SRI CHANDRASEKHARENDRA SARASWATHI VISWA MAHAVIDYALAYA

SCSVMV UNIVERSITY

(University Established under section 3 of UGC Act 1956)

Accredited with "B" Grade by NAAC

Enathur, Kanchipuram - 631561

CURRICULUM FOR

B.E (MECHATRONICS ENGINEERING)

FULL TIME PROGRAMME

CHOICE BASED CREDIT SYSTEM

(For Candidates admitted from the year 2014 onwards)

MECHATRONICS ENGINEERING

CHOICE BASED CREDIT SYSTEM FOR BE (MECHATRONICS) FULL-TIME PROGRAMME

CREDITS

Theory courses: Courses with 4/3 credits will be assigned 3 Lectures and 2/1 Tutorial hours per week.

Practical courses: Courses with 2 credits will be assigned 3 hours of lab/practical work per week

Each semester curriculum shall normally have a blend of theory and practical courses. In the first year the total number of credits will be 25 for each Semester. For semester III to VII, the average credits per semester will be 25 and for semester VIII, the credits will be 18. For the award of the degree, a student has to earn a minimum of 196 credits.

DURATION OF THE PROGRAMME

A student is normally expected to complete B.E (MECHATRONIC**S**) programme in four years and in any case, not more than seven years from the time of admission.

REGISTRATION FOR COURSES

A newly admitted student will automatically be registered for all the courses prescribed for the first year, without any option.

All other students shall submit a completed registration form indicating the list of courses intended to be credited during the next semester. This registration will be done a week before the last working day of the current semester. Late registration, with the approval of the Dean on the recommendation of the Head of the Department, along with a late fee will be done, up to the last working day.

Registration for the project work shall be done only for the final semester.

ASSESSMENT

The break-up details of Assessment and Examination marks for Theory subjects are as follows.

Continuous Internal Assessment comprising of tests, assignments, seminars, group discussion and attendance	:	40 Marks
End semester Examination	:	60 Marks

The break-up details of the Assessment and Examination marks for Practical are as follows.

Continuous Internal Assessment comprising of Model tests, Observation, Record work and attendance	:	40 Marks
End semester Examination	:	60 Marks

The project work will be assessed for 40 marks by a Committee consisting of the Guide and the Head of the Department. The Head of the Department is said to be the Chairman. 60 marks are allotted for the project viva voce examination at the end of the semester.

WITHDRAWAL FROM A COURSE

A student can withdraw from the course at any time before a date fixed by the Head of the Department prior to the second assessment, with the approval of the Dean on the recommendation of the Head of the Department.

TEMPORARY BREAK OF STUDY

A student can take a one-time temporary break of study covering the current year/semester and/or the next semester with the approval of the Dean on the recommendation of the Head of the Department, not later than seven days after the completion of the mid-semester test. However, the student must complete the entire program within the maximum period of seven years.

SUBSTITUTE ASSESMENT

A student, who has missed, for genuine reasons accepted by the Head of the Department, one or more of the assessments of a course other than the end semester examination, may take a substitute assessment for any one of the missed assessments. The substitute assessment must be completed before the comment of the end semester before examination.

A student who wishes to have a substitute assessment for a missed assessment must apply to the Head of the Department within a week from the date of the missed assessment.

ATTENDANCE REQUIREMENTS

To be eligible to appear for the examination in a particular course, a student must put in a minimum of 80% of attendance in the course. However, if the attendance is 70% or above but less than 80% in any course, the authorities can permit the student to appear for the examination in the course on payment of the prescribed condonation fee.

A student who withdraws from or does not meet the minimum attendance requirement in the course must re-register for and repeat the course.

PASSING AND DECLARATION OF EXAMINATION RESULTS

All assessments of all the courses on the absolute mark basis will be considered and passed by the results passing board in accordance with the rules of the University. Thereafter, the Controller of Examinations shall convert the marks for each course to the corresponding letter grade as follows, compute the grade point average & cumulative grade point average and prepare the grade cards.

90 to 100 marks	-	Grade ‘S’
80 to 89 marks	-	Grade ‘A’
70 to 79 marks	-	Grade ‘B’
60 to 69 marks	-	Grade ‘C’
55 to 59 marks	-	Grade ‘D’
50 to 54 marks	-	Grade ‘E’
less than 50 marks	-	Grade ‘F’
Insufficient attendance	-	Grade ‘I’
Withdrawn from the course	-	Grade ‘W’

A student who obtains less than 50 marks out of 100 in the subject or less than 24 out of 60 in External exam or is absent for the examination will be awarded Grade ‘F’.

A student who earns a grade of S, A, B, C, D or E for a course is declared to have successfully completed that course and earned the credits for that course. Such a course cannot be repeated by the student.

A student who obtains letter grade F in a course has to reappear for the examination in that course.

The following grade points are associated with each letter grade for calculating the grade point average.

S–10; A–9; B–8; C–7; D–6; E–5; F–0

A student can apply for revaluation of one or more of his /her examination answer papers within a week from the date of issue of Grade sheet to the student on payment of the prescribed fee per paper. The application must be made to the Controller of Examinations with the recommendation of the Head of the Department.

After results are declared, Grade cards will be issued to the students. The Grade card will contain the list of courses registered during the year/semester, the grades scored and the grade point average (GPA) for the year/semester.

GPA is the sum of the products of the number of credits of a course with the grade point scored in that course, taken over all the courses for the Year/Semester , divided by the sum of the number of credits for all courses taken in that year/semester. CGPA is similarly calculated considering all the courses taken from the time of admission.

After successful completion of the program, the Degree will be awarded with the following classification based on CGPA:

For First Class with Distinction, the student must earn a minimum of 160 credits within four years from the time of admission, pass all the courses in the first attempt and obtain a CGPA of 8.25 or above.

For First Class, the student must earn a minimum of 195 credits within five years from the time of admission and obtain a CGPA of 6.5 or above.

For Second Class, the student must earn a minimum of 195 credits within seven years from the time of admission.

ELECTIVES

Apart from the various Core courses offered in the curriculum of the branch of specialization, a student can choose elective subjects from a list of electives offered by the Department and from other Departments with the approval of the Head of the Department and the Head of the Department offering the course.

Examination Pattern for Sanskrit & Indian Culture paper

There will not be any External examination for Sanskrit and Indian Culture paper. Performance of students will be assessed through tests and assignments conducted by the same Department. The internal assessment pattern is as follows.

First test	30 Marks
Second test	30 Marks
Assignment (G.D + Seminar + Attendance + Class test)	40 Marks
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Total	100 Marks

Total Marks	100Marks
Minimum marks Percentage for Passing	50%

In the last semester (B.E. - VIII) marks are allotted for test (50) and project work (50). A Candidate shall be declared to be passed the examination, if he/she has secured a minimum marks of 50

SRI CHANDRASEKHARENDRA SARASWATHI VISWA MAHA VIDYALAYA UNIVERSITY
COURSE CONTENT AND SCHEME OF EXAMINATION

BE – MECHATRONICS ENGINEERING

CURRICULAM FOR THE STUDENTS ADMITTED FROM 2014 – 15

I SEMESTER

SL.NO.	SUB CODE	SUBJECT	C	IA	E	TM	DE
1	EN1T1	ENGLISH -I	3	40	60	100	3 Hrs
2.	MA1T2	BASIC MATHEMATICS FOR ENGINEERING - I	3	40	60	100	3 Hrs
3.	PH1T3	ENGINEERING PHYSICS	3	40	60	100	3 Hrs
4.	EE1T4	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	3	40	60	100	3 Hrs
5.	CS1T5	COMPUTER PROGRAMMING	3	40	60	100	3 Hrs
6.	SA1T1	SANSKRIT AND INDIAN CULTURE - I	1	100	-	100	2 Hrs
7.	ME1P6	ENGINEERING GRAPHICS (Practical)	3	40	60	100	3 Hrs
8.	PH1P7	PHYSICS LAB	2	40	60	100	3 Hrs
9.	CS1P8	COMPUTER PROGRAMMING LAB	2	40	60	100	3 Hrs
10.	EE1P9	BASIC ELECTRICAL WORKSHOP	2	40	60	100	3 Hrs
							Total no of credits: 25

II SEMESTER

SL.NO.	SUB CODE	SUBJECT	C	IA	E	TM	DE
1	EN2T1	ENGLISH -II	3	40	60	100	3 Hrs
2.	MA2T2	BASIC MATHEMATICS FOR ENGINEERING - II	3	40	60	100	3 Hrs
3.	CH2T3	ENGINEERING CHEMISTRY	3	40	60	100	3 Hrs
4.	ME2T4	BASIC CIVIL AND MECHANICAL ENGINEERING	3	40	60	100	3 Hrs
5.	EE2T5	ELECTRIC CIRCUIT THEORY	3	40	60	100	3 Hrs
6.	CH2T6	ENVIRONMENTAL SCIENCE AND ENGINEERING	3	40	60	100	3 Hrs
7.	SA2T2	SANSKRIT AND INDIAN CULTURE - II	1	100	-	100	2 Hrs
8.	CH2P7	CHEMISTRY LAB	2	40	60	100	3 Hrs
9.	EE2P8	CIRCUIT THEORY LAB	2	40	60	100	3 Hrs
10.	ME2P9	BASIC MECHANICAL WORKSHOP	2	40	60	100	3 Hrs
							Total no of credits: 25

C- Credits, IA - Internal Assessment, E External Assessment, TM - Total Marks, DE – Duration of Examinations

III SEMESTER

SL.NO.	SUB CODE	SUBJECT	C	IA	E	TM	DE
1	MH3T1	Mathematics III	3	40	60	100	3 Hrs
2.	MR3T2	Manufacturing Technology for Mechatronics	3	40	60	100	3 Hrs
3.	EC3T4	Electronic Devices and Circuits	3	40	60	100	3 Hrs
4.	ME3T3	Material Science & Metallurgy	3	40	60	100	3 Hrs
5.	EE3T3	Electrical Engineering	3	40	60	100	3 Hrs
6.	CS3T6	Object Oriented Programming using C++	3	40	60	100	3 Hrs
7.	SA3T3	Sanskrit & Indian Culture III	1	100	-	100	2 Hrs
8.	SS3P1	Soft Skills - I*	1*	-	-	-	-
9.	ME3P6	Manufacturing Process Lab	2	40	60	100	3 Hrs
10.	EI3P7	Electronic Devices and Circuits Lab	2	40	60	100	3 Hrs
11.	CS3P9	Object Oriented Programming using C++ Lab	2	40	60	100	3 Hrs
	Total no of credits: 25						

IV SEMESTER

SL.NO.	SUB CODE	SUBJECT	C	IA	E	TM	DE
1	MH4T1	Mathematics IV	3	40	60	100	3 Hrs
2.	EI4T2	Linear Integrated Circuits	3	40	60	100	3 Hrs
3.	ME4T4	Mechanics of Solids & Fundamentals of Fluids	3	40	60	100	3 Hrs
4.	EI4T3	Industrial Instrumentation	3	40	60	100	3 Hrs
5.	EE4T2	Digital Electronics	3	40	60	100	3 Hrs
6.	EE4T7	Measurement & Instrumentation	3	40	60	100	3 Hrs
7.	SA4T4	Sanskrit & Indian Culture IV	1	100	-	100	2 Hrs
8.	SS4P2	Soft Skills -II*	1*	-	-	-	-
9.	EI4P7	LIC and Digital Electronics Lab	2	40	60	100	3 Hrs
10.	ME4P9	Strength of Materials & Fluid Mechanics Lab	2	40	60	100	3 Hrs
11.	EE4P6	Measurement & Instrumentation Lab	2	40	60	100	3 Hrs
							Total no of credits: 25

V SEMESTER

SL.NO.	SUB CODE	SUBJECT	C	IA	E	TM	DE
1	MH5T1	Mathematics V	3	40	60	100	3 Hrs
2.	EI5T2	Sensors & Actuators	4	40	60	100	3 Hrs
3.	MG5T3	Thermo Dynamics & Heat transfer	3	40	60	100	3 Hrs
4.	EC5T4	Control Systems	3	40	60	100	3 Hrs
5.	MG5T4	Theory of Machines	3	40	60	100	3 Hrs
6.	EI5T4	Power Electronics & Drives	3	40	60	100	3 Hrs
7.	SA5T5	Sanskrit & Indian Culture V	1	100	-	100	2 Hrs
8.	SS5P1	Soft Skills - III*	1*	-	-	-	-
9.		Open Elective***	2***	40	60	100	3 Hrs
10.	MH5P7	Manufacturing and Assembly drawing(Practical)	2	40	60	100	3 Hrs
11.	ME5P9	Thermo Dynamics Lab	2	40	60	100	3 Hrs
12.	EC5P7	Power Electronics & Drives Lab	2	40	60	100	3 Hrs
13.	PT5T1	Industrial Training Practice - I**	1**	-	-	-	-
							Total no of credits: 26

VI SEMESTER

SL.NO.	SUB CODE	SUBJECT	C	IA	E	TM	DE
1	MH6T1	Mathematics VI – OPERATION RESEARCH	3	40	60	100	3 Hrs
2	ME6T3	Design of Machine Elements	4	40	60	100	3 Hrs
3	EC6T3	Microprocessors & Microcontrollers	3	40	60	100	3 Hrs
4	ME6T5	CAD & CAM	3	40	60	100	3 Hrs
5	ME6T8	Fluid Power Systems	3	40	60	100	3 Hrs
6	MR6T6	Micro Electro Mechanical systems- MEMS	3	40	60	100	3 Hrs
7	SA6T6	Sanskrit & Indian Culture VI	1	100	-	100	2 Hrs
8	SS6P4	Soft Skills - IV*	1*	-	-	-	-
9	EC6P7	Microprocessors & Microcontrollers Lab	2	40	60	100	3 Hrs
10		CAD & CAM Lab	2	40	60	100	3 Hrs
11	ME6P9	Fluid Power Control Lab	2	40	60	100	3 Hrs
12	PT6P2	Industrial Training Practice - II **	1**	-	-	-	-
							Total no of credits: 26

VII SEMESTER

SL.NO.	SUB CODE	SUBJECT	C	IA	E	TM	DE
1	MH7T1	Robotics & Automation	3	40	60	100	3 Hrs
2.	EI7T2	Embedded Systems	3	40	60	100	3 Hrs
3.	MH7T3	Design of Mechatronics Systems	3	40	60	100	3 Hrs
4.	MH7T4	PLC & Data acquisition Systems	4	40	60	100	3 Hrs
5.		Elective - I	3	40	60	100	3 Hrs
6.		Elective - II	3	40	60	100	3 Hrs
7.	MH7P6	Mechatronics Lab(Robotics & Simulation)	2	40	60	100	3 Hrs
8.	MH7P7	PLC Lab	2	40	60	100	3 Hrs
9.	MH7Z1	Project Work (Phase - I)	2	40	60	100	3 Hrs
							Total no of credits: 25

VIII SEMESTER

SL.NO.	SUB CODE	SUBJECT	C	IA	E	TM	DE
1	MH8T1	Principles of Management and Professional Ethics	3	40	60	100	3 Hrs
2	MH8T2	Machine Vision	3	40	60	100	3 Hrs
3		Elective - III	3	40	60	100	3 Hrs
4		Elective - IV	3	40	60	100	3 Hrs
5.	MH8Z2	Project Work (Phase - II)	6	40	60	100	3 Hrs
							Total no of credits: 18

C-Credits, IA-Internal Assessment, E-External, TM- Total Marks, DE-Duration of Exam.

Total No of Credits (from III Semester to VIII semester) : 145

Total No of Credits (from I semester to VIII semester) : 195

Soft Skills* The syllabus and the course will be monitored by placement and training cell. It carries 1credit/Sem from III Semester to VI Semester which is not considered for CGPA calculation.

Industrial Training Practice** For Industrial Practice, students have to go for Industrial Training for a prescribed period. It carries 1credit that is not considered for CGPA calculation.

Open Elective*** Students have to take one course from other department (from non engineering department only). Faculties from other department will handle this paper. It carries 1credit which is not considered for CGPA calculation.

B.E. /B.Tech. Open elective **Semester – V**

S.No	Sub. Code	Subject	Credit
1	OE5TA	**ASTRO-PHYSICS**	**1**
2	OE5TB	**BIOINFORMATICS**	**1**
3	OE5TC	**BUSINESS ADMINISTRATION**	**1**
4	OE5TD	**COMMUNICTION SKILLS**	**1**
5	OE5TE	**FINANCE FOR NON FINANCE MANAGERS**	**1**
6	OE5TF	**FRENCH PRIMER**	**1**
7	OE5TG	**FUEL CELL & BATTERIES**	**1**
8	OE5TH	**GERMAN PRIMER**	**1**
9	OE5TI	**HINDI LITERATURE**	**1**
10	OE5TJ	**HR MANAGEMENT**	**1**
11	OE5TK	**INSTRUMENTAL METHODS OF CHEMICAL ANALYSIS**	**1**
12	OET5L	**JAPANESE**	**1**
13	OET5M	**KEYBOARD**	**1**
14	OET5N	**LOGISTICS AND SUPPLY CHAIN**	**1**
15	OET5O	**NANO TECHNOLOGY**	**1**
16	OET5P	**NUCLEAR AND PARTICLE PHYSICS**	**1**
17	OET5Q	**PSYCHOLOGY**	**1**
18	OET5R	**PANINI GRAMMAR**	**1**
19	OET5S	**STATISTICAL METHODS WITH EXCEL**	**1**
20	OET5T	**VIOLIN**	**1**
21	OET5U	**VOCAL MUSIC**	**1**

LIST OF ELECTIVES

SEVENTH SEMESTER

S.No		Sub. Code	Subject	Credit
1	Elective - I	MH7EA	Analytical Instrumentation	3
2		MH7EB	Principles of Communication	3
3		MH7EC	Process control Instrumentation	3
4		MH7ED	Virtual Instrumentation	3
5		MH7EE	Digital Control Systems	3
1	Elective - II	MH7EF	Finite Element Analysis	3
2		MH7EG	Design of Jigs and Fixtures	3
3		MH7EH	Mechanical Vibrations and Noise Control	3
4		MH7EI	Rapid Manufacturing Technologies	3
5		MH7EJ	Computer Integrated Manufacturing -CIM	3

EIGHT SEMESTER

S.No		Sub. Code	Subject	Credit
1	Elective - III	MH8EA	Adaptive Control	3
2		MH8EB	Aircraft Instrumentation	3
3		MH8EC	Neural Networks and Fuzzy Logic Control	3
4		MH8ED	Energy Management and Industrial Safety	3
5		MH8EE	Biomedical Instrumentation	3
1	Elective - IV	MH8EF	TQM and Reliability Engineering	3
2		MH8EG	Automobile Engineering	3
3		MH8EH	Autotronics	3
4		MH8EI	Factory Automation	3
5		MH8EJ	Process Planning and Cost Estimation	3

SYLLABUS

I SEMESTER

SUB CODE: EN1T1 **ENGLISH – I** **Sem:I** **Credit 3**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)**

NIT - I **TECHNICAL WORDS, PHOBIA WORDS AND MANIA WORDS**
{List Enclosed}

UNIT- II **FUNCTIONAL GRAMMAR**
Parts of Speech, Articles, Prepositions, Verbs, Adverbs, Sentence Analysis, Tenses, Basic Patterns, Prefixes and Suffixes, Syllabification and Spelling

UNIT -III **ESSAYS**

1. Spoken English and Broken English G.B. Shaw
2. Arguing - Robert Lynd
3. The Verger - Somerset Maugham
4. The Beauty Industry Aldous Huxley

UNIT –IV Paragraph writing relating to Charts, Tables and graphs and Acronyms.

UNIT - V Dialogue Writing, Advertisement

VOCABULARY

Technical Words:

Collateral
Amalgamation
Permeability
Volatile
Defy
Paradox
Plague
Douse
Fantasy
Malevolent
Benevolent
Myth
Crux
Vagaries
Ballast
Sanctuary
Repository
Panorama
Heritage
Innovation
Nuances
Vicissitudes
Nodal
Viable
Deluge
Amphibian
Ornithologist
Pulmonary
Retard
Impediment
Rapport

Mania - Words:

1. Bibliomania
2. Dipsomania
3. Egomania
4. Kleptomania
5. Megalomania
6. Pyromania

Phobia - Words

1. Acrophobia
2. Gynophobia
3. Hydrophobia
4. Claustrophobia
5. Ergophobia
6. Zoophobia
7. Agoraphobia
8. Arachnophobia
9. Triskaidekaphobia
10. Xenophobia

SUB CODE: MA1T2 MATHEMATICS FOR ENGINEERS – I Sem:I Credit 3

Branch: MECHATRONICS (For Students admitted from 2014 onwards)

UNIT – I NUMERICAL SOLUTION OF ALGEBRAIC, TRANSCENDENTAL EQUATION

Solution of algebraic and transcendental equations - Bisection method Method of successive approximation-Method of false position (Regula-Falsi Method) - Newton-Raphson method-Honer's method-Secant method. Matlab applications.

UNIT- II EIGEN VALUES, EIGEN VECTORS

Rank of matrix Elementary transformation Elementary matrices-solution of linear system of equations-Cramer's rule-Matrix inversion method-Consistency of linear system of equations; Linear Transformations Linear dependence of vectors Eigen values and Eigen vectors Properties of Eigenvalues Cayley Hamilton theorem (without proof). Matlab applications

UNIT- III DIFFERENTIAL CALCULUS AND DIFFERENT IAL EQUATION

Function of two or more variables Partial derivatives Total derivative Taylor's expansion Maxima and Minima of functions of two variables Jacobians Homogenous functions - Euler's theorem for homogeneous function Operator D Rules for finding Complementary function Inverse operator Rules for finding particular Integral Working procedure to solve the equation. - Method of undetermined coefficients

UNIT-IV LINEAR DIFFERENTIAL EQUATIONS

Method of variation of parameters- Equations reducible to linear equations with constant coefficients: Cauchy's homogeneous linear equation , Legendre's linear equation - Linear dependence of solutions - Simultaneous linear equations with constant coefficients

UNIT -V VECTOR DIFFERENTIATION

Differentiation of vectors - Curves in space - Velocity and acceleration - Scalar and vector point functions vector operator Del- Del applied to scalar point functions : Gradient - Del applied to vector point functions Divergence and curl - Physical interpretation of divergence and curl-irrotational and solenoidal vectors Del applied twice to point functions - Del applied to products of point functions-Conservative vector field.

Note: Questions are to be set on problem solving and not on the theoretical aspects.

TEXT BOOKS:

1. Grewal B.S, Higher Engineering Mathematics, 41st Edition, Khanna Publishers, New Delhi, 2011.

REFERENCE BOOKS:

1. Alan Jeffrey, Advanced Engineering Mathematics, Academic Press
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons
3. Gerald C.F and Wheatley P.O, Applied Numerical Analysis, Addison-Wesley Publishing Company

SUB CODE: PH1T3 ENGINEERING PHYSICS Sem: I Credit 3

Branch: MECHATRONICS (For Students admitted from 2014 onwards)

UNIT- I PROPERTIES OF MATTER

Elasticity

Stress - Strain - Hooke's law - Elastic Behavior of Material - Factors affecting elasticity - Young's modulus by cantilever depression - Non-uniform bending - Application -I-shaped girders. Torsional Pendulum - Couple per unit twist of a wire- Time period-Application- Determination of Rigidity Modulus.

UNIT- II TECHNICAL ACOUSTICS

Acoustics

Acoustics of buildings - Reverberation - Weber Fechner law- Factors affecting acoustics of a building and remedies - Noise Pollution - Noise control in machines - Sabine's formula for standard reverberation time-Absorption coefficient.

Ultrasonics

Generation - Piezoelectric method - Magnetostriction method - Application of Ultrasonics in industries NDT.

UNIT- III PHOTONICS

LASER

Properties- Population inversion- Einstein's theory of stimulated emission of radiation - Different types of Lasers Nd:YAG laser, CO2 laser Application of Lasers in holography.

Fiber Optics

Types of Optical Fibers (material, mode, index) - Fiber losses - acceptance angle - Numerical aperture - applications in engineering (communication).

UNIT -IV CRYSTAL PHYSICS

Crystalline and amorphous solids - lattice and unit cell - seven crystal systems and Bravais lattices - crystal planes and directions- Miller indices-Expression for interplanar distance - Atomic radius, Coordination number and packing factor for simple structures: SC, BCC, FCC and HCP.

UNIT -V PHYSICS OF MATERIALS

Dielectric materials

Definition - Dielectric Breakdown - Dielectric loss - Internal field - Claussius Mossotti relation.

Superconducting materials

Introduction - Meissner effect - Type I & Type II superconductors - BCS theory-Applications.

Nanomaterials

Introduction - Synthesis of nano materials - Top - down and Bottom - up approach- Ball milling- PVD method- Applications.

TEXT BOOKS

1. Applied Physics for Engineers K.Venkatramanan, R.Raja, M.Sundarrajan (Scitech)
2. Applied Engineering Physics Rajendran & Marikani (Tata McGraw Hill)
3. Modern Engineering Physics R.K.Gaur & S.L.Gupta, Dhanpat Rai publications.
4. Modern Engineering Physics A.S.Vasudeva S.Chand & Company Ltd.
5. Engineering Physics Bhattacharya, Bhaskaran Oxford Publications.
6. Engineering Physics I & II G.Senthilkumar, VRB publications.

REFERENCE BOOKS

1. Properties of Matter - D.S.Mathur (Unit I)
2. Sound - Brijilal & Subramanian (Unit II)
3. Engineering Physics - M.N.Avadhanulu (Unit III)
4. Fiber Optics - R.Agarwal (Unit III)
5. Solid state Physics C.Kittal (Unit IV)
6. Modern Physics - R.Murugesan (Unit IV, V)
7. Fundamentals of Physics, 6th Edition, D. Halliday, R. Resnick and J. Walker, John Wiley and Sons, New York.

SUB CODE: EE1T4 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING Sem: I Credit 3

Branch: MECHATRONICS (For Students admitted from 2014 onwards)

UNIT -I ELECTRICITY AND MAGNETISM

Electric current - Ohms law - Temperature coefficient of resistance-Kirchhoff's laws Electromagnetic induction: Relation between magnetism and electricity - Production of induced E.M.F and current - Faraday's laws of electromagnetic induction - Direction of induced E.M.F and current-Fleming's Right rule-Lenz's law-Induced E.M.F Dynamically induced E.M.F-Statically induced E.M.F-Self inductance-Coefficient of self inductance (L)-Mutual inductance Coefficient of mutual inductance(M) -Coefficient of magnetic coupling-Inductances in series.

UNIT -II COMPLEX ALGEBRA AND A.C CIRCUITS

Mathematical representation of vectors - Symbolic notation - Significance of operator j Conjugate complex numbers - Trigonometrical form of vector representation - Exponential form of vector representation - Polar form of representation - Addition and subtraction of complex quantities - Multiplication and division of complex quantities - Powers and roots of vectors - Complex algebra applied to series circuits - Complex algebra applied to parallel circuits Series Parallel circuits.

UNIT- III THREE PHASE CIRCUITS

Generation of three phase voltages - Phase sequence Numbering of phases-Inter connection of three phases Star or wye(Y) connections Voltages and currents in Y-connection - Neutral current in unbalanced star-connection Delta(Δ) or mesh connection - Balanced Y/Δ and ΔY conversions Comparison: star and delta connections Comparison between single and three phase supply system - Power factor improvement - Power factor correction equipment - Power measurement in three phase circuits Three wattmeter method, Two wattmeter method (Balanced and unbalanced load), Two wattmeter method Balanced load, Reactive power One wattmeter method.

UNIT- IV DIGITAL ELECTRONICS

Binary number system - Logic gates Boolean algebra - Half and Full adders - Flip Flops - Registers and counters - A/D and D/A conversion - (Basics only), Junction diodes basic types - transistors basic types.

UNIT- V FUNDAMENTALS OF COMMUNICATION ENGINEERING

Types of signals: Analog and digital signals Modulation and demodulation: Principles of amplitude and frequency modulation. Communication systems: Radio, T.V, Fax, Microwave, Satellite and Optical fiber (Block diagram approach only).

