE ROBOTICS

Introduction - types of mobile robot - kinematics of wheeled mobile robot - predictive modeling and system identification - kalman filters - bayesian estimation - Localization and mapping - ROS and programming.

FOR FURTHER READING

Industrial robots for welding, painting and assembly, Industrial automation, Typical example of automated industries, application of visual inspection.

Total: 45 Hours

Reference(s)

1. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel, Nicholas G. Odrey, Industrial Robotics:Technology, Programming and Applications, McGraw Hill Book Company, 2012
2. Ashitava Ghosal, Robotics: Fundamental Concepts and Analysis, Oxford University Press, 2008
3. J.J. Craig, Introduction to Robotics: Mechanics and Control, Prentice Hall Inc. / Pearson Education, 2008.
4. Kelly, Alonzo. Mobile robotics: mathematics, models, and methods. Cambridge University Press, 2013
5. R.N. Jazer, Theory of Applied Robotics. Springer, 2010
6. Mark W Spong,Seth Hutchinson, M.Vidyasagar Robot Modeling and Control, Wiley India Edition, New Delhi., Nov, 2006.

3 0 0 3

18MC016 FUZZY LOGIC AND ARTIFICIAL NEURAL NETWORK

Course Objectives

- To understand fuzzy logic and neural network concepts
- To equip with the latest application of soft computing

Programme Outcomes (POs)

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

e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Explain the concept of fuzzy set theory and its architectures.
2. Apply the knowledge based rules and its controller types for the given application
3. Carry out the design for fuzzy knowledge representation and multi objective decision making controllers
4. Implement machine learning through neural networks
5. Interpret the concept of artificial neural networks and their control applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2				2									2
2	2				3									3
3	2				3									3
4	2				3									3
5	2				3									3

UNIT I **9 Hours**

FUZZY LOGIC SYSTEMS

Classical sets-fuzzy sets- fuzzy operation -fuzzy relations - fuzzification - defuzzification - if-then rules- Fuzzy Functions.

UNIT II **9 Hours**

FUZZY SYSTEMS

Membership function-knowledge base - data base - rule base -decision-making logic -fuzzy logic controller: Mamdani and Sugeno-Takagi architecture

UNIT III **9 Hours**

FUZZY RULES AND LOGIC

Representation of fuzzy knowledge - fuzzy inference systems - Fuzzy decision making - Multi Objective Decision Making-Fuzzy logic controller for inverted pendulum

UNIT IV **9 Hours**

ARTIFICIAL NEURAL NETWORK

Introduction -biological neuron and their artificial models - neuron modeling- learning rules - types of neural networks - single layer - multi layer feed forward network - back propagation - learning factors.

UNIT V **9 Hours**

NEURAL NETWORKS IN CONTROL APPLICATIONS

Feedback networks - Hopfield networks - Applications of neural networks - Process identification - Artificial neuro controller for inverted pendulum

FOR FURTHER READING

ANN in mobile robots navigation and control, Neuro fuzzy approach in machine vision system for parts identification

Total: 45 Hours

Reference(s)

1. Jacek M. Zurada, Introduction to Artificial Neural Systems, Jaico Publishing House, New Delhi,2012.
2. John Yen, Reza Langari, Fuzzy logic Intelligence, control and Information, Pearson Education,1999.
3. C T Jang, J S R Sun and E Mizutani , Neuro Fuzzy and Soft computing, Pearson Education,2006.
4. Laurene Fauseett: Fundamentals of Neural Networks, PHI,2004
5. Timothy J.Ross: Fuzzy Logic Engineering Applications, McGrawHill, 2004
6. B. Yagnanarayanan, Artificial Neural Networks, Prentice Hall of India Ltd .,New Delhi.2012.

18MC017 ARTIFICIAL INTELLIGENCE 3 0 0 3

Course Objectives

- To understand the various characteristics of intelligent agents
- To understand the different search strategies in AI
- To represent knowledge in solving AI problems and understand the different ways of designing software agents
- To know about the various applications of AI

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
m. Analyze, design and develop electro mechanical system using contemporary tools
n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Represent a problem using first order and predicate logic
2. Select appropriate search algorithms for any AI problem
3. Choose the apt agent strategy to solve a given problem
4. Design software agents to solve a problem
5. Design applications for Natural Learning Process that uses Artificial Intelligence.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1											1	
2	1	1												
3	2	1												
4	3	3	2											2
5	1	3	2											2

UNIT I **9 Hours**

INTRODUCTION

Introduction -Definition - Future of Artificial Intelligence - Characteristics of Intelligent Agents - Typical Intelligent Agents - Problem Solving Approach to Typical AI problems

UNIT II **9 Hours**

PROBLEM SOLVING METHODS

Problem solving Methods - Search Strategies- Uninformed - Informed - Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations - Constraint Satisfaction Problems - Constraint Propagation - Backtracking Search - Game Playing - Optimal Decisions in Games - Alpha - Beta Pruning - Stochastic Games

UNIT III **9 Hours**

KNOWLEDGE REPRESENTATION

First Order Predicate Logic - Prolog Programming - Unification - Forward Chaining-Backward Chaining - Resolution - Knowledge Representation - Ontological Engineering-Categories and Objects - Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information

UNIT IV **9 Hours**

SOFTWARE AGENT

Architecture for Intelligent Agents - Agent communication - Negotiation and Bargaining - Argumentation among Agents - Trust and Reputation in Multi-agent systems

UNIT V **9 Hours**

APPLICATIONS

AI applications - Language Models - Information Retrieval- Information Extraction - Natural Language Processing - Machine Translation - Robot - Hardware - Perception - Planning - Moving

FOR FURTHER READING

Speech Recognition Application

Total: 45 Hours

Reference(s)

1. Gerhard Weiss, Multi Agent SystemsÃ¢??, Second Edition, MIT Press, 2013.
2. Bratko, Prolog: Programming for Artificial Intelligence, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
3. David L. Poole and Alan K. Mackworth, Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010
4. S. Russell and P. Norvig, Artificial Intelligence: A Modern ApproachÃ¢??, Prentice Hall, Third Edition, 2009
5. M. Tim Jones, Artificial Intelligence: A Systems Approach(Computer Science)Ã¢??, Jones and Bartlett Publishers, Inc.; First Edition, 2008
6. https://nptel.ac.in/courses/106105079

18MC018 OPTIMIZATION TECHNIQUES 3 0 0 3

Course Objectives

- To formulate design optimization problems for engineering applications
- To provide knowledge on single variable unconstrained problems
- To learn multi-objective unconstrained optimization problems
- To introduce concepts of constrained non-linear and non- traditional optimization problems

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. Analyze, design and develop electro mechanical system using contemporary tools
n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Formulate design optimization problem from real world applications.
2. Compute the solution for single variable unconstrained optimization problems
3. Identify the solution for multivariable unconstrained optimization problems
4. Compute the solution for the constrained non-linear optimization problems
5. Apply non-traditional optimization techniques to solve engineering problems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1											1	2
2	3	2	2											2
3	3	2	2											2
4	3	2	2											2
5	3	2	2		1									2

UNIT I **9 Hours**

INTRODUCTION TO DESIGN OPTIMIZATION

Optimization - design process, Conventional Vs Optimum design - Statement of an optimization problem- Classifications of optimization problems. Optimum design problem formulation - process steps - Problem formulation for engineering applications - Two-bar bracket, Design of coil springs

UNIT II **9 Hours**

SINGLE VARIABLE NONLINEAR UNCONSTRAINED OPTIMIZATION ALGORITHMS

Optimality criteria - Unimodal function - Eliminating methods - Exhaustive search, Dichotomous search, Interval halving method, Fibonacci search method, Golden section search method. Point estimation method (Powell's algorithm) - Gradient-based methods - Newton-Raphson method (Taylor's series expansion), Bisection method, Secant method, Cubic search method

UNIT III **9 Hours**

MULTI VARIABLE NONLINEAR UNCONSTRAINED OPTIMIZATION ALGORITHMS

Optimality criteria - Unidirectional search - Direct search methods - Evolutionary optimization method - Random search methods, Simplex search method, Hooke-Jeeves pattern search method, Indirect search (gradient) methods- Cauchy's (steepest descent) method, Newton's method, Conjugate gradient method.

UNIT IV **9 Hours**

CONSTRAINED NONLINEAR OPTIMIZATION ALGORITHMS AND SPECIALIZED PROGRAMMING

Introduction, Characteristics - Indirect search methods - Transformation methods, Penalty function method, Method of multipliers - Sensitivity analysis - Kuhn-Tucker conditions, Theorems. Test problems on three-bar truss, welded beam design. Direct search minimization methods- Variable elimination method, Complex search method and Random search methods - Feasible direction method.

UNIT V **9 Hours**

NON TRADITIONAL OPTIMIZATION TECHNIQUES

Genetic Algorithms (GA)- principle, difference and similarities between GA and traditional methods, constrained optimization, GA operators, Real-coded and Advanced GAs - Simulated Annealing - Neural Network based Optimization

FOR FURTHER READING

Unconstrained algorithms - Variable metric method (Davidson-Fletcher-Powell method). Constrained algorithms - Geometric programming- Primal-Dual relationship. Powell's quadratic function.

Total: 45 Hours

Reference(s)

1. Singiresu S.Rao, Engineering Optimization: Theory and Practice, Fourth Edition, Wiley India Pvt Ltd, Delhi,2009.
2. Kalyanmoy Deb, Optimization for Engineering Design- Algorithms and Examples, Second Edition, PHI Learning Pvt. Ltd., New Delhi,2012.
3. Jasbir Singh Arora, Introduction to Optimum design, Third Edition, Elsevier India Pvt.Ltd. New Delhi, 2011
4. R.Saravanan, Manufacturing optimization through intelligent techniques, First Edition, Taylor & Francis Publications, CRC Press, New Delhi, 2006
5. http://www.nptelvideos.in/2012/12/design-and-optimization-of-energy.html
6. http://nptel.ac.in/courses/112106064/

18MC019 MACHINE LEARNING 3 0 0 3

Course Objectives

- To Understand the fundamentals of various machine learning algorithms
- To gain knowledge on important methods in ANN, Fuzzy and Genetic algorithm
- To study the machine learning algorithms for various heuristic and non heuristic algorithms.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Differentiate the basics of supervised and semi supervised learning methods.
2. Retrieve the unsupervised and reinforcement learning methods involved in artificial learning
3. Interpret the concept of artificial neural networks and their control applications
4. Implement the fuzzy knowledge representation and multi objective decision making controllers
5. Compute the knowledge about various heuristic and non heuristic algorithms.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		3		1								3	
2	1		3		1								2	
3	2		3		1								2	
4	3		2		3								2	
5	1		1		3								2	

UNIT I **9 Hours**

SUPERVISED AND SEMI SUPERVISED LEARNING METHODS

Introduction to learning & classifiers- LDA - ANN - Naive Bayes classifier- decision tree Regression- Ordinary Least Squares - linear and Logistic Regression- Gaussian process -Stepwise Regression - Multivariate Adaptive Regression Splines (MARS) - Locally Estimated Scatterplot Smoothing (LOESS) - overview of nearest neighbour - Support vector machines- Temporal difference learning - Q-learning

UNIT II **9 Hours**

UNSUPERVISED

Expectation -maximization (EM) - Vector quantization, Clustering Fuzzy K & C means algorithm - Density-based spatial clustering of applications with noise (DBSCAN) - Conceptual clustering- Association rule learning - Apriori algorithm- SVD

UNIT III **9 Hours**

NEURAL NETWORK

Perceptron - Probabilistic Neural Network (PNN) - Back-Propagation (BPN) - Hopfield Network - Self-Organizing Map (SOM) - Learning Vector Quantization (LVQ) -Adaptive Resonance Theories 1 & 2 - Case studies on GA based algorithm development

UNIT IV **9 Hours**

FUZZY CLASSIFICATION

Basic concepts in Fuzzy Set theory-Fuzzy logic controllers - Principles - Various industrial Applications of Fuzzy logic control - Adaptive Fuzzy systems - Fuzzy Decision making - Fuzzy classification - Fuzzy pattern Recognition - Image Processing applications - Fuzzy optimization - Case studies on fuzzy based algorithm development

UNIT V **9 Hours**

HEURISTIC AND NON HEURISTIC ALGORITHMS

Introduction to genetic algorithm -initialization, selection, mutation and termination Swarm intelligence - PSO-ACO - Tabu search - Reactive search optimization (RSO)- cross-entropy (CE) methods. Case studies on GA based algorithm development

FOR FURTHER READING

Self-driving cars, Face recognition, Web search, Industrial robots, Missile guidance

Total: 45 Hours

Reference(s)

1. Ethem Alpaydin, Introduction to Machine Learning, The MIT Press, Cambridge, London.2014.
2. Klir, G.J. Yuan Bo, Fuzzy sets and Fuzzy Logic: Theory and Applications, Prentice Hall of India Pvt. Ltd.New jersey. 2005
3. Randy L. Haupt, Sue Ellen Haupt Practical Genetic Algorithms, Wiley interscience 2004
4. S. Rajasekaran, GA Vijayalakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms, Prentice Hall of India Private Limited, 2003
5. Simon Haykin, Neural Networks Ã¢?? A comprehensive foundation, Prentice Hall, 3rd Edition, 2004
6. https://onlinecourses.nptel.ac.in/noc18_cs26/course.