TEXT BOOKS

1. B.L.THERAJA-Fundamentals of Electrical Engineering and Electronics - 2012 Edition, S.Chand Publishers.

2. T.L.THYGARAJAN-Fundamentals of Electrical Engineering and Electronics - 2012 Edition, Scitech Publishers.

3. V.K.MEHTA Principle of Electronics - 2012 Edition S.Chand Publishers.

SUB CODE: CS1T5 **COMPUTER PROGRAMMING** **Sem: I** **Credit 3**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)**

UNIT - I

Introduction to digital computer ALU Memory Unit, Control Unit-Types of Computers-Number Systems-Conversion Problems. DOS commands - Computer Languages - High Level, machine Level and Assembly Level language - Algorithm Flow Chart.

UNIT- II

Introduction to C - Character set, Constants, Variables, Data Types-Operators - Expression. Decision Making statement - Looping statements, break continue, goto functions.

UNIT - III

Arrays and its types - Functions - call by reference - storage classes in C Auto, Register, Static, Extern - Recursive function.

UNIT - IV

Structures and Unions, Introduction to Pointer, Pointer arithmetic, String operations.

UNIT - V

User defined data types - Introduction to Preprocessor, Macros, Files, Command line arguments

TEXT BOOKS

1. Let Us 'C' - Yashawant Kanetkar, (Unit 2 to 5), BPB publications, 10 Edition, 2010.
2. Ashok N Kamthane, “Computer Programming”, Pearson education, Second Impression, 2008.
3. Venugopal.K and Kavichithra.C, “Computer Programming”, New Age International Publishers, First Edition, 2007.

REFERENCE BOOKS

1. Kernighan B.W and Ritchie,D.M , The C programming language: second edition, Pearson education,2006
2. Fundamentals of Computing and Programming- V.Ramesh Babu, R.Samyuktha, M.Muniratham by VRB Publishers 2012 edition.
3. Balagurusamy. E, “Programming in ANSI C”, Tata McGraw Hill, Third edition, 2006

SUB CODE: SA1T1 **SANSKRIT & INDIAN CULTURE –I** **Sem:I** **Credit 1**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)**

UNIT - I

1. An Introduction to Sanskrit Language
2. Meaning and definition, Significance of Sanskrit language
3. Relations between Sanskrit and other languages

UNIT - II

4. Introduction to Vedic literature, Origin of Vedas, Classification of Vedas
5. Structure of Vedas (Samhitā, Brāhmaṇā, Āranyaka)
6. Introduction to Upaniṣads and its relavance

UNIT - III

7. Introduction to Upavedas and their classification & its significance
8. Introduction to Āyurveda,
9. Application of Āyurveda in present days

UNIT - IV

10. Introduction to Dhanurveda - the Indian Martial Art, History of Dhanurveda, Dhanurveda and its impacts in the regional styles
11. Introduction to Gāndarvaveda
12. Text on dramaturgy and music

UNIT - V

13. Introduction to Arthaśāstra - the Indian statecraft, economic policy and military strategy
14. Relevance of Arthaśāstra to the present days
15. Message of Paramacharya

REFERENCE BOOKS

1. A text book of elementary Linguistics and Phonetics by Dr. R. Ravi S Sharma, New Delhi 2012
2. A history of Sanskrit literature by A. B. Keith New Delhi 1993
3. A history of Indian literature by Maurice Winternitz New Delhi 1990
4. Samskruta Sahitya Ka Itihas - by Baladev Upadyaya
5. A short history of Sanskrit Literature by T.K. Balachandra Iyer, Palaghat 1998

SUB CODE: ME1P6 ENGINEERING GRAPHICS (PRACTICAL) Sem:I Credit 2

Branch: MECHATRONICS (For Students admitted from 2014 onwards)

UNIT - 0 (Not included for the examination)

BASICS OF DRAWING

Use of Drawing instruments - BIS conventions and specifications - size layout and folding of drawings sheets - lettering and dimensioning - studying the method of drawing ellipse, Parabola and Cycloids.

VISUALIZATION CONCEPTS AND FREE HAND SKETCHING

Visualization principles Representation of Three Dimensional objects Layout of views- Free hand sketching of multiple views from pictorial views of objects

UNIT - I

PROJECTION OF POINTS

Introduction to orthographic projections - Projection of points

PROJECTION OF LINES

Projection of straight lines in the first quadrant, lines parallel to both planes - inclined to one plane and parallel to other - inclined to both planes.

UNIT - II

PROJECTION OF SOLIDS

Projection of Simple solids like prism, pyramid, cylinder, cone and sphere - Auxiliary projections.

UNIT - III

SECTION OF SOLIDS

Section of solids like prism, pyramid, cylinder, cone and sphere in simple position - True shape of sections for the above.

DEVELOPMENT OF SURFACES

Surfaces like - Prism, Pyramid, Cylinder, Cone and Cut solids.

UNIT - IV

ORTHOGRAPHIC PROJECTION

Conversion of pictorial views to orthographic views of simple machine members.

INTERPENETRATION OF SOLIDS

Interpenetration of solids - Cylinder and cylinder, cone and cylinder

UNIT - V

ISOMETRIC PROJECTIONS

Isometric Projections of solids.

PERSPECTIVE PROJECTIONS

Perspective projections of solids.

UNIT - VI (Not for examination)

COMPUTER AIDED DRAFTING (DEMONSTRATION ONLY) Introduction to drafting packages and demonstration of their use.

TEXT BOOKS

1 Engineering Drawing - K. Venugopal, Wiley Eastern Ltd., 1922. 2 A text book of Engineering Drawing - K.V. Natarajan.

REFERENCE BOOKS

1 Elementary Engineering Drawing (First Angle Projection) N.D. Bhatt, Charotar publishing Co., Anand.

2 Engineering Drawing - S.M. Sekkilar & S. Tamarai Selvi, Anuradha Agencies, Kumbakonam.

3 Engineering Drawing and Graphics - Prof. K.Venkataraman.

Special points applicable to University Examinations on Engineering Graphics:

1 There will be five questions, each of either or type covering all units of the syllabus.

2 All questions will carry equal marks of 20 each making a total of 100.

3 The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.

4. The examination will be conducted in appropriate sessions on the same day

SUB CODE: PH1P7 **PHYSICS PRACTICAL** **Sem : I** **Credit 2**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)**

Any SIX

1. Determination of Rigidity Modulus & Moment of Inertia using Torsional Pendulum.
2. Determination of Young's Modulus.
3. (a) Determination of Wavelength of Laser light using transmission grating.

   (b) Measurement of numerical aperture of an optical fiber.
4. Determination of refractive index of material of prism using i-d curve.
5. Determination of radius of curvature of the given lens using Newton's Rings.
6. Determination of Velocity of sound waves in liquid using Ultrasonic interferometer.
7. Determination of wavelength of prominent colours of mercury spectrum using Spectrometer and grating.
8. Determination of emissivity of the surface of a black body.
9. Determination of number of lines per meter of the grating using normal incidence method.
10. Basic logic gates- Verification of truth tables

REFERENCE BOOKS FOR PHYSICS PRACTICALS

1. Practical Physics - Ouseph and Rangarajan.
2. Engineering Practical Physics-K. Srinivasan.
3. Engineering Practical Physics - M.N. Avadhanulu.
4. Experimental Physics K.Venkatramanan, R.Raja, M.Sundarrajan (Scitech)

SUB CODE: CS1P8 **COMPUTER LABORATORY** **Sem: I** **Credit 2**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)**

1. Evaluate Expressions using library Function.

a. pr^2

b. (A+B+(2C/3A)+A2+2B)

c. √S(S-A) (S-B) (S-C)

d. LOG ($x^3+y^3+z^3$)

2. Find Sum & Average of 'N" numbers.

3. Find the Biggest among 3 numbers.

4. Find the factorial of given number.

5. Check whether the number is prime or not.

6. Find the sum of digits using (i) For loop (ii) While loop

7. Program to add the first N odd numbers and even numbers.

8. Generate the Fibonacci series and Evaluate Sine series.

9. Arithmetic operations using Switch - Case Statements.

10. Find the biggest & smallest among "N" numbers.

11. Sort "N" numbers in ascending order.

12. Matrix addition and Multiplication.

13. Display the student information & marks using Structure & Unions.

14. Evaluate the Binomial coefficient.

15. Swapping of numbers using call by value, call by reference.

16. Number system Conversions

17. Basic File Operations

18. Preprocessor directives usage.

19. Pointer Arithmetic and Array access using Pointers.

20. Introduction to graphics.

SUB CODE: EE1P9 BASIC ELECTRICAL WORKSHOP Sem: I Credit 2

Branch: MECHATRONICS (For Students admitted from 2014 onwards)

Course objectives:

- To understand the concepts of industrial & domestic wiring
- To train students on logic gates.

Course Outcomes:

- Learners should be familiar with the concepts of Domestic & Industrial Wiring.
- Should be able to do simple exercise and measurements using CRO.
- Should able to do PCB Fabrication and measurements using Multimeter.

LIST OF EXPERIMENTS:

1. House Wiring Series, Parallel, 3 Pin Plug Socket, etc.
2. Staircase Wiring.
3. Tube Light / CFLWiring.
4. Circuit Tester.
5. Single Phase & Three Phase Energy meters.
6. To Study the use of Megger.
7. To Study The Applications Of CRO.
8. Logic Gate Trainer.
9. Soldering Practice for fabrication of DC power Supply.
10. Different faults in Domestic Electrical equipments.
11. Power wiring for three phase induction motor.
12. Power wiring for single phase induction motor.
13. To Study the use of Multimeter, Tong- tester.

II SEMESTER

SUB CODE: EN2T1 **ENGLISH – II** **Sem:II** **Credit 3**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)**

Unit I : **Words for Social Interaction {List Enclosed}**

Unit II : **Functional Grammar**

Noun Group, Verbal Group, Modal Verbs, Conditionals, Connectives, Passivity, Gerund and Infinitives, Reported Speech,Synonyms and Antonyms, Concord and Error detection.

Unit III : **Essays**

1. On Habits A.G. Gardiner
2. How to Make a Speech - Edgar Baker
3. Springtime - O.Henry
4. Dangers of Drug Abuse Hardin Jones

Unit IV : Letter Writing, Report Writing, Essay Writing (Essays on Sports Social Issues, Science and Technology and Proverb Expansions) and Comprehension.

Unit V : British English and American English With Emphasis on Vocabulary and Spelling (From Reader's Digest's Publication)

REFERENCE BOOKS

1. Bikaram K. Das : Functional Grammar and Spoken and Written communication in English (Orient Blackswan Chennai - 600002)
2. T. M.Farhathullah : English Practice Book (Emerald Publishers)

The prescribed Essays will be compiled and edited by the staff of the Department of English.

Words for Social Interaction

1. Euthanasia
2. Bier
3. Charlatan
4. Cynosure
5. dejà vu
6. Myopia
7. Epicentre
8. Oedipus complex
9. Electra complex
10. Halitosis
11. Imbroglio
12. Impasse
13. Paranoia
14. Id
15. Ego
16. Super Ego
17. Psychopath
18. Guarantee
19. Warranty
20. Neologism
21. Nepotism
22. Oligarchy
23. Anarchy
24. Utopia
25. Dystopia
26. Philanthropy
27. Plagiarism
28. Euphemism
29. Autarky
30. White Paper
31. Theocracy
32. Ombudsman
33. Anthology
34. Dialectic
35. Asphyxiation
36. Doggy bag
37. Somnambulism
38. Dermatitis
40. Biopsy
41. Anti-biotic
42. Vendetta
43. Virago
44. Prefixes pseudo, quasi, bi, mono, poly, semi, retro, circum, intro, intra and inter

SUB CODE: MA2T2 BASIC MATHEMATICS FOR ENGINEERS – II Sem: II Credit 3

Branch: MECHATRONICS (For Students admitted from 2014 onwards)

UNIT- I NUMERICAL SOLUTION OF SIMULTANEOUS EQUATIONS

Solution of linear simultaneous equations - Direct methods of solution: Gauss elimination method , Inversion of a matrix using Gauss Elimination method- Gauss Jordan method Method of Factorization-Crout's method, Iterative methods of solution : Jacobi's method , Gauss Seidel method.

UNIT- II ORTHOGONAL REDUCTION

Orthogonal transformation-Reduction to diagonal form Similarity matrices Powers of a matrix - Reduction of quadratic form to canonical form Nature of a quadratic form Hermitian, Skew Hermitian and Unitary matrices Outline of applications of Eigen values and Eigen vectors in engineering

UNIT -III INTEGRAL CALCULUS AND ITS APPLICATIONS

Reduction formulae reduction formulae[without proof] and Bernoulli's formula.Definite integrals , length of the curve. Double integrals - Change of order of integration - Double integrals in polar coordinates - Areas enclosed by plane curves - Triple integrals - Volume as triple integral

UNIT- IV BETA AND GAMMA FUNCTIONS

Change of variables in double integrals and Triple integrals Area of a curved surface Beta function - Gamma function Reduction formula for - Relation between Beta and Gamma functions Outline of applications of multiple integrals

UNIT -V VECTOR INTEGRATION

Integration of vectors - Line integral-circulation-work - Surface integral - Green's theorem in the plane (without proof) - Stoke's theorem (without proof) - Volume integral - Gauss divergence theorem (without proof) - Irrotational fields Outline of applications of vector calculus in engineering.

Note: Questions are to be set on problem solving and not on the theoretical aspects.

TEXT BOOKS:

Grewal B.S, Higher Engineering Mathematics, 41st Edition, Khanna Publishers, New Delhi, 2011.

REFERENCE BOOKS

1. Alan Jeffrey, Advanced Engineering Mathematics, Academic Press.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons
3. Gerald C.F and Wheatley P.O, Applied Numerical Analysis, Addison-Wesley Publishing Company

SUB CODE: CH2T3 ENGINEERING CHEMISTRY Sem: II Credit 3

Branch: MECHATRONICS (For Students admitted from 2014 onwards)

UNIT-I CHEMICAL THERMODYNAMICS

Entropy - entropy changes in isothermal expansion of an ideal gas - reversible and irreversible processes - work & free energy functions - Helmholtz and Gibbs free energy functions - Gibbs-Helmholtz equation - Gibbs-Duhem equation - Clausius-Clapeyron equation & its applications - Van't Hoff isotherm and its applications.

UNIT-II CHEMICAL KINETICS AND CATALYSIS

Kinetics of second and third order reactions half life period - saponification of ester - kinetics of opposing, parallel and consecutive reactions and its examples - effect of temperature on reaction rate - theory of absolute reaction rate. Classification and characteristics of catalysts autocatalysis steady state principle - enzyme catalysis - Michaelis menton equation (derivation) acid base catalysis (derivation).

UNIT-III THERMAL AND SPECTROSCOPIC TECHNIQUES

Thermogravimetry (TGA) schematic and block diagram - characteristics of thermo-balance design - methods expressing TG results - applications in qualitative analysis, composition of alloys and mixtures, study of polymers. Differential thermal analysis (DTA) - schematic and block diagram representation of DTA data - qualitative application (calcium oxalate monohydrate only). Electromagnetic spectrum - Beer Lambert's law (Derivation) - principle, theory, instrumentation and simple applications of: Flame photometry - UV-visible spectroscopy - IR spectroscopy.

UNIT –IV CORROSION - THEORY & PROTECTION

Electrochemical cells - standard electrode potential - electrochemical series - principles of chemical and electrochemical corrosion - factors influencing corrosion - types of corrosion - galvanic corrosion - differential aeration corrosion - stress corrosion - corrosion control - cathodic protection and sacrificial anode - corrosion inhibitors - protective coatings - constituents, functions and uses of paints and varnishes.

UNIT-V POLYMERS AND NANOMATERIALS

Polymer Chemistry: Monomers - functionality - polymers - degree of polymerization - effect of polymer structure on properties - addition, condensation, co-polymerization - mechanism of addition polymerization (free radical polymerization only). Nanomaterials: Introduction - synthesis of nano materials by physical and chemical methods - ball milling - chemical vapour deposition -sol-gel method - applications of nano materials.

TEXT BOOKS:

1. Engineering Chemistry, P.C. Jain and Monika Jain, Dhanpat Rai Publishing Co Pvt. Ltd., New Delhi, 2008.

REFERENCE BOOKS

1. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and Madan S. Pathania, Shoban Lal Nagin Chand & Co., Jalandhar, 2000.
2. Physical Chemistry for Engineers, P.C. Jain and Renuka Jain, Dhanpat Rai & sons, New Delhi, 2001.
3. Applied Chemistry, K. Sivakumar, Anuradha Publications, Chennai, 2009.
4. Chemistry in Engineering & Technology, J.C. Kuriacose and J. Rajaram, Vol. 1, Tata McGraw-Hill, New Delhi, 1996

SUB CODE: ME2T4 BASIC CIVIL AND MECHANICAL ENGINEERING Sem II Credit 3
Branch: MECHATRONICS (For Students admitted from 2014 onwards)

PART A CIVIL ENGINEERING

UNIT - I

BUILDING MATERIALS: Construction Materials and foundation Properties and uses of construction materials such as stone, bricks, cement, concrete, steel.
BUILDING COMPONENTS: Selection of site - simple foundations such as well footing- isolated footing. Combined footing. Pile foundation - foundations of machinery. Superstructure Brick and stone masonry - beams. Columns and lintel RCC roofing - simple steel roof trusses and AC roofing - Flooring types such as granolithic. Concrete, mosaic, tile, terrazzo, marble etc., - plastering.
VALUATION : Valuation by plinth area method -simple problems.

UNIT - II

MECHANICS Units - Simple stresses and stains for uniform section - Moduli of elasticity - Factory of safety - centre of gravity and moment of inertia - simple problems.
DAMS Selection of site - Brief idea of different types of dams - their purpose.
BRIDGES Components of bridge - classification - slab bridge - T-beam bridge.

UNIT - III

SURVEYING - Different types of surveying - chain survey - calculation of area by Simpson's rule and trapezoidal rule - compass - conversion on bearings - simple leveling - reduction of levels - simple problems.
ROAD Classification - brief description of earthen road. Water bound macadam. Bituminous. Concrete roads - traffic signs and signals.
ENVIONMENTAL ENGINEERING Protected water supply - sewage treatment - septic tanks.

PART B MECHANICAL ENGINEERING

UNIT - I

BOILERS Classification - Principles of Low pressure steam generators simple Vertical Boiler, Cochran Boiler, Locomotive Boiler, Lancashire Boiler, Bab-cock Wilcox Boiler

POWER PLANTS Layout of Steam, Gas Turbine, Diesel, Nuclear and Hydropower Plants.

NEW SOURCES OF ENERGY Study of different types of alternative energy sources - Solar, Wind, Wave, Tidal and Geo - thermal.

UNIT - II

INTERNAL COMBUSTION ENGINES- Working principles of Petrol and Diesel Engines - Two stroke and Four stroke cycles-Function of main components - single jet carburation - ignition. Cooling and lubrication systems - fuel pump and injector.

METAL CASTING PROCESS Patterns - Types of patterns - Pattern materials - pattern allowances - Molding sand - Properties of molding sand - types of molding - preparation of Green sand mould for casting - melting of cast iron in cupola furnace only - casting defects.

UNIT - III

METAL FORMING PROCESS- Principles of Forging. Rolling, Drawing and Extrusion.

METAL JOINING PROCESS Principles of welding - fundamental of Arc welding. Gas welding and gas cutting - Brazing and soldering.

METAL MACHINING PROCESS Types of lathes - Main components and the functions of a centre lathe - operations - cutting tools - Drilling machines.

TEXT BOOKS

1 Basic Civil Engineering- V. Ramesh Babu, Anuradha Agencies, Kumbakonam.
2 Basic Civil Engineering- K.V. Natarajan, Madras.
3 Basic Mechanical Engineering - K. Venugopal, Anuradha gencies,Kumbakonam.

REFERENCE BOOKS

1 Basic Civil Engineering - N. Arunachalam, Pratheeba Pub. Coimbatore.
2. Basic Civil and Mechanical Engineering - G. Shanmugam and M.S. Palanichamy, Tata McGraw Hill Publishing Co., 1993.

SUB CODE: EE2T5 **ELECTRIC CIRCUIT THEORY** **Sem: II** **Credit 3**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)**

UNIT - I

BASIC CIRCUIT CONCEPTS Lumped circuits - Kirchhoff's Laws - V-I-relationships of R, L and C - Independent sources - Dependent sources Simple resistive circuits - Network reduction - voltage division - current division - source transformation.

UNIT - II

SINUSOIDAL STEADY STATE ANALYSIS Phasor - sinusoidal steady state response - concepts of impedance and admittance - analysis of simple circuits - power and power factor - series resonance and parallel resonance-bandwidth and Q factor - Solution of three-phase balanced circuits - power measurements by two-wattmeter methods - solution of three-phase unbalanced circuits.

UNIT - III

MESH-CURRENT AND NODE-VOLTAGE METHODS Formation of matrix equations and analysis of complex circuits using mesh-current and nodal-voltage methods mutual inductance - coefficient of coupling - Ideal transformer.

UNIT - IV

NETWORK THEOREMS AND APPLICATIONS Superposition theorem - Reciprocity theorem - Compensation theorem - Substitution theorem - Maximum Power transfer theorem - Thevenin's theorem - Norton's theorem and Millman's theorem with applications.

UNIT - V

TRANSIENT ANALYSIS Forced and free response of RL, RC and RLC circuits with D.C. and sinusoidal excitations.

TEXT BOOK:

1. Paranjothi S.R.,“Electric Circuit Analysis”, New Age International Ltd., Delhi, 2nd Edition.

2. Hyatt W.H. and Kemmerly, “Engineering Circuits Analysis”, McGraw- Hill International Editions, 1993.

REFERENCE BOOKS:

1. Edminister J.A., “Theory and Problems of Electric Circuits”, Schaum's outline series McGraw Hill Book Company, 2nd Edition, 1983.

2. Sudhakar A and Shyam Mohan S.P., “Circuits and Network Analysis and Synthesis”, Tata McGraw-Hill Publishing Ltd., New Delhi, 1994.

SUB CODE: CH2T6 ENVIRONMENTAL SCIENCE AND ENGINEERING Sem: II Credit 3

Branch: MECHATRONICS (For Students admitted from 2014 onwards)

UNIT – I INTRODUCTION TO ENVIRONMENT AND ENVIRONMENTAL STUDIES

Introduction to environment - components - nature of environment - need of awareness - reasons for environmental problems - anthropocentric and eco centric views.

Environmental studies - multidisciplinary nature - scope and aim - sustainable development - principles - RRR concept-Indian environmental movements - environmental calendar.

UNIT- II ECOSYSTEM AND BIODIVERSITY

Ecosystem - structure - functions - simplified ecosystem models (food chain and food webs and their types,energy flow) - forest - grassland - pond ecosystems - ecological succession - ecological pyramids - Bio-geochemical cycles of water oxygen-carbon-phosphorous and sulphur.

Biodiversity - definition - types - species - genetic and ecosystem diversities - values of biodiversity - threats to biodiversity - conservation of biodiversity - endemism - biodiversity hotspots - Indian biodiversity - endemic species of India - IUCN lists -red-green and blue data books.

UNIT- III NATURAL RESOURCES

Natural resources - definition - types - forest resources - uses - deforestation- reasons - effects - water resources dams - effects of dams - food resources - modern agriculture ill effects -energy resources- types hydel - nuclear - solar - wind and biomass energy - world scenario - Indian scenario.

Population and environment - reasons for over exploitation of resources - population - demography - population curves - population explosion - effect - consumerism - effects - urbanization - reasons and effects- role of an individual.

UNIT –IV ENVIRONMENTAL POLLUTION

Pollution - definition - types - air pollution - causes and effects - effects of CO2 - CO - NOx - SOx - particulates - control of air pollution - water pollution-causes - effects - remedies - soil pollution - solid waste management - e-waste - ill effects of e-waste - proper recycling- Noise pollution - reasons effects - control - nuclear pollution - cases - effects and control - thermal pollution causes - effects and remedies.

Legal provisions for protecting environment - article 48 A - 51 A (g)-Environment act 1986 - Air act 1981 - Water **act 1974 - wild** life protection act - Forest act 1980- problems in implementation-reasons.

UNIT –V SOCIAL ISSUES AND ENVIRONMENTAL ETHICS

Present environmental scenario - green house effect - climate change - The Kyoto Protocol - ozone layer depletion -The Montreal Protocol - acid rain - causes - effects - disparity among the nations - The Copenhagen UNFCCC summit - carbon currency- virtual water- genetically modified organisms, Disaster management.

Environmental ethics - introduction - people - getting affected - resettlement and rehabilitation issues involved - Sardhar Sarovar project - Tawa Matsya sang - Melting icebergs of Arctic.

Text Book

1. Anubha Kaushik and C.P. Kaushik, ”Prospects of Environmental Science”, New Age International publishers, 2013.

Reference books

1. Environmental Studies, N. Nandini, N. Sunitha and Sucharita Tandon, Sapna Book House,2007.
2. Text book of Environmental Science, Ragavan Nambiar, Scitech Publications, 2009.
3. Text book of Environmental Chemistry and Pollution Control, S.S.Dara, S.Chand and Co., 2002.
4. Environmental Chemistry, Colin Baird, W.H.Freeman and company, New York,1999.
5. Environmental Chemistry, Gary W. VanLoon and Stephen J.Duffy, Oxford University Press, 2000.
6. New Trends in Green Chemistry, V.K. Ahluwalia and M. Kidwai, Anamaya Publishers, 2006.

SUB CODE: SA2T2 SANSKRIT & INDIAN CULTURE – II Sem: II Credit 1

Branch: MECHATRONICS (For Students admitted from 2014 onwards)

Unit - I

1. Introduction to Vedāṅgas
2. Introduction to Śikśā, Vyākaraṅa, Chandas
3. Introduction to Nituktam, Jyotiṣa, Kalpa

Unit - II

4. Introduction to classical literature
5. Introduction to Epics
6. Introduction to Purānas

Unit - III

7. Introduction to Sanskrit poets any five
8. Introduction to Kāvyas and their classifications, Pañcamahākāvyas and their significance in Sanskrit literature
9. Significance of Kālidasa and his contribution

Unit - IV

10. Introduction to Dramas
11. Introduction to Subhāṣitas
12. Tales and fables

Unit - V

13. Introduction to System of Indian philosophy, Six Darśanas and their profounder, principles of Nyāya and Vaiśeṣika schools
14. Valid means of Sāṅkya philosophy and its significance, Yoga and Patañjali, Aṣṭāṅgayoga and its application
15. Introduction to (Manu and Yāgñyavalkya)

Reference Books

1. A history of Sanskrit literature by A. B. Keith New Delhi 1993
2. Samskruta Sahitya Ka Itihas - by Baladev Upadyaya
3. A short history of Sanskrit Literature by T.K. Balachandra Iyer, Palaghat 1998

SUB CODE: CH2P7 CHEMISTRY LABORATORY Sem: II Credit 2

Branch: MECHATRONICS (For Students admitted from 2014 onwards)

List of experiments (ANY SIX of the following)

1. Estimation of Na_2CO_3 present in washing soda sample.
2. Estimation of alkalinity of the given water sample.
3. Estimation of total hardness of the given water sample- EDTA method
4. Conductometric titration Strong acid Vs Strong base.
5. Conductometric titration Strong base Vs mixture of acids
6. Potentiometric titration - Strong acid Vs Strong base.
7. Potentiometric titration Fe^{2+} Vs KMnO4.
8. Determination of K_{SP} of a sparingly soluble salt concentration cell method
9. Construction of phase diagram for a simple eutectic system.
10. Rate and order of reaction between $K_2S_2O_8$ and KI Clock reaction method.

SUB CODE: EE2P8 CIRCUIT THEORY LAB Sem:II Credit 2

Branch: MECHATRONICS (For Students admitted from 2014 onwards)

LIST OF THE EXPERIMENTS:

1. Verification of Kirchhoff's laws
2. Verification of Superposition theorem.
3. Verification of Thevenin's Theorem.
4. Verification of Norton's Theorem.
5. Verification of Maximum Power Transfer theorem.
6. Verification of Reciprocity theorem.
7. Verification of Compensation theorem.
8. Verification of Millman's theorem.
9. Three phase power and power factor Measurement by two wattmeter method.
10. Series and Parallel resonance in RLC Circuits.
11. Verification of theorems using Digital simulation.
12. Circuit Transients by Digital simulation.

SUB CODE: ME2P9 BASIC MECHANICAL WORKSHOP Sem: II Credit 2

Branch: MECHATRONICS (For Students admitted from 2014 onwards)

CARPENTRY

Names and uses of tools used in carpentry - Handling of the tools. Practice in marking, sawing, planning and chiseling to size. Making simple joints such a half lap, mortises and Tenon joints.

FITTING

Name and uses of tools like files, chisels, hammer, tri square, calipers, hacksaw, etc., and handling of these tools. Practice in marking, chipping, fitting to size and drilling marking of simple mating, profiles such as Vee , Square.

WELDING

Study of Arc & Gas Welding, Tools and Equipments Simple welding exercises Butt welding and Lap Welding.

TURNING

Study of Centre Lathe, Accessories and tools Simple turning exercises Facing and Step turning - use of measuring Instruments for lathe work.

DRILLING

Study of drilling machines Drills, Taps, and reamers Demonstration of Drilling and Tapping operations.

Demonstration of the following (not included for the examination)

1. Preparation of green sand mould.
2. Study of tool in smithy shop and making a square section from circular section.
3. Gas welding and cutting.
4. Brazing and soldering.
5. Sheet Metal Work.

III SEMESTER

SUB CODE: MH3T1 **MATHAMATICS III** **Sem: III**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 3**

UNIT I
(INTERPOLATION AND NUMERICAL INTEGRATION)

Interpolation with equal intervals – Newton's forward interpolation formula – Newton's backward interpolation formula - Interpolation with unequal intervals: Lagrange's interpolation formula, Newton's divided difference formula - Numerical integration: Trapezoidal rule - Simpson's one-third rule - Simpson's three-eighth rule – Outline of applications of interpolation and numerical integration in engineering.

UNIT II
(LAPLACE TRANSFORMS AND APPLICATIONS)

Transforms of elementary functions : $1, t^n, e^{at}, \sin at, \cos at, \sinh at, \cosh at$ - Properties of Laplace transforms: Linearity Property, First shifting property, Change of scale property –Transforms of derivatives - Transforms of integrals - Multiplication by t^n - Division by t - Evaluation of integrals by Laplace transform - Inverse transforms: Method of partial fractions – Other methods of finding inverse - Convolution theorem (Without proof) - Unit step function – Unit Impulse function - Application to differential equations – Outline of applications of Laplace transforms in engineering.

UNIT III
(FOURIER TRANSFORMS AND APPLICATIONS)

Fourier integral theorem (without proof) - Fourier Sine and Cosine integrals – Complex form of Fourier integral - Fourier integral representation of a function - Fourier transform – Fourier sine and Cosine transforms – Properties of Fourier Transforms: Linear property, Change of scale property, Shifting property - Parseval's identity for Fourier transforms (without proof) – Application of transforms to boundary value problems: Heat conduction, Vibrations of a string, Transmission lines.

UNIT IV (DIFFERENCE EQUATIONS AND APPLICATIONS)

Formation of difference equations – Linear difference equations – Rules for finding the complementary function – Rules for finding the particular integral – Simultaneous difference equations with constant coefficients – Outline of other applications of difference equations in engineering

UNIT V (Z – TRANSFORM AND APPLICATIONS)

Standard z-transforms of $1, a^n, n^p$ – Linearity property – Damping rule – Shifting rules – Multiplication by n - Initial and final value theorems (without proof) – inverse z –transforms – Convolution theorem (without proof) – Convergence of z-transforms – Two sided z-transform – Evaluation of inverse z-transforms: Power series method, Partial fraction method, inversion integral method – Application to difference equations – Outline of applications of z-transform in engineering

Note: Questions are to be set on problem solving and not on the theoretical aspects.

TEXT BOOKS:

Grewal B.S, Higher Engineering Mathematics, 41st Edition, Khanna Publishers, New Delhi, 2011.

REFERENCE BOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons
2. Gerald C.F and Wheatley P.O, Applied Numerical Analysis, Addison-Wesley Publishing Company
3. Murrey R.Spiegel, Laplace Transforms, Schaum's Outlines, McGraw Hill

SUB CODE: MR3T2 MANUFACTURING TECHNOLOGY FOR MECHATRONICS Sem: III

Branch: MECHATRONICS (For Students admitted from 2014 onwards) Credit: 3

Prerequisite: Basic Mechanical Engineering

Aim

To make the students aware of different manufacturing processes like metal forming, casting, metal cutting processes, gear manufacturing processes.

Objectives

1. Study the various ways of working of metals
2. Concept of casting Technology
3. Concept of Machining with lathes and automats
4. Study of Milling machine and Gear manufacturing process
5. Various Surface finishing and Surface hardening processes

Outcome

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

1. Develop through basic knowledge about casting and working of metals.
2. Acquire knowledge on the applications of manufacturing Processes.
3. Learn the usage of different types of manufacturing processes.

UNIT - I - CASTING AND WELDING

Introduction to casting, Patterns, Types, Pattern materials, Allowances - Moulding - types- Moulding sand, Gating and Risering, Cores &Core making. Special Casting Process- Shell, Investment, Die casting, Centrifugal Casting. Special welding- Laser, Electron Beam, Ultrasonic, Electro slag, Friction welding, electrical resistance welding.

UNIT - II - MECHANICAL WORKING OF METALS

Hot and Cold Working: Rolling, Forging, Wire Drawing, Extrusion- types- Forward, backward and tube extrusion. Sheet Metal Operations: Blanking- blank size calculation, draw ratio, drawing force, Piercing, Punching, Trimming, Stretch forming, Shearing, Bending- simple problems- Bending force calculation, Tube forming - Embossing and coining, Types of dies: Progressive, compound and combination dies.

UNIT - III - THEORY OF METAL CUTTING

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

UNIT - IV - GEAR MANUFACTURING AND SURFACE FINISHING PROCESS

Gear manufacturing processes: Extrusion, Stamping, and Powder Metallurgy. Gear Machining: Forming. Gear generating process- Gear shaping, Gear hobbing.-Grinding process, various types of grinding machine, Grinding Wheel- types- Selection of Cutting speed and work speed, dressing and truing. Fine Finishing- Lapping, Buffing, Honing, and Super finishing.

UNIT - V - MACHINE TOOLS

Milling Machine - specification, Types, Types of cutters, operations, Indexing methods- simple problems. Shaping, Planning and Slotting Machine- description, Operations, Work and tool holding Devices. Boring machine- Specification, operations, Jig boring machine. Broaching machine- operations, Specification, Types, Tool nomenclature.

TEXT BOOKS

1. Sharma, P.C., "*A textbook of Production Technology*" - Vol I and II, S. Chand & Company Ltd., New Delhi, 1996
2. Rao, P.N., "*Manufacturing Technology*", Vol I & II, Tata McGraw Hill Publishing Co., New Delhi, 1998

REFERENCE BOOKS

1. Chapman W. A. J., "*Workshop Technology*" Vol. I and II, Arnold Publisher, New Delhi, 1998
2. Hajra Choudhary, S. K. and Hajra Choudhary, A. K., "*Elements of Manufacturing Technology*", Vol II, Media Publishers, Bombay, 1988
3. Jain. R. K., "*Production Technology*", Khanna Publishers, New Delhi, 1988
4. Kalpakjian, "*Manufacturing and Technology*", Addison Wesley Longman Pvt., Singapore, 2000

SUB CODE: EC3T4 **ELECTRONIC DEVICES AND CIRCUITS** **Sem: III**

Branch: MECHATRONICS **(Common to MECHATRONICS/EIE)** **Credit: 3**

(For Students admitted from 2014 onwards)

Prerequisite: Basic Electronics

Aim

The aim of this course is to understand the concepts and to familiarize the student with the principle of operation, capabilities and limitations of various electronic devices so that he will be able to use these devices effectively.

Objectives

The course should enable the students to:

1. Understand the Diode operation and switching characteristics.
2. Understand the Operation of BJT, FET, MOSFET metal semiconductor rectifying and ohmic contacts,
3. Study the characteristics of special type semiconductor diodes.

Outcome

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

1. Develop through basic knowledge on the behavior and the characteristics of semiconductor junction.
2. Acquire knowledge on the applications of BJT, FET, MOSFET,
3. Learn the usage of different types of devices for various applications.

UNIT I - SEMICONDUCTORS & DIODES

Semiconductor fundamentals –Energy Band diagram – Intrinsic and Extrinsic Semiconductors- Working and description of a PN diode– Varactor Diode –Avalanche and Zener Breakdown – Zener diode –Photo diode – Photo voltaic cell – Light emitting diode – Liquid crystal display – Light dependant resistor.

UNIT II - TRANSISTORS

Principle of transistor action – Cut off, Active and saturation regions of a transistor – CE,CB,CC Configurations – Transistor as a switch – Use of a heat sink – Constructional features of a field effect transistor –theory of operation–MOSFET –Working and V-I Characteristics – Depletion and enhancement types –Working and V-I characteristics of UJT – SCR

UNIT III - AMPLIFIERS

Classification of amplifiers– Distortion in amplifiers– frequency response of an amplifier– operation and of class A Power amplifier– push-pull amplifier–Class B amplifier, class C amplifiers –single tuned and double tuned amplifier - stagger tuned amplifier

UNIT IV - OSCILLATORS & MULTI VIBRATORS

Classification of oscillators – Barkhausen criterion operation and analysis of RC phase shift – Hartley and colpitts oscillators – Multivibrators – Astable, Monostable and Bistable multivibrators

UNIT V - RECTIFIERS & POWER SUPPLIES

Single –phase, half-wave and full-wave rectifiers – Bridge rectifiers – Ripple factor, rectification efficiency, Transformer utilization factor and regulation – Performance characteristics of rectifiers with filters – Regulated power supply– switched mode power supplies.

TEXT BOOKS

1. Millman and Halkias, "*Electronic devices and Circuits*", Tata McGraw Hill International, 2nd Edition 2008.
2. G.K.Mithal, "*Electronic Devices and Circuits*", Khanna Publishers, 1999.

REFERENCE BOOKS

1. Salivahanan, "*Electronic devices and Circuits*", Tata McGraw Hill International, 2nd Edition 2008.
2. David A. Bell, "*Electron Devices and Circuits*", Prentice Hall Of India, 4th Edition,1999.
3. Thomas L. Floyd , "*Electron Devices*", Charles & Messil Publications, 2008.
4. Boylestad & Nashelsky, "*Electronic Devices & Circuit Theory*", Tenth edition, Prentice Hall Of India (P) Ltd., 2009.
5. Sedha.R.S, "*A Text Book of Applied Electronics*", Sultan chand Publishers, 5th Edition 2013.

SUB CODE: ME3T3 MATERIAL SCIENCE & METALLURGY Sem: III

Branch: MECHATRONICS (For Students admitted from 2014 onwards) Credit: 3

Prerequisite: Basic Mechanical Engineering

Aim

The Aim of this course is to develop comprehension of the rapidly changing technological scenario and the requisite expertise for appropriate selection of materials for specific engineering applications.

Objectives

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

1. Understand electrical properties of materials,
2. Understand the properties and applications of semi conducting materials,
3. Understand general properties and applications of magnetic and dielectric materials,
4. Understand the behaviour of materials on exposure to light,
5. Understand general properties and application of modern engineering and bio materials, and
6. Get familiarized with the concepts of Nano Science and Technology

Outcome

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

1. Develop through basic knowledge about properties of materials.
2. Acquire knowledge on the applications of magnetic and dielectric materials.
3. Learn the usage of different types of materials.

UNIT – I

Structure of Metal and alloys – Ionic, covalent and metallic bonding – space lattice, crystal structure, miller indices for atomic planes and direction, crystal defects – point line and plane defect, polymorphisms and allotropy grains and grain boundaries and simple problems - strengthening mechanism

UNIT – II

Mechanical Properties – Tensile test, luder's band, engineering stress – strain curve. True stress – strain curve, elastic deformation, plastic deformation – effect of mean stresses & notches. Creep test –p primary, secondary & Territory creep failure analysis & factography.

UNIT – III

Phase diagrams – phase rules, solid solutions, inter – metallic components, cooling curves, equilibrium diagram – isomorphous, eutectic, peritectic and eutecoid types – iron – carbon equilibrium diagram. Types of steel, cast iron, slow cooling of steels, tool steel, alloy steel – phase transformation, TTT DIAGRAM, Alloys of Cu, Al, Mg, Ni.

UNIT – IV

Heat treatment of steels and non – ferrous materials annealing, normalizing, hardening, tempering – Austempering, Martempering, Case hardening techniques, Hardenability test. Powder metallurgy – processes and applications with examples.

UNIT : V

Polymer, fiber, Ceramics and composite materials – high strength alloys, super alloys, alloys of Titanium, Cobalt and their applications. Uncommon materials like Beryllium, Zirconium, Hafnium, Tantalum, Nobium and their applications. Introduction to nano materials and nano composites.

TEXT BOOKS

1. G.E. Dieter, *Mechanical Metallurgy*, Mc Graw Hill, ISE. 1988
2. O.P Khanna, *Meterial Science and Metallurgy*, Dhanpat Rai & Sons.2008, 1st Edition

REFERENCE BOOKS

1. S.H.Avener, *Introduction to physical metallurgy*, McGraw Hill, ISE
2. Lawrence H. Vanvlack, *Elements of Material science and Engineering* Addition wiley Publishing Co.,
3. Raghavan, *Material Science and Engineering* ,Prentice Hall India Ltd, 2007 5th Edition.
4. Marc Andre Meyers & Krishnakumar Chawla, *Mechanical Behaviour of Materials* PHI, 1999.
5. Reymond A.Higgins, *Engineering Metallurgy*, ELBS.
6. Michel F. Ashby & David R.H. Jofnns, *Engineering Materials – An Introduction to their properties and Applications* – 2nd ed. Butterworths.
7. *Material Hand Book*, Vol – II, III & IV, ASM, 9th edition.

SUB CODE: EE3T3 **ELECTRICAL ENGINEERING** **Sem: III**

Branch: MECHATRONICS **(Common to MECHATRONICS/EIE/ECE)** **Credit: 3**

(For Students admitted from 2014 onwards)

Prerequisite: Circuit Theory.

Aim

To expose the Students to the Concepts of Various types of Electrical Machines, Transmission and Distribution Systems of Electrical Power

Objectives

The course will enable the students to:

1. Learn constructional details, principle of operation, performance, starters and testing of D.C.Machine.
2. Learn constructional details, principle of operation and performance of transformers.
3. Learn constructional details, principle of operation and performance of induction motors.
4. Learn constructional details and principle of operation of alternators and special machines.

Outcome

The students should have knowledge in the following:

1. Various types, Principle of Operation and Characteristics of DC Motors and DC Generators.
2. Construction and Principle of Operation, Testing, Regulation , equivalent circuit of Transformers
3. Construction, Types and Principle of operation of induction motors. Starting and speed control of 1Φ induction motors.
4. Synchronous Machines, Brushless alternators, Reluctance motor, Hysteresis motor and Stepper motor.

UNIT – I

D.C. Machines: Construction, principle of operation of D.C. motor and D.C. Generator, Various types of D.C. motors and generators. Performance characteristics of D.C. motors and D.C. generators. Starting and speed control.

UNIT – II

Transformers: Construction details and principles of operation of single phase transformers - losses and efficiency. Special types of transformers - Servo stabilizer, pulse transformer, Isolation transformer

UNIT – III

Synchronous Machines: Constructional features - operating principle of 3-phase alternator and synchronous motor principle and operation of synchronous motor

UNIT – IV

Induction Machine: Constructional features - Operating principle of 3-phase induction motor [squirrel cage and slip ring] and single phase induction motor, Slip - Torque characteristics - Starters - Speed control methods.

UNIT – V

Special Machines: Tachogenerator - A.C and D.C. Servo motor, Stepper motor, synchronous– PWM Methods. Linear induction motor – switched reluctance motor, Brushless motors.

TEXT BOOKS:

1. B.L.Theraja & A K Theraja: "*Electrical Technology*", 24th edition, 2007
2. Rajput: "*Electrical Machines*", 5th edition, 2008

REFERENCE BOOKS:

1. M.G. Say and Taylor: "*D.C. Machines*" ELBS 2nd edition, London: Pitman publishing 1986.
2. M.G. Say: "*Alternating Current Machines Performance & Design AC machines*" 2005.
3. E.V. Armensky and G.B. Falk: "*Fractional Horsepower Electrical Machines*", 1985.
4. B.R. Sharma: "*Utilization of Electrical Energy*", Satyaprakashan Publications, 2012.
5. B. Ravindranath and M. Chander: "*Power system Protection and Switchgear*", Wiley Eastern Ltd, 2005
6. C.R. Paul, S.A. Nasar and L.E. Unnewehr: "*Introduction to Electrical Engineering*", 2nd Edition, McGraw Hill Inc., 1992.

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SUB CODE: CS3T6 OBJECT ORIENTED PROGRAMMING USING C++ Sem: III

Branch: MECHATRONICS (Common to MECHATRONICS/EIE) Credit: 3

(For Students admitted from 2014 onwards)

Prerequisite: Basic Computer Science.

Aim

To expand knowledge in computer languages and to introduce object oriented programming

Objectives

The course will enable the students to:

1. Study the object oriented programming principles, tokens, and expressions, control a structures and functions.
2. Introduce the classes, objects, constructors and destructors.
3. Introduce the operator overloading, inheritance and polymorphism concepts in C++.
4. Introduce constants, variables, data types, operators, classes, objects, methods, arrays and strings in Java.
5. Introduce the programming approach in Java, interfaces and packages, multithreading, managing errors and exceptions and Applet programming.

Outcome

After completion of the course the students are expected to be able to

1. Understand basic programming principles.
2. Write programs using concepts like overloading, inheritance and polymorphism.
3. Write programs in java.
4. Create their own package and can write programs using interface concept.
5. Write multithreaded program and manage exceptions.

UNIT – I

Need for object oriented programming, Characteristics of object oriented language -objects, classes, Inheritance, Reusability, creating new data types, Polymorphism and overloading. C++ programming basis – Data types, Manipulators, Cin, Cout, Type conversion, arithmetic operators, Loops and decisions.

UNIT – II

Class and objects: A simple class, C++ Objects as physical Objects, C++ Objects as Data Types, Constructors, destructors, objects as function arguments, overloaded constructors, member functions defined outside the class, inline functions, and Returning objects from Functions.

UNIT – III

Arrays: Defining & accessing Array elements, arrays as class member data, array of Objects. Operator Overloading: Overloading Unary Operators, Operator Arguments, Return Values, nameless Temporary objects, postfix notations. Overloading Binary Operators - Arithmetic operators, Concatenating Strings, Multiple overloading Comparison operators, Arithmetic Assignment Operators.

UNIT – IV

Inheritance-Derived class and base class, derived class constructors, overriding member functions, Class Hierarchies, Abstract base class, Public and private inheritance, Levels of inheritance, Multiple inheritance. Memory management – new and delete operator, a string class using new, Pointers to Objects – Referring to Members, another Approach to new, An array of pointers to Objects.

UNIT –V

Virtual Functions – Pure virtual functions, Late Binding, Abstract Classes, Virtual base classes. Friend Functions – Friend Classes, Friends for functional Notation. Static Functions, investigating destructors. Assignment and copy – initialization- overloading the assignment operator, the copy constructor, the this pointer. Templates, function templates, class template.

TEXT BOOKS:

1. "*Object Oriented Programming in Microsoft C++*" - Robert Lafore, Galgotia Publication Pvt Ltd.,1998.
2. "*Let us C++*" - Yaswant Kanitkar(used for templates), BPB Publication, 2002.

REFERENCE BOOKS :

1. "*Object Oriented Programming in C++*" - C. Balagurusamy, Tata Mcgraw Hill.2nd edition, 2001.
2. "*Teach yourself C++*" - Herbertsehildt, OSBORNE/MH, 1992.

SUB CODE: SA3T3 **SANSKRIT & INDIAN CULTURE – III** **Sem: III**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit 1**

Unit - I (Gītā)

1. Introduction to Jñānayoga
2. Introduction to Bhaktiyoga
3. Introduction to Karmayoga

Unit - II (Upaniṣadic principles)

4. Introduction to Śaṅkara's Phillosophy
5. Introduction to Rāmānuja's Phillosophy
6. Introduction to Mādhva's Phillosophy

Unit - III

7. Amazing creations in Sanskrit (Varnacitras, Sthānacitras and Svaracitras, Gaticitras, Citrabandanas)
8. Intercity verses in Sanskrit, some intercity discoveries, Sanskrit and artificial intelligence beauty and charm of Sanskrit Poetry.
9. Stotrakāvyas and its relevance

Unit - IV

10. Introduction to Maths
11. Introduction to Physics and Chemistry
12. Introduction to Environmental science

Unit - V

13. Introduction to Yoga
14. Introduction to Botany & Zoology
15. Introduction to Agriculture

Reference Texts

1. The wonder that was India by Arthur Llewellyn Basham - 1971
2. The wonder that is Sanskrit by Sampadananda Misra - 2002
3. Vedic Science & Technology by Sadasiva Biswal and Bidyut Lata Ray - 2009
4. Vedavijnanasree by Urmila Srivatsava – 2002

SUB CODE: ME3P6 **MANUFACTURING PROCESS LABORATORY** **Sem:III**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 2**

LIST OF EXPERIMENTS

1. Introduction- lathe machine, plain turning, Step turning & grooving (Including lathe mechanisms, simple problems)
2. Taper turning-compound rest/offset method & Drilling using lathe (Including Drilling feed mechanism, Twist drill nomenclature, and Different types of taper turning operations)
3. External threading-Single start (Including Thread cutting mechanism-simple problems)
4. Eccentric turning-Single axis
5. Shaping-V-Block (Including Shaper quick return mechanism)
6. Grinding-Cylindrical/ Surface/ Tool & cutter
7. Slotting-Keyways (Including Broaching tool nomenclature and Slotter mechanism)
8. Milling-Polygon/ Spur gear (Including Milling mechanism, simple problems)
9. Gear hobbing-Helical gear
10. Drilling, reaming, counter boring
11. Planning/Capstan lathe/Burnishing process (Planner Mechanism, Description of capstan and turret lathe)
12. Mini Project work- Application oriented products using above experiments

SUB CODE: EI3P7 ELECTRONIC DEVICES AND CIRCUITS LAB Sem: III

Branch: MECHATRONICS (For Students admitted from 2014 onwards) Credit: 2

LIST OF EXPERIMENTS

1. V-I characteristics of PN & Zener diode.

2. Characteristics BJT (CE mode)

3. Characteristics of JFET

4. Characteristics of SCR

5. Characteristics of UJT

6. Characteristics of LED, Photo diode

7. Hartley oscillators & Colpit's oscillators

8. Astable Multivibrator

9. Single Phase Half Wave Rectifier & Full Wave Rectifier

10. Bridge Rectifier.

11. Zener voltage regulator

SUB CODE: CS3P9 OBJECT ORIENTED PROGRAMMING USING C++ LAB Sem:III

Branch: MECHATRONICS (For Students admitted from 2014 onwards) Credit: 2

LIST OF EXPERIMENTS

1. Illustrate class & objects
2. To demonstrate the use of Switch –Case statement and to Perform arithmetic operations.
3. To demonstrate the use of constructor and destructor.
4. To demonstrate the use of this pointer
5. To enter the records of n number of students and then display them using nested structure.
6. Illustrate the use of inline functions
7. Illustrate the use of Copy Constructor
8. Illustrate operator overloading
9. To demonstrate the concept of polymorphism applied to the member functions.
10. To demonstrate the use of Inheritance.
11. To demonstrate the use of Demonstration of New & Delete Operator
12. To demonstrate the Pure Virtual Function
13. To demonstrate the use of unary operator
14. To demonstrate the use of Binary operator
15. To demonstrate the use of Friend Function.
16. To demonstrate the use of class template.

IV SEMESTER

SUB CODE: MH4T1 **MATHAMATICS IV** **Sem: IV**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 3**

UNIT- I FOURIER SERIES

Euler's Formulae (Without Proof) – Condition for Fourier expansion – Functions having points of discontinuity – Change of interval – Expansions of even and odd functions - Half-Range series – Parseval's formula (without proof) – Root mean square value (without proof) – Typical waveforms (Definition Only): Square wave form, Saw toothed waveform, Modified saw toothed waveform, Triangular waveform, Half wave rectifier, Full wave rectifier - Outline of applications of Fourier series in engineering

UNIT –II SERIES SOLUTION OF DIFFERENTIAL EQUATIONS

Validity of series solution - Series solution when x=0 is an ordinary point - Frobenius method (Series solution when x=0 is a regular singularity) - Bessel's equation (Bessels functions of the first and second kind) - Recurrence formulae for $J_n(x)$ - Expansions for J_0 and J_1 : Value of $J_{1/2}$ - Generating function for $J_n(x)$ - Equations reducible to Bessel's equation – Orthogonality of Bessel functions – Outline of applications of Bessel's functions in engineering.

UNIT- III NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS

Picard's method – Taylor series method - Euler's method – Modified Euler's method – Runge's method – Runge-Kutta method – Predictor-corrector methods: Milne's method, Adams Bashforth method – Outline of applications of numerical solutions of ordinary differential equations in engineering.

UNIT- IV PARTIAL DIFFERENTIAL EQUATIONS

Formation of partial differential equations – Solution of a partial differential equation – Equations solvable by direct integration – Linear equations of first order – Non linear equations of the first order – Charpit's method - Homogeneous linear equations with constant coefficients –Rules for finding complementary functions – Rules for finding particular integral – Solution of homogeneous linear equation of any order.

UNIT –V NUMERICAL SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS

Classification of second order equations – Finite difference approximation to derivatives – Elliptic equations: Laplace Equation, Poisson's equation – Solution of Laplace's equation – Solution of Poisson's equation – Parabolic equations: Heat equation – Solution of heat equation – Hyperbolic equations: Wave equation – Solution of wave equation – Outline of applications of numerical solution of partial differential equations in engineering.

Note: Questions are to be set on problem solving and not on the theoretical aspects.

TEXT BOOKS

Grewal B.S, Higher Engineering Mathematics, 41st Edition, Khanna Publishers, New Delhi, 2011.

REFERENCE BOOKS

1. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons
2. Gerald C.F and Wheatley P.O, Applied Numerical Analysis, Addison-Wesley Publishing Company
3. Peter V.O'Neil, Advanced Engineering Mathematics, Thomson

SUB CODE: EI4T2 LINEAR INTEGRATED CIRCUITS Sem: IV

Branch: MECHATRONICS (Common to MECHATRONICS/EIE) Credit: 3
(For Students admitted from 2014 onwards)

Prerequisite: Basic knowledge in Electronic devices.

Aim

To teach the basic concepts in the design of electronic circuits using linear integrated circuits and their applications in the processing of analog signals.

Objectives

The course should enable the students to:

1. Learn the IC fabrication technology.
2. Know the Op -amp characteristics and its linear applications.
3. Learn comparator, Schmitt-Trigger circuits, Voltage regulator and some linear and nonlinear oscillators
4. Study how an Op-Amp can act as a filter on an electrical signal
5. Learn the theory and applications of PLL, ADC and DAC.

Outcome

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

1. Enumerate different steps involved in the process of fabrication of integrated circuit.
2. Distinguish clearly between ideal and actual characteristics of an Op-amp and to learn different linear applications.
3. Understand different nonlinear applications.
4. Understand the advantages of using active filters in place of passive filters.
5. Understand how an operational amplifier can be helpful in signal processing

UNIT I - IC FABRICATION

IC classification, Fundamental of Monolithic IC technology, Basic Planar processes: epitaxial growth, masking and etching, diffusion of impurities. Assembly processing and packaging. Fabrication of diodes, capacitance, resistance and FETs.

UNIT II - CHARACTERISTICS OF OPAMP

Ideal OP-AMP characteristics, DC characteristics, AC characteristics, offset voltage and offset current, CMRR, Slew rate, virtual ground concept, differential amplifier: Transfer characteristics, Inverting and Non-inverting amplifier, voltage follower, summer, multiplier, differentiator and integrator.

UNIT III - APPLICATIONS OF OPAMP

Instrumentation amplifier, first order active filters, V/I & I/V converters, comparators, multivibrators, waveform generators, clippers, clampers, peak detector, S/H circuit, D/A converter (R-2R ladder and weighted resistor types), A/D converter - Dual slope, successive approximation and flash types.