18MC020 LINEAR INTEGRATED CIRCUITS 3 0 0 3

Course Objectives

- To study the IC fabrication procedure.
- To study the characteristics, realize circuits, design for signal analysis using Op-amp ICs.
- To familiarize students with applications of various IC's
- To study internal functional blocks and the applications of special ICs like Timers, PLL circuits, regulator circuits, ADCs

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Classify the ICs and examine the processes involved in IC fabrication
2. Analyse the DC & AC Characteristic of OPAMP and specify the application of OPAMP
3. Design the circuits using OP-AMP for various linear and nonlinear applications
4. Analyse the characteristics and applications of special ICs like Timers, PLL circuits, and regulator circuits.
5. Analyse the function of different of voltage regulators and infer the need for Optocoupler.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1													
2	1	3	2											
3	2	3	3											3
4	1	2	2											2
5	1	3	1											2

UNIT I **9 Hours**

IC FABRICATION

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking, diffusion of impurities, Realization of monolithic ICs and packaging.

UNIT II **9 Hours**

CHARACTERISTICS OF OP-AMP

Basic information of Operational Amplifier -Ideal Operational amplifier- Block diagram-Differential amplifier-DC characteristics- AC characteristics-Frequency response-stability-CMRR-Slew rate

UNIT III **9 Hours**

APPLICATIONS OF OP-AMP

Inverting and non inverting amplifiers-summing amplifier-voltage follower-Instrumentation amplifier, V/I and I/V converters, comparators-Zero crossing detector- D/A converter (R-2R ladder and weighted resistor types), A/D converter - Dual slope, successive approximation and flash types.

UNIT IV **9 Hours**

SPECIAL ICS

555 Timer circuit Functional diagram-monostable operations-Astable operations-schmitt trigger-Voltage regulator-series op-amp regulator-IC voltage regulator-723 General purpose regulator-Switching regulator-Voltage controlled oscillator(VCO)

UNIT V **9 Hours**

APPLICATION ICS

IC Voltage regulators-LM78XX,79XX, LM317-adjustable voltage regulators-Phase-locked loop-565-block diagram-applications-LM380 power audio amplifier-Switch mode power supply(SMPS)

FOR FURTHER READING

Etching, summer, differentiator and integrator, peak detector, Analog multiplier ICs, opto electronic ICs.

Total: 45 Hours

Reference(s)

1. Ramakant A. Gayakward, Op-amps and Linear Integrated Circuits, Pearson Education, New Delhi, 2009.
2. D. Roy Choudhury and Sheil B. Jani, Linear Integrated Circuits, New Age International, New Delhi, 2010
3. Jacob Millman and Christos C.Halkias, Integrated Electronics - Analog and Digital Circuits System, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2003
4. Robert F. Coughlin and Fredrick F. Driscoll, Op-amp and Linear ICs, Pearson Education, New Delhi, 2008
5. David A. Bell, Op-amp and Linear ICs, Prentice Hall of India Learning. Ltd., New Delhi, 2007

3 0 0 4

18MC021 CONTROL SYSTEM AND DRIVES FOR ELECTRIC VEHICLES

Course Objectives

- To impart knowledge in c electric vehicles.
- To understand the control system of electric vehicles

Programme Outcomes (POs)

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

b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Program Specific Objectives(PSO)

m. Analyze, design and develop electro mechanical system using contemporary tools

Course Outcomes (COs)

1. Understand working of Electric Vehicles and recent trends
2. Understand the properties of batteries and its types
3. Develop the electric drives unitits control for application of electric vehicles.
4. Outline the control of electric vehicle design system.
5. Analyse different power converter topology used for electric vehicle application

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1											1	
2	2	2											2	
3	2	2											2	
4	2	3											2	
5	2	3											2	

UNIT I **9 Hours**

ELECTRIC VEHICLES

Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Electric Drive Trains, Architecture of Electric Drive Trains.

UNIT II **9 Hours**

ENERGY STORAGE FOR EV

Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, proton exchange membrane fuel cell (PEMFC) and its operation, Modelling of PEMFC, Super Capacitors.

UNIT III **9 Hours**

ELECTRIC DRIVES

EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives.

UNIT IV **9 Hours**

DESIGN OF ELECTRIC VEHICLES

Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of battery, design of electric motor drive capacity, transmission design, energy storage design.

UNIT V **9 Hours**

POWER ELECTRONIC CONVERTER FOR BATTERY CHARGING

Charging methods for battery, Termination methods, charging from grid, The Z-converter, Isolated bidirectional DC-DC converter, Design of Zconverter for battery charging, High-frequency transformer basedisolated charger topology, Transformer less topology

Total: 45 Hours

Reference(s)

1. M. Ehsani, Y. Gao, S. Gay and Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design, CRC Press, 2015
2. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2017
3. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug-in Hybrid Electric Vehicles, Springer, 2018.
4. C.C. Chan and K.T. Chau, Modern Electric Vehicle Technology, OXFORDUniversity Press, 20161.
5. Chris Mi, M. AbulMasrur, David WenzhongGao, Hybrid Electric Vehicles Principles And Applications With Practical Perspectives, Wiley Publication, 2018

18MC022 PROCESS CONTROL 3 0 0 3

Course Objectives

- To obtain the mathematical models for first order and higher order real-time systems and also understand the concept of self-regulation
- To get adequate knowledge about the characteristics of various controller modes and controller tuning methods
- To understand how to apply the control schemes for various applications

Programme Outcomes (POs)

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

e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Program Specific Objectives (PSO)

m. Analyze, design and develop electro mechanical system using contemporary tools

n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Solve the mathematical models for first order real time systems.
2. Understand the characteristics of various control modes and the concept of various control schemes.
3. Understand the various controller tuning methods to tune the controller.
4. Know the construction, characteristics and applications of different type of actuators.
5. Apply the process control knowledge on Industrial environment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1			2		3									2
2			2		3								1	
3			2		3								2	
4			2		3									3
5			3		1								2	

UNIT I **9 Hours**

INTRODUCTION

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 **9 Hours**

CONTROLLER CHARACTERISTICS

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 **9 Hours**

TUNING OF CONTROLLERS AND MULTI-LOOP CONTROL

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 range control.

UNIT IV **9 Hours**

FINAL CONTROL ELEMENT

Pneumatic and electric actuators valve positioner control valve characteristics of control valves type of valves: globe, butterfly, diaphragm, ball valves control valve sizing cavitation and flashing in control valves. Response of control valves, electric and electro pneumatic valves Selection of control valves

UNIT V **9 Hours**

SELECTED UNIT OPERATIONS

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

FOR FURTHER READING

Interacting and non interacting system-Cascade control for level process-temperature process station.

Total: 45 Hours

Reference(s)

1. George Stephanopoulos, Chemical Process Control, Prentice Hall of India learning Pvt. Ltd., New Delhi, 2012
2. B. Wayne Bequette, Process Control: modeling, design, and simulation, Prentice Hall of India Learning Pvt.Ltd., New Delhi, 2008
3. Donald P. Eckman, Automatic Process Control, Wiley-India Pvt. Ltd., New Delhi, 2009
4. Dale E. Seborg, D. A. Mellichamp and Thomas F Edgar, Process Dynamics and Control, Wiley-India, 2010.
5. Peter Harriott, Process Control, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2008
6. S B Thakore and B I Bhatt, Introduction to Process Engineering and Design, Tata McGraw-Hill PublishingCo. Ltd., New Delhi, 2008

18MC023 AD-HOC AND SENSOR NETWORK 3 0 0 3

Course Objectives

- To understand the wireless adhoc and sensor networks enable them to recognizethe wide range of applicability of these networks.
- To understand the major design issues such as protocol mechanisms and resource constraints.

Programme Outcomes (POs)

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

e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Program Specific Objectives (PSO)

m. Analyze, design and develop electro mechanical system using contemporary tools

n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. To comprehend the fundamental Concepts and applications of ad hoc and wireless sensor networks.
2. To solve the MAC protocol issues of ad hoc networks.
3. To label routing protocols for ad hoc wireless networks with respect to TCP design issues.
4. To elucidate the concepts of network architecture and MAC layer protocol for WSN.
5. To discuss the WSN routing issues by considering QoS measurements.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1			2	3									
2				2	3									
3		1		2	3									
4	2			1	3									
5	2			1	1							2	2	2

UNIT I **9 Hours**

INTRODUCTION

Fundamentals of Wireless Communication Technology -The Electromagnetic Spectrum - Radio propagation Mechanisms - Characteristics of the Wireless channel mobile ad hoc networks (MANETs) - Wireless Sensor Networks (WSNs): concepts and architectures - Applications of Ad Hoc and Sensor Networks - Design Challenges in Ad hoc and Sensor Networks.

UNIT II **9 Hours**

MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS

Issues in designing a MAC Protocol - Issues in Designing a MAC Protocol for Ad Hoc Wireless Networks - Design Goals of a MAC Protocol for Ad Hoc Wireless Networks - Classification of MAC Protocols -Contention based protocols - Contention based protocols with Reservation Mechanisms - Contention based protocols with Scheduling Mechanisms - Multi channel MAC - IEEE 802.11.

UNIT III **9 Hours**

ROUTING PROTOCOLS AND TRANSPORT LAYER IN AD HOC WIRELESS NETWORKS

Routing Protocol: Issues in designing a routing protocol for Ad hoc networks - Classification-proactive routing - reactive routing (on-demand) - hybrid routing - Transport Layer protocol for Ad hoc networks - Design Goals of a Transport Layer Protocol for Ad Hoc Wireless Networks -Classification of Transport Layer solutions-TCP over Ad hoc wireless - Network Security - Security in Ad Hoc Wireless Networks - Network Security Requirements.