UNIT IV - SPECIAL ICs

555 Timer circuit – Functional block, characteristics & applications, 566-voltage controlled Oscillator circuit, 565-phase lock loop circuit functioning and applications.

UNIT V - APPLICATION ICs

IC voltage regulators - LM317, 723 regulators, 78xx, 79xx regulators, switching regulator, Power amplifier: MA 7840, LM 380, Function generator IC: XR2206, isolation amplifiers, Opto coupler.

TEXT BOOKS

1. Ramakant A.Gaykward, "*Op-amps and Linear Integrated Circuits*", IV edition, Pearson Education, 2003 / PHI – 2000.
2. D.Roy Choudhary, Sheil B.Jani, "*Linear Integrated Circuits*", II edition, New Age, 4e, 2010.

REFERENCE BOOKS

1. Jacob Millman, Christos C.Halkias, "*Integrated Electronic Analog and Digital circuits system*", Tata McGraw Hill, 2nd ed, 2011.
2. Robert F.Coughlin, Fredrick F.Driscoll, "*Op-amp and Linear ICs*", Pearson Education, 4th edition, 2002 / PHI.
3. David A.Bell, "*Op-amp & Linear ICs*", Prentice Hall of India, 5th edition, 1998.

SUB CODE: ME4T4 MECHANICS OF SOLIDS & FUNDAMENTALS OF FLUIDS Sem: IV

Branch: MECHATRONICS (For Students admitted from 2014 onwards) Credit: 3

Prerequisite: Engineering Physics

Aim

To provide an overview of the concepts involved in the solid and fluid mechanics.

Objectives

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

1. To estimate the displacement and stresses in deformable bodies under the action of forces and torque.
2. To solve problems in fluid statics, fluid kinematics and incompressible fluid dynamics

Outcome

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

1. Develop through basic knowledge about fluid and solid mechanics.
2. Acquire knowledge on the applications of fluids.
3. Learn the usage of different types of materials and stresses developed.

UNIT - I - STRESS, STRAIN AND DEFORMATION OF SOLIDS

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

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

Types of Beams, Transverse loading on beams shear force and Bending moment in beams - cantilever, simply supported, overhanging beam subjected to concentrated load and UDL - maximum bending moment and point of contra flexure. Theory of simple bending and assumption

UNIT - III - TORSION, SPRINGS AND COLUMNS

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

UNIT - IV - FLUID FLOW CONCEPTS AND BASIC EQUATIONS

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

UNIT - V - DIMENSIONAL ANALYSIS AND FLOW THROUGH CIRCULAR CONDUITS

Dimension and units, Buckingham Ω theorem. Discussions on dimensionless parameters - applications. Fluid flow - Laminar and Turblent flow through circular tubes. Darcy Equation on pipe roughness - Friction factor - Moody diagram, Minor loss.

TEXT BOOKS

1. Ramamrutham S. and Narayanan .R., *Strength of materials*, Dhanpat Rai Pvt. Ltd., New Delhi, 2001
2. Bansal. R.K. *Strength of Materials*, Lakshmi publications Pvt. Ltd., New Delhi, 1996
3. Kumar .K.L., *Engineering Fluid Mechanics*, Eurasla publishers Home Ltd., New Delhi, 1995
4. Bansal .R.K, *Fluid Mechanics and Hydraulic Machines*, Laxmi publications (P) Ltd., New Delhi, 1995

REFERENCE BOOKS

1. Ferdinand P. Beer and Russell Johnston. E, *Mechanics of Materials* SI metric Edition McGraw Hill, 1992
2. Ramamrutham.S. *Fluid Mechanics and Hydraulics* Dhanpat Rai and Sons, Delhi
3. Popov.E.P., *Mechanics of Materials*, Prentice Hall, 1982
4. Timoshenko .S.P and Gere M.J., *Mechanics of Materials*, C.B.S. publishers,
5. Srinath L.N. Advanced Mechanics of Solids Tata McGraw Hill Ltd., New Delhi

SUB CODE: EI4T3 **INDUSTRIAL INSTRUMENTATION** **Sem: IV**

Branch: MECHATRONICS **(Common to MECHATRONICS/EIE)** **Credit: 3**

(For Students admitted from 2014 onwards)

Prerequisite: Electron Devices and Circuits, Sensors and Transducers.

Aim

To equip the students with relevant knowledge to suit the industrial requirements.

Objectives

The course will enable the students to:

1. Learn about Tachometer, Load cells, Torque meter and various densitometers.
2. Have an adequate knowledge about pressure transducers.
3. Have an idea about the temperature standards, calibration, thermocouples, signal conditioning used in RTD's and pyrometer techniques.
4. Study about various types of flow meters and their installation.
5. Have sound knowledge about various types of viscometers, level measurements, humidity and moisture measurements adopted in industrial environment

Outcome

At the end of the course, the students should be able to:

1. Understand the various techniques used for the measurement of industrial parameters.
2. Explain the design and working of various instruments.
3. Understand the installation techniques of various systems.
4. Understand the concept of various transducers used in industries.
5. Work with signal conditioning circuit of various measuring equipments.

UNIT I - MEASUREMENT OF SPEED, FORCE, TORQUE, ACCELERATION

Measurement of speed- Revolution counter, Drag cup tachometer, AC and DC tacho generators, photo electric pickup. Measurement of force - Load cell, pneumatic load cell, hydraulic load cell. Measurement of Torque using strain gauges and magneto elastic principle, Measurement of acceleration - Elementary accelerometers, seismic accelerometers, practical accelerometers, calibration.

UNIT II - MEASUREMENT OF PRESSURE

Manometers – different types of manometers, Elastic pressure transducers, Dead weight Tester, Electrical types, Vacuum gauges - McLeod gauge, Knudsen gauge, thermocouple gauge, ionization gauge, Differential pressure transmitter - electrical & pneumatic types

UNIT III - MEASUREMENT OF TEMPERATURE

Temperature scales, Bimetallic thermometer, filled- in Thermometers, Vapour pressure thermometers, Resistance thermometers, Thermistor, Thermostat, Thermocouples - types and ranges, characteristics, laws of thermocouples, cold junction compensation, IC temperature sensors AD 590, Pyrometers - radiation and optical pyrometers.

UNIT IV - MEASUREMENT OF FLOW, LEVEL

Orifice, Venturi, Pitot tube, flow nozzle rotameter, Positive displacement meter, turbine flowmeter, electromagnetic flow meter, ultrasonic flow meter, open channel flow measurement, solid flow measurement. Sight glass, float gauge, displacer, torque tube, bubbler tube, diaphragm box, Differential Pressure methods, electrical methods- resistance type, capacitance type, ultrasonic level gauging.

UNIT V - MEASUREMENT OF DENSITY, VISCOSITY, HUMIDITY

Hydrometer – continuous weight measurement, liquid densitometer – float principle, air pressure balanced method, using gamma rays – gas density measurements – gas specific gravity measurements – Viscosity terms, saybolt viscometer, rotometer type viscometer, and Industrial consistency meters. Humidity terms – dry & wet bulb psychrometers – hot wire electrode type hygrometer, electrolytic hygrometer, Dew point hygrometer

TEXT BOOKS:

1. D. Patranabis, "*Principles of Industrial Instrumentation*", Tata McGraw Hill, Third Edition, New Delhi, Reprint 2010.
2. S. K. Singh, "*Industrial Instrumentation & Control*" 3rd Edition, Tata McGraw Hill, Reprint 2013.
3. K.Krishnaswamy & S.Vijayachitra, "*Industrial Instrumentation*" New age International, Reprint 2010.

REFERENCE BOOKS:

1. Ernest O. Doeblin, Dhanish. N. Manik, "*Measurement Systems Application & Design*", TMH, 5th Edition, 2007.
2. R.K.Jain, "*Mechanical & Industrial Measurements*", Khanna Publishers, 11th Edition, 2004.

SUB CODE: EE4T2 **DIGITAL ELECTRONICS** **Sem: IV**

Branch: MECHATRONICS **(Common to MECHATRONICS/EIE)** **Credit: 3**

(For Students admitted from 2014 onwards)

Prerequisite: Basic Electronics.

Aim

To have the Knowledge of Basic Digital Circuits and their Design

Objectives

The course should enable the students to:

1. Study various number systems and to simplify the mathematical expressions using Boolean functions - simple problems.
2. Study implementation of combinational circuits.
3. Study the design of various synchronous and asynchronous circuits.
4. Learn about the various hazards present in the circuit
5. Expose the students to various memory devices

Outcome

The students should be able to:

1. Understand the basic number system and Boolean algebra.
2. Understand the basics of combinational circuits.
3. Know about Flip flops and synchronous sequential circuits and their design.
4. Analyze about various hazards present in the circuit.

UNIT I - NUMBER SYSTEMS AND CODES

Review of Number systems: Binary, Octal and Hexadecimal. Representations of numbers and their conversions. Binary arithmetic's. Conversion algorithms. Weighted binary codes and Non-weighted binary codes. Error detecting and error correcting codes. Alphanumeric codes.

UNIT II - BOOLEAN ALGEBRA AND LOGIC FUNCTIONS

Boolean Algebra: Introduction to Boolean algebra - The AND, OR and NOT operations. Laws of Boolean algebra. Minimization of Boolean expression. Boolean expressions and logic diagrams. Universal building blocks. Negative logic.

Logic Simplifications: Truth tables and maps. Sum-of-products and product-of-sums. Simplification of logic functions using Karanaugh map Minimization and Quine-McCluskey method of minimization.

UNIT III - COMBINATIONAL CIRCUITS

Arithmetic circuits: Half Adder, Full Adder, Half Subtractor and Full Subtractor, Number complements. Multiplexer - Demultiplexer, Decoder and Encoder code converters – BCD to Excess3, Gray, Seven Segment Display Conversions – Parity Generator and Checkers.

UNIT IV - SEQUENTIAL CIRCUITS

Synchronous sequential circuits: Basic latch circuits - Flip-flops, truth table and excitation table. Shift Registers. Synchronous counter design using JK, T, D flip flops, Up-down counter, General BCD counter and Ring counters.

Asynchronous Sequential Circuits – State Reduction, Multiple Inputs.

UNIT V - LOGIC FAMILIES AND PROGRAMMABLE LOGIC DEVICES

Logic Families: BJT as a switch- Logic Specifications – RTL, DTL, IIL, TTL open Collector O/P, Totem pole O/P, Tristate O/P, Schottky TTL gate, ECL, MOS, CMOS Logic – Comparison of Logic Families.

Programmable Logic Devices: PAL, PLA, PROM.

TEXT BOOKS:

1. W.H. Gothmann, "*Digital Electronics - An Introduction, Theory and Practice*", Prentice Hall of India.2nd Edition, 2000.
2. M.Morris Mano & Charles kime pearson 2013– "*Digital Logic & Computer Design*" – PHI, 4th Edition, 1999.

REFERENCE BOOKS:

1. A. Anand Kumar, "*Switching Theory and Logic Design*" – PHI, 2nd Edition 2014.
2. Heiser Man, "*Handbook of Digital IC applications*", Prentice Hall. 2002.
3. D.J. Comer, "*Digital Logic and State Machine Design*", HOLT-SAUN-DERS, 3rd Edition, 2012.
4. T.L. Floyd & Jain, "*Digital Fundamentals*", Pearson, 10th Edition, 2010.

SUB CODE: EE4T7 **MEASUREMENT AND INSTRUMENTATION** **Sem: IV**

Branch: MECHATRONICS **(Common to MECHATRONICS/EIE)** **Credit: 3**
(For Students admitted from 2014 onwards)

Prerequisite: Electric Circuits.

Aim
To introduce the concept of measurement and the related instrumentation requirement as a vital ingredient of electronics and communication engineering.

Objectives
The course should enable the students to:
1. Acquire the knowledge on basic measurement concepts
2. Acquire the knowledge on basic electronic measurements
3. Acquire the knowledge on recording devices
4. Acquire the knowledge on digital instruments

Outcome
At the end of the course the student should be able to:
1. Understand Measurement systems, Bridge measurements
2. Know the principles of cathode ray oscilloscopes and other measuring instruments
3. Compare analog and digital techniques, and measurement errors

UNIT I - SCIENCE OF MEASUREMENT AND CHARACTERISTICS OF TRANSDUCERS
Functional elements of an instrument - Units and standards - calibration methods – errors in measurement - statistical methods - Static characteristics - accuracy, precision, sensitivity, linearity, Reproducibility, Repeatability and Noise - Dynamic characteristics – impulse, step, ramp and sinusoidal inputs.
Classification of transducers – Selection of Transducer – Applications of Transducer - Resistive Transducer: Strain gauges, Resistance Thermometers, Thermistor - Inductive Transducers: LVDT, RVDT- Capacitive Transducers – Piezoelectric Transducer.

UNIT II - POTENTIOMETERS AND ELECTRICAL INSTRUMENTS
DC potentiometer - Loading effect – Application – Basic circuit - standardization – Laboratory type (Crompton's) – AC potentiometer – Drysdale (polar type) type – Gall-Tinsley (coordinate) type – Limitations & applications – Instrument Transformer - C.T and V.T construction, theory, operation, phasor diagram, characteristics, testing, error elimination – Applications – Single and three Phase Wattmeters and Energy meter.

UNIT III - MEASUREMENT OF RESISTANCE AND IMPEDANCE
Low Resistance: Kelvin's double bridge – Ductor Ohmmeter - Medium Resistance: Voltmeter Ammeter method, Substitution method, Wheatstone bridge method – High Resistance: Megger, Direct deflection method, Megohm bridge method- Earth resistance measurement. Introduction to A.C. bridges – Sources and Detectors in A.C. bridges – Measurement of Inductance – Anderson Bridge. - Measurement of Capacitance: Schering's bridge, De-Sauty's bridge - Measurement of frequency using Wien's bridge- LCR meter- Q meter

UNIT IV- CRO AND RECORDING INSTRUMENTS
Oscilloscope: CRO – CRT, Deflection System, Specifications, Controls, Phosphors -Dual Beam / Dual trace oscilloscope - Storage Oscilloscope, Digital Storage Oscilloscope and Sampling Oscilloscope.
Recording Instruments: Method of Recording – Frequency Modulated (FM) recording-Pulse Duration Modulation (PDM) Recording - Strip Chart Recorders, X-Y, UV Recorders, and Plotters.

UNIT V- ANALOG & DIGITAL INSTRUMENTS
Operating Forces – Deflecting Force, Controlling Force, Damping Force - Galvanometer, PMMC & moving iron instruments – Principle of operation, construction and sources of errors and compensation – Dynamo meter – True RMS meter - electronic voltmeter – Digital Voltmeter – Multimeter – vector voltmeter.

TEXT BOOKS

1. D. Patranabis, "*Sensors and Transducers*", Prentice Hall of India, 2nd Edition, 2008.
2. Helfrick & Cooper, "*Modern Electronic Instrumentation and Measurement Techniques*", Prentice Hall of India, 5th Edition, 2008.
3. Joseph J Carr, "*Elements of Electronic Instrumentation & Measurement*", Pearson, 3rd Edition 1996.
4. H.S.Kalsi, "*Electronic Instrumentation*", TMH Co., 3rd Edition 2012.
5. Moorthy, D.V.S., "*Transducers and Instrumentation*", Prentice Hall of India Pvt. Ltd., 2nd Edition 2010.
6. A.K Sawhney, "*A course in Electrical & Electronic Measurement and Instrumentation*", Dhanpat Rai and Co (P) Ltd., 18th Edition 2010.
7. Oliver and Cage, "*Electronics measurements & Instrumentation*" TMH Co, 1st Edition, 2008
8. M.M.S.Anand, "*Electronic Instruments and Instrumentation Technology*", PHI, 2006.

REFERENCE BOOKS

1. E.A. Doeblin, "*Measurement Systems – Applications and Design*", Tata McGraw Hill, New York, Fourth Edition 1990
2. S. Ranganathan, "*Transducer Engineering*", Allied Publishers Pvt. Ltd., 2003.
3. Stout M.B., "*Basic Electrical Measurement*", Prentice Hall of India, 1986
4. Dalley,J.W., Riley, W.F. and Meconnel, K.G., " *Instrumentation for Engineering Measurement*", John Wiley & Sons, 1993.

SUB CODE: SA4T4 **SANSKRIT & INDIAN CULTURE – IV** **Sem: IV**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit 1**

Unit I – (1) Introduction to Sindh Vedic Cultures; significance & how it is different from the other cultures. (2) Why we have to follow? Important features. (3) Chronology of Indian Cultures; origin & spread; general features.

Unit II – (4) Literary Heritage of India – significance of Indian Literature; (5 & 6) chronology of Indian literature; (7) Literature in Sanskrit and other languages;

Unit III – (8) Early Indian Education – significance & advantages. (9) Gurukulas and Guru-sishya parampara. Learning methods. (10) Evolution of script and languages; important early scripts and writing materials; (11) important early educational centers (*ghattikas,* universities) & their unique features.

Unit IV - (12 & 13) duties & responsibilities of human - *gruhya sutras, smrities* & *sruties* - significance in day to day life.

Unit V - (14 & 15) Scientific thoughts of Early Indian Sages;

Reference Books

1. Joshi,K. 1992(rp). *The Veda and Indian Culture.* Rastriya Veda Vidya Pratishthana.
2. New Delhi.
3. Majumdar, R.C. 1994 (rp). *Ancient India*. Motilal Banarsidas Publishers. Delhi.
4. Patel, I.S. (ed). 1984. *Science and the Vedas*. Bombay.
5. Sri Chandrasekarendra Sarasvati Swamihi. 1991. *The Guru Tradition*. Bharatiya Vidya Bhavan. Bombay.
6. Sri Jayendra Saraswatiji Maharaj. 1951. *The Vedas and Vedangas*. Prakashan Kendra. Lucknow.
7. Vartak, P.V. 1986. *Scientific Knowledge in the Vedas.* Delhi.
8. Winternize, M. 1996(rp). *History of Indian Literature*. Delhi.

SUB CODE: EI4P7 LINEAR INTEGRATED CIRCUITS AND DIGITAL ELECTRONICS LAB

Branch: MECHATRONICS **Sem: IV**

Credit: 2

(For Students admitted from 2014 onwards)

LIST OF EXPERIMENTS

1. Applications of Op-amp-I-Inverting, Non-Inverting, Adder & Subtractor.

2. Applications of Op-amp II – Differential Amplifier, Comparator, Integrator & Differentiator.

3. Op-amp characteristics – Slew rate verifications, CMRR, Input-Offset voltage.

4. Study of Basic Digital – IC's – Verification of TT for AND, OR, EXOR, NOT, NOR & NAND.

5. Study of flip-flops - JK, RS, D &T FF.

6. Implementation of Boolean functions, Adder / Subtractor Circuits.

7. Counters: Design and implementation of 4-bit Ripple and Decade counter.

8. Shift registers – SISO, PIPO, PISO and SIPO.

9. Timer IC application – NE555 timer in Astable , Monostable operation.

10. Pspice simulation : Inverting /Non inverting amplifier, voltage follower, integrator, differentiator.

SUB CODE: ME4P9 STRENGTH OF MATERIALS & FLUID MECHANICS LABORATORY

Branch: MECHATRONICS **Sem: IV**

Credit: 2

(For Students admitted from 2014 onwards)

LIST OF EXPERIMENTS

1. Tension test on MS and twisted bar (Electronic UTM)
2. Comparison of hardness value of steel, copper and aluminium using Rockwell, Brinell and Vickers hardness measuring machines
3. Estimation of notch toughness of steel using impact testing machine
4. Estimation of spring constant under tension and compression
5. Tension test on MS (Tensile Testing Machine)
6. Torsion test on Mild steel.
7. Verification of Bernoulli's equation
8. Calibration of orifice meter
9. Flow through nozzle
10. Flow through pipes and losses in pipes
11. Buoyancy experiment – Meta centric height
12. Wind tunnel – Drag and Lift measurement

SUB CODE: EE4P6 **MEASUREMENTS AND INSTRUMENTATION LAB**

Branch: MECHATRONICS **Sem: IV**

Credit: 2

(For Students admitted from 2014 onwards)

LIST OF EXPERIMENTS

1. Measurements of medium resistance using Wheatstone bridge.
2. DC Bridge - Kelvin double bridge & Megger.
3. Design of Wien's, Anderson and Schering Bridge
4. Instrumentation amplifiers.
5. A/D Converter D/A Converter.
6. Calibration of single phase energy meter.
7. Measurement of three phase power & P.F
8. Measurement of iron loss.(Using Maxwell bridge)
9. Calibration of Voltmeter and Ammeter.
10. Extension of range of a Voltmeter and Ammeter.
11. Calibration of CT & PT.
12. MATLAB Simulation.

V SEMESTER

SUB CODE: MH5T1 **MATHAMATICS IV** **Sem: V**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 3**

UNIT –I PROBABILITY THEORY

Random experiment – Mathematical, statistical and axiomatic definitions of probability – Conditional probability – Independent events - Theorem of total probability – Theorem of probability of causes: Bayes's theorem – Bernoulli's trials – De Moivre-Laplace approximation – Generalization of Bernoulli's theorem multinomial distribution – Outline of applications of probability theory in engineering.

UNIT- II ONE DIMENSIONAL RANDOM VARIABLES

Discrete random variable – Probability mass functions of Binomial, Poisson, Pascal and Geometric distributions - Continuous random variable – Probability density function of Uniform, Normal, Gamma, Erlang, Rayleigh, Maxwell and Laplace distributions - Cumulative distribution function – Outline of applications of one dimensional random variables in engineering.

UNIT- III TWO DIMENSIONAL RANDOM VARIABLES

Two dimensional random variables – Probability mass function – Joint probability density function – Cumulative distribution function – Marginal probability distribution – Conditional probability distribution – Independent random vectors – Function of random variable - Outline of applications of two dimensional random variables in engineering.

UNIT –IV STATISTICAL AVERAGES

Measures of central tendency – Mathematical expectation and moments – Measures of dispersion – Coefficient of variation – Skewness – Kurtosis – Pearson's shape coefficients – Expected values of a two dimensional random variables – Linear correlation – Correlation coefficient – Rank correlation coefficient – Regression – Equation of the regression line – Outline of applications of statistical averages in engineering.

UNIT –V STATISTICAL INEQUALITIES

Characteristic function – Moment generating function – Cumulative generating function – Bounds on probability: Tchebycheff, Bienayme's, Schwartz and Cauchy-Schwartz inequalities (without proof) – Convergence concepts and central limit theorem – Outline of applications of statistical inequalities in engineering.

Note: Questions are to be set on problem solving and not on the theoretical aspects.

TEXT BOOKS

1. Veerarajan. T.," Probability, Statistics and Random Processes, Third Edition, Tata McGraw-Hill Publishers, New Delhi 2008.

REFERENCE BOOKS

1. Gubner, John, Probability and random process for electrical and computer engineers, Cambridge
2. Gupta S.P, Statistical methods, Sultan Chand & Sons
3. Papoulis, Probability, Random Variables and Stochastic Processes, McGraw Hill.

SUB CODE: EI5T2 **SENSORS AND ACTUATORS** **Sem: V**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 4**

Prerequisite: Nil.

Aim

The aim of the course is to provide in-depth knowledge of the principles of operation of various sensory devices and actuators for Mechatronics applications.

Instructional Objectives

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

1. Understand the science of measurements and sensors
2. Identify and avoid errors in measurements
3. Select appropriate sensors for various applications.
4. Understand the science of Micro actuators & Micro sensors

Outcome

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

1. Understand the characteristics of sensors and actuators
2. Know well about Micro actuators & Micro sensors
3. Analyze various sensors and actuators.

UNIT I- SENSORS AND ACTUATOR CHARACTERISTICS:

Measurement devices; Difference between sensor, transmitter and transducer - Primary measuring element selection and characteristics: Range; resolution, Sensitivity, error, repeatability, linearity and accuracy, impedance, backlash, Response time, Dead band. - System response- first order system response, undamped second order system response, frequency response. - Signal transmission: Types of signal: Pneumatic signal; Hydraulic signal; Electronic Signal. Standard signal ranges: Electronic transmitter adjusted range; Pneumatic transmitter adjusted range; Transmission system dynamics; transmission Lag; Transmitter Gain; Smart transmitters.

UNIT II- SENSORS

Classification of sensors, Principles and Applications of displacement sensor – position sensors, linear and angular – velocity sensors – Torque sensors. Principle and applications of pressure sensor, flow sensors, temperature sensors, acoustic sensor and vibration sensors. Application of sensors in Robotics

UNIT III- ACTUATORS

Definition, types and selection of Actuators; linear; Rotary; Logical and Continuous Actuators.- Fluid power actuators: Pneumatic actuator; Electro-Pneumatic actuator; cylinder, rotary actuators, Mechanical actuating system: Hydraulic actuator; Control valves; Construction; Valve coefficient or valve sizing; valve characteristics; types of valves; valve selection.

Electrical actuating systems: Solid-state switches, Solenoids, Electric Motors; D.C. motors, Classifications; Application; Brushless DC Motor; Working principle and its application; AC motors, Single phase Motor; 3 Phase Motor; Induction Motor; Synchronous Motor; Stepper motors; half stepper; full stepper; linear motor, Piezoelectric Actuator.

UNIT IV-MICRO SENSORS AND MICRO ACTUATORS

Micro Sensors: Principles and examples, Force and pressure micro sensors, position and speed micro sensors, acceleration micro sensors, chemical sensors, biosensors, temperature micro sensors and flow micro sensors.

Micro Actuators: Actuation principle, shape memory effects-one way, two way and pseudo elasticity. Types of micro actuators- Electrostatic, Magnetic, Fluidic, Inverse piezo effect, other principles.

Microbotics: Drive principle, classification, application, micro assembly with the help of microbots, flexible microbots, Automated desktop station using micromanipulation robots.

UNIT V-SENSOR MATERIALS AND PROCESSING TECHNIQUES:

Materials for sensors : Silicon, Plastics, metals, ceramics, glasses, nano materials

Processing techniques: Vacuum deposition, sputtering, chemical vapour deposition, electro plating, photolithography,silicon micro machining, LIGA process.

TEXT BOOKS

1. Patranabis.D, *Sensors and Transducers*, Wheeler publisher, 1994.

2. Sergej Fatikow and Ulrich Rembold, *Microsystem Technology and Microbotics* First edition, Springer –Verlag NEwyork, Inc, 1997.

3. Jacob Fraden, "Hand Book of Modern Sensors: Physics, Designs and Application" Fourth edition, Springer, 2010.

REFERENCE BOOKS

1. Robert H Bishop, "The Mechatronics Hand Book", CRC Press, 2002.

2. Thomas . G. Bekwith and Lewis Buck.N, *Mechanical Measurements*, Oxford and IBH publishing Co. Pvt. Ltd.,

3. Massood Tabib and Azar, *Microactuators Electrical, Magnetic, thermal, optical, mechanical, chemical and smart structures* , First edition, Kluwer academic publishers, Springer,1997.

4. Manfred Kohl , *Shape Memory Actuators*, first edition, *Springer*.

SUB CODE: MG5T3 **THERMODYNAMICS AND HEAT TRANSFER** **Sem: V**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit:3**

Prerequisite: Basic Mechanical Engineering

Aim

This course provides the basic knowledge about thermodynamics and its application I.C. Engines, steam and gas turbines and introduction to heat transfer.

Objectives

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

1. Understand and apply the basic concepts of first law second law of Thermo Dynamics
2. Know about the basic principles of IC engines, Gas Turbines and different modes of Heat Transfer

Outcome

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

1. Develop through basic knowledge about thermodynamics.
2. Acquire knowledge on the applications IC engines.
3. Learn the usage of different types of Gas Turbines and different modes of Heat Transfer.

UNIT - I - BASIC CONCEPTS & FIRST LAW OF THERMODYNAMICS

Working substance - system - ideal gas laws - perfect gas - property - state, process, path and cycle - Equilibrium - Zeroth law of Thermodynamics - point and path functions - Quasi static process, reversible and irreversible processes. First law of thermodynamics:- Energy - first law - specific heat - internal energy and Enthalpy - Energy changes in non-flow processes - The flow equation.

UNIT - II - SECOND LAW OF THERMODYNAMICS

Kelvin - Plank and Clausius statements, Basic concepts of Heat Engines and Heat pumps (efficiency and COP) - Corollaries of II Law - Absolute temperature scale, Entropy, Entropy change for a perfect gas, principle of entropy increase, Clausius inequality.

UNIT - III - I.C. ENGINES

Classifications - Four stroke SI & CI engines, Two stroke SI & CI engines, Power developed by engines, Factors deciding power output, specific weight and specific volume, indicated and brake thermal efficiencies, mechanical efficiency, specific fuel consumption, Performance curves. Heat Balance - Comparison of two stroke and four stroke engines, SI and CI engines. Application of SI & CI engines.

UNIT - IV - STEAM AND GAS TURBINES

Steam Turbines: Types of steam turbines, condensing, non condensing, multi cylinder turbines. Properties of steam - steam tables/ Mollier chart, Ranking cycle - Simple problems, Concept of Reheat and regeneration.

Gas Turbine: Open and Closed cycle, Applications. Flow through stages, degree of reaction - Single stage - reaction impulse - their blade profiles, velocity triangles, specific work, loses and efficiencies. Simple Problems - Multi stage turbines - reaction (Parson) impulse - Pr Compounded and Velocity compounded - Their merits and demerits.

UNIT - V - HEAT TRANSFER

Modes of heat transfer Conduction: Steady state heat conduction - Heat conduction through a plane wall, composite wall, hollow cylinder and composite cylinders - overall heat transfer coefficient.

Convection: Heat transfer by convection - Empirical relations.

Radiation: Laws of radiations - Concept of block body- Radiant Heat transfer between two surfaces.

TEXT BOOKS

1. Rajput R K, "*Thermal Engineering*", Lakshmi Publications 2001
2. Ballaney P L, "*Thermal Engineering*", Khanna Publishers, 1986

REFERENCE BOOKS

1. Holman J. P., "*Thermodynamics*", McGraw Hill.1988
2. Nag P. K., "*Engineering Thermodynamics*", Tata McGraw Hill, 1995
3. Pandya N. C & Shah C. S., "*Elements of Heat Engines*", Charoter Pulishers, 1986

SUB CODE: EC5T4 **CONTROL SYSTEMS** **Sem: V**

Branch: MECHATRONICS (Common to MECHATRONICS/EIE/ECE/EEE) Credit: 3
(For Students admitted from 2014 onwards)

Prerequisite: Basic knowledge in circuit theory and Laplace transform.

Aim
To acquire knowledge in designing and analyzing stable systems

Objectives
The course should enable the students to:
1. Analyze representation of systems and to derive transfer function models.
2. Provide adequate knowledge in the time response of systems and steady state error analysis.
3. Give basic knowledge in obtaining the open loop and closed-loop frequency responses of systems.
4. Provide the concept of stability of control system and methods of stability analysis.
5. Study the three ways of designing compensation for a control system.

Outcome
The students should be able to:
1. Describe various input/output models of dynamic system.
2. Be familiar with frequency domain descriptions and dynamic analysis.
3. Understand the concept of stability and effect of feedback control on sensitivity.
4. Apply the basic methods of classical control system design such as root locus and phase lead-lag compensation based on Bode plots.
5. Understand the principles of control theory.

UNIT I - SYSTEM AND THEIR REPRESENTATION
Basic elements of control systems- open and close loop systems – Differential equation - Transfer function – Modeling of Electrical systems, translational and rotational mechanical systems – Block diagram reduction techniques – Signal flow graphs.

UNIT II - TIME RESPONSE
Time response – Time domain specifications – types of input – I and II order system response – Error coefficients – Generalized error series – Steady state error –Effect of P,PI,PD and PID modes of feedback control ,Analysis using MATLAB.

UNIT III - FREQUENCY RESPONSE
Frequency response – Bode plot – Polar plot – Nyquist plot – Frequency domain specifications from plots – Constant M and N circles – Nichol's chart– Analysis using MATLAB.

UNIT IV - STABILITY AND COMPENSATOR DESIGN
Characteristic equation – BIBO stability - Routh Hurwitz criterion - Root locus technique Construction of Root locus - Nyquist stability criterion – Effect of Lag, Lead and lag-lead compensation on frequency response, Analysis using MATLAB.

UNIT V - STATE VARIABLE ANALYSIS
Concept of state variables – State models for linear and time invariant systems – solution of state and output equation in controllable canonical form – concept of controllability and observability – Effect of state feedback.

TEXT BOOKS:

1. M.Gopal, "*Control system – Principle and Desi*gn", Tata McGraw Hill, 3rd Edition, 2008.
2. K.Ogata, "*Modern control Engineering*", 5th Edition, PHI, 2012.

REFERENCES:

1. Benjamin C.Kuo & Farid Golnaraghi, "*Automatic control systems*", 7th Edition, PHI, 2010.
2. J.Nagrath & Gopal , "*Control System Engineering*", 5th Edition, New Age International 2008.

SUB CODE: MG5T4 **THEORY OF MACHINES** **Sem: V**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 3**

Prerequisite: Mechanics of solids

Aim

To expose the students on fundamentals of various laws governing rigid bodies and its motions. To study vibration characteristics and balancing of mechanical machines.

Objectives

At the end of the course, the student will be able:

1. To draw the profile of cams and its analysis
2. To understand concepts of gear and gear train calculations
3. To balance rotating and reciprocating masses
4. To Understand Fundamentals of vibrations - Single degree of freedom systems

Outcome

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

1. Develop through basic knowledge about gears and gear trains.
2. Acquire knowledge on the applications gears and cams.
3. Learn the usage of different types of gears and gear trains.

UNIT - I - BASICS OF MECHANISMS AND FORCE ANALYSIS

Introduction - links-pairs-chain-Mechanism-Inversion of machine-structure-degree of freedom-Four bar chains - Grashoff's law - Kutzback criterion D'Alembert's principle - The principle of super position - Dynamic analysis in reciprocating engines -Gas forces - Equivalent masses - Bearing loads -Crank shaft torque - Turning moment diagrams - flywheels.

UNIT - II – CAM

Classification of Cam and Follower - displacement diagrams -cam profile construction for Uniform velocity, Uniform acceleration, SHM and Cycloidal motion of follower. Derivative of follower motion.

UNIT - III – GEARS

Fundamentals of toothed gearing - Spur gear terminology and definition - Involute as a gear tooth profile - Interchangeable of gears - Interference and under cutting - Minimum number of teeth to avoid interference - contact ratio - Internal gears - cycloidal tooth form. Gear trains-Types-velocity ratio and torque calculations in epicyclic gear - Automobile differential.

UNIT - IV – BALANCING

Static and dynamic balancing -Balancing of rotating and reciprocating masses - Balancing of single cylinder Engine - Balancing of multi cylinder inline Engine - Partial balancing in locomotive Engines - Hammer blow - Swaying couple -Tractive force-Balancing machines.

UNIT - V - VIBRATIONS (Single degree of freedom system)

Introduction - Types of Vibration - Frequency of undamped system - Viscous damping - Damped free vibration - stiffness of spring - Series, parallel and combined springs - Critical speed of shafts.

TEXT BOOKS

1. Ratan, S.S. "*Theory of Machines*", Tata McGraw Hill Publishing Company Ltd., 1993
2. Shigley J.E, "*Theory of Machines and Mechanisms*", McGraw Hill 1998
3. Singiresu S.Rao, "*Mechanical Vibrations*", Nem Chand and Bros, 1998
4. Thomas Beven, "*Theory of Machines*", CBS Publishers and Distributors, 3rd edition, 1984

REFERENCE

1. Ghosh .A and Mallick A.K "*Theory of Mechanisms and machines*" - Affiliated East - West Pvt. Ltd. New Delhi, 1998
2. Sing V.P "*Mechanical Vibrations*" -Dhanpat Rai and Co., 1998
3. Rao J.S and Dukkipati R.V "*Mechanism and Machine Theory*", Wiley Eastern Ltd., New Delhi, 1989
4. John Hannah and Stephens R.C., "*Mechanics of Machines*", Viva Low Prices student Edition, 1999

SUB CODE: EI5T4 **POWER ELECTRONICS AND DRIVES** **Sem: V**

Branch: MECHATRONICS **(Common to MECHATRONICS/EIE)** **Credit: 3**
(For Students admitted from 2014 onwards)

Prerequisite: Electronic Devices and Circuits

Aim
To introduce the application of electronic devices for conversion, control and conditioning of electric power.

Objectives
The course will enable the students to:
1. Have an overview of different types of power semi-conductor devices and their switching characteristics.
2. Understand the operation, characteristics and performance parameters of controlled rectifiers.
3. Study the operation, switching techniques and basic topologies of DC-DC switching regulators.
4. Learn the different modulation techniques of PWM inverters and to understand the harmonic reduction methods.
5. Understand the practical application for power electronics converters in conditioning the power supply

Outcome
At the end of the course students should able to do the following:
1. Choose the Power Devices based on the Application.
2. Selection and Design of AC to DC, AC to AC Controlled Converters
3. Design Choppers and Switching Regulators.
4. Understand Fixed DC to Variable AC converters, Various Modulation Techniques employed in Inverters and the Effect of Harmonics.
5. Apply Power Converters in a Power System such as HVDC Transmission and FACTS.

UNIT I - POWER SEMICONDUCTOR DEVICES
Power diodes – power transistor – characteristics of SCR, Triac, power MOSFET – IGBT – MCT – LASCR – SCR turn on, turn off characteristics – thyristor specifications – thyristor protection circuits. Thyristor trigger circuits

UNIT II - CONVERTERS
Operation of 1ϕ half wave rectifiers with R, RL & RLE load.- 1ϕ Full wave rectifier with R, RL, & RLE load (fully controlled and half controlled) - effect of source inductance & load inductance – introduction to Cyclo converters.

UNIT III - INVERTERS & CHOPPERS
Voltage source inverters – series, parallel & bridge inverters – Current source inverters – PWM inverters. Commutation – Choppers – Control strategies – DC chopper – AC Chopper – Applications.

UNIT IV - DC DRIVES
Advantages, types & selection of electrical drives, Methods of speed control of DC motors – Armature control & Field control – Ward Leonard drives –Converter fed & Chopper fed DC drives - Two quadrant & Four quadrant chopper drives.

UNIT V - INDUCTION MOTOR DRIVES
Induction Motor fundamentals – Speed control of Induction motors – Stator control: Voltage, Frequency, V/F control (AC chopper, Inverter fed drives) – Rotor resistance control – slip power recovery scheme – Introduction – Synchronous motor drive.

TEXT BOOKS
1. Bhimbra. Dr.P.S, "*Power Electronics*", Khanna Publishers, 4th edition, 2002.
2. Muhammad H. Rashid, "*Power Electronics – Circuits, Devices & Applications*", Pearson Education India, 3rd edition, 2003.
3. Dubey G.K, "*Fundamentals of Electric Drives*", 2nd edition, 2002.

REFERENCE BOOKS
1. Dubey, G.K., et.al, "*Thyristorised Power Controllers*", New Age International (P) Publishers Ltd., 2002.
2. Vedam Subramaniam, "*Power Electronics*", New Age International (P) Publishers Ltd., 2000.
3. Pillai S.K., "*A first course on Electrical Drives*", New Age International (p) Ltd., 1989, 2nd edition.

SUB CODE: SA5T5 **SANSKRIT & INDIAN CULTURE –V** **Sem: V**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 1**

Unit I – (2) Samskaras or Sacraments – Important occasions & significance; Sixteen important Samskaras in due course of human life.

Unit II – (1) Responsibilities of Human - four Ashrama Dharmas .

Unit III – (2) significance of social gatherings & celebrations of different occasions. – Worship – personal and public rituals & their significance; (2) soi-cultural significance of festivals and impact on culture. (1) Significance of sound science – *Gandharvaveda* (Music) & Dance.

Unit IV – (2) Significance of Yoga in daily life.

Unit V – (2) Scientific heritage - importance and significance of Upavedas. (3) Special reference to Ayurveda and Arthasastra.

Reference Books

1. Acharya, D. 1999. *Dharnuveda* (sub-Veda of Yajurveda). Hindi. Vijaya Kumar Govindram Harsanand. Delhi.
2. Kangle, R.P. 1992 (rp). *The Kautilya Arthasastra.* Delhi.
3. Rao, S.K.R. 1994. *Nityarchana*. Agama-kosha (Agam Encyclopaedia). Kalpatharu Research Academy Publications. Vol X. Banglore.
4. Ray, P. (tr). 1997. *Vasistha's Dhanurveda Samhita*. J.J. Publishing House. Delhi.
5. Shalini, K. 1997. *Vedic Leguminous Plants* (Medical and Microbiological Study). Classical Publishing Company. New Delhi.
6. Swami Satyananda Saraswati. 1997 (rp). *Asanas Pranayama Mudra Bandha*. Bihar Yoga Bharati. Bihar.

SUB CODE: MH5P7 MANUFACTURING AND ASSEMBLY DRAWING (Practical) Sem: V

Branch: MECHATRONICS (For Students admitted from 2014 onwards) Credit: 2

Prerequisite: Engineering graphics

Aim

To develop in the engineering student the ability to draw a detailed production and assembly drawing for given components.

Objectives

At the end of this course the student should be able to understand

1. Indian codes and standards for engineering drawing
2. Representation of Fits and Tolerances in technical drawing
3. Assembly drawing of machine elements
4. Production drawing of components

Outcome

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

1. Develop through basic knowledge about Indian codes and standards.
2. Acquire knowledge on the applications of Fits and Tolerances.
3. Learn the usage of Production drawing.

UNIT - I - TECHNICAL DRAWING STANDARDS

Indian Standard Code of practice for Engineering Drawing: General principles of presentation, conventional representation of dimensioning and sectioning, conventional representation of threaded parts, gears, springs and common features. Abbreviations and symbols used in technical drawings. Symbols and method of indication on the drawing for surface finish, welding and riveted joints.

UNIT - II - FITS AND TOLERANCES

Tolerance types and representation on the drawing - Fits types and selection for different applications - Basic hole systems - Basic shaft systems - Allowances. Geometric tolerances - Form and positional. Datum and datum features symbols used to represent geometric tolerances.

UNIT - III - ASSEMBLY DRAWING OF JOINTS, COUPLING AND BEARINGS

Preparation of drawing for keys and keyways, cotter joints, pin joints and screwed fasteners. Preparation of drawing for Couplings - Flange coupling and universal coupling, Bearings: Plummer block - Foot step bearing. Representation of tolerances on drawing.

UNIT - IV - PRODUCTION DRAWING

Preparation of production drawing for simple components, interpretation of production drawings.

UNIT - V - ASSEMBLY DRAWING OF MACHINE ELEMENTS

Preparation of assembled views given parts details - Lathe tail stock - Lathe chuck - Connecting rod - Screw jack, machine vice, tool head of shaper and stop valve. Representation of tolerances on drawing.

NOTE: Examination must include an assembly drawing of machine elements.

TEXT BOOKS

1. Gopalakrishnan, K.R., "*Machine Drawing*", Subash Publishers, 2000
2. Narayana, K.L., Kanniah, P., and Venkata Reddy . K., "*Production Drawing*", New Age International, 2002

REFERENCE BOOKS

1. Sidheswar Kannaiah, N., Sastry, P.V.V.V., "*Machine Drawing*",Tata McGraw Hill, 1997
2. Bhatt, N.D., "*Machine Drawing*", Charotar publishing house, 1999
3. Junnarkar, N.D., "*Machine Drawing*", First Indian print, Pearson Education (Singapore) pvt Ltd, 2005
4. "*P.S.G. Design Data Book*" 2001
5. "*Revised IS codes"*: 10711, 10712, 10713, 10714, 9609, 1165, 10715, 10716, 10717, 11663, 11668, 10968, 11669, 8043, 8000

SUB CODE: ME5P9 **THERMO DYNAMICS LABORATORY** **Sem: V**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 2**

LIST OF EXPERIMENTS

1. Performance test on single stage reciprocating air compressor
2. Performance test on constant speed centrifugal air blower
3. Valve timing diagram on single cylinder four stroke petrol engine
4. Port timing diagram on single cylinder two stroke petrol engine
5. Load test on single cylinder petrol engine
6. Performance test on high speed diesel engine with alternator loading
7. Performance test on slow speed – diesel engine
8. Performance characteristic and Morse test on a multi cylinder petrol / diesel engine
9. Testing of fuels and lubricants using Say bolt and Redwood viscometer
10. Flash and fire point of fuels and lubricating oil.

SUB CODE: EC5P7 **POWER ELECTRONICS AND DRIVES LAB** **Sem: V**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 2**

LIST OF EXPERIMENTS

1. SCR, MOSFET & IGBT Characteristics – Study.
2. UJT, R, RC Firing circuits for SCR.
3. SCR based half controlled & fully controlled converters.
4. SCR based DC Voltage Commutated chopper.
5. SCR based DC Current Commutated chopper.
6. SCR based Series Inverter.
7. SCR based Parallel Inverter.
8. Simulation of above Experiments using PSIM.
9. Simulation of closed loop control of converter fed DC motor using PSIM.
10. Simulation of closed loop control of chopper fed DC motor using PSIM.
11. Simulation of VSI fed 3-phase induction motor using PSIM.
12. Simulation of 3-phase synchronous motor drive using PSIM.

VI SEMESTER

SUB CODE: MH6T1 **MATHAMATICS V** **Sem: VI**

OPERATION RESEARCH **Credit: 3**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)**

UNIT -I LINEAR PROGRAMMING AND SIMPLEX METHOD

Mathematical formulation of the problem - Graphical solution method - Exceptional cases - General linear programming problem - Canonical and standard forms of linear programming problem - The simplex method - Computational procedure : The simplex algorithm - Artificial variable techniques : Big M method, Two phase method - problem of degeneracy.

UNIT -II TRANSPORTATION, ASSIGNMENT AND ROUTING PROBLEMS

Mathematical formulation of the transportation problem - Triangular basis - Loops in a transportation table - Finding initial basic feasible solution (NWC, IBM and VAM methods) - Moving towards optimality - Degeneracy in transportation problems- Transportation algorithm (MODI method) - Unbalanced transportation problems - Mathematical formulation of the assignment problem - Assignment algorithm : Hungarian assignment method - Routing problems : Travelling salesman problem.

UNIT –III GAME THEORY AND SEQUENCING PROBLEMS

Two person zero sum games - Maxmin Minmax principle - Games without saddle points (Mixed strategies) - Solution of 2 X 2 rectangular games - Graphical method - Dominance property - Algebraic method for m x n games - Matrix oddments method for m x n games - Problem of sequencing - Problems with n jobs and 2 machines - Problems with n jobs and k machines - Problems with 2 jobs and k machines.

UNIT –IV INTEGER PROGRAMMING AND INVENTORY CONTROL

Gomory's All I.P.P method - Gomory's mixed integer method - Branch and bound method - Reasons for carrying inventory - Types of inventory - Inventory decisions - Economic order quantity - Deterministic inventory problem - EOQ problem with price breaks - Multi item deterministic problem.

UNIT- V REPLACEMENT PROBLEMS AND PERT/CPM

Replacement of equipment or asset that deteriorates gradually - Replacement of equipment that fails suddenly - Recruitment and promotion problem - Network and basic components - Rules of network construction - Time calculations in networks - Critical path method (CPM) - PERT - PERT calculations - Negative float and negative Slack - Advantages of network (PERT/CPM).

TEXT BOOKS

1. Kanti Swarup, P.K.Gupta and Man Mohan, Operations Research, Eighth Edition, Sultan Chand & Sons, New Delhi, 1999.

REFERENCE BOOKS

1. H.A.Taha, Operations Research, Sixth Edition, MacMillen.
2. Richard Bronson, Operations Research, (Schaum's Outline Series, McGraw Hill Company, 1982.
3. J.K.Sharma, Operation Research (Theory and Applications), Mac Millen Ltd., 1997.

SUB CODE: ME6T3 **DESIGN OF MACHINE ELEMENTS** **Sem: VI**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 4**

Prerequisite: Mechanics of solids & Fundamentals of fluids.

Aim

To introduce the basic design principles and to apply them to loads. To design various transmission systems.

Objectives

On completion of the course the students will be able to

1. Design Machine elements under various loading and failure conditions
2. Select the appropriate drives for various applications

Outcome

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

1. Develop through basic knowledge about shaft, Key, Coupling and Spring.
2. Acquire knowledge on the applications of Gears.
3. Learn the usage of different types of Drives.

UNIT - I - FUNDAMENTALS OF DESIGN

Phases of design computer aided design -Mechanical properties of materials - Types of loads-stresses - static, varying - Soderberg's and Goodman's equation - Factors of safety - Theories of failure - Stress concentration - Notch sensitivity.

UNIT - II - SHAFT, KEY, COUPLING AND SPRINGS

Shafts-materials for shafts - standard diameter of shafts - Design for strength and rigidity. Keys - Various types of keys - Design of keys. Design of flange coupling, flexible coupling - bush type and disc type. Spring - Types of springs - Uses of springs - Design of helical springs and leaf springs.

UNIT - III - SPUR AND HELICAL GEAR

Introduction to transmission elements - Positive drives and friction drives, Gear drives - Standard modules and various proportions - design of spur and helical gears based on contact stress and beam strength - Based on Lewis and Buckingham equations.

UNIT - IV - BEVEL GEAR AND WORM GEAR

Bevel gear - Nomenclature - Design based on contact stress and beam strength - Based on Lewis and Buckingham equations. Worm and Worm wheel - Nomenclature -Design procedure - heat balance.

UNIT - V - BELT, ROPE AND CHIAN DRIVES

Importance of friction drives - Power and motion transmission over long distance. Belt drives - design of belt drives - calculation of length of belt-number of plies and width of the belt; Vee belts - Cross section - selection procedure of vee belts - pulley details for both flat belts and vee belts. Rope drive - Design and application of rope drive -chain drives - selection of chain and sprockets for various applications - selection procedure.

TEXT BOOKS

1. Joseph Shigley, "*Mechanical Engineering Design*", McGraw Hill, 1989
2. Robert .C.Juvinall, "*Fundamentals of Machine Component Design*", John Willey and Sons, 3rd edition, 2002
3. Spotts.M.F., "*Design of Machine Elements*", PHI, 1988

REFERENCE BOOKS

1. Dobrovolsky, "*Machine Elements*", MIR Publication, 1983
2. William Orthwein, "*Machine Component Design*" - Vol - I & II Jaico Publishing House, Chennai, 1996
3. Prabhu. T.J., "*Design of Transmission systems*", Private Publication, 1999
4. Prabhu .T.J., "*Design of Machine Elements*", Private Publication, 1999
5. Maitra, "*Hand Book of Machine Design*", TMH, 1986
6. Maitra, "*Hand Book of Gear Design*", TMH, 1986
7. "*Design Data PSG College of Technology*", 2000

SUB CODE: EC6T3 **MICROPROCESSORS AND MICROCONTROLLERS** **Sem: VI**

Branch: MECHATRONICS **(Common to MECHATRONICS/EIE /EEE,)** **Credit: 3**
(For Students admitted from 2014 onwards)

Prerequisite: Basic knowledge of computer, digital electronics

Aim

To excel in the Architecture of 8086 & 8051 and to develop skill in simple program writing, to study simple applications.

Objectives

The objective of the course is to impart knowledge on:

1. The Architecture of 8086 & 8051.
2. The addressing modes & instruction set of 8086 & 8051.
3. The need & use of Interrupt structure.
4. Simple program Skills.
5. Commonly used peripheral / interfacing ICs.

Outcome

After completion of the course the students are expected to be able to:

1. Understand the block diagram, Timing Diagram, Interrupt structure & configurations of 8086 Microprocessor.
2. Develop the Programming skills using Loop structure with counting & Indexing, Look up table, Subroutine instructions.
3. Interface ICs 8255 PPI, 8259 PIC, 8257 DMA, 8251 USART, 8279 Key board display controller and 8253 Timer/ Counter, A/D and D/A converter.
4. Comprehend the Functional block diagram ,Instruction format and addressing modes, Interrupt structure ,I/O Ports and Serial communication of 8051 Microcontroller.
5. Develop the programming skills in PID control algorithm, square, triangular and sine wave form generation, closed loop control of servo motor and stepper motor control.

UNIT I - INTRODUCTION TO MICROPROCESSOR- 8085

Comparison of microcomputer with "mini" and "large" Computers-Advantages and limitations of Microprocessor based system design -8085 Microprocessor architecture-Addressing modes- Instruction set-Programming the 8085- interrupts – Memory and I/O

UNIT II - 16 BIT MICROPROCESSOR – 8086

Intel 8086 microprocessor - Architecture - Instruction Set-Addressing Modes-- Assembly Language Programming-Procedures- Interrupts

UNIT III - MULTIPROCESSOR CONFIGURATIONS

Coprocessor Configuration – Closely Coupled Configuration – Loosely Coupled Configuration –8087 Numeric Data Processor – Data Types – Architecture –8089 I/O Processor –Architecture –Communication between CPU and IOP

UNIT IV - INTERFACING AND SYSTEM DESIGN USING MICRO PROCESSOR

8255-Programmable peripheral Interface along with 8085-Both Mode 0 and Mode 1, detailed study.

8254 - Programmable Interval Timer along with Intel 8086 - Both Mode 0 and Mode 3 to be studied.

Need for the following ICs: (a) 8251 - USART; (b) 8257 - Direct Memory Access Controller; (c) 8259-Programmable Interrupt Controller; (d) 8279 - Keyboard / Display Interface

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

UNIT V - MICROCONTROLLERS

Architecture of 8051 Microcontroller – signals – I/O ports – memory – counters and timers – serial data I/O – interrupts-

Interfacing -keyboard, LCD,ADC & DAC

TEXT BOOKS

1. Ramesh S. Goankar , "*Microprocessor – Architecture, Programming and Applications with the 8085*" Penram International Publisher , 5th Edition, 2006
2. Yn-cheng Liu,Glenn A.Gibson, "*Microcomputer systems: The 8086 / 8088 Family architecture, Programming and Design*", 2nd Edition, Prentice Hall of India , 2006 .
3. LA Levant Hal, "*Introduction to Microprocessor, Software, Hardware, Programming*", PHI, Inc.1978.
4. Kenneth J.Ayala, "*The 8051 microcontroller*",3rd Edition, 2004.

REFERENCE BOOKS

1. Douglas V.Hall, " *Microprocessors and Interfacing : Programming and Hardware"*, 2nd Edition , TMG Hill, 2006.
2. A.K.Ray & K.M Bhurchandi, "*Advanced Microprocessor and Peripherals – Architecture, Programming and Interfacing*", Tata Mc Graw Hill, 2006.
3. Mohamed Ali Mazidi,Janice Gillispie Mazidi, "*The 8051 microcontroller and embedded systems using Assembly and C*", 2nd Edition, Pearson education /Prentice hall of India , 2007.

SUB CODE: ME6T5 **CAD & CAM** **Sem: VI**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit 3**

Prerequisite: Nil

Aim

To introduce the concepts and techniques used in CAD and CAM.

Objectives

On completion of the course the students will be able to

1. Understand the role of hardware and software
2. Understand the graphics display techniques
3. Understand the role of computers in CAD/CAM and its Integration

Outcome

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

1. Develop through basic knowledge about CAD and CAM.
2. Acquire knowledge on the applications of Modeling.
3. Learn the usage of CAM.

UNIT - I – INTRODUCTION

Introduction of CAD/CAM. The design process morphology of design - Product cycle - Sequential and Concurrent Engineering - Role of computer in CAD/CAM. Benefits of CAD/CAM.

UNIT - II - INTERACTIVE COMPUTER GRAPHICS

Introduction of Hardware and Software - Input and Output devices - Creation of Graphics primitives - Graphical Input techniques - Display transformation in 2D and 3D - viewing transformation - clipping - hidden line elimination - Model storage and data structure - Data structure organization - Engineering Data Manufacturing Systems.

UNIT - III - SOLID MODELING AND GRAPHICS SYSTEM

Geometric modeling - wire frame, Surface and Solid models - CSG and B-Rep techniques - Wire frame versus Solid modeling - Introduction the software Configuration of Graphics System, Functions of Graphics Packages, Graphic standards - CAD/CAM Integration - Introduction to Finite Element Analysis.

UNIT - IV - COMPUTER AIDED MANUFACTURING

Introduction to CNC, DNC Machines and their elements, Manufacturing planning and control - Principles of Computer Integrated Manufacturing - Hierarchical network of computers - Local Area Networks - Process Planning - Computer Aided Process Planning - Retrieval and Generative Approaches.