UNIT IV **9 Hours**

WIRELESS SENSOR NETWORKS (WSNS) AND MAC PROTOCOLS

Single node architecture: hardware and software components of a sensor node -WSN Network architecture: typical network architectures -data relaying and aggregation strategies - MAC layer protocols: self-organizing - Hybrid TDMA/FDMA and CSMA based MAC - IEEE 802.15.4

UNIT V **9 Hours**

WSN ROUTING, LOCALIZATION & QOS

Issues in WSN routing –OLSR - Localization –Indoor and Sensor Network Localization - absolute and relative localization - triangulation - QOS in WSN - Energy Efficient Design – Synchronization.

Total: 45 Hours

Reference(s)

1. C. Siva Ram Murthy, and B. S. Manoj, "Ad Hoc Wireless Networks: Architectures and Protocols ", Pearson Education, 2008.
2. Labiod. H, “Wireless Adhoc and Sensor Networks”, Wiley, 2008.
3. Li, X, “Wireless ad -hoc and sensor Networks: theory and applications”, Cambridge University Press, 2008.
4. Carlos De Morais Cordeiro, Dharma Prakash Agrawal “Ad Hoc & Sensor Networks: Theory and Applications”, World Scientific Publishing Company, 2nd edition, 2011.
5. Feng Zhao and Leonides Guibas, "Wireless Sensor Networks", Elsevier Publication

18MC024 INDUSTRIAL IOT

3 0 0 3

OBJECTIVES

- To understand the IoT concepts and standards
- To use various components of IoT system
- To analyze the challenges in IoT implementation
- To relate and apply IoT for the applications

PROGRAM OUTCOMES (POs)

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

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

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

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

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.

Program Specific Objectives (PSO)

m. Analyze, design and develop electromechanical system using contemporary tools

n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation

COURSE OUTCOMES (COs)

1. Implement the IoT concepts and its standards.
2. Develop components of IoT system
3. Configure IoT platform for the security and privacy.
4. Apply IoT system for transportation, health care and agriculture.
5. Analyze the challenges in IoT implementation.

Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1.	2	1	2			1							1	
2.	2	2	3			1							2	
3.	2	1	3	2		2							2	
4.		2	3			3								2
5.		2				3								2

UNIT I **9 Hours**

IOT CONCEPTS

IoT - Technologies that led to evolution of IoT - IoT and SCADA - IoT and M2M - IoT and Big Data - International standard - Operating platforms - Communication protocols – Modbus – Profibus – RS485 – RTU - Ethercat.

UNIT II **9 Hours**

COMPONENTS OF IOT SYSTEM

Design of IoT systems - Device configuration and addressing - Interfacing IoT sensors and actuators - IoT cloud building blocks - Platform specific dashboard - MQTT Server - Time series database - Data monitoring, visualization and IoT analytics.

UNIT III **9 Hours**

SECURITY IN IOT

MQTT vs HTTP performance - Security considerations - Firmware updates - Cryptography basics - Cryptography in IoT - Privacy considerations and design guidelines - Individual privacy.

UNIT IV **9 Hours**

IOT CASE STUDY

Lighting as a service - Intelligent traffic systems - Smart parking - smart water management - smart cities - IoT for health services – IoT for OEE evaluation – IoT for Smart Factory and Smart Home Automation.

UNIT V **9 Hours**

CHALLENGES IN IOT IMPLEMENTATION

Big data management - Connectivity challenges - Dashboard development challenges - privacy implementation - Mission critical applications.

For Further Reading

Implementation on two platforms - Amazon IoT cloud - Microsoft Azure basics - Open source IoT platform on local machine.

Total: 45 Hours

References

1. Michael Miller, The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World, QUE , 26 March 2015
2. Arsheep Bahga, Vijay Madisetti, Internet of Things: A Hands-On Approach, Orient Blackswan Private Limited - New Delhi; First edition, 2015.
3. Srinivasa K. G., Siddesh G. M., Hanumantha Raju R., Internet of Things, Cengage Learning India Pvt. Ltd., 2018.
4. Adrian Mcewen, Hakin Cassimally, Designing The Internet of Things, Wiley, 2015

18MC025 INDUSTRIAL DRIVES AND CONTROL 2 0 2 3

Course Objectives

- To understand the working principle and performance characteristics of 3-Phase Induction motor
- To determine the operation, characteristics and performance parameters of converters
- To describe feedback control and basic components of control drive system

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Program Specific Objectives (PSO)

n. Acclimate multidisciplinary approach to solve complex engineering problems associated with mechanical, control systems, robotics, drives and automation.

Course Outcomes (COs)

1. Understand the various types of drive system with gear arrangement
2. Understand the construction and working principle of asynchronous and asynchronous machine
3. Interpret the operation and characteristics of invertors and its related techniques
4. Acquire the knowledge on various types of frequency pattern and control modes
5. Write the integrate positioning programming for various types of application

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		3		2									1
2	3		2		2									2
3	3		2	2										3
4	3	2		-	1									2
5		2	2		1									2

UNIT I **6 Hours**

BASICS OF DRIVE SYSTEM AND GEARS

Drive system introduction Comparison of drives Characteristic curves Gears introduction Gears sizes and Gear ratio Various types

UNIT II **6 Hours**

BASICS OF ASYNCHRONOUS

Design and theory of operation Motor poles Construction - Enclosure Torque Vs Speed characteristics curve Brakes& Brake rectifiers Encoder theory of operation Various types

UNIT III **6 Hours**

BASICS OF FREQUENCY INVERTERS

Block diagram Components of inverter Brake chopper & 4 quadrant operation accessories of invertors Energy recovery EMC effects Various communication types.

UNIT IV **6 Hours**

FREQUENCY PATTERNS

Introduction to the V/f characteristic curve- 50Hz pattern 70Hz pattern 87Hz pattern Open loop control modes (V/F & VFC) closed loop control modes (VFCN & CFC)

UNIT V **6 Hours**

IPOS PROGRAMMING, PARAMETER SET

Basics of IPOS programming commands Sample programs Touch probe Compiler specific information Various parameter sets Various fault codes & its description.

FURTHER READING

Application modules- Extended Positioning via bus-Modulo Positioning- Drive sync via S-Bus

List of Experiments

1. Working with Motion studio operating software
2. Startup with Keypad and Motion Studio software for open loop drive
3. Parameterization and operating mode- open loop system.
4. Startup with Keypad and Motion Studio software for closed loop drive
5. Parameterization and operating mode- Closed loop system
6. Frequency pattern and fault code diagnosis
7. IPOS program - Write a program to change the travel speed during movement.
8. IPOS program - Write a program for table positioning.
9. Application Module - Extended positioning via bus
10. Application Module - Module Positioning.

Total: 30+30=60 Hours

Reference(s)

1. Muhammad H. Rashid, Power Electronics - Circuits, Devices and Applications, Prentice Hall of India Learning. Ltd., New Delhi, 2004
2. G. K. Dubey, Fundamentals of Electrical Drives, Wiley Eastern Ltd., New Delhi, 2007
3. D.P.Kothari and J.J.Nagrath, Electric Machines, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2010
4. J. Nagrath and M. Gopal, Control System Engineering, New Age International Publisher, New Delhi, 2011
5. SEW Study materials, practical workbooks

18MC026 LEAN MANUFACTURING 3 0 0 3

Course Objectives

- To impart knowledge on globally competitive manufacturing organization using lean manufacturing
- principles
- To provide knowledge on various plant layout and techniques for improving the productivity.
- To acquire knowledge on quality improvement tools such as TQM, 5S and VSM.
- To expertise the six sigma tools applications in various industrial field.
- To familiarize the methods of six sigma technique.

Programme Outcomes (POs)

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

b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

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

Program Specific Objectives (PSO)

m. Analyze, design and develop electromechanical system using contemporary tools

Course Outcomes (COs)

1. Exemplify the basic lean manufacturing concepts, principles and its tools
2. Elucidate the concepts of plant layout and techniques for improving the productivity.
3. Explain the various quality improvement tools such as TQM, 5S and VSM
4. Classify the basic concepts of six sigma and its tools.
5. Apply the six sigma methodologies in various industrial fields

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2										3	
2	2	3	2	2									3	
3	3	2	2										3	
4	2	3	2										3	
5	2	-	3	2									3	

UNIT I **9 Hours**

INTRODUCTION TO LEAN MANUFACTURING

Conventional Manufacturing versus Lean Manufacturing, Principles of Lean Manufacturing, Basic elements of lean manufacturing, Introduction to LM Tools

UNIT II **9 Hours**

CELLULAR MANUFACTURING, JIT, TPM

Cellular Manufacturing, Types of Layout, Principles of Cell layout, Implementation, Just in Time (JIT), Principles of JIT and Implementation of Kanban, Pillars of Total Productive Maintenance (TPM), Principles and implementation of TPM.

UNIT III **9 Hours**

SETUP TIME REDUCTION, TQM, 5S, VSMMANAGEMENT

Set up time reduction, Definition, philosophies and reduction approaches, Total Quality Maintenance Principles and implementation, 5S Principles and implementation, Value stream mapping, Procedure and principles

UNIT IV **9 Hours**

SIX SIGMA - TOOLS

Cost of Quality - Conformance and Non-conformance cost - Basic quality control tools - Seven management tools - Failure mode and effect analysis.

UNIT V **9 Hours**

SIX SIGMA METHODOLOGY

Need for Six Sigma - Six Sigma Team - Define, Measure, Analyze, Improve and Control Methodology: Define Measure, Analyze, Improve and control - Lean Six Sigma.

FURTHER READING

Various Case Studies of implementation of lean manufacturing in industries

Total: 45 Hours

Reference(s)

1. Dennis P. Hobbs, Lean Manufacturing Implementation, APICS, 2009.
2. Mikell P. Groover, Automation, Production Systems and CIM, Pearson International Edition,2002.
3. Rich Charron, H. James Harrington, Frank Voehl and Hal Wiggin,The Lean Management Systems and book Hardcover, CRC Press, 2004.
4. Ronald G. Askin and Jeffrey B. Goldberg, Design and Analysis of Lean Production System John Wiley & Sons, 2003.
5. M. Rother and J Shook, Learning to See: Value Stream Mapping to Add Value and Eliminate Muda, Lean Enterprise Institute, Brookline, 2004.
6. Nor Azian Abdul Rahman, SariwatiMohd Sharif and Mashitah Mohamed Esa, "Lean Manufacturing Case Study with Kanban System Implementation", Procedia Economics and Finance, Vol. 7, pp.174-180, 2013.

18MC027 GREEN MANUFACTURING 3 0 0 3

Course Objectives

- To acquire a broad understanding of sustainable manufacturing, green product and process
- To understand the analytical tools, techniques in green manufacturing
- To understand the structures of sustainable manufacturing, environmental and management
- Practice

Programme Outcomes (POs)

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

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

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

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

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

Program Specific Objectives(PSO)

m. Analyze, design and develop electromechanical system using contemporary tools

Course Outcomes

1. Understand the basic design concepts, methods, tools, the key technologies and the operation of sustainable green manufacturing.
2. Design the rules and processes to meet the market need and the green manufacturing requirements by selecting and evaluating suitable technical, managerial / project management and supply chain management scheme
3. Identify the strategies for the purpose of satisfying a set of given sustainable closed-loop production systems in green manufacturing requirements.
4. Apply the principles, techniques and methods to customize the learned generic concepts to meet the needs of a particular industry/enterprise and to develop electronic manufacturing systems that will be environment friendly
5. Design and develop systems that will be able to assess the environmental sustainability and its impacts

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2			3	2						1	
2	1	2	2			2	3						2	
3	2	1	3	2		2	2						2	
4	1	2	3			2	2						2	
5	2	2	1			3	3						2	

UNIT I **9 Hours**

INTRODUCTION TO GREEN MANUFACTURING

Why Green Manufacturing, Motivations and Barriers to Green Manufacturing, Environmental Impact of Manufacturing, Strategies for Green Manufacturing

Introduction on the Social, Business, and Policy Environment for Green Manufacturing, The Social Environment—Present Atmosphere and Challenges for Green Manufacturing, The Business Environment: Present Atmosphere and Challenges, The Policy Environment—Present Atmosphere and Challenges for Green Manufacturing

UNIT II **9 Hours**

METRICS FOR GREEN MANUFACTURING

Introduction, Overview of Currently Used Metrics, Overview of LCA Methodologies, Metrics Development Methodologies, Outlook and Research Needs.

Motivation and Introduction on Green Supply Chain, Definition, Issues in Green Supply Chains (GSC), Techniques / Methods of Green Supply Chain, Future of Green Supply Chain.

Principles of Green Manufacturing, Background and Technology Wedges, Principles, Mapping five Principles to Other Methods and Solutions.

UNIT III **9 Hours**

CLOSED-LOOP PRODUCTION SYSTEMS

Life Cycle of Production Systems, Economic and Ecological Benefits of Closed Loop Systems, Machine Tools and Energy Consumption, LCA of Machine Tools, Process Parameter Optimization, Dry Machining and Minimum Quantity Lubrication, Remanufacturing, Reuse, Approaches for Sustainable Factory Design

UNIT IV **9 Hours**

SEMICONDUCTOR MANUFACTURING

Overview of Semiconductor Fabrication, Micro fabrication Processes, Facility Systems, Green Manufacturing in the Semiconductor Industry: Concepts and Challenges, Use-Phase Issues with Semiconductors, Example of Analysis of Semiconductor Manufacturing.

UNIT V **9 Hours**

ENVIRONMENTAL IMPLICATIONS OF NANO-MANUFACTURING

Introduction, Nano-manufacturing Technologies, Conventional Environmental Impact of Nano-manufacturing, Unconventional Environmental Impacts of Nano-manufacturing, Life Cycle Assessment (LCA) of Nanotechnologies

Green Manufacturing through Clean Energy Supply, Clean Energy Technologies, Application Potential of Clean Energy Supplying Green Manufacturing

FURTHER READING

Method to Determine Opportunities for Improved Pallet Utilization, Applying Sensor Flows in Decision Making: Automated Monitoring, Evolution of Manufacturing, Leveraging Manufacturing, Energy of Labor.

Total: 45 Hours

Reference(s)

1. Dornfield David, Green Manufacturing, Springer, 2012
2. Davim.J.Pauls, Green Manufacturing Processes and Systems, Springer, 2013
3. Hsiao-fan wang and Surendra M.Gupta Green supply management Product life cycle approach
4. McGraw Hill, 2011
5. Joseph Fiksel, "Design for Environment – A guide to sustainable Product Development",
6. second edition, McGraw Hill, 2012
7. John X.Wang 'Green Electronics Manufacturing', CRC Press Indian Prentice Hall, 2012
8. Sammy G Shina, 'Green Electronics Design and Manufacturing' Mc Graw Hill 2008.

18MC028 WIRELESS SENSOR NETWORKS 3 0 0 3

Course Objectives

- To obtain a broad understanding of various challenges involved to design wireless sensor networks.
- To focus on network architecture and protocols of wireless sensor networks.
- To understand the recent technologies and applications of wireless sensor networks.

Programme Outcomes (POs)

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

b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

d. Conduct Investigations of Complex Problems Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Program Specific Objectives (PSO)

m. Analyze, design and develop electromechanical system using contemporary tools

Course Outcomes (COs)

1. Infer the fundamentals of wireless sensor networks and its applications in enabling technologies.
2. Analyze the architecture of wireless sensor network and its execution environment
3. Apply the MAC and routing protocols for wireless sensor networks and also the assignment of MAC Addresses.
4. Design wireless sensor networks with the role of topology control, synchronization and localization for various applications.
5. Predict the tools and platforms needed to establish sensor networks and its applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2			3	2						1	
2	1	2	2			2	3						2	
3	2	1	3	2		2	2						2	
4	1	2	3			2	2						2	
5	2	2	1			3	3						2	

UNIT I **9 Hours**

OVERVIEW OF WIRELESS SENSOR NETWORKS

Key definitions of sensor networks, Challenges for Wireless Sensor Networks-Characteristics requirements required mechanisms, Difference between mobile ad-hoc and sensor networks, Advantages of sensor Networks, Applications of sensor networks-Enabling Technologies for Wireless Sensor Networks.

UNIT II **9 Hours**

ARCHITECTURES

Single-Node Architecture - Hardware Components, Energy Consumption of Sensor Nodes , Operating Systems and Execution Environments, WSN Network architecture: typical network architectures-data relaying and aggregation strategies- Sensor Network Scenarios, Optimization Goals and Figures of Merit.

UNIT III **9 Hours**

NETWORKING OF SENSORS

Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Issues in Designing a MAC protocol for wireless sensor network, Address and Name Management, Assignment of MAC Addresses, Routing Protocols

UNIT IV **9 Hours**

INFRASTRUCTURE ESTABLISHMENT

Topology Control, Clustering, Time Synchronization, Localization and positioning- properties-approaches Single Hop localization, localization services, Sensor Tasking and Control.

UNIT V **9 Hours**

SENSOR NETWORK PLATFORMS AND TOOLS

Sensor Node Hardware - Berkeley Motes, Programming Challenges, Node-level software platforms, Node level Simulators, State-centric programming, Applications Of WSN: WSN Applications -Home Control Building Automation -Industrial Automation -Medical Applications -Reconfigurable Sensor Networks Highway Monitoring –Military Applications.

FURTHER READING

Gateway Concepts - Energy Efficient Routing, Geographic Routing.

Total: 45 Hours

Reference(s)

1. Holger Karl,Andreas Willig,Protocols And Architectures for Wireless Sensor Networks, John Wiley, 2005
2. Feng Zhao,Leonidas J,J Guibas,Wireless Sensor Networks An Information Processing Approach,Elsevier, 2007
3. Kazem Sohraby,Daniel Minoli,Taieb Znati,Wireless Sensor Networks-Technology,Protocols, And Applications, John Wiley, 2007.
4. Anna Hac,Wireless Sensor Network Designs,John Wiley,2003
5. BhaskarKrishnamachari,Networking Wireless Sensors,Cambridge Press, 2005
6. Mohammad Ilyas and Imad Mahgaob,Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems, CRC Press, 2005

18MC029 COMPUTATIONAL FLUID DYNAMICS 3 0 0 3

Course Objectives

- To provide the knowledge on fundamental governing equations of fluid mechanics and heat transfer
- To acquire knowledge on formulation of governing Equations for fluid flow problems in finite difference method
- To study the steady and unsteady state diffusion type problems using finite volume method.
- To impart one dimensional and two dimensional elements in finite element techniques for fluid flow problems.
- To learn the structured and unstructured grids generation techniques.

Programme Outcomes (POs)

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

b. Problem Analysis: Identify, formulate, review research literature,and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

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

Program Specific Objectives(PSO)

m. Analyze, design and develop electromechanical system using contemporary tools

Course Outcomes (COs)

1. Formulate the fundamental governing equations of fluid mechanics and heat transfer.
2. Solve the fluid dynamics problems using finite difference method.
3. Construct finite volume equations for steady and unsteady state diffusion type problems.
4. Apply the finite element methods for fluid flow problems.
5. Generate the grids using grid generation techniques for simple and complex geometries.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3	2	2									2	
2	2	3	2	2									3	
3	3	2	2	2									3	
4	2	3	2	2									3	
5	2	-	3	2									3	

UNIT I **9 Hours**

INTRODUCTION

Introduction - Applications and impact of CFD in diverse fields - Navier Stroke equations in fluid dynamics continuity- - momentum and energy - generic integral form for governing equations -Initial and Boundaryconditions. Classification of partial differential equations-Elliptic, Parabolic and Hyperbolic types.

UNIT II **9 Hours**

FINITE DIFFERENCE METHOD

Basics and discretization of simple and complex governing equations. Applications. Incompressible in-viscid Flows - Illustrative and physical examples of Elliptic, Parabolic and Hyperbolic equations - Discretization of partial Differential Equations. Implicit, explicit and Crank Nicolson finite difference methods for viscous flows. Stability, convergence, accuracy.

UNIT III **9 Hours**

FINITE VOLUME METHOD

Basic rules for FV Discretization. Finite Volume (FV) Discretization of one and two dimensional steady state diffusion type problems - 1-D convection-diffusion type problem - Unsteady flows - implementation of boundary conditions in Finite Volume. Solution of discretized equations. Solution algorithm for Pressure Velocity coupling in steady flows

UNIT IV **9 Hours**

FINITE ELEMENT METHOD IN FLUIDS

Over view of Finite Element Techniques in Computational Fluid Dynamics. Weighted residual and Variational formulations. Finite element interpolation. One and two dimensional elements. Steady state conduction and incompressible potential flow problems.

UNIT V **9 Hours**

NUMERICAL GRID GENERATION

Introduction. Algebraic grid generation. Differential Grid Generation. Structured and unstructured grids. Body fitted Coordinate Method.

FURTHER READING

Pressure-velocity coupling - SIMPLE scheme.

Total: 45 Hours

Reference(s)

1. J. D. Anderson., Jr. Computational Fluid Dynamics- The Basic with Applications, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2004
2. S. C. Gupta, Applied Computational Fluid Dynamics, Wiley India Pvt. Ltd., New Delhi, 2019
3. S. V. Patankar, Numerical Heat Transfer and Fluid Flow, Hemisphere, New York, 2004.
4. H. K. Versteeg and W. Malalasakera, An Introduction to Computational Fluid Dynamics The Finite Volume Method, Pearson Education Ltd., New Delhi, 2007.
5. K. A. Hoffman, Computational Fluid Dynamics for Engineering, Engineering Education System, Austin, Texas 2005.
6. Introduction to computational fluid dynamics http://nptel.ac.in/courses/112105045/.

18MC0YA INDUSTRIAL ROBOTICS 3 0 0 3

Course Objectives

- To analyze robot manipulators in terms of their kinematics, control
- Enable to program and control an industrial robot system that performs a specific task
- To discuss various applications of industrial robot systems

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling 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.