UNIT - V - PRODUCTION PLANNING AND SHOP FLOOR CONTROL

Computer Integrated Production Management System - Master Production Schedule - Material Requirement Planning - Inventory Management - Manufacturing and Design Data Base - Capacity Planning - Shop Floor Control - Functions - Order release - Order scheduling.

TEXT BOOKS

1. Sadhu Singh. "*Computer Aided Design and Manufacturing*", Khanna Publishers, New Delhi, 1998
2. Ibrahim Zeid, "*CAD/CAM, Theory and Practice*", Tata McGraw Hill Ed, 1998

REFERENCE BOOKS

1. David F. Rogers and Alan Adams. J, "*Mathematical Elements for Computer Graphics*", McGraw - Hill Publishing Company International Edition, 1990
2. William M. Newman, Robert F.Sproull, "*Principles of Interactive Computer Graphics*", McGraw-Hill International Book company, 1984
3. Groover&Zimmers, "*CAD/CAM Computer Aided Design& Manufacturing*", PHl India, New Delhi,1994
4. Groover .M.P., "*Automation Production systems and Computer Integrated Manufacturing*", Prentice - Hall of India Pvt. Ltd., New Delhi, 1996
5. Paul G. Ranky, "*Computer Integrated Manufacture*", Prentice - Hall International, UK, 1986
6. P. Radha Krishnan and C.P. Kothandaraman, "*Computer Graphics and Design*", Dhanpat Rai and sons, New Delhi, 1991
7. P. RadhaKrishnan&S.Subramanian, "*CAD/CAM/CIM*",Wiley Eastern Ltd, New Age International Ltd., 1994

SUB CODE: ME6T8 **FLUID POWER SYSTEMS** **Sem: VI**

Branch: MECHATRONICS (For Students admitted from 2014 onwards) **Credit 3**

Prerequisite: Fundamentals of Fluids

Aim

To provide an overview of the concepts involved in the Fluid power Systems.

Objectives

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

1. To know the Construction and working of pumps and actuators.
2. To design the hydraulic circuits and Pneumatic circuits.

Outcome

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

1. Develop through basic knowledge about components of fluid power systems.
2. Acquire knowledge on the applications of fluid power circuits.
3. Learn the usage of different types of fluid power circuits.

UNIT I INTRODUCTION

Introduction – Principles of fluid power – Types – ISO symbols for fluid power elements – Advantages and applications of Fluid power systems– Hydraulic & Pneumatic Comparison – Selection criteria – Sources of Hydraulic Power – Pump classification – Gear pump, Vane Pump, piston pump – Construction and working of pumps – Pump performance – Variable displacement pumps – power pack design – Reservoir capacity – Heat dissipation – Selection of accumulator

UNIT II FLUID POWER ACTUATORS AND CONTROL SYSTEM COMPONENTS

Linear actuators – Types of hydraulic cylinders – Single acting cylinder – Double acting cylinders and its types – Rotary actuators – Fluid motors – Gear, Vane and Piston motors – Directional control valve – Pressure control valves – Shuttle valve – Check valve – Flow control valve – Electrical control solenoid valves – Valve actuation techniques – Counter balance valve – Overlapped and underlapped spool valves – Electro hydraulic servo valves – Characteristics and performance – Fluid power maintenance – Safety regulation as per BIS

UNIT III DESIGN OF HYDRAULIC CIRCUITS

Hydraulic circuit – Design methodology – Ladder diagram – Cascade method – Vehicle suspension system – Lift hydraulic press – Automatic reciprocating system – Shock absorber – Conveyor feed system – Hydraulic cranes and Earth moving equipments – Programmable logic control – Electrical control for fluid power circuits – Temperature control in Hydraulic circuits – Sequencing circuits – Combinational and Logic circuit

UNIT IV INTENSIFIER AND PNEUMATIC COMPONENTS

Accumulators and Intensifiers: Types of accumulators – Accumulators circuits – Sizing of accumulators – Intensifier – Applications of Intensifier – Intensifier circuit – Regenerative – Metering out – Bleed off – Pneumatic Components: Properties of air – Compressors – Filter, Regulator, Lubricator Unit – Mufflers – Air dryers – Air control valves – Quick exhaust valves – Pneumatic actuators – Fluid Power Circuit Design – Speed control circuits – Synchronizing circuit –Pneumo- hydraulic Circuit

UNIT V DESIGN OF PNEUMATIC CIRCUITS

Basic principles of pneumatic circuits – Merits and demerits over hydraulic system – Pneumatic logic controls – Pneumatic conditioners – Control of pneumatic circuits – Pneumo-hydraulic circuits – Electrical control of pneumatic circuits – Programmable logic control of pneumatics circuits – Servo systems – Hydro Mechanical servo systems – Electro hydraulic servo systems and proportional valves – Electronic drive circuits for various Motors – Failure and troubleshooting

TEXT BOOKS:

1. Anthony Esposito, "*Fluid Power with Applications*", Pearson Education 2003
2. Majumdar S.R.,"*Pneumatic systems – Principles and maintenance*", Tata McGraw Hill, 1995
3. Peter Rohner, "*Fluid Power Logic Circuit Design*", Mcmelan Prem, 1994

REFERENCE BOOKS:

1. Herbert R. Merritt, "*Hydraulic control systems*", John Wiley & Sons, Newyork, 1967
2. Anthony Lal, "*Oil hydraulics in the service of industry*", Allied publishers, 1982.
3. Dudbey.A.Peace, "*Basic Fluid Power*", Prentice Hall Inc, 1967
4. W.Bolton, "*Mechatronics, Electronic control systems in Mechanical and Electrical Engineering*", Pearson Education, 2003.
5. Harry L. Stevart D.B, "*Practical guide to fluid power*", Taraoeala sons and Port Ltd. Broadey,1976

SUB CODE: MR6T6 MICRO ELECTRO MECHANICAL SYSTEMS – MEMS Sem:VI

Branch: MECHATRONICS (For Students admitted from 2014 onwards) Credit 3

Pre - requisite: Electronic devices and circuits, Digital Electronics.

Objectives:
To understand the principles of CMOS-VLSI technology and the design issues involved at circuit, logic, layout, system level and to learn programmable logics.

Objectives
The course should enable the students to:
1. Study the evolution of micro fabrication.
2. Study various fabrication technologies.
3. Learn about the Micro sensors and Micro actuators.
4. Study the design of various micro actuators.

Outcome
The students should be able to:
1. Understand the basic fabrication methods.
2. Understand the materials for MEMS.
3. Know about various micro machining process.
4. Analyze about various packaging materials and technologies.

UNIT I - Introduction
Basic definitions – evolution of Micro fabrication – Micro systems and Micro electronics, scaling laws: Scaling in Electrostatic force, Electromagnetic force, Rigidity of structures, Fluid mechanics and Heat transfer.

UNIT II - Micro Sensors
Introduction – Micro sensors: Bio medical sensors and Biosensors – Chemical sensors – Optical sensors – Pressure sensors – Thermal sensors, Acoustic wave sensors.

UNIT III - Micro Actuators
Micro Actuation: Actuation using thermal Forces, Piezo electric crystals, Electro static forces. Micro actuators: Micro grippers, Micro motors, Micro valves, Micro pumps – Micro accelerometers – Micro fluidics.

UNIT IV - MEMS Fabrication Technologies
Materials for MEMS: Silicon, Silicon compounds, Piezo electric crystals, Polymers

Micro system Fabrication Process: Photolithography, Ion implantation, Diffusion, Oxidation, CVD, Sputtering, Etching techniques.

UNIT V - Micro Machining
Micro Machining: Bulk micro machining, Surface micro machining, LIGA process. Packaging: Micro system packaging, Essential packaging technologies, Selection of packaging materials.

TEXT BOOKS

1. Tai Ran Hsu, " *MEMS and Microsystems Design and Manufacture*", Tata Mcraw Hill, 2002
2. Cheng Liu, "*Foundations of MEMS*", Pearson education India limited, 2006.

REFERENCE BOOKS

1. Marc Madou, "*Fundamentals of Micro fabrication"* CRC press 1997.
2. Stephen D.Senturia, "*Micro system Design*" Kluwer Academic publishers, 2001.
3. K.Anatha suresh, K.J.Vinoy, S.Gopala Krishnan, K.N.Bhat, V.K.Aatre, "*Micro and smalt systems*", Willy India.
4. Nitaigrun Premchand Mahalik, "*MEMS*", TMH, 2007.

SUB CODE: SA6T6 **SANSKRIT & INDIAN CULTURE –VI** **Sem: VI**
Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit 1**

Unit I – (2) Social significance of religion - evolution of religious thoughts and ritual practices; (1) different philosophical Schools.

Unit II – (1) structural evolution for ritual practices; significance of temples & other constructions. (2) Civil engineering skill & construction technologies; scientific aspects in *Vastusastra* .

Unit III – (1) Important personalities and their Contribution – Devarishies, Maharishies, Rishies, Seers and contribution of their institutions to protect the cultural heritage.

Unit IV – (3) Vedic Mathematics, Astrology & Astronomy, etc. early Indian works and its importance in day to day life.

Unit V – (5) project work - ancient Indian technological thoughts with modern applications in different fields.

Reference Books

1. Datta, B. & A.N. Singh. 1962(rp). History of Hindu Mathematics. 2 Vols. Asian Publishing House. Bombay.
2. Jagadguru Swami Sri Bharati Krishna Tirthaji Maharaj. 1994 Vedic Mathematics. Motilal Banarasidas. New Delhi.
3. Kulkarni, R.P. 1983. Geometry according to Sulba Sutra. Samsodhana Mandal. Pune.
4. Radhakrishna, S. 1993(rp). Indian Philosophy. Vol I & II. Oxford University Press. Delhi.
5. Rao, J. 1960. Principles and Practices of Medical Astrology. Raman Publications. Banglore.

SUB CODE: EC6P7 MICROPROCESSORS AND MICROCONTROLLERS LABORATORY Sem:VI

Branch: MECHATRONICS (For Students admitted from 2014 onwards) Credit 2

LIST OF EXPERIMENTS

EXPERIMENTS IN MICROPROCESSOR 8085:

1) Write a ALP to perform basic arithmetic operation on two 8 bit numbers
2) Write a ALP to find the square of a given number using Look up Table Technique
3) Write a ALP to sort the given array of numbers in Ascending/Descending Order
4) Write a ALP to search for a given number and display the number of occurrences of the given number
5) INTERFACING USING 8085
    a) Study the various modes of 8255 interfaced with 8085 microprocessor
    b) Generation of Square, Triangular and Saw tooth waveform using DAC interfaced with 8085 microprocessor
    c) Write a ALP to control the speed and direction of Stepper motor

EXPERIMENTS IN MICRPROCESSOR 8086:

1) Write a ALP to perform basic arithmetic operation on two 16 bit Numbers
2) Write a ALP to study the addressing modes in 8086

EXPERIMENTS IN MICROCONTROLLER 8051:

1) Write a microcontroller program to perform basic arithmetic operation on two 8 bit numbers
2) Study and analyze the interfacing of Seven Segment Display with Microcontroller 8051
3) Study and analyze the interfacing of Keyboard with Microcontroller 8051.
4) Study and analyze the interfacing of Traffic Light Control with Microcontroller 8051.
5) Study and analyze the interfacing of 16 x 2 LCD Display with Microcontroller 8051 using Keil µVision.

SUB CODE: **CAD & CAM LABORATORY** **Sem: VI**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit 2**

CAD LABORATORY

1. Computer Aided Drafting of Machine Elements Orthographic views - Isometric Views - Sectional views. Dimensioning - Annotations - symbols - welding - surface finish - threads. Text - Bill of Materials - Title Block. Script writing.
2. Exercise: Knuckle joint, Gib and Cotter Joint, Screw jack, Footstep bearing, Isometric views with their orthographic views.
3. Geometric modeling of machine components Protrusion - cut - sweep - draft and loft - Modify /edit pattern - Transformation - Boolean operation
4. Exercise: Individual parts of universal joint - Flange coupling - Piston and Connecting rod. (Using a popular commercial package)

CAM LABORATORY

1. Manual programming for CNC machines using standard G and M codes CNC Lathe - Part programming for Turning, Facing, Chamfering, Step turning, Taper turning circular interpolation. CNC Milling machine - Part programming for PTP motions, Line motions, Contour motions, Pocketing - Circular, Rectangular and Mirror commands.
2. Part programming using fixed / canned cycles. Drilling, Peck Drilling, Boring, Tapping, Thread cutting
3. Simulation of Tool Path for different operations
4. Machining of small components using CNC Lathe and CNC Milling Machine

SUB CODE: ME6P9 **FLUID POWER CONTROL LABORATORY** **Sem: VI**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit 2**

LIST OF EXPERIMENTS

1. Study of the components of Hydraulics and Pneumatics systems
2. Study the different types of valves and its port positions using Cut–section Model
3. Study of Temperature Transducer with offline and online modes
4. Study of Electro Pneumatic Sequencing circuits
5. Simulate the various pneumatics circuits for different applications
6. Simulate the various hydraulics circuits for different applications
7. Study of Hydraulic and Pneumatic Circuits using simulation software
8. Design and testing of fluid power circuits to control

   (i) velocity (ii) direction and (iii) force of single and double acting actuators
9. Design of circuits with logic sequence using Electro pneumatic trainer kits
10. PID controller interfacing

VII SEMESTER

SUB CODE: MH7T1 **ROBOTICS AND AUTOMATION** **Sem: VII**
Branch: MECHATRONICS **(Common to MECHATRONICS/EIE)** **Credits: 3**

(For Students admitted from 2014 onwards)

Prerequisite: Basic Physics, Sensors and Transducers

Aim
To expose students to Robotics and its application in the field of Automation.

Objectives
The course will enable the students to:
1. Understand the various kinematics and inverse kinematics of robots.
2. Study the Euler, Lagrangian formulation of Robot dynamics.
3. Study the trajectory planning for robot.
4. Study the control of robots for some specific applications.

Outcome
At the end of the course the students will be able to
1. Explain forward and inverse kinematics of Robotics is learned by which of robotic arm shall be calculated.
2. Explain Dynamic behavior of Robots is learned by which Velocity kinematics is studied in detail.
3. Understand trajectory planning the path travelled by robotic arm from initial position to final position is planned.
4. Explain the Applications of Robotics in various industries are studied.

UNIT-I
Robots introduction - Asimov's laws of robotics -Basic components- Classification- Characteristics-Work volume, spatial resolution and repeatability, Coordinate system- Drives & Control systems –Actuators-Control loop, Feedback system.

UNIT-II
Transducers & Sensors-Tactile sensors-Proximity & Range sensors-Image Processing & Analysis-Image Data reduction-Feature extraction-Object Recognition

UNIT-III
End effectors – Wrist configuration, Pitch, Yaw, Roll – Types-Mechanical Grippers-Vacuum Cups-Magnetic Grippers -Robot/End effectors Interface-Software for industrial robots.

UNIT-IV
Robot motion analysis–Kinematics-Homogenous Transformations-Robot Dynamics Configuration of Robot controller

UNIT-V
Industrial Robots – Programming –welding painting-Assembly-Remote Controlled Robots for Nuclear, Thermal, 3 and Chemical plants-Industrial Automation-Economics of Robot- Robot Safety.

TEXT BOOKS
1. Oran Koren, "*Robotics for Engineers*", McGraw Hill, 1985.
2. Mikell P. Groover, "*Industrial Robots – Technology Programming & Applications*" McGraw Hill Ltd.,
2012.
3. Deb.S.R. "*Robotics Technology and Flexible Automation*", Tata McGraw Hill, 2010.

REFERENCE BOOKS
1. Fuk S, Gonzalez R C Lee C S G, "*Robotics Control, Sensing, Vision and Intelligence*", McGraw Hill, 2003.
2. John J.Craig, "*Introduction to Robotics*", Pearson, 2009.

SUB CODE: EI7T2 **EMBEDDED SYSTEMS** **Sem: VII**
Branch: MECHATRONICS **(Common to MECHATRONICS/EIE)** **Credits: 3**

(For Students admitted from 2014 onwards)

Prerequisite: Microprocessor and Microcontroller, Basics of C programming.

Aim
To give an insight of Embedded Systems

Objectives
The course will enable the students to:
1. Get introduced to features that build an embedded system.
2. Learn about the various components within an embedded system.
3. Learn the techniques of interfacing between processors & peripheral device related to embedded processing
4. Do the efficient programs on any dedicated processor.

Outcome
The students should be able to:
1. Understand Basic building blocks of embedded systems
2. Interface various peripherals to processors
3. Program embedded systems
4. Use the basic concepts of systems programming like operating system, assembler compliers etc., and to understand the management task needed for developing embedded system.

UNIT I - EMBEDDED COMPUTING
Challenges of Embedded Systems – Embedded system design process. Embedded processors – 8051 Microcontroller, ARM processor – Architecture, Instruction sets and programming.

UNIT II - MEMORY AND INPUT / OUTPUT MANAGEMENT
Programming Input and Output – Memory system mechanisms – Memory and I/O devices and interfacing – Interrupts handling.

UNIT III - PROCESSES AND OPERATING SYSTEMS
Multiple tasks and processes – Context switching – Scheduling policies – Interprocess communication mechanisms – Performance issues.

UNIT IV - EMBEDDED SOFTWARE
Programming embedded systems in assembly and C – Meeting real time constraints – Creating an Embedded Operating Systems - Multi-state systems and function sequences

UNIT V - EMBEDDED SYSTEM DEVELOPMENT
Design issues and techniques –Using the Serial Interface - Case studies – Intruder Alarm Systems – Controlling a Mobile Robot.

TEXT BOOKS
1. Wayne Wolf, "*Computers as Components: Principles of Embedded Computer System Design*", Elsevier, 2nd Edition, 2008.
2. Michael J. Pont, "*Embedded C*", Pearson Education, 2007.

REFERENCE BOOKS
1. Steve Heath, "*Embedded System Design*", Elsevier, 2005.
2. Raj Kamal, "*Embedded Systems Architecture, Programming and Design*", 2nd Edition, 2008.

SUB CODE: MH7T3 **DESIGN OF MECHATRONICS SYSTEMS** **Sem: VII**
Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credits: 3**

Prerequisite: Nil

Aim

To provide an overview of the concepts involved in the mechatronics Systems.

Objectives

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

1. To know the Mechatronics design and control systems.
2. To know real time interfacing.

Outcome

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

1. Develop through basic knowledge about mechatronic systems.
2. Acquire knowledge on the applications of Mechatronics systems.
3. Learn the usage of different types of control systems.

UNIT I INTRODUCTION TO MECHATRONICS SYSTEM

Mechatronics systems – Integrated product design issue in Mechatronics – Mechatronics Design process – Mechatronics key elements – Design process – Advanced approaches in Mechatronics – Traditional and Mechatronics designs – Adaptive control and distributed control system – Advanced approaches in Mechatronics - Industrial design and ergonomics – Safety Applications in Mechatronics

UNIT – II DRIVES, SYSTEM MODELING AND CONTROL

Control devices: Mechanical systems – Fluid systems – Electrical drives – Electro pneumatic devices– Electro hydraulic control devices – Power semiconductor devices: Converters, Choppers, Invertors and Cyclo-convertors – System modeling: Mechanical systems – Fluid systems – Electrical drives – Control Modes: Two – Step mode – Proportional Mode – Derivative Mode – Integral Mode – PID Controllers – Adaptive Control – Digital Logic Control – Micro Processors Control

UNIT III REAL TIME INTERFACING

Introduction – selection of interfacing standards – Elements of a data acquisition and control systems – Over view of I/O process – installation of I/O card and software – Installation of the application software Data conversion process – Application Software: Lab view Environment and its applications – VIM-SIM Environment & its applications – over framing – Man-machine interface

UNIT – IV CASE STUDIES ON DATA ACQUISITION AND CONTROL

Case studies on data acquisition – Strain gauge weighing system – solenoid force –Rotary optical encoder – controlling temperature of a hot/cold reservoir de-icing temperature control

System – skip control of a CD player – sensors for condition monitoring – mechatronic control in automated manufacturing

UNIT V CASE STUDIES ON MECHATRONIC SYSTEMS

Introduction –Fuzzy based Washing machine – Autofocus Camera and Exposure Control – Timed switch – Windscreen wiper motion – Pick and place robot – Car park barriers – Bar code reader – Engine management systems – Part identification and tracking using RFID – Online surface measurement using image processing

TEXT BOOKS:

1. Devdas shetty, Richard A. Kolk, "*Mechatronics System Design*", 2nd Edition, Cengage Learning 2011

2. Georg pelz, "*Mechatronic Systems: Modeling and simulation with HDL's*", John wiley and sons Ltd, 2003

3. Bolton, "*Mechatronics – Electronic control systems in mechanical and electrical Engineering"*, 2nd edition, Addison Wesley Longman Ltd., 1999.

4. Bradley D.Dawson, N.C.Burd and A.J.Loader, "*Mechatronics: Electronics in products and processes*", Chapman and Hall, London 1991.

REFERENCE BOOKS:

1. Brian morris, "*Automated manufacturing Systems – Actuators Controls, sensors and Robotics*", McGraw Hill International Edition, 1995.

2. Appu Kuttan K. K., "*Introduction to Mechatronics*", Oxford Press, London

3. David G. Alciatore and Michael B. Histand, "*Introduction to Mechatronics and Measurement Systems*", Tata McGraw Hill

4. Karnopp D. C., Margolis D. L. & Rosenberg R. C. (2000). "*System Dynamics: Modeling and Simulation of Mechatronics Systems"*. 3rd edn. Wiley Interscience.

5.Bishop, R. H. (2007) "*The Mechatronics Handbook"*, 2nd edn CRC Press

SUB CODE: MH7T4 **PLC AND DATA ACQUISITION SYSTEMS** **Sem: VII**
Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credits: 4**

Prerequisite: Analog and Digital Electronics

Aim
To expose the students to PLC and its applications for Industrial Automation.

Objectives
The course will enable the students to
1. Understand the need of computer control in automation.
2. Study the data acquisition systems.
3. Study the advanced PLC functions and SCADA.
4. Study the use of PLC for some specific applications.

Outcome
At the end of the course the students will be able to
1. Understand the basics of data conversion and data acquisition.
2. Understand the fundamental of PLC.
3. Program a PLC with different logical languages.
4. Various industrial Applications of PLCs are studied.

COMPUTER CONTROL-INTRODUCTION
Need of computer in a control system-Functional block diagram of a computer control system-Data loggers-Supervisory computer control- Direct digital control-Digital control interfacing-SCADA. (Elementary treatment only).

DATA ACQUISITION SYSTEMS
Sampling theorem – Sampling and digitising – Aliasing – Sample and hold circuit – Practical implementation of sampling and digitising – Definition, design and need for data acquisition systems – Interfacing ADC and DAC with Microprocessor / Multiplexer - Multiplexed channel operation –Microprocessor/PC based acquisition systems.

BASICS OF PLC
Evolution of PLC's – Components of PLC - Advantage of PLC - Sequential and programmable controllers – Architecture- PLC Programming language – Relay logic – Ladder logic – Programming of Gates – Flow charting as a programming method – connecting PLC to computer - PLC Troubleshooting and Maintenance.

PLC PROGRAMMING
Programming of Timers – Introduction - ON delay, OFF delay, Retentive Timers – PLC Timer functions – Examples of timer function Industrial application, Industrial process timing application.
Programming Counters – up/down counter – Combining counter - Examples of counter function Industrial application

ADVANCED PLC FUNCTIONS
Introduction of Instructions in PLC – Program control instructions, Math instructions, Sequencer instructions - Types of PLC Analog modules and systems, PLC analog signal processing – BCD or multibit data processing – PID Tuning – Typical continuous process control curve . – Case study of Tank level control system, bottle filling system and Sequential switching of motors.

TEXT BOOKS

1. Petrezeulla, *Programmable Controllers*, McGraw Hill, 1989.
2. Curtis D. Johnson Process Control Instrumentation Tech 8TH Edition Prentice Hall June 2005

REFERENCE BOOKS

1. Hughes .T, *Programmable Logic Controllers*, ISA Press, 1989.
2. G.B.Clayton, *Data Converters*, The Mac Millian Press Ltd., 1982.
3. John w.Webb & Ronald A.Reis., *Programmable logic controllers- principles and applications*, 5th Edition – PHI Learning Pvt. LTd, New Delhi -2010.

SUB CODE: MH7P6	**MECHATRONICS LABORATORY**	**Sem: VII**
Branch: MECHATRONICS	**(ROBOTICS AND SIMULATION)**	**Credits: 2**

(For Students admitted from 2014 onwards)

LIST OF EXPERIMENTS

1. Study of different types of robots based on configuration and application
2. Study of different type of links and joints used in robots
3. Study of components of robots with drive system and end effectors
4. Robot programming exercises
5. Study the components of Robots using RoboX simulation software
6. Study the different components of Programmable logical controllers
7. Designing of ladder logic for various practical applications
8. Execution of ladder logic using PLC's
9. Circuits with multiple cylinder sequences in Electro pneumatic using PLC
10. Modeling and analysis of basic electrical, hydraulic and pneumatic systems using LAB VIEW
11. Computerized data logging system with control for process variables like pressure flow and temperature

SUB CODE: MH7P7 **PLC LABORATORY** **Sem: VII**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 2**

LIST OF EXPERIMENTS

1. Programming basic logic gate operations.
2. Programming Timers and Counters.
3. Programming using compare instructions.
4. Programming data manipulation instructions.
5. Programming program control instructions.
6. Programming Math instructions.
7. Programming Sequencer instructions.
8. Programming a PLC to Control bottle filling system.
9. Programming a PLC to demonstrate an operation of batch process.
10. Programming a PLC to control the level of liquid in a tank
11. Programming a PLC to control the temperature of a water bath.

VIII SEMESTER

SUB CODE: MH8T1 PRINCIPLES OF MANAGEMENT AND PROFESSIONALETHICS SEM:VIII

Branch: MECHATRONICS Common to MECHATRONICS/EIE/ECE/EEE) Credit: 3

(For Students admitted from 2014 onwards)

Prerequisite: Nil

Aim

The students are expected to learn the basics of management functions and realize the ideal characteristics of a manager. The impetus of this subject is to make the students familiarize with the professional skills required to be an effective manager.

Objectives

The course should enable the students to:

1. Knowledge on the principles of management is essential for all kinds of people in all kinds of organizations.
2. Have a clear understanding of the managerial functions like planning, organizing, staffing, leading and controlling.
3. To understand global business and diversity.
4. Students will also gain some basic knowledge on international aspect of management.
5. To understand the concepts of computer ethics in work environment.

Outcomes

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

1. Helps to examine situations and to internalize the need for applying ethics principles, values to tackle with various situations.
2. Develop a responsible attitude towards the use of computer as well as the technology.
3. Able to envision the societal impact on the products / projects they develop in their career.
4. Understanding the code of ethics and standards of computer professionals.
5. Analyze the professional responsibility and empowering access to information in the work place.

UNIT- I

INTRODUCTION TO MANAGEMENT:

Definition of Management, process of Management- Planning, Organizing, leading, Controlling Classical Approach-Contribution. and Limitation, Management Science Approach,Skills, Roles and Performance: Types of managers Managerial Skills,- Technical Skill, Analytical SkillDecision Making skill, Human Relation skill, Communication skill. Managerial Roles –Interpersonal Role, Informational Role, Decisional Role.

UNIT – II

PLANNING FUNCTION:

Elements of Planning-Objectives, Action, Resource, Implementation. Managerial Decision Making: Types of Decision, Process of Decision Making, Decision Making-Certainty Condition, Uncertainity Condition, Selecting Alternative.Managing Information System; Need for Decision Support System, MIS and DSS Strategic Planning – Organizational Strategy, Business Portfolio Matrix.