Course Outcomes (COs)

1. Identify the configuration of a robot
2. Analyze the kinematics and control of robots
3. Understand different robot sensors and vision system
4. Perform simple programming of robot
5. Identify a suitable robot for a given application

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	1	2	3		3	2						
2	2	2	3		2	1						
3	3	2	1		2	3						
4	3	1	2		2	1						
5	2	1	3		2	2						

UNIT I **8 Hours**

INTRODUCTION

Definition of a robot - scope of industrial robots, Robot anatomy - robotics and automation, law of robots, specification of robots, resolution, repeatability and accuracy of manipulator. Classification of robots and justifying the use of robots. Drive mechanisms - hydraulic, electrical, pneumatic drives

UNIT II **10 Hours**

ROBOT CONTROL AND KINEMATICS

Power transmission systems and control - mechanical transmissions method- Rotary to rotary, rotary to linear conversions - rotary problem- remote centered compliance devices. End effectors - vacuum, magnetic and air operated grippers. Robot Kinematics- Forward Kinematics, Inverse Kinematics and Differences -Forward Kinematics and Reverse Kinematics of Manipulators with Two, Three Degrees of Freedom (In 2 Dimensional), Four Degrees of Freedom (In 3 Dimensional) -DH matrices

UNIT III **9 Hours**

ROBOT SENSORS AND VISION SYSTEMS

Sensors - types - tactile sensors, proximity and range sensors, contact and non-contact sensors, velocity sensors, touch and slip sensors, force and torque sensors. Robotic vision systems, imaging components, image representation - picture coding, object recognition and categorization, visual inspection, robot cell, design and control layouts

UNIT IV **9 Hours**

ROBOT PROGRAMMING AND ARTIFICIAL INTELLIGENCE

Robotics programming: Teach Pendant Programming, Lead through programming, Robot programming Languages - VAL Programming - Motion Commands, Sensor Commands, End effector commands, and Simple programs. Basics - Goals of Artificial Intelligence

UNIT V **9 Hours**

INDUSTRIAL APPLICATIONS

Application of robots in machining - Welding - Assembly - Material handling - Loading and unloading- CIM-hostile and remote environments. Inspection and future application-safety, training, maintenance and quality. Economic analysis of robotics. SCARA robots, wheeled robots, Bipedal robots (humanoid robots), hexapod robots

FOR FURTHER READING

Economic and social issues - Micro motor and micro gripper - Performance characteristics of a robot - Simple programs for drilling operations using VAL - Robot cell

Total: 45 Hours

Reference(s)

1. M. P. Groover, Industrial Robotics - Technology, Programming and Applications, Tata McGraw-Hill Publishing Company. Ltd., New Delhi, 2011
2. K. S. Fu, R. C. Gonzalez and C. S. G. Lee, Robotics Control, Sensing, Vision and Intelligence, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2003
3. D. Richard, Klafter A. Thomas, Chmielewski and Michael Negin, Robotics Engineering â€“ An Integrated Approach, Prentice Hall of India, New Delhi, 2009
4. Ramesh Jain, Machine Vision, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 1995
5. Yoram Koren, Robotics for Engineers, Tata McGraw-Hill Publishing Company Pvt. Ltd., New Delhi, 2004
6. James G. Keramas, Robot Technology Fundamentals, Cengage Learning India Pvt. Ltd., New Delhi, 2011

18MC0YB BASICS OF MECHATRONICS 3 0 0 3

Course Objectives

- To provide a basic background to mechatronics and link to more specialized skills
- To develop the mix of skills in mechanical engineering, electronics and computing
- To familiarize about sensors and control system used in mechatronics
- To develop confidence and competence in designing mechatronics systems

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Identify the Mechatronics system based on sensor and transducer; analyze the sensors for Particular applications.
2. Characterize the components and design the Hydraulic and Pneumatic circuit for Industrial applications.
3. Analyze the characteristics of actuators and select the suitable actuator for applications.
4. Develop the simple programmable logic controller and differentiate relay logic with ladder logic.
5. Develop the mechatronics system design and implement the Process parameters for given application.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3	2	1									
2	2	2	1		3							
3	2	1	2		3							
4	1	1	3		2						2	
5	2				3						2	

UNIT I **9 Hours**

MECHATRONICS

Introduction to Mechatronics Systems - Measurement Monitoring Systems Automation - Control Systems -Microprocessor based Controllers. Sensors and Transducers - Performance Terminology - Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors - Selection of Sensors

UNIT II **8 Hours**

ACTUATION SYSTEMS

Pneumatic and Hydraulic Systems - Directional Control Valves - Rotary Actuators. Mechanical Actuation Systems - Cams - Gear Trains - Ratchet and pawl - Belt and Chain Drives - Bearings. Electrical Actuation Systems - Mechanical Switches - Solid State Switches - Solenoids - D.C Motors - A.C Motors - Stepper Motors -Servomotors.

UNIT III **10 Hours**

SYSTEM MODELS AND CONTROLLERS

Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational - Translational Systems, Electromechanical Systems - Hydraulic - Mechanical Systems. Continuous and discrete process Controllers - Control Mode - Two - Step mode - Proportional Mode - Derivative Mode - Integral Mode - PID Controllers - Digital Controllers - Velocity Control - Adaptive Control - Digital Logic Control - Micro Processors Control

UNIT IV **9 Hours**

PROGRAMMABLE LOGIC CONTROLLERS

Programmable Logic Controllers - Basic Structure - Input / Output Processing -Programming - Mnemonics - Timers, Internal relays and counters - Shift Registers - Master and Jump Controls - Data Handling - Analogue Input / Output - Selection of PLC

UNIT V **9 Hours**

DESIGN OF MECHATRONICS SYSTEM

Stages in designing Mechatronics Systems - Traditional and Mechatronic Design - Possible Design Solutions Case Studies of Mechatronics Systems, Automatic washing Machine - Automatic Camera - Pick and place robot - Automatic Car Park Systems - Engine Management Systems

FOR FURTHER READING

Smart sensors - Hybrid motor - Advanced Controllers - PLC in Mechatronics - Fault finding

Total: 45 Hours

Reference(s)

1. W. Bolton, Mechatronics: Electronic control systems in Mechanical and Electrical Engineering, Pearson Education, New Delhi,2013
2. David G. Alciature and Michael B. Histand, Introduction to Mechatronics and Measurement Systems, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi,2007
3. Nitaigour Premchand Mahalik, Mechatronics : Principles, Concepts and Applications, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi,2008
4. M. D. Singh, and J. G. Joshi, Mechatronics, Prentice Hall of India, New Delhi,2009
5. K. P. Ramachandran, G. K. Vijayaraghavan, and M. S. Bala-Sundram, Mechatronics : Integrated Mechanical Electronic Systems, Wiley India Pvt. Ltd.,New Delhi 2008
6. Newton C. Braga, Mechatronic Source Book, Delmar Cengage Learning, 2009

3 0 0 3

18MC0YC MICRO ELECTRO MECHANICAL SYSTEMS

Course Objectives

- To acquire a knowledge about fabrication process in MEMS
- To know about various etching techniques in micromachining
- To have a knowledge about applications in micromachining techniques

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
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.

Course Outcomes (COs)

1. Know the scaling laws that are used extensively in the conceptual design of micro-devices and able to use materials for common micro-components and devices
2. Select a fabrication process suitable for production of a MEMs device
3. Choose a micromachining technique, such as bulk micromachining and surface micromachining for a specific MEMS fabrication process
4. Understand the working principles of micro-sensors, actuators, valves, pumps, and fluidics used in Microsystems
5. Acquire knowledge on micro system packaging and design

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3		2			1						
2	2		2			2						
3	3		2			1						
4	2		3			1						
5	1		1			3						

UNIT I **9 Hours**

INTRODUCTION

Introduction to MEMS: Introduction to Microsystems and micro electronics - Market scenario for MEMS. Working principle: Trimmers scaling vector and scaling laws - scaling in geometry - scaling in rigid body dynamics- scaling in electrostatic forces - scaling in electricity - scaling in fluid mechanics - scaling in heat transfer. Materials for MEMS: Silicon as a MEMS material - Crystal structure of silicon - Miller indices - silicon compounds - SiO2, SiC, Si3N4 and polycrystalline silicon
- silicon piezo-resistors - Gallium arsenide - polymers for MEMS -quartz.

UNIT II **9 Hours**

FABRICATION OF MEMS

Clean room technology - Substrates and wafer - single crystal silicon wafer formation - ideal substrates - mechanical properties - Processes for bulk micromaching - Wet Vs dry etching - Chemical etching of Silicon - etchant systems and etching process - Reactive ion etching and DRIE - mask layout design. Processes for Surface micromaching - Deposition processes - ion implantation - Diffusion - oxidation - chemical vapor deposition -physical vapor deposition - deposition by epitaxy - photolithography and photoresists. Limitations of Bulk and surface micromachining - LIGA, SLIGA and other micromolding processes such as HeXIL

UNIT III **9 Hours**

DESIGN CONSIDERATIONS BASED ON MICROMECHANICS

Micromechanics considerations - static bending of thin plates - circular plates with edge fixed - rectangular plate with all edges fixed - square plate with all edges fixed - mechanical vibration - resonant vibration - micro accelerometers - design theory and damping coefficients - thermo mechanics - thermal stresses - fracture mechanics - stress intensity factors - fracture toughness - and interfacial fracture mechanics

UNIT IV **9 Hours**

MEMS DEVICES

Micro actuation techniques - piezoelectric crystals - Shape memory alloys - bimetallics - conductive polymers. Micro motors - micro grippers - Microfluidic devices - Micro pumps - mechanical and nonmechanical micropumps - micro valves - valveless micropumps - Lab on Chip. Types of micro sensors - Microaccelerometer - Micropressure sensors, MEMS switches/resonators, MEMS reliability.

UNIT V **9 Hours**

MICROSYSTEM PACKAGING AND DESIGN

Micro system packaging - materials die level device level - system level - packaging techniques - die preparation - surface bonding - wire bonding - sealing - Case studies. Design considerations - process design - mechanical design - applications of micro system in automotive - bio medical - aerospace - telecommunication industries

FOR FURTHER READING

Use of gold and other metals in MEMS- MEMS devices for automotive application-MEMS device for the same purpose may be manufactured by different types of processes-Need for micromechanics considerations in MEMS design- Optical MEMS devices- Use of MEMS devices in cell phones, robots, automobiles, etc

Total: 45 Hours

Reference(s)

1. Mohamed Gad-el-Hak, The MEMS Handbook, CRC Press Publishers, India, 2002
2. Tai Ran Hsu, MEMS and Micro Systems Design and Manufacture, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008
3. Nadim Maluf, An Introduction to Micro Electro Mechanical System Design, Artech House Publishers, London, 2004
4. Chang Liu, Foundations of MEMS, Pearson Education, New Delhi, 2011.James J. Allen, Micro Electro Mechanical System Design, CRC Press Publishers, India, 2005
5. Julian w. Gardner, Vijay K. Varadan and Osama O. Awadelkarim, Micro sensors MEMS and smart Devices, John Wiley and Sons Ltd., England, 2002
6. E.H. Tay, Francis and W.O.Choong, Micrfluids and Bio MEMS applications, Springer, 2002

3 0 0 3

18MC0YD INDUSTRIAL DRIVES AND AUTOMATION

Course Objectives

- To study the industrial control methods of AC and DC drives
- To Understand the theory and applications of Industrial AC and DC drive systems
- To analyze the operation of Artificial-Intelligence Based drive

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

Course Outcomes (COs)

1. Explain fundamental principles of various AC Machines and drives
2. Describe different types of Induction Motor Slip-Power Recovery Schemes..
3. Explain various AC drive control methods.
4. Apply control techniques for synchronous motor drives.
5. Apply Expert System and Fuzzy Logic principles for drives control

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3											
2	-	2										
3		2										
4	-		2									
5					3							

UNIT I **9 Hours**

AC MACHINES FOR DRIVES

Induction Machines, Torque Production, Equivalent Circuit Analysis, Torque-Speed Curve, NEMA Classification of Machines, variable-Voltage, Constant frequency Operation, Variable-Frequency Operation, Constant Volts/Hz operation, Drive operating Regions, Variable Stator current operation, the effect of Harmonics.

Synchronous Machines: Wound Field Machine- Equivalent Circuit, Developed Torque, Salient Pole Machine Characteristics, Synchronous Reluctance Machine, Permanent MagnetMachine.

UNIT II **9 Hours**

INDUCTION MOTOR SLIP-POWER RECOVERY DRIVES

Introduction, Doubly-Fed Machine Speed Control by Rotor Rheostat, Static Kramer Drive, Static Scherbius Drive.

UNIT III **9 Hours**

CONTROL OF INDUCTION MOTOR DRIVES

Introduction, Vector of Field-Oriented Control, Indirect or Feed forward Vector Control, Vector Control of Line-Side PWM Rectifier, Stator Flux Oriented Vector Control, Vector Control of Current- Fed Inverter Drive, Vector Control of Cycloconverter Drive, Direct Torque and Flux Control (DTC).

UNIT IV **9 Hours**

CONTROL OF SYNCHRONOUS MOTOR DRIVES

Introduction, Sinusoidal SPM Machine Drives, Vector Control, Synchronous Reluctance Machine Drives, Wound-Field Synchronous Machine Drives.

UNIT V **9 Hours**

FUZZY LOGIC PRINCIPLES AND APPLICATIONS

Introduction, Fuzzy Sets, Fuzzy System, Defuzzification Methods, Fuzzy Control, General Design Methodology, Applications in Electrical Machines and Drives

FOR FURTHER READING

Neuro-fuzzy based control of DC drives, Design of AC drives using Brain Emotional Learning Based Intelligent Controller, Varialbe frequency control of multiple synchronous motor drives

Total: 45 Hours

Reference(s)

1. Bimal K Bose, "Power Electronics and Variable Frequency Drives - Technology and Application", IEEE Press, 1997.
2. Gopal K Dubey, Fundamentals of Electric Drives, Narosa Publishing House, New Delhi, 2005.
3. Peter Vas, "Vector Control of AC Machines", Oxford University Press, 1990.
4. Ned Mohan, Advanced Electric Drives: Analysis, Control and Modeling using Simulink, John Wiley and Sons Ltd, 2001
5. Peter Vas, Artificial-Intelligence-based Electrical Machines and Drives, Oxford University Press, 1999

18MC0XA COMMUNICATION PROTOCOLS

1 0 0 1

Course objectives

- To understand the importance of industrial communication protocols and acquire basic knowledge on various industrial communication standards used in automation industries

Data logging in Industrial automation with 485 MODBUS - Temperature monitoring using 485 MODBUS - Data transferring using RS232 for PLC and HMI - Ethernet And Can Interface For Industrial Automation - Speed control of motors using the RS485- Control of solenoid valves using the PROFINET - Management of servo devices using PROFIBUS - Flexible Manufacturing System with CC-link Network Decentralized - Scalable Motion control system using Ether-CAT based on shared variables - Automatic Packing Control using Ethernet I/P - Power monitor networked control based on DEVICENET field-bus.

Total: 15 hours

References

1. Communication Protocol Engineering by Miroslav Popovic, CRC Press, 2006
2. Industrial Communication Technology, 2nd edition by Richard Zurawski, CRC Press, December 2017

18MC0XB AC/DC DRIVES 1 0 0 1

Course Objectives

- To study the various power electronics devices and their characteristics
- To understand the real time application in AC/DC DRIVES
- To practically study the various AC/DC Drives foe speed control application

Brief Basic Power Electronics (including Thyristors, Power-Transistors & IGBTs). DC Motor Basics (construction, principle of operation, T-N Characteristic etc). DC Drives Basics (Block diagram, 1Q-4Q principle of operation, T-N Curves etc) Selections, Calculations & applications of typical DC drives. Siemens DC Drives (6RA70) - Ratings, Specs, features, options & applications. AC Motor Basics (construction, principle of operation, T-N Characteristic etc). AC Drives Basics (Block diagram, 1Q-4Q principle of operation, T-N Curves etc) Selections, Calculations & applications of typical AC drives. AC Drives (Micromaster-MM4)-Ratings, Specs, features, options & applications. AC Drives (Master Drive-VC): Ratings, Specs, features, options & applications. AC Drives (Sinamics-G)-Ratings, Specs, features, options & applications in brief. MEDIUM VOLTAGE (MV Drives & Motors): MV Motor types & Fundamentals (including starting methods, options/features), MV Motor offers from Germany (separately for Induction & Synchronous Motor), MV Converter Basics & types (Voltage, Current Source & Cyclo- converters), Siemens MV Converters (Sinamics GM, Simovert-S and Perfect Harmony), Selection, configuration & Applications of MV Drive systems

Total: 15 Hours

Reference(s)

1. G. K. Dubey, Fundamentals of Electrical Drives, Wiley Eastern Ltd., New Delhi, 2007.
2. S. K. Pillai, A First Course on Electrical Drives, New Age International Pvt. Ltd., New Delhi, 2012.
3. Vedam Subrahmaniam, Electric Drives (concepts and applications), Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2007

1 0 0 1

18MC0XC ADVANCED METROLOGY AND QUALITY CONTROL

Course Objectives

- Understand and explain the relevance of metrology in industries
- Recapitulate the need of various measuring instruments and the way it supports accuracy
- Examine and provide solution on measurements for a given industrial part/component

Advanced measuring machines, CNC systems, Laser vision, In-process gauging, 3D metrology, metrology softwares, Nano technology instrumentation, stage position metrology, testing and certification services, optical system design, lens design, coating design, precision lens assembly techniques, complex opto mechanical assemblies, contact bonding and other joining technologies. Statistical Methodologies: Graphical methods, Statistical control charts, Regression analysis, Analysis of variance, Sampling and acceptance. Quality and Calibration Techniques : Size and scale, Predictable accuracy, Trace-ability of measurement, Measurement uncertainty, surface texture, roundness. Metrology of machine tools: Alignment and practical tests. Case studies: Inspection and Validation practices adopted in various industries.

Total: 20 Hours

Reference(s)

1. Kalpakjian, S. and Steven R. Schmid, Manufacturing, Engineering & Technology, Pearson.
2. G. T. Smith, Industrial Metrology, Springer, ISBN: 9781852335076, 2012.
3. D. J. Whitehouse, Hand book of surface and nanometrology, 2nd Edition, CRC Press, ISBN: 9781420082012, 2012.
4. John W. Greve, Frank W. Wilson, Hand book of industrial metrology, PHI Publisher, New Delhi
5. Khare MK, Dimensional Metrology, OXFORD-IBH Publishers

18MC0XD INDUSTRIAL HYDRAULICS 1 0 0 1

Course Objectives

- To study the various standards and principles in hydraulics and pneumatics
- To understand the real time application in hydraulics and pneumatics
- To practically study the various hydraulics and pneumatics components and their manufactures

An Introduction to Hydraulics and its Principles - Hydraulic Fluids: Contamination control and fluid conductors - Cartridge Valves - Proportional and Servo Valves - Pressure switches and Pressure gauges - Measuring equipments: Flow , Temp , Oil level - Sound Dampening devices - Filters and other Tank Accessories - Oil coolers - Hydraulic Symbols - Calculations for designing a Hydraulic Systems - Analyzing the Hydraulic circuits - Basics to be considered while Assembling the Hydraulic systems - Standards for Hydraulics - Trouble shooting in Hydraulic Systems - Maintenance requirements in Hydraulic Systems - Application and usage of Hydraulics in Industries - Manufacturers of Hydraulic elements - Manufacturers of Hydraulic Machines - Scope and Future for Hydraulic Industry

Total: 15 Hours

Reference(s)

1. Henry M. Morris and James M. Wiggert., "Applied Hydraulics in Engineering", John Wiley & Sons Publications., New York, 1972.
2. John H. Pippenger, Tyler G. Hicks., "Industrial Hydraulics", Gregg Division McGraw-Hill., New York, 1979
3. Majumdar .S.R., "Oil Hydraulic Systems: Principles and Maintenance"., McGraw-Hill Education, New York 2003

1 0 0 1

18MC0XE DESIGN AND ASSEMBLY OF ELECTRONICS COMPONENTS IN PCB

Course Objectives

- To study various standards and principles related with Electronics Manufacturing Service Industries.
- To understand the process methodologies and safety pre-cautions in EMS industries.
- To acquire practical knowledge about various electronic components, Printed Circuit Boards, assembly of Components, Inspection, Testing and Packing standards.

Introduction to EMS companies Operating Principles of machines in EMS - Electronics component SMT components - THT components other packages. Process methodologies - flowchart for solder paste and SMD glue with through hole component. THT electronics assembly floor: pre-forming cutting placing smaller and bigger components wave soldering fluxing pre heating lead bathing. SMD solder paste process kitting storage screen printing PCB with Solder paste SMD component stuffing or placement pre soldering inspection and correction reflow soldering post soldering inspection rework SMD glue with through hole components - kitting storage screen printing PCB with Solder paste SMD component stuffing or placement pre soldering inspection and correction glue curing glue curing inspection correction through hole stuffing through hole inspection correction wave soldering post soldering inspection and correction cleaning final inspection and correction SMD electronics assembly floor: Kitting stacking of PCBs in PCB loader printing using stencils role of stencils use of glue and solder paste selection criteria pick and place machine - automatic component health monitoring and rejection of defective components introduction to magazines and feeders role of colour in feeders (yellow, red and white) oven reflow ramp stage soak stage TAL stage cleaning materials used in cleaning. Inspection standards in ems need for such standards - IPC standards (Institute for Printed Circuits)

-MDA testing automated optical inspection X ray inspection Testing methods and process - functional testing cleanliness testing workmanship standards - IPC A 610 - Packing and shipping anti static packaging Code of conduct - Nature of job for electronics / Mechatronics engineers in EMS companies- skills set expected in EMS industries from fresh engineering graduates.

Total: 15 Hours

Reference(s)

1. Documents available at http://www.ipc.org - IPC - The global trade association serving the printed board and electronics assembly industries, their customers and suppliers.
2. Handbook - The Course of IPC-A-610 and IPC-J-STD-001 -Standard for Electronics Assemblies from IPC.
3. Handbook In-Plant Training at Electronic Manufacturing Service Industries by Sanjay Technologies, Coimbatore Private Circulation.

18MC0XF CNC SERVICING 1 0 0 1

Course Objectives

- Understand and explain the System Configuration of CNC Machine System
- Analyze the root cause for the machine failures.
- Evaluate and rectify the failures occurred in various Machine Functions
- Generate the safety instructions in handling CNC Machine

Manufacturing CNC Machine Structures, CNC State Display, Configuration Screens- Software, Module, ID Information, Alarm history, Maintenance Information screen, Color and Contrast Setting, Periodic Maintenance Screen,

Hardware Configuration, Connection diagrams, Mounting and De mounting -Connectors, Card and Power supply, DIMM module, PCBs Replacement procedure- Battery, LCD, Fuses.

Diagnostic display, Servo Parameter alarm, Machine position, Reference Position, position Deviation, Displacement Detection, Motor temperature.

Causes and Remedies for failures Machine position, Reference Position, Manual operation, Automatic operation, Jog Operation, Feed rate, Spindle Speed , LCD Display, Abnormal Servo System.

Warnings-Check operation, Replacement, Parameters, Daily Maintenances - Caution, Note, Alarms, Maintenance Parts, Parameters.