UNIT –III

ORGANIZING FUNCTION:

Organizational Structure- Job Design, Departmentation, Span of Control, Delegation of Authority,Decentralized authority, Chain of Command and Authority, Line and Staff concept Matrix organizational Design

UNIT –IV

ENGINEERING ETHICS:

Senses of 'engineering ethics' – variety of moral issues – types of inquiry – moral dilemmas – moral autonomy – kohlberg's theory – Gilligan's theory – consensus and controversy – professions and professionalism – professional ideas and virtues – theories about right action – self-interest – customs and religion – uses of ethical theories

UNIT – V

ENGINEER'S RESPONSIBILITY FOR SAFETY:

Safety and risk – Assessment of safety and risk – Risk benefit analysis – Reducing risk – The three mile Island and chernobyl case studies

TEXT BOOKS

1. Mike Martin & Roland schinzinger "*Ethics in engineering*" Mc Graw Hill 2010.
2. Govindarajan M, Natarajan. S.Senthil kumar V.S, "*Engineering Ethics*", Prentice Hall of India, 2013

REFERENCE BOOKS

1. Charles D.Fleddermamm, "*Engineering Ethics*", Prentice Hall, 2007
2. Charles E.Haris, Michael S.Protchard & Michael J.Rabins, " *Engineering Ethics- concepts and cases*", Wadsworth Thompson Learning 2013
3. John R.Boartright, " *Ethics and the conduct of Business*", Pearson Education 2009
4. Edmund G.See Bauer & Robert L.Bany, "*Fundamental of Ethics for Scientists and Engineering*", Oxford University 2001.

SUB CODE: MH8T2 **MACHINE VISION** **Sem: VIII**
Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 3**

Prerequisite: Design of Mechatronics systems

Aim

To provide an overview of the concepts involved in the Machine Vision.

Objectives

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

1. To know the Machine vision and image acquisition.
2. To know image processing and analysis.

Outcome

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

1. Develop through basic knowledge about Machine vision.
2. Acquire knowledge on the applications of image processing and analysis.
3. Learn the usage of image processing and analysis.

UNIT I INTRODUCTION

Human visual system – Active vision system – Machine vision and Computer vision – Benefits of machine vision – Machine vision components – Block diagram and function of machine vision system – Frame Grabber – Sensing and Digitizing Image Data – Signal Conversion – Image Storage – Lighting Techniques – implementation of industrial machine vision system – Refraction at a spherical surface – Thin Lens Equation – image function and characteristics – image formation – image sensing frequency space analysis

UNIT II IMAGE ACQUISITION

Physics of Light – Interactions of light – Lighting parameters – Lighting sources – Lighting Techniques – Scene constraints – Types and Setups – Machine Vision Lenses – Optical Filters – Imaging Sensors – General problem in capturing the image – selection of camera – optics in camera – CCD and CMOS Specifications – Interface Architectures – Analog and Digital Cameras – Digital Camera Interfaces – Camera Computer Interfaces – Geometrical Image formation models – Camera Calibration

UNIT III IMAGE PROCESSING

Machine Vision Software – Fundamentals of Digital Image – Image formation – Filtering technique - Image Acquisition - Image Processing in Spatial and Frequency Domain – Sampling and quantization – Segmentation- Thresholding - Grayscale Stretching – Image Smoothing and Sharpening – Edge Detection – Binary Morphology – Color image processing.

UNIT IV IMAGE ANALYSIS

Feature extraction –Decision Making – Geometry of curves – Shape identification – Edge detection techniques –Normalization – Gray scale correction – Template techniques – Texture and texture Analysis – Image resolution – Depth and volume – Colour image processing – Pattern recognition – Image data compression – Template Matching and Classification – 3D Machine Vision Techniques

UNIT V MACHINE VISION APPLICATIONS

Machine vision applications in Manufacturing, Electronics, Printing, Pharmaceutical, Textile – Applications in Non-visible spectrum – Metrology and Gauging – OCR and OCV– Inspection part identification – Vision guided robotics: Industrial robot control – Mobile robots – Field and Service Applications – Agricultural and Bio medical field - Vision system calibration – Case studies

TEXT BOOKS:

1. K.S.Fu, R.C.Gonzalez, C.S.G.Lee, "*Robotics: Sensing, Vision & Intelligence*", Tata McGraw- Hill Publication, 1987.
2. Janakiraman.P.A., "*Robotics and Image Processing*", Tata McGraw-Hill, 1995
3. A.K. Jain, "*Fundamentals of Digital Image Processing*", Prentice Hall of India

REFERENCE BOOKS:

1. Fu.K.S. Gonzalz.R.C., and Lee C.S.G., "*Robotics Control, Sensing, Vision and Intelligence*", McGraw-Hill Book Co., 1987
2. Alexander Hornberg, "*Handbok of Machine Vision*", First Editon,206
3. Milan Sonka, Vaclav Hlavac, Roger Boyle, "*Image Processing Analysis & machine*",vision publisher, 1995.
4. Rafael C.Gonzales, Richard.E.Woods, "*Digital Image Processing*", Publishers,1992.
5. Ramesh Jain, Rangachari Kasturi, Brain G.Schunck, "*Machine Vision*", Tata McGraw Hill, 1991.

ELECTIVES

SUB CODE: MH7EA **ELECTIVE – I**

Branch: MECHATRONICS **ANALYTICAL INSTRUMENTATION** **Sem: VII**

(For Students admitted from 2014 onwards) **Credit: 3**

Prerequisite: Sensors and Transducers.

Aim

To equip the students with relevant knowledge to suit the industrial requirements.

Objectives:

1. To understand various techniques and methods of analysis occur in various regions of the spectrum.
2. To study important methods of analysis of industrial gases.
3. To understand the important radio chemical methods of analysis.

Outcome:

At the end of this course the students should be able to:

1. Know the basic concepts of spectrometry
2. Have adequate knowledge about different types of analyzers.
3. Understand the important and modern methods of Chromatographic techniques
4. Comprehend about the NMR spectrometer and Mass spectrometer.

UNIT I COLORIMETRY AND SPECTROPHOTOMETRY

Spectral methods of analysis– Beer-Lambert law – Colorimeters – UV-Visible spectrophotometers – Single and double beam instruments , Sources and detectors – IR Spectrophotometers – Types – Attenuated total reflectance flame photometers – Atomic absorption spectrophotometers – Sources and detectors – FTIR spectrophotometers – Flame emission photometers – Fluorescence spectrophotometer

UNIT II CHROMATOGRAPHY

Different techniques – Techniques by chromatographic bed shape- Column chromatography-Planer Chromatography-Paper Chromatography-Thin layer Chromatography-Applications - Techniques by physical state of mobile phase- Gas chromatography – Sources- Detectors – Liquid chromatographs – sources- detectors- Applications – High-pressure liquid chromatographs – sources-detectors-Applications- Techniques by separation mechanism-Ion exchange chromatography-size-exclusion chromatography-Applications

UNIT III INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS

Types of gas analyzers – Oxygen, NO_2 and H_2S types, IR analyzers, thermal conductivity analyzers, analysis based on ionization of gases. Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation - Dust and smoke measurements.

UNIT IV PH METERS AND DISSOLVED COMPONENT ANALYZERS

Principle of pH measurement, glass electrodes, hydrogen electrodes, reference electrodes, selective ion electrodes, ammonia electrodes, biosensors, dissolved oxygen analyzer – Sodium analyzer – Silicon analyzer.

UNIT V NUCLEAR MAGNETIC RESONANCE AND MICROSCOPIC TECHNIQUES

NMR :– Basic principles , NMR spectrometer and Applications - Electron spin Resonance spectroscopy: – Basic principles, Instrumentation and applications. Scanning Electron Microscope (SEM) :- Basic principles, Instrumentation and applications. Transmission Electron Microscope (TEM):– Basic principles – Instrumentation and applications. Mass spectrometers :– Different types and Applications.

TEXT BOOKS:

1. R.S. Khandpur, "*Handbook of Analytical Instruments*", Tata McGraw Hill publishing Co. Ltd., 2nd edition, 2006.
2. G.W. Ewing, "*Instrumental Methods of Analysis*", Mc Graw Hill, 2004.
3. Liptak, B.G., "*Process Measurement and Analysis*", CRC Press, 2005.

REFERENCE BOOKS:

1. Braun, R.D., "*Introduction to Instrumental Analysis*", Mc Graw – Hill, Singapore, 2006.
2. H.H.Willard, L.L.Merritt, J.A.Dean, F.A.Settle, "*Instrumental methods of analysis*", CBSpublishing & distribution, 1995.
3. James keeler ; "*Understanding NMR Spectroscopy*", Second Edition John Wiley & Sons, 2010.
4. John H.Nelson , "*Nuclear Magnetic Resonance Spectroscopy*", Prentice Hall/Pearson Education,2003.
5. Frank G. Kerry "*Industrial Gas Handbook: Gas Separation and Purification*", Taylor and Francis group, 2007

SUB CODE: MH7EB **PRINCIPLES OF COMMUNICATION** **Sem: VII**
Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 3**

Prerequisite: Basic Electronics.

Aim

To study the various analog communication fundamentals viz., Amplitude modulation and demodulation; Angle modulation and demodulation. To introduce the basic concepts of digital modulation techniques.

Objectives

The course should enable the students to:

1. Study the need of modulation, Amplitude Modulation and demodulation
2. Provide various Angle modulation and demodulation
3. Understand different methods of pulse digital modulation and demodulation schemes.
4. Study some basic information theory with some channel coding theorem. Analyze pass band digital modulation and demodulation schemes and compare its bit error probability.

Outcome

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

1. Understand the need for modulation and amplitude modulation techniques.
2. Understand frequency modulation, demodulation and the comparison of AM and FM.
3. Understand the PAM, PPM and PWM techniques.
4. Understand the different methods of PCM, PAM, DPCM, DM, ADM schemes which are used in digital communication.
5. Understand the analysis of ASK, FSK, PSK, DPSK, DEPSK, QPSK, MSK and GMSK schemes and comparison of bit error probability.

UNIT I AMPLITUDE MODULATION

Generation and demodulation of AM, DSB-SC, SSB-SC, VSB Signals, Filtering of sidebands, Comparison of Amplitude modulation systems, Frequency translation, Frequency Division multiplexing, AM transmitters - Super heterodyne receiver, AM receiver.

UNIT II ANGLE MODULATION

Angle modulation, frequency modulation, Narrowband and wideband FM, transmission bandwidth of FM signals, Generation of FM signal - Direct FM - indirect FM, Demodulation of FM signals, FM stereo multiplexing, PLL - Nonlinear model and linear model of PLL, Non-linear effects in FM systems, FM Broadcast receivers, FM stereo receives, Pre-emphasis and de-emphasis in FM, Comparison of performance of AM and FM systems.

UNIT III PULSE MODULATION

Time Divison Multiplexing, Types of Pulse modulation, PAM (Single polarity, double polarity) PWM-Generation & demodulation of PWM, PPM- Generation and demodulation of PPM

UNIT IV PULSE DIGITAL MODULATION

Elements of digital communication systems, advantages of digital communication systems, Elements of PCM: Sampling, Quantization & Coding, Quantization error. PAM and Other forms of pulse modulations Differential PCM system (DPCM), TDM, Delta modulation, adaptive delta modulation, comparison of PCM and DM systems, noise in PCM and DM systems.

UNIT V MODULATION SCHEMES

Introduction of digital modulation techniques- Generation, Detection, Signal space diagram, calculation of bit error probability and Power spectra of ASK, FSK, PSK, DPSK, DEPSK, QPSK, MSK and GMSK, similarity of BFSK and BPSK, Comparison of Digital modulation systems using bit error probability.

TEXT BOOK

1. Simon Haykin, "*Communication Systems*", John Wiley & sons, NY, Fifth Edition, 2010.
2. Simon Haykin, "*Digital communications*", John Wiley, 2013.
3. H. Taub and D. Schilling, "*Principles of Communication Systems*", TMH, Third Edition, 2008.

REFERENCE BOOKS

1. Roddy and Coolen, "*Electronic communication*", PHI, New Delhi, Fourth Edition, 2003.
2. Bruce Carlson et al, "*Communication systems*", McGraw-Hill Int., Fifth Edition, 2010.
3. Bernard Sklar, "*Digital Communication*",Paerson Education, Second Edition , 2009.
4. Sam Shanmugam, "*Digital and Analog Communication Systems*", John Wiley, 2008.

SUB CODE: MH7EC **PROCESS CONTROL INSTRUMENTATION** **Sem: VII**
Branch: MECHATRONICS (For Students admitted from 2014 onwards) **Credit: 3**

Prerequisite: Control System, sensors and Transducers

Aim
To provide an overview of the concepts involved in Process control instrumentation.

Objectives
The course should enable the students to:
1. Understand the mathematical modeling of process.
2. Understand the controller characteristics & tuning,
3. Study the characteristics of fuzzy logic control system.

Outcome
At the end of the course the student should be able to:
1. Develop through basic knowledge on the behavior and the characteristics of controller & tuning.
2. Acquire knowledge on the case studies of fuzzy logic system,
3. Learn the usage of different types of finite control elements.

UNIT I : MATHEMATICAL MODELLING OF PROCESSES

Need for process control – Mathematical model of first order liquid level and thermal processes – First and second order process – Process with dead time, process with inverse response – Interacting and non-interacting systems – Continuous and batch process – Servo and regulator operation.

UNIT II : CONTROLLER CHARACTERISTICS & TUNING

Basic control action – Characteristics of ON-OFF, proportional, integral and derivative control modes – Composite control modes – P+I, P+D and P+I+D control modes – Electronic controllers to realize various control actions – Evaluation criteria – IAE, ISE, ITAE and ¼ decay ratio – Tuning of controllers – Ziegler-Nichol's method and - Cohencoon method – Damped oscillation method.

UNIT III : CONTROL SYSTEMS WITH MULTIPLE LOOPS

Cascade control – Feed forward control – Ratio control – Selective control systems – Split range control – Adaptive and inferential control. MIMO controller.

UNIT IV: FUZZY LOGIC CONTROL SYSTEM

Fuzzy logic controller - fuzzification interface - knowledge base- - decision making logic - defuzzification interface - design of fuzzy logic controller case study.

UNIT V : FINAL CONTROL ELEMENT

I/P and P/I converter – Pneumatic, hydraulic and electric actuators – Valve positioned including smart positioning – Control valves characteristics – Classification of control valves – Control valve sizing – Cavitations and flashing – Selection of control valves – pressure relief valve, self regulating valve, solenoid.

TEXT BOOKS

1.Donald P. Eckman, "*Automatic Process Control*", Wiley Eastern Ltd., New Delhi, 1993.
2.G.Stephanopoulis, "*Chemical Process Control*", Prentice Hall of India, New Delhi, 1990.
3. Klir G.J., and Yuan B.B., "*Fuzzy sets and fuzzy logic*", Prentice Hall of India, New Delhi, 1997.
4.Donald R. Coughanowr, "*Process System Analysis and Control*",Mcgraw Hill,1991.

REFERENCE BOOKS

1. B.G.Liptak, "*Process Control*", Chilton Book Company, 1994.
2. Curtis D. Johnson, "*Process Control Instrumentation Technology*", 7th Edition,Pearson Education, New Delhi, 2002 / PHI.
3. J.G.Balchen and K.J.Mumme, "*Process Control structures and Application*", Vannostrand Reinhold Co., New York, 1988

SUB CODE: MH7ED **VIRTUAL INSTRUMENTATION** **Sem: VII**
Branch: MECHATRONICS (For Students admitted from 2014 onwards) **Credit: 3**

Prerequisite: Digital Electronics and C Programming..

Aim
To provide the students with LabVIEW software to suit the industrial applications.

Objectives:

1. To understand various methods of loops and charts.
2. To study important methods of Data acquisition and control.
3. To understand the LabVIEW based advanced control system.

Outcome:
At the end of this course the students should be able to:

1. Know the basic concepts of LabVIEW.
2. Have adequate knowledge about different types of controls in LabVIEW.
3. Understand the methods of Data acquisition and control..
4. Design the LabVIEW based advanced control system

UNIT: I -Introduction
Programming paradigms- Virtual Instrumentation- Definition to Virtual Instrumentation (VI)– LabVIEW software- LabVIEW basics- LabVIEW environment- Simple problems

UNIT: II -VI using LabVIEW
Creating, Editing and debugging a VI in LabVIEW- Creating a sub VI- Loops and charts-Case and sequence structures- File I/O- VI customization- Simple problems

UNIT: III -Data acquisition and control in VI
Plug-in DAQ boards- Organization of the DAQ VI System- Performing analog input and analog output- Scanning multiple analog channels - Driving the digital I/Os - Buffered data acquisition-Simple problems

UNIT: IV -LabVIEW for Advanced Systems
Bio-bench control and simulation using LabVIEW- Integrated design Environment for dynamic systems- LabVIEW based fuzzy logic and genetic algorithms

UNIT: V -LabVIEW and Automation Technology
Mathematics and simulation in LabVIEW- Commercial communication applications- Fourier transform analysis- Time frequency analysis of signals- Designing digital filters- Quality, Reliability and maintenance of LabVIEW programs

TEXT BOOKS

1. Rahman, and Herbert Pichlik,, "*LabVIEW – Applications and Solutions*", National Instruments Release, ISBN 0130964239
2. "*National Instruments LabVIEW Manual*"

REFERENCE BOOKS

1. Lisa K. Wells Jeffrey Travis, "*LabVIEW for Everyone*", National Instruments Release, ISBN 013065096
2. "*Sensors and Transducer and LabVIEW*", National Instruments Release, ISBN 0130811556

SUB CODE: MH7EE **DIGITAL CONTROL SYSTEMS** **Sem: VII**
Branch: MECHATRONICS (For Students admitted from 2014 onwards) **Credit: 3**

Prerequisite: Digital Electronics and Control Systems.

Aim

To make the students to have relevant knowledge for the industrial requirements.

Objectives:

1. To understand various techniques and methods of analysis which occur in the various regions of the spectrum.
2. To understand system response and stability.
3. To study various applications of digital control systems.

Outcome:

At the end of this course the students should be able to:

1. Know the basic concepts of converters.
2. Have adequate knowledge about different digital control algorithms.
3. Understand the important of digital control design in real time applications.

Unit I: Sample Theory and Converters

Review of Sample theory - Shannon's sampling theorems - Sampled Data Control system, Digital to Analog conversion – Analog to Digital conversion, Ramp type A/D, Dual slope A/D, Successive approximation A/D. - A/D & D/A converters - Review of Z and Inverse Z transform - Reconstruction - Zero Order Hold.

Unit II: System Response

Response of sampled data systems to step and ramp inputs - Steady state errors - Z domain equivalent - Stability studies - Bilinear transformation - Jury's stability test.

Unit III: Function Realisation

State sequences for sampled data systems - solutions - Pulse transformation function by direct, cascade and parallel realization - Sampled data model for continuous system - Controllability and observability.

Unit IV: Digital Process Control Design

Digital PID algorithm - Positional and incremental forms - Dead-beat algorithm-Ringing - Dahlin's and Kalman's algorithms - Implementation of control algorithms using microprocessors - General description of microcontrollers - Digital quantization.

Unit V: Applications

System models, control algorithms and their implementation for micro processor based position and temperature control systems - Operational features of stepper motors - Drive circuits - Interfacing of stepper motor to microprocessors.

Text Book

1. Gopal.M: "*Digital Control Engineering*",Wiley Eastern Publications, 1988

Reference Books

1. Ahson, S.I., "*Microprocessors with Applications in Process Control*", TMH, 1984.
2. Nagrath, J.J, and Gopal, M, "*Control System Engineering*", Wiley & Sons. 1985
3. Constantine Houpis, and Garry Lamont., "*Discrete Control systems -Theory, Hardware and Software*", McGraw Hill, 1985.

ELECTIVE - II

SUB CODE: MH7EF **FINITE ELEMENT ANALYSIS** **Sem:VII**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 3**

PREREQUISITE: Theory of machines

AIM

To provide an overview of the concepts involved FEA.

OBJECTIVES

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

1. To know the Finite element analysis.
2. To know the Finite element method.

OUTCOME

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

1. Develop through basic knowledge about FEA.
2. Acquire knowledge on the applications of FEA.
3. Learn the usage of FEA.

UNIT I

INTRODUCTION - Historical background – Matrix approach – Application to the continuum – Discretisation – Matrix algebra – Gaussian elimination – Governing equations for continuum – Classical Techniques in FEM – Weighted residual method – Ritz method

UNIT II

ONE DIMENSIONAL PROBLEMS - Finite element modeling – Coordinates and shape functions- Potential energy approach – Galarkin approach – Assembly of stiffness matrix and load vector – Finite element equations – Quadratic shape functions – Applications to plane trusses

UNIT III

TWO DIMENSIONAL CONTINUUM - Introduction – Finite element modelling – Scalar valued problem – Poisson equation –Laplace equation – Triangular elements – Element stiffness matrix – Force vector – Galarkin approach - Stress calculation – Temperature effects

UNIT IV

AXISYMMETRIC CONTINUUM - Axisymmetric formulation – Element stiffness matrix and force vector – Galarkin approach – Body forces and temperature effects – Stress calculations – Boundary conditions – Applications to cylinders under internal or external pressures – Rotating discs

UNIT V

ISOPARAMETRIC ELEMENTS FOR TWO DIMENSIONAL CONTINUUM - The four node quadrilateral – Shape functions – Element stiffness matrix and force vector – Numerical integration - Stiffness integration – Stress calculations – Four node quadrilateral for axisymmetric problems.

TEXT BOOKS

1. Chandrupatla T.R., and Belegundu A.D., "*Introduction to Finite Elements in Engineering"*, Pearson Education 2002, 3rd Edition.
2. David V Hutton "*Fundamentals of Finite Element Analysis*"2004. McGraw-Hill Int. Ed.
3. Rao S.S., "*The Finite Element Method in Engineering*", Pergammon Press, 1989

REFERENCE BOOKS

1. Logan D.L., "*A First course in the Finite Element Method*", Third Edition, Thomson Learning, 2002.
2. Robert D.Cook., David.S, Malkucs Michael E Plesha, "*Concepts and Applications of Finite Element Analysis*" 4 Ed. Wiley, 2003.
3. Reddy J.N., "*An Introduction to Finite Element Method*", MG-Hill International Student Edition, 1985
4. O.C.Zienkiewicz and R.L.Taylor, "*The Finite Element Methods, Vol.1", "The basic formulation and linear problems, Vol.1*", Butterworth Heineman, 5th Edition, 2000.
5. C. S. Krishnamoorthy, "*Finite Element Analysis*", TMH, 2007, 2nd Edition.
6. K. J. Bathe, "*Finite Element Procedures*", PHI, 2006,
7. Desai/ Abel, "*Introduction to Finite Element Method*", CBS Publishers, 2005.
8. S. M. Murigendrappa, "*Fundamental of Finite Element Method*", Interline Publishing, 2006.

SUB CODE: MH7EG **DESIGN OF JIGS & FIXTURES** **Sem:VII**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 3**

PREREQUISITE: Design of Machine Elements

AIM

To provide an overview of the concepts involved in the Jigs and Fixtures.

OBJECTIVES

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

1. To know the Locating and clamping methods and devices.
2. To know the design of dies.

OUTCOME

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

1. Develop through basic knowledge about Jigs and Fixtures.
2. Acquire knowledge on the applications of Jigs and Fixtures.
3. Learn the usage of clamping methods and devices.

UNIT I

PRINCIPLES OF LOCATION AND CLAMPING - Locating and clamping methods and devices. Objectives of Jigs design – principles of Jig. Types of drill and their design – Module design – chip control, drill bushings.

UNIT II

FIXTURES - Objectives of Fixture design – Fixtures and economics, Types of Fixtures, Grinding Fixtures, Milling Fixtures, Shaping Fixtures, Welding Fixtures, and Assembly Fixture.
Clamping force calculations, errors in location and clamping, Design and drawing.

UNIT III

SHEET METAL - Power press types – Press specification, material handling, Equipment cutting action in punch and Die operations, die clearance, cutting forces in blanking, Piercing and shearing, punch and die mounting, stripping force, press tonnage.

UNIT IV

Pilot, Stripper, Pressure pad and automatic stop – Strip layout and material calculations. Selection of Die sets – Designing of simple, progressive and compound die sets.

UNIT V

FORMING DIE DESIGN - Bending methods, bend radius, bend allowance, spring back, bending pressure. Design of bending die, metal flow in drawing, single and double action die, development of blank reduction factor, drawing forces, blank diameter calculation, Design of drawing die. Principles of forging and extrusion dies. Defects and remedies.

TEXT BOOKS

1. DONALDSON. C, "*Tool Design*", Tata McGraw Hill Co Ltd.
2. HOFFMAN. G, "*Fundamentals of Tool Design*", SMF Publishers.

REFERENCE BOOKS

1. KEMPSTER, "*Introduction to tool design and jigs and fixtures*".
2. KORASAKOW, "*Fundamentals of Jigs and Fixtures*", MIR Pub.
3. JOSHI. P.H. "*Jigs and Fixtures*", Tata McGraw Hill Co Ltd.
4. Hiram E. Grant, "*Jigs and Fixtures*", TMH, 2006

SUB CODE: MH7EH MECHANICAL VIBRATION AND NOISE CONTROL **Sem:VII**

Branch: MECHATRONICS (For Students admitted from 2014 onwards) **Credit: 3**

PREREQUISITE: Nil

AIM

To provide an overview of the concepts involved in the vibration and noise control.

OBJECTIVES

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

1. To know about the vibration and noise control.
2. To know about the Rotor balancing methods.

OUTCOME

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

1. Develop through basic knowledge about vibration and noise control.
2. Acquire knowledge on the applications of rotor.
3. Learn the usage of Rotor balancing.

UNIT I

SINGLE AND TWO DEGREES OF FREEDOM VIBRATION - Review of single degree of freedom systems – free damped vibration – linear and torsion vibrations, seismometer, accelerometer. Two degrees of freedom – vibration absorbers – undamped and damped, vibration isolation.

UNIT II

MULTI DEGREE FREEDOM VIBRATIONS - Multi degree vibration system – free vibration – close coupled and far coupled systems, eigen value problems, Orthogonality of mode shapes, model analysis, forced vibration modal analysis, numerical methods – dunkerley, Raleigh and Holzer methods.

UNIT III

BALANCING - Rotor balancing methods – rigid &flexible rotor balancing, modal balancing – analytical developments – application to balancing, advantage and limitations of modal balancing, influence coefficient balancing, analytical developments balancing –procedure –advantages and limitations. Unified balancing approach – analytical development- balancing procedure – experimental comparison of various methods.

UNIT IV

VIBRATION MONITORING - Experimental methods in vibration analysis – vibration exciters measurements devices, analyzer, condition based maintenance of monitoring and analysis – case studies.

UNIT V

NOISE CONTROL - Sound wave characteristic – levels and decibels – directivity, source of noise, estimation of noise source, acoustics of walls – enclosures barriers, sound absorbing materials duct noise, mufflers.

TEXT BOOKS

1. RAO J.S AND GUPTA K, "*Theory and Practice of Mechanical*", John Wiley
2. TIMSOHENKO, S. YOUNG D.H & WEAVER W, "*Vibration Problems in Engineering*", 4th ed. John Wiley & Sons, 1967.
3. KEWAL K. RUJARA, "*Vibrations and Noise for Engineering*", Dhanpat Rai & Sons.

REFERENCE BOOKS

1. ASHOK KUMAR MALLIK, "*Principle of Vibration Control*", Affiliated East West Press, 1993
2. GROVER. G.K, "*Mechanical Vibration*", New Chand Bros., Roorkie (UP), 1989.
3. MARK S, DARLOW, "*Balancing of High Speed Machinery*", Springer Verlog

SUB CODE: MH7EI RAPID MANUFACTURING TECHNOLOGIES Sem:VII

Branch: MECHATRONICS (For Students admitted from 2014 onwards) Credit: 3

PREREQUISITE: Nil

AIM

To provide an overview of the concepts involved in the rapid manufacturing.

OBJECTIVES

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

1. To know about the rapid prototyping.
2. To know about the rapid tooling.

OUTCOME

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

1. Develop through basic knowledge about rapid prototyping.
2. Acquire knowledge on the applications of rapid prototyping.
3. Learn the usage of rapid tooling.

UNIT - I - OVERVIEW OF RPT

Definitions, evolution, CAD for RPT. Product design and rapid product development. The cost and effects of design changes during conceptual modeling, detail designing, prototyping, manufacturing and product release. Fundamentals of RPT technologies, various CAD issues for RPT. RPT and its role in modern manufacturing mechanical design. 3D solid modeling software and their role in RPT. Creation of STL or SLA file from a 3D solid model.