Total: 20 Hours

Reference(s)

1. Daniel D Nelson, The CNC Toolbox: Top Service for Machine Tools, Aero Publishing, 2nd Edition 1999
2. Fanuc Series oi-Model C, Maintenance Manual, Fanuc Series, 2016.
3. B S Pabla and M Adithan, CNC Machines, New age International Publishers, 2005

18GE0XA ETYMOLOGY **1 0 0 1**

Course Objectives

- To increase vocabulary and enhance use, knowledge, and understanding of the English language
- To stimulate an appreciation for the English language, including how it developed, how new wordsenter the language, and how it continues to be dynamic
- To demonstrate the importance of a broad-based vocabulary for effective oral and written communication

Course Outcomes (COs)

1. Examine prefixes, roots, and suffixes of Latin, Greek, Germanic, and Anglo-Saxon origin.
2. Explore the historical aspects of language, including the infusion of Indo-European languages, semantic changes, and the influence of world events

7 Hours

CONVENTIONS

Acronyms, Abbreviations, Initialises, Jargon Neologisms - Idiomatic Expressions, Euphemisms Spoonerisms Malapropisms ; Mondegreens - Words Derived from Latin - Words Derived from Greek - Words Derived from - Germanic/Anglo-Saxon - Abstract word Acronym - Affix Analogy - Antonym Apheresis - Blend word Assimilation - Colloquial language Clipped word

8 Hours

WORD ANALYSIS

Concrete word Derivative - Dialect Diminutive suffix - Dissimilation Doublet - Etymology Euphemism - Figurative word Homonym - Hybrid word Inflection - Informal language Infusion - Jargon Linguistics - Loan words Metathesis ; Modify - Philology Onomatopoeia - Romance language Prefix - Semantics - Root-base word - Suffix Slang - Word component Synonym

Total: 15 Hours

Reference(s)

1. Norman, Lewis. Word Power Made Easy,Goyal Publisher. Edition 2.2014.
2. C T Onions. The Oxford Dictionary of English Etymology.Volume 11, Issue 1.70, Wynford Drive, Don Mills, Ont.Oxford University Press.1965.
3. Nurnberg W, Maxwell and Rosenblum, Morris, How to build a better Vocabulary, Completely Revised and Updated, Popular Library.1961

18GE0XB GENERAL PSYCOLOGY 1 0 0 1

Course Objectives

- To provide a basic understanding of psychology
- Defining Psychology and the subject matter of psychology
- To provide an awareness of various methods and branches of psychology
- To explain social and work psychology of people and the need for mental health

Course Outcomes (COs)

1. Understand the basics of human behavior in the workplace and society at large
2. Understand the different fields of psychology and its uses
3. Deal people effectively in their personal and social life

15 Hours

GENERAL PSYCOLOGY

Psychology - Introduction - Mind body relationship - Methods and Scope of Psychology Motivation- Types of Needs- Motivational Cycle- Intelligence: Concept of Intelligence and IQ- measurement - Social psychology: individual behavior and group behavior - Group dynamics- group formation- social influence-social cognition, stereotypes- prejudice- discrimination - Definitions, formation of attitude, factors of attitude formation-change of attitude

Total: 15 Hours

Reference(s)

1. Atkinson & Atkinson, Introduction to Psychology, 6th Ed McGraw-Hill Publications. 1975
2. Mishra, B. K, Psychology: The study of human behavior, 2nd Ed New Delhi: Prentice Hall of India Learning Pvt. Ltd. 2016
3. Baron, R.A., Branscombe. N.R, Social Psychology, 14th Ed. New Delhi; Pearson Education. 2016
4. Morgan, C.T., King, R.A., Weisz, J.R., & Schopler, J. Introduction to Psychology, 7th Ed. New Delhi: Tata McGraw Hill. 1993

18GE0XC NEURO BEHAVIOURAL SCIENCE **1 0 0 1**

Course Objectives

- To provide an introduction to the Cognitive Neuro Science of languages
- To provide an understanding of the Cognitive processes

Course Outcomes (COs)

1. Identify the psychological problems that will impact mental health
2. Value ethical conduct in professional and personal life
3. Recognize the need for rationale and evidence in decision-making

15 Hours

NEURO BEHAVIOURAL SCIENCE

Introduction to physiology - Anatomy - Neuro Biology - Psycho Neuro Science Behaviour and Hormones - Behaviour Modifications - Relaxation Therapy - Psycho Education for minds

Total: 15 Hours

Reference(s)

1. Beck, Robert. Handbook of Physiology. Vol I. Oxford University Press March 15,1996
2. Horon C Philip. Sexology and Mind. Academic Press. 1993
3. Blatteis M.Clark and Melvin J. Fregly. Handbook of Physiology Sect 4, Oxford University Press. March 15, 1996

18GE0XD VISUAL MEDIA AND FILM MAKING 1 0 0 1

Course Objectives

- To acquire fundamental knowledge on development of film making as an art, and video production
- To provide students a basic understanding of the techniques and nuances of visual medium
- To inculcate an ability to plan and produce a short film

Course Outcomes (COs)

1. Understand the significance and techniques of visual medium
2. Analyse and produce visual clippings

15 Hours

ART OF FILMMAKING

History of Cinema (Origin and Narrative) Cinema as a visual medium -Significance of Editing Styles of Editing Editing as a methodology (Hollywood s Invisible Editing) Technical Aspects of Editing (Final Cut Pro (FCP), AVID and Premire Pro) - Basics of video production (pre-production to post-production) Different types of shots and angles Film style and Narrative (Italian Neo-realism, Avant Garde, Russain Formalism, Alternative Cinema etc.,) Regional Cinema to National Cinema Basics of Script Writing (Double and Single Column) Basics of Video Production (script to screen) Final submission of a script for five minutes short film

Total: 15 Hours

Reference(s)

1. Monaco, James, How to Read a Film: Movies, Media, and Beyond. Auckland: OUP, 2009
2. Belavadi, Vasuki, Video Production. India: OUP, 2013

18GE0XE YOGA FOR HUMAN EXCELLENCE 1 0 0 1

Course Objectives

- To know about the history and schools of yoga
- To know the difference between supreme consciousness and individualconsciousness
- To apply the knowledge by the way of practice andintrospection

Course Outcomes (COs)

1. Understand the historical aspects and schools of yoga
2. Ensure their physical & mental wellness through yoga practice
3. Develop the power to concentrate and have stress free mind

15 Hours

YOGA FOR HUMAN EXCELLENCE

What is Yoga , History of Yoga - Yoga in todays scenario- Schools of Yoga - Eight Limbs of Yoga - Sathvic, Rajasic, Tamasic Foods and Thoughts - Science of Yoga Loosening Exercises - Yogasanas & Benefits - Super Brain Yoga - Surya Namaskar Standing Asanas - Sitting Asanas - Prone Asanas - Supine Asanas - MudrasRelaxation
- Pranayama - Meditation

Total: 15 Hours

Reference(s)

1. Vethathiri Publications, Yoga Practices-2, Erode, 2012
2. Iyengar B.K.S. Yoga: Wisdom & Practice, B.K.S. Iyengar, 2009
3. Ramesh Partani, The Complete Secret, Ru Education, 2013
4. http://www.sarvyoga.com/
5. http://www.wikihow.com/Do-Superbrain-Yoga

18GE0XF VEDIC MATHEMATICS 1 0 0 1

Course Objectives

- To improve their calculation speed, analytical thinking and numerical skills

Course Outcomes (COs)

1. Solve problems creatively in mathematics and its applications

15 Hours

VEDIC MATHEMATICS

Addition- Subtraction- System of Multiplication- Squaring numbers- Cube roots- Square roots- Solution of simultaneous equations- Solutions of Quadratic equations

Total: 15 Hours

Reference(s)

1. Dhaval Bathia, Vedic Mathematics, JAICO Publishing House, 29th Edition, Mumbai, 2014
2. Jagadguru Swami Sri Bharathi Krsna Tirthaji Maharaja, Vedic Mathematics, Motilal Banarsidass Publishers Private Limited, New Delhi, 1997

18GE0XG HEALTH AND FITNESS 1 0 0 1

Course Objectives

- To understand the fundamental concepts about physical fitness & its types, training and assessment of physical fitness

Course Outcomes (COs)

1. Acquire the knowledge and training of the individual physical, mental and social concepts
2. Understand the fundamental concepts of yogic practice and physical fitness
3. To acquire the knowledge about nutrition and health consciousness

5 Hours

FITNESS

Meaning & Definition, Need & importance of Physical fitness Types Physical fitness - Exercise, Training and Conditioning and it is important

5 Hours

YOGA AND MEDITATION

Meaning and definition; Principles of practicing; Basic Asana and it important, Pranayama and Meditation - Relaxation Techniques

5 Hours

NUTRITION AND BALANCE DIET

Nutrition and Balance Diet: Needs and Important, Significant of Nutritional Food - Tips for balance diet. Common Diseases for IT professionals: Common diseases – cause, prevention First aid for common sports injuries.

Total: 15 Hours

Reference(s)

1. Anderson, Bob., Pearl, Bill.,&Burke, Edmund R., (2001). Getting in Shape Workout Programs for Men&Women. Mumbai: Jaico Publishing House
2. Baechle, Thomas. R, & Earle, Roger. W., (2000). Essentials of Strength Training and Conditioning. Champaign: Human Kinetics
3. Iyengar, BKS., (2003). The Art of Yoga. New Delhi: Harper Collins Publishers
4. Singh, Hardayal, (1995). Science of Sports training. New Delhi: D.V.S. Publications
5. Begum, Raheena. M., (2002). A Textbook of Foods, Nutrition and Dietetics. New Delhi: Sterling Publishers Private Limited

18GE0XH CONCEPT, METHODOLOGY AND APPLICATIONS OF VERMI COMPOSTING **1 0 0 1**

Course Objectives

- To understand the importance of safe methods of treating solid wastes generated through various human activities
- To appreciate the skills / devices / practices associated with the compact proceedures of biodegradation of unwanted solid residues

Course Outcomes (COs)

1. Understand the role of recycling of garbage leading to the sustenance of our health and environment.
2. Recognize the organic farming practices and production of healthy food products.
3. Prepare and maintain tips for small scale compost units and thereby becoming more environmentally conscious

15 Hours

VERMICOMPOSTING TECHNOLOGY

Ecological roles and economic importance of earthworms - need for earthworm culture, scope and importance of vermiculture , limiting factors - types of worm culturing and the relative benefits Small scale and commercial methods: process & advantages , Vermicomposting equipments, devices, Design and maintenance of vermi bed - Products from vermiculture (matter & humus cycle), vermicastings in organic farming/horticulture - Marketing the products of vermiculture quality control, market research, marketing techniques , Applied vermiculture: use of urban solids & farm/ industrial residues for vermicomposting - Constraints of vermiculture and its future perspectives Artificial Earthworm as a standalone biodegradation assembly.

Total: 15 Hours

Reference(s)

1. Sultan Ahmed Ismail, 2005. The Earthworm Book, Second Revised Edition. Other India Press, Goa, India.4
2. Vermiculture Technology; Earthworms, Organic Wastes and Environmental Management, 2011, Edited by Clive A Edwards, Norman Q Arancon & Rhonda Sherman, CRC Press
3. www.organicgrowingwithworms.com.au
4. New York Times , Scientists Hope to Cultivate and Immune System for Crops

18GE0XI BLOG WRITING

1 0 0 1

Course Objectives:

- To sharpen and improve writing skills, including draft writing, voice, and format.
- To develop general and global knowledge.
- To experiment with non-written forms of online communications, including images, audio and video.
- To be able to add content to your website without the assistance of a webdesigner.

Course Outcome (COs):

Students will be able to:

- Understand the flow of language in natural manner.
- Understand the elements of a blog and be able to use them effectively.
- Find a niche for a long-term blog.
- Gain insight into the strategies, methods and writing of successful bloggers.
- Develop their creativity thinking.

Unit I **7 Hours**

Concept: What is blog writing? Types of blog posts—personal experience, opinion, reviews, advice, news/updates. Focusing your blog—concept, audience, uniqueness, posts. Company blogs. **Structure:** Types of structure—inverted pyramid, feature article, list, story, other options. Creating effective openings. Planning a post.

Unit II **8 Hours**

Voice: Defining and achieving voice. Exploring various voices. Stylistic tips—rhythm, verbs, interesting words, senses, emphasis. Smartness and sarcasm. **Reliability** - accuracy, provability, specificity. Transparency about payments. Sample Blogs and Activities

Total: 15 hours

References:

1. The Elements of Blogging: Expanding the Conversation of Journalism, by Mark Leccese and Jerry Lanson. (Taylor & Francis, 2015) ISBN: 978-1-13-802154-9. $29.95 paperback.
2. *Blogging Heroes,* by Michael Banks. Choose 15 of the 30 interviews/profile segments to read, be sure to include the segments on Chris Anderson and Brian Lam.
3. Huffington Post Complete Guide to Blogging.

16GE0XJ INTERPERSONAL SKILLS

1 0 0 1

Course Objectives:

- To communicate and work effectively, both individually and in groups
- To be able to understand and manage one's own and other's emotions
- To define and solve problems by making decisions about the best course of action

Course Outcome (COs):
Students will be able to:

- Express themselves clearly and confidently
- Listen to others completely and with empathy
- Assert an opinion without diminishing other's opinion
- Be responsible and timely with a willingness to collaborate
- Develop innate personality traits to handle certain social situations

Unit I **7 Hours**
Conversational Skills – Active Listening – Team working – Empathy – Emotional Intelligence

Unit II **8 Hours**
Conflict Resolution and Mediation skills – Decision-making and Problem Solving – Negotiation and Persuasion skills

Total: 15 hours

References:

1. Stephen P. Robbins, Phillip L. Hunsaker, Training in Interpersonal Skills, Pearson, 2015
2. Robert B. Cialdini, Influence: The Psychology of Persuasion, Harper Business; Revised Edition, 2006
3. Suzanne C De Janasz, Karen O Dowo & Beth Z Schneder, Interpersonal Skills in Organisations, McGraw-Hill Education; 5th Edition, 2014

18GE0XK COMMUNITY SERVICE AND LEADERSHIP DEVELOPMENT

- - - 1

Course Objectives

- understand the basic concepts of National Service Scheme and its activity
- identify the needs and problems of the community and involve them in problem solving
- develop competence required for group living and acquire leadership qualities

Course Outcomes (COs)

- understand the community in which they work and render their service
- develop among themselves a sense of social and civic responsibility

Community service and leadership development

Introduction and Basic Concepts of NSS: History-philosophy-aims & objectives of NSS- Emblem, flag, motto, song, badge- Organizational structure – roles and responsibilities functionaries. NSS Programmes and Activities: Concept of regular activities, special camping, DayCamps-Basisofadoption of village/slums-Methodology of conducting Survey -Financial pattern ofthescheme -Coordination withdifferent agencies-Maintenance oftheDiary. Community Mobilization: Mapping of community stakeholders-Designing the message in the context of the problem and the culture of the community- Identifying methods of mobilization-Youth-adult partnership.Health, Hygiene & Sanitation: Definition, needs and scope of health education- Food and Nutrition - Safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan). Entrepreneurship Development: Definition & Meaning - Qualities of good entrepreneur - Steps/ways in opening an enterprise -Role of financial and support service Institutions.

Total : 15 Hours

Reference(s)

1. A Hand book on National Service Scheme, Anna University, Chennai, 2012
2. http://nss.nic.in/intro.asp
3. Delgado-Gaitán and Concha, The Power of Community: Mobilizing for Familyand SchoolingNew York: Rowman& Littlefield Publishing, Inc. 2001
4. James Bailey,Guide to Hygiene and Sanitation in Aviation, World healthorganization, 2nd edition. 1980
5. AnuradhaBasu, Mark Casson, Nigel wadeson and Bernard Yeung, The oxford hand book of entrepreneurship, Oxford Press. 2009

18GE0XL NATIONAL CADET CORPS 1 0 0 1

Course Objectives

- To understand the importance of NCC and its organization.
- To realize the skills in the applications of drill and weapon training.
- To analyze the factors in National unity
- To identify the utility of smart materials in engineering applications.

Course Outcomes (COs)

- Recall the motto and aim of NCC.
- Implement synergy in disaster management.
- Execute an example patriotic leader to serve nation.

NCC ORGANIZATION

National Cadet Corps: Aim and Objectives - Administrative and Organizational pattern - NCC flag and NCC song - Duties, Responsibilities and Conduct by NCC Cadets - Badges of ranks in NCC and Armed forces- Types of NCC camps - Eligibility conditions for writing B and C certificate examinations. Cadet welfare society and Career opportunities for NCC cadets.

DRILL AND WEAPON TRAINING

Drill: Aims of drill - Types of drill - Foot drill, Arms drill and Ceremonial drill. Word of commands, Guard of honour. Weapon training - Rifles used in NCC: Parts and Characteristics of 0.22" and INSAS – Stripping, Assembling and Cleaning of weapons.

NATIONAL INTEGRATION AND SOCIAL AWARENESS

National Integration: Introduction - Constitution of India- Importance and Necessity - Factors affecting National integration - Role of NCC in National integration. Social service and its need - Rural development programs - NGO's role and Contribution - Social Security schemes.

PERSONALITY DEVELOPMENT AND LEADERSHIP

Personality Development: Introduction - Factor influences in personality development. Leadership: Leadership traits and Skills - Indicator of good leader - Honour code concept - Type of leaders - Case studies of effective leader.

DISASTER MANAGEMENT AND FIRST AID

Disaster types - Natural and Manmade disasters. Role of NCC cadets in disaster management. Civil defence: Civil defence measures - Civil defence services. First aid: First aid kits and Equipments - First aid for snake bite, Sun stroke and Drowning - Respiration -Types of respiration.

Total: 20 Hours

REFERENCES

1. Cadet's Hand book Common subject, DG NCC, New Delhi.
2. Cadet's Hand book Special subject, DG NCC, New Delhi.
3. Misra R.C and Sanjaykumar Mishra "A HAND BOOK OF NCC'' (English), Kanti Prakashan, 2016.
4. Gupta R. K, NCC: Handbook of NCC Cadets for 'A', 'B' and 'C' Certificate Examinations (English) RPH Editorial Board, 2018.

18GE0XM NEW AGE INNOVATION AND ENTREPRENEURSHIP

1 0 0 1

- To make the participants understand as to how to get along with the task of setting independent business units and on the various facets of running a business
- To get the budding young entrepreneurs to appreciate the structured knowledge of the dynamics of operationalizing a business opportunity

Programme Outcomes (POs)

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

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

f. 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.

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

Course Outcomes (COs)

1. Understanding entrepreneurship as an important career option
2. Concept and methodology of idea translation to viable start-ups
3. Events to occur in the building of a technology based venture for students or working professionals or women
4. Overview of Indian trends in the start-up scene

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						2			2					
2						2			2					
3		-				2			2					
4			-			2			2					

UNIT I **15 Hours**

NEW AGE INNOVATION AND ENTREPRENEURSHIP

Introduction to Entrepreneurship - Opportunity Identification ideation -MVPPositioning as an Entrepreneur Starting own Business - Developing Effective Business Model - Industry and Competitor Analysis - Building Business PlanMentoring Session with Investors- Legal and Ethical Foundation for Startup. Types of startups and licensing systems - MSME -Evaluating the Financial Strength of a New Venture/Project - Getting Funding - Types of Sources VCs, Angel funding, PE etc. -Marketing Strategies for New Ventures - IT Systems - IPR - Strategies for New Venture Growth - Talent Acquisition and Management for New Ventures - Valuation Challenge in Entrepreneurship - Intrapreneurship Sustainability - Exit strategies and Start-up trends in India.

Total: 15 Hours

Reference(s)

1. Kathleen R. Allen, Launching New Ventures, South-WesternCengage Learning, 6th Edition, 2012
2. Alex Osterwalder and Yves Pigneur, Business Model Generation, publishedby the authors, 2010
3. Branson. R. Business stripped bare, New York, Penguin books, 2011
4. Moris MH, Kuratko DF and Covin JG, Corporate entrepreneurship and innovation, 3 edition, Mason, Oh; CENGAGE/SOUTH WESTERN publisher, 2

18GE0XN DISRUPTIVE INNOVATION BASED START UP ACTIVITIES

1 0 0 1

Course Objectives

- To make the participants understand as to how to get along with the task disruptionled innovations.
- To get the budding young entrepreneurs to appreciate the structured knowledge of the dynamics of operationalizing creativity based disruption strategy

Course outcomes

- Understanding contemporary entrepreneurship as an important careeroption
- Concept and methodology of creative disruption to viable start-ups
- Events to occur in the building of a technology based venture for students or working professionals or women with disruptive technology option
- Overview of Indian trends with reference to disruptive innovation based start-ups

Unit I **15 Hours**

Creativity linked innovation – Differences between Disruptive & incremental Innovations - Historical, theoretical, and practical evolution of disruptive innovation (DI). - Idea generation & communication of creativity leading to DI. Innovation management concepts in DI based entrepreneur generation - How do firms bring in new business models and get new products and services to the market? – Investor preferences in core versus new or disruptive business models - disruptors and the disrupted frameworks for assessing company's capabilities and rethinking product, market and strategy - Right customers for DI: strategy in a world that is changing so rapidly – Application of disruptive theories to complex problems and opportunities.

Total 15 Hours

References

1. https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1540-5885.2005.00177.x
2. http://www.brinq.com/workshop/archives/2005/01/08/what-is-disruptive-innovation
3. https://hbr.org/2006/12/disruptive-innovation-for-social-change

18GE0XO SOCIAL PSYCHLOGY

1 0 0 1

Course Content

Introduction-Ice breaker, TIme Line , Tasks and Challenges of the age(Erik Erikson),
Introduction to Reproductive Health, Student Questions
Reproductive Organs, Menstruation, Changes during Puberty, Difference between Sex and Gender
Introduction to the origins of Patriarchy, Gender
Images of Beauty and Body Image, Introduction to Media, Feedback Attraction,
Friendship , Differences and Similarities
Sexuality
Boundaries
Relationships, Marriage, Love, Emotional Health
Sexual Abuse and Safety
Role of Media
Abortions, Contraception,
Wrapping up the Course

Total: 20 Hours

1 0 0 1

18GE0XP FM RADIO BROADCASTING TECHNOLOGY

Course Objectives

- The course focuses on community radio technology and various program productions techniques for FM Radio Broadcasting.

Course Outcomes (COs)

- Understand the hardware required for field recording and setting up a studio and carryout studio and field recording.
- Examine the available options for telephony interfaces for radio.
- Demonstrate proper techniques of wiring, fixing of connectors, soldering and use of tools and equipment for studio work.

UNIT I **3 Hours**

INTRODUCTION TO AM/ FM RADIO

History of Radio-Types of Radio and its Reach- Entertainment Radio- Community Radio- Internet Radio-Satellite Radio. Evolution of Community Radio (CR) in India- principles behind setting up of FM/CR-policy guidelines and their impact on technology and content of a CR station- fundamental principles behind deciding the technology for a CR station.

UNIT II **3 Hours**

STUDIO TECHNOLOGY

Use of Microphones-Console handling-OB Recordings & Live Shows-Properties and components of sound-difference between analogue and digital audio-hardware required for field recording and setting up a studio-fundamental principles for setting up an audio studio.

UNIT III **3 Hours**

AUDIO PRODUCTION

Concept of recording and storing audio-hardware related to audio recording-open source software solutions for audio production-telephony interfaces for radio- audio Post Production. Voice Culture Exercise- Radio Production Techniques & Tools.

UNIT IV **3 Hours**

STUDIO OPERATIONS

Wiring, fixing of connectors, soldering and use of tools and equipment- preventive and corrective maintenance of studio and equipment.

UNIT V **3 Hours**

RADIO TRANSMISSION TECHNOLOGY

Components of the FM transmission chain- FM transmitter-different types of FM antenna - coaxial cable-propagation and coverage of RF signals-FM transmitter setup- Radio audience - measurements systems.

Total: 15 Hours

Reference(s)

1. UNESCO (2001). Community Radio Handbook.
2. Vinod Pavarala, Kanchan K Malik, Other Voices: The Struggle for Community Radio in India, SAGE Publications India, 2007.
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