UNIT - II - LIQUID BASED RP PROCESSES

Principles of STL and typical processes such as the SLA process, solid ground curing and others.

UNIT - III - POWDER BASED RP PROCESSES

Principles and typical processes such as selective laser sintering and some 3D printing processes.

UNIT - IV - SOLID BASED RPT PROCESSES

Principles and typical processes such as fused deposition modeling, laminated object modeling and others.

UNIT - V - RAPID TOOLING

Principles and typical processes for quick batch production of plastic and metal parts through quick tooling.

TEXT BOOKS

1. Burns. M, "*Automated Fabrication*", PHI, 1993
2. Chua. C.K, "*Rapid Prototyping*", Wiley, 1997
3. Hilton. P.D. et all, "*Rapid Tooling*", Marcel, Dekker 2000

REFERENCE BOOKS

1. Beaman J.J, et all, "*Solid free form fabrication*", Kluwer, 1997
2. Jacobs P.F., "*Stereolithography and other Rapid Prototyping and Manufacturing Technologies*", ASME, 1996
3. Pham D.T. and S.S. Dimov, "*Rapid Manufacturing: The technologies and application of RPT and Rapid tooling*", Springer, London 2001

SUB CODE: MH7EJ **COMPUTER INTEGRATED MANUFACTURING** **Sem:VII**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 3**

PREREQUISITE: CAD & CAM

AIM

To provide an overview of the concepts involved in the CIM.

OBJECTIVES

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

1. To know about the CIM.
2. To know about the Group technology and process planning.

OUTCOME

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

1. Develop through basic knowledge about CIM.
2. Acquire knowledge on the applications of CIM.
3. Learn the usage of group technology and process planning.

UNIT I

Introduction to Automation -Production system Facilities, Manufacturing Support Systems, Automation in Production Systems, Automated Manufacturing Systems, Types of Automation, Computerized manufacturing Support System, Reasons for Automating, Manufacturing Industries and Products, Manufacturing operations, Product / Production Relationships, Production Concepts and Mathematical Models. Basic elements of an Automated System, Advanced Automation Functions, Levels of Automation.

Industrial Control Systems-Process Industries versus Discrete Manufacturing Industries, Continuous versus Discrete Control, Computer Process Control, Forms of Computer Process Control

UNIT II

Fundamentals of CAD, CAM and CAE, CIM Definition, CIM Wheel, CIM components, Evolution of CIM - Development of computers - Needs of CIM, Benefits of CIM. CIM Hardware & Software, CIM Models.

DBMS and Network system - Data base and DBMS- requirement, features and architecture of DBMS. CIM Communications (Network) System, Communication Matrix, Network Architectures, Tools and Techniques.

UNIT III

Group Technology – Introduction - coding and classification system, Production Flow Analysis, Coding System - OPTIZ, MICLASS, Benefits of Group Technology , Machine cell design.

Process Planning- Structure of a Process Planning, Process Planning function, CAPP - Types of CAPP, Retrieval and Generative type CAPP, Concurrent engineering, Design for Manufacturing and Assembly, Advanced Manufacturing Planning.

UNIT IV

Fundamentals of NC Technology – Basic components of an NC System, NC Coordinate and Motion Control systems, Computer Numerical Control, Features of CNC, Machine Control Unit for CNC, CNC Software, DNC Machines, Application of NC machine tools Applications, Structure of CNC Machines, , CNC Controllers, NC Part Programming, Computer-Assisted Part Programming.

Features and Applications of CNC Turning Centre, CNC Milling Machine, CNC Turn-Mill Centre, CNC machining Centre, CNC Tooling system and Automatic Tool Changing System, Computer Aided Quality Control - contact, non contact inspection methods, Coordinate Measuring Machine CMM - Integration of CAQC with CAD / CAM.

UNIT V

FMS -Components of FMS, Computer control and function, FMS planning, scheduling and control, Knowledge Based Scheduling, FMS operation control, Hierarchy of computer control, supervisory control, types of software used in FMS, Applications and Benefits.

Production Support Machines and Systems -Industrial Robots, Automated Material Handling, Automatic Guided Vehicles, Automated Storage and Retrieval system.

Developments in Manufacturing Technologies- AI and Expert System, Agile manufacturing, Lean Manufacturing, Virtual Manufacturing, Simulation in Manufacturing – Factories of Future.

TEXT BOOKS

1. KANT VAJPAYEE.S, "*Principles of Computer- Integrated Manufacturing*"; 1st ed. PHI 2006.
2. MIKELL P. GROOVER, "*Automation, Production Systems & CIM*", 2nd ed. PHI 2001.
3. James A.Rehg, Henry W.Kraebber, "*Computer- Integrated Manufacturing*", second Edition, Pearson Education.
4. P.N. Rao, "*CAD/CAM Principles and Applications*", Second Edition, TMH 2006.

REFERENCE BOOKS

1. Radhakrishnan.P, Subramanyan. S, Raju.V, "*CAD/CAM/CIM*", Second Edition, New Age International publishers, 2000
2. Daniel Hunt.V., "*Computer Integrated Manufacturing Hand Book*", Chapman & Hall, 1989
3. Groover M.P, "*Computer Aided Design and Manufacturing*", Prentice Hall of India, 1987
4. Yorem Koren, "*Computer Control of Manufacturing System*", McGraw Hill, 1986
5. Ranky Paul. G., "*Computer Integrated Manufacturing*", Prentice Hall International, 1986.
6. ROGER MANNAM, "*Computer Integrated Manufacturing from Concepts of Realization*" 1st ed. Addison Wiley, 1997.
7. P. N. Rao, "*Computer Aided Manufacturing*", TMH, 2007, 12th Edition.

SUB CODE: **METROLOGY AND MEASUREMENTS** **Sem:VII**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 3**

PREREQUISITE: Nil

AIM

To provide an overview of the concepts involved in the Metrology and Measurement.

OBJECTIVE

At the end of the course, the student will be able:

1. To understand the basic principles of measurements
2. To learn the various linear and angular measuring equipments, their principle of operation and applications
3. To learn about various methods of measuring Mechanical parameters

OUTCOME

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

1. Develop through basic knowledge about linear and angular measurement devices
2. Acquire knowledge on the form measurement, laser metrology and applications
3. Learn about various methods for measurement of mechanical properties

UNIT I CONCEPT OF MEASUREMENT

Introduction to Metrology- Objectives - Standards of Measurement– Generalised measurement system - Elements of Measuring System - Methods of Measurement- Measurement terminology: sensitivity, range, stability, accuracy and precision- repeatability-Errors in measurement: Systematic and Random errors – Correction - Calibration - Dimensional and Geometric Toleranceing –Interchangeability.

UNIT II LINEAR AND ANGULAR MEASUREMENT

Introduction and classification of Linear measuring instruments: Slip gauges, Vernier Calliper, Vernier height and depth gauge, Micrometer - Line and end standard – Miscellaneous linear measuring instruments: bore gauge, telescopic gauge, slip gauges and Dial indicators- Comparators: limit gauges, Mechanical, pneumatic and electrical comparators, applications. Angular measurements: Working principle & construction of Sine bar, bevel protractor, angle gauges, Clinometers and angle Decker, Auto collimator.

UNIT III TAPER AND FORM MEASUREMENT

Measurement of screw threads: Specification and forms of Screw Threads - Various Methods for measurement of external and internal Screw Thread - Screw Thread Gauges - Errors in Threads - floating carriage micrometer, Gear Measurements: Measurement and testing of spur gear - Various methods of measurement of gear tooth thickness: constant chord and base tangent method– Gleason gear testing machine -Gear Errors– Radius measurements.

UNIT IV FLATNESS MEASUREMENT AND LASER METROLOGY

Straightness, Flatness, Squareness, Parallelism and Roundness measurements -Tool Makers Microscope – Interferometer and optical flats - Taper measuring instruments: Measurement of taper shafts and holes -Precision instruments based on laser - Principles- Laser interferometer and its applications in measurements - machine tool metrology: Various Alignment test on lathe, Milling Machine, Drilling Machine - Coordinate measuring machine (CMM): working, types and applications - computer aided inspection – machine vision – Non-contact and in-process inspection.

UNIT V MEASUREMENT OF SURFACE FINISH AND MECHANICAL PARAMETERS

Measurement of Surface Finish: Surface Texture - Methods of Measuring Surface finish - Surface roughness Symbols - Adverse effects of poor surface finish - Force, torque, power measurements:-mechanical, pneumatic, hydraulic and electrical type-Pressure measurements– Flow measurements: Venturi, Orifice, Rotameter, Pitot tube –Temperature measurements: bimetallic strip, thermocouples, pyrometer, electrical resistance thermistor.

TEXT BOOKS:

1. Jain R.K., “Engineering Metrology”, Khanna Publishers, 2005
2. Alan S. Morris, “The Essence of Measurement”, Prentice Hall of India, 1997

REFERENCE BOOKS

1. Gupta S.C, “Engineering Metrology”, Dhanpat rai Publications, 2005
2. Jayal A.K, “Instrumentation and Mechanical Measurements”, Galgotia Publications, 2000
3. Beckwith, Marangoni, Lienhard, “Mechanical Measurements”, Pearson Education, 2006.
4. Donald Deckman, “Industrial Instrumentation”, Wiley Eastern, 1985.

ELECTIVE III

SUB CODE: MH8EA **ADAPTIVE CONTROL** **Sem:VIII**

Branch: MECHATRONICS (For Students admitted from 2014 onwards) **Credit: 3**

Prerequisite: Control System.

Aim

To provide the knowledge about various advanced control techniques and their importance in industry.

Objectives:

1. To understand various techniques and methods of adaptive schemes and problems.
2. To study important methods of analysis of PID tuning.
3. To understand the important Practical Issues and Implementation.

Outcome:

At the end of this course the students should be able to:

1. Know the basic concepts of adaptive control schemes.
2. Have adequate knowledge about different types of tuning methods.
3. Understand the Practical Issues and Implementation of these controllers in industries.

Unit I Introduction

Linear Feedback- Effect of Process variations: Non-linear Actuators-Flow and speed variation – Variations in Disturbance Characteristics - Adaptive schemes- The Adaptive control Problem-applications

Unit II Model Reference Adaptive Systems

Introduction-MIT Rule- Determination of the Adaptation Gain-Lyapunov Theory-design of MRAC using Lyapunov Theory-Bounded input, bounded output Stability- Applications to Adaptive control-Output feedback-Relations between MRAC and STR- Nonlinear Systems

Unit III Auto Tuning

Introduction- PID Control Auto tuning techniques-Transient Response methods: Ziegler-Nichols Step response method-Characterization of step response- Method based on relay feedback: Ziegler- Nichols closed loop method-Method of Describing function- relay oscillations

Unit IV Gain Scheduling

Introduction-The principle- Design of gain scheduling Controllers- nonlinear Transformations-Applications of Gain scheduling: Ship steering-pH Control-Combustion control-Fuel Air control in car Engine-Flight control systems

Unit V Practical Issues and Implementation

Introduction-Controller Implementation-Controller Design-Solving the Diophantine equation- Estimator Implementation-Square Root Algorithms-Interaction of Estimation and control- prototype algorithms- Operational issues

TEXT BOOKS

1. Karl J. Astrom, Biorn Wittenmark, "*Adaptive Control*" Pearson Education Asia, Second Edition, 2001.
2. Gang Tao, "*Adaptive Control design and Analysis*", John Wiley & Sons, New Jersey,2003

REFERENCE BOOKS

1. Gang Tao, "*Adaptive Control Design And Analysis*", John Wiley & Sons, 2003

SUB CODE: MH8EB **AIRCRAFT INSTRUMENTATION** **Sem:VIII**
Branch: MECHATRONICS (For Students admitted from 2014 onwards) **Credit: 3**

Prerequisite: Measurements and Instruments.

Aim
The aim of this course is to understand the concepts and to familiarize the student with the principle of operation, capabilities and limitations of various Aircraft instruments so that he will be able to operate these instruments effectively.

Objectives
The course should enable the students to:
1. Understand the Instrument display and Cockpit layout.
2. Understand the Operation of Flight instruments.
3. Study the characteristics of Gyroscopic Instruments.

Outcome
At the end of the course the student should be able to:
1. Develop basic knowledge on the behavior and the characteristics of various indicators in aircraft.
2. Acquire knowledge on the aircraft computer systems
3. Learn the usage of power plant instruments in an aircraft..

UNIT I: Introduction
Classification of aircraft ~instrumentation -instrument displays, panels, cock- pit layout.

UNIT-ll: Flight Instrumentation
Static & pitot pressure source -altimeter -airspeed indicator -machmeter -maximum safe speed indicator- accelerometer.

UNIT-III: Gyroscopic Instruments
Gyroscopic theory -directional gyro indicator arti ficial horizon -turn and slip indicator.

UNIT-IV: Aircraft Computer Systems
Terrestrial magnetism, aircraft magnetism, Direct reading magnetic components- Compass errors gyro magnetic compass.

UNIT- V : Power Plant Instruments
Fuel flow -Fuel quantity measurement, exhaust gas temperature measurement and pressure measurement.

TEXT BOOKS

1. Pallett, E.B.J ., : "*Aircraft Instruments -Principles and applications*", Pitman and sons, 1981.

2. "*Aircraft Instrumentation and systems*", S.Nagabhushana, L.K.Sudha. I.K. International Publishing House Pvt., Ltd., S-25, Green Park Extensions, Uphaar Cinema Market, New Delhi – 110016(India), Info@ik international .com, ISBN : 978-93-80578-35-4

SUB CODE: MH8EC NEURAL NETWORKS AND FUZZY LOGIC CONTROL **Sem:VIII**

Branch: MECHATRONICS (For Students admitted from 2014 onwards) **Credit: 3**

Prerequisite.
It is highly recommended to have some knowledge on crisp set theory and be familiar with Matlab/Simulink.

Aim
This course provides a way to understand the concepts of Artificial Intelligence, ANN , Genetic Algorithms and Fuzzy systems and its applications .

Objectives

1. To expose the students to the concepts of feed forward neural networks.
2. To provide adequate knowledge about feedback neural networks.
3. To teach about the concept of fuzziness involved in various systems.
4. To provide adequate knowledge about fuzzy set theory.
5. To provide comprehensive knowledge of fuzzy logic control and adaptive fuzzy logic and to design the fuzzy control using genetic algorithm.
6. To provide adequate knowledge of application of fuzzy logic control to real time systems.

Outcome
At the end of the course the student should be able to:
1. Develop through basic knowledge about analysis of learning systems in conjunction with feedback control systems
2. Acquire knowledge on the applications of Computer simulation of intelligent control systems.
3. Learn the usage of different types of algorithms.

UNIT – I
Introduction to neural networks, different architectures of neural networks, Rosenblott's perceptrons, multi layer perceptrons, back propagation algorithm, Hopfield's networks, Kohnen's self organizing maps, adaptive resonance theory.

UNIT – II
Neural networks for control systems: Schemes of neuro-control, identification and control of dynamical systems , case studies(Inverted Pendulum, Articulation Control)

UNIT – III
Introduction to fuzzy logic: Fuzzy sets, fuzzy relations, fuzzy conditional statements, fuzzy rules, fuzzy learning algorithms.

UNIT – IV
Fuzzy logic for control systems: Fuzzy logic controllers, fuzzification interface, knowledge / rule base, decision making logic, defuzzification interface, design of fuzzy logic controllers, case studies(Inverted Pendulum, Articulation Control)

UNIT – V
Neuro-fuzzy and fuzzy-neural control systems: Adaptive fuzzy systems, optimizing the membership functions and the rule base of fuzzy logic controllers using neural networks, fuzzy transfer functions in neural networks.

TEXT BOOKS
1. Kosko, B, "*Neural Networks and Fuzzy Systems : A Dynamical Approach to Machine Intelligence*", Prentice Hall, New Delhi , 1991.
2. Wasserman P.D, "*Neural Computing Theory & Practice*" ,Van Nortland Reinhold,1997.
3. J.Ross, "*Fuzzy Logic with Engineering Applications*", 1997 – ISBN-0-07-144711-X

REFERENCE BOOKS
1. Jacek M. Zurada, "*Introduction to Artificial Neural Systems*", Jaico Publication House,1995.

SUB CODE: MH8ED ENERGY MANAGEMENT AND INDUSTRIAL SAFETY **Sem:VIII**
Branch: MECHATRONICS (For Students admitted from 2014 onwards) **Credit: 3**

Prerequisite: Nil.

Aim
To provide the knowledge about various energy conservation techniques and industrial safety methods.

Objectives:

1. To understand various techniques and methods of adaptive schemes and problems.
2. To study important methods of combustion of fuels.
3. To understand the various hazards in industry.

Outcome:
At the end of this course the students should be able to:

1. Know the basic concepts of energy management.
2. Have adequate knowledge about different types fuels for energy production methods.
3. Understand the Practical Issues and Implementation of industrial safety.

UNIT I - SOLID FUELS

Energy crisis in the world and position in India.-Solid fuels: principal solid fuel – coal, origin, composition, classification, storage, washing, pulvarisation, properties and uses of coal. Analysis of coal, distribution of Indian coals, carbonization, briquetting, liquefaction of coal

LIQUID FUELS: Petroleum: origin, reserves, production and consumption, classification, constituents and properties of petroleum– petroleum refining in India.-Petroleum products – Naphtha, motor gasoline, aviation gasoline, kerosene, diesel oils, gas oils, fuel oils, lubricants, petroleum waxes

GASEOUS FUELS: Types, natural gas, producer gas, water gas, LPG, gasification of coal and oil, gases from biomass, purification of gaseous fuels

UNIT II - COMBUSTION

Distinct features of combustion of solid, liquid and gaseous fuels – determination of gross and net calorific values – combustion of solid fuels including pulverized fuels, stoking and ash removal – fluidized bed combustion of solid fuels – combustion of liquid fuels – burners and nozzles – combustion of gaseous fuels –types of combustion: surface combustion, submerged combustion and pulsating combustion

UNIT III - ENERGY CONSERVATION & MANAGEMENT

Generation and co generation waste heat recovery, recuperation and regeneration – waste heat boiler – pinch point – alternate methods for heating and cooling of systems based on the principle of heat pump-Conservation of energy – demand forecasting – energy monitoring and target setting – principle of energy accounting and auditing – economics of energy management and optimization

UNIT IV

Hazards: Chemical hazards classification. Types of fire and fire prevention methods. Mechanical hazards. Electrical hazard Psychology and Hygiene: Industrial psychology Industrial hygiene. Safety in plant site selection and plant layout. Industrial lighting and ventilation. Industrial noise. Occupational diseases and control: Occupational diseases and prevention methods. Safe housekeeping Instrumentation for safe operation. Personal protective equipments. Safety in chemical operations and processes.

UNIT V

Management: Safety organization – safety committee – safety education and training. Management process. Philosophy and need for Industrial safety. Role of Government in Industrial safety.

TEXT BOOKS

1. Gupta, "*Elements of fuels, furnaces and refractories*", Khanna Publishers, New Delhi, 1998.
2. Rao S.& Dr. Parulakar B.B., "*Energy Technology*", Khanna Publishers, New Delhi,1994.
3. H.H. Fawcett & W. S .Wood," Safety and Accident Prevention in Chemical Operation", 2nd Ed ,WileyInterscience, 1982.

REFERENCE BOOKS

1. Haslam R.J.,. Russal R.P, "*Fuels and their combustion*", 1997.
2. David S., "*Handbook of Industrial energy conservation*", Van Nostrand, New York, USA,1997.
3. Altert P.E.Thimann, "*Handbook of Energy Audit*", The Fairmount Press Inc. Georgia, USA,1995.
4. *Guide for Safety in the Chemical laboratory Second edition 1977, Manufacturing Chemists Association. VanNostrand Reinhold Company, New York.*

SUB CODE: MH8EE **BIOMEDICAL INSTRUMENTATION** **Sem:VIII**
Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 3**

Prerequisite: Sensors and Transducers

Aim

To make the student understand about the construction, working and operation of various biomedical instruments

Objectives

The course will enable the students to:

1. Understand the Physiology of the heart, lung, blood circulation and respiration including different transducers used.
2. Learn about various sensing and measurement devices of electrical and non-electrical origin.
3. Understand modern methods of imaging techniques.
4. Study about medical assistance techniques and therapeutic equipments

Outcome

At the end of this course the students should be able to:

1. Know the basic concepts of Anatomy & Physiology
2. Have adequate knowledge about different types of Electrodes, Transducers and Amplifiers
3. Understand the important and modern methods of imaging techniques
4. Comprehend about the Human Assist Devices and Therapeutic Equipments

UNIT I FUNDAMENTALS OF BIOMEDICAL ENGINEERING

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems -Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues - Basic mechanics of spinal column and limbs -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

UNIT II NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES

Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements.

UNIT III ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS

Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipments.

UNIT IV IMAGING MODALITIES AND ANALYSIS

Radio graphic and fluoroscopic techniques – Computer tomography – MRI – PET-SPECT-Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging - Imaging application in Biometric systems - Analysis of digital images.

UNIT V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery – Advanced 3D surgical techniques- Orthopedic prostheses fixation.

TEXT BOOKS:

1. Leslie Cromwell, Biomedical Instrumentation and Measurement, Prentice hall of India, New Delhi,2007.
2. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.
3. Khandpur R.S, Handbook of Biomedical Instrumentation, , Tata McGraw-Hill, New Delhi, 2nd Edition, 2003.

REFERENCES:

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, NewYork, 1998.
2. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.
3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.
4. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.
5. Joseph J.carr and John M. Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th Edition, 2012.

ELECTIVE - IV

SUB CODE: MH8EF **TQM & RELIABILITY ENGINEERING** **Sem:VIII**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 3**

Prerequisite: probability and statistics

Aim

To provide an overview of the concepts involved TQM & reliability.

Objectives

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

1. To know about the TQM.
2. To know about the Reliability Engineering.

Outcome

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

1. Develop through basic knowledge about TQM.
2. Acquire knowledge on the applications of TQM.
3. Learn the usage of seven management tools.

UNIT - I - BASIC CONCEPTS

Evolution of total quality Management, Definition of quality, Comparison between traditional approach and TQM, Deming, Crosby, Juran, Taguchi, Ishikawa theories, Quality costs- product quality Vs Service quality Strategic planning- Goal setting, steps involved in Strategic planning, TQM implementation.

UNIT - II - TQM PRINCIPLES & BASIC TOOL

Customer Satisfaction - Types of Customers, customer supplier chain, and customer perception of Quality Customer feed back, customer complaints, Customer retention, and Service quality. Employee involvement - Employee motivation, Maslow's Hierarchy of needs, Herzberg theory,, Empowerment & Team work.

Basic Tools: Introduction to Seven basic tools -Check sheets, Histograms, Control charts, Pareto diagram, Cause & effect diagram, Stratification, Scatter diagrams.

UNIT - III - NEW SEVEN MANAGEMENT TOOLS & ADVANCED TOOLS

Affinity diagram, Relations diagram, Tree diagram, matrix diagram, Matrix data analysis diagram, Process decision program chart, Arrow diagram.

Advanced QC tools: Advanced QC tools like QFD, Root cause analysis, Taguchi method, Mistake proofing (poka-yoke), Failure mode and effects analysis (FMEAs), failure mode and effects criticality analysis (FMECAs) and Fault tree analysis (FTAs) etc. Quality Management Systems.

UNIT - IV – RELIABILITY

Definition- Probabilistic nature of failures, Mean failure rate, Meantime between failures, hazard rate, hazard models, Weibull model- System reliability improvement- Redundancy- Series- Parallel and Mixed configurations.

UNIT - V – MAINTAINABILITY

Introduction, choice of maintenance strategy. Mean time- to Repair (MTTR), Factors contributing to Mean Down Time (MDT), fault diagnosis, and routine testing for unrevealed faults. Factors contributing to Mean Maintenance Time- (MMT) on condition maintenance periodic condition monitoring, continuous condition monitoring, economics of maintenance.

TEXT BOOKS

1. Joel E. Rose, *Total Quality Management*, 2nd Edn, Kogan Page Ltd., USA 1993
2. Srinath, L.S., *Reliability Engineering*, Affiliated East West Press, New Delhi 1995

REFERENCE BOOKS

1. Balagurusamy, E., *Reliability Engineering* Tata McGraw Hill pub. Cop., New Delhi. 1984
2. Greg bound et.al *Beyond Total Quality Management towards the emerging paradigm* MGHill Inc. 1994
3. Zeiri, Total Quality Management for Engineers, Wood Head Publishers, 1991

SUB CODE: MH8EG **AUTOMOBILE ENGINEERING** **Sem:VIII**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 3**

Prerequisite: Basic Mechanical Engineering

Aim

To provide an overview of the concepts involved Automobile Engineering.

Objectives

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

1. To know about the Automobile Engineering.
2. To know about the Autotronics.

Outcome

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

1. Develop through basic knowledge about Automobile Engineering.
2. Acquire knowledge on the applications of Automobile Engineering.
3. Learn the usage of Autotronics.

UNIT I

Vehicle construction – chassis and body – integral and chassis mounted body – specifications, engine – types – construction – power and torque requirements – cylinder arrangement, operation, road performance under different speed and load conditions – choice of engine for different applications – engine trouble shooting, pollution and control – Indian emission standards.

UNIT II

Principle of steering – steering geometry and wheel alignment– steering linkages – power steering, wheels and tyres– construction– type and specification– tyre wear and causes, front and rear axle– types– sub-axles.

Suspension systems – need of types – independent – coil and leaf spring and air suspensions, torsion bar, shock absorbers.

UNIT III

Clutches – need – types – single and multi-plate-diaphragm clutch – over-running clutch – fluid coupling.

Gear boxes – manual and automatic – epi-cyclic and hydromatic transmission, universal joint, propeller shaft, hotchkiss drive, torque tube drive, differential – need and types – construction – four wheel drive.

UNIT IV

Brakes - need – types – mechanical, hydraulic and pneumatic – details of components, redundancy in brake systems, trouble shooting in brake system, power brake.

Alternative fuels – hydrogen – compressed natural gas (CNG) – liquefied petroleum gas (LPG), alternative power plants – electric – hybrid vehicle – fuel cells.

UNIT V

Carburetors, electronic fuel injection systems – mono point and multi point types, principles of modern electrical systems – battery, dynamo, alternator, starting motor, lighting and ignition (battery and electronic types) – automobile air conditioning, turbo charging.

TEXT BOOKS

1. JOSEPH HEITNER, "*Automotive Mechanics*", Affiliated East West Pvt. Ltd.
2. KIRPAL SINGH, "*Automobile Engineering. Vol- I & II*", Standard Publications. 2006,
3. R. B. GUPTA, "*Automobile Engineering*", Satya Prakashan, New Delhi 1993.

REFERENCE BOOKS

1. WILLIAM. H. CROUSE, "*Automotive Mechanics*",. Mc Graw Hill.
2. BENNET, "*Engine: Fuel And Computerized Management*". 1999.
3. HOLLEMBEAK, "*Automotive Electricity, Electronics and Computer Control*", 1999.
4. NEWTON. K & STEEDS. W. GARRET "*T. K, Motor Vehicle*", Butterworth, IE,1989.
5. R. P. Sharma, "*A Course in Automobile Engineering*", Dhanpat Rai & Sons, 2003.

SUB CODE: MH8EH **AUTOTRONICS** **Sem:VIII**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 3**

PREREQUISITE: Automobile Engineering

AIM

To provide an overview of the concepts involved in autotronics

OBJECTIVE

At the end of the course, the student will be able:

1. To understand the basics of ignition, injection and engine control systems
2. To learn the various chassis and safety system operation and applications
3. To learn about various methods of sensors and actuators for engine control parameters

OUTCOME

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

1. Develop through basic knowledge about various ignition and injection systems.
2. Acquire knowledge on the safety systems of the automobile.
3. Learn about various methods of sensors for engine controls.

UNIT I INTRODUCTION

Evolution of electronics in automobiles – emission laws – introduction to Euro I, Euro II, Euro III, Euro IV, Euro V 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 IGNITION AND INJECTION SYSTEMS

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

UNIT III SENSOR 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, vacuum operated actuator.

UNIT IV ENGINE CONTROL SYSTEMS

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 CHASSIS AND SAFETY SYSTEMS

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.

TEXT BOOKS:

1. Ribbens, "*Understanding Automotive Electronics*", 7th Edition, Elsevier, Indian Reprint, 2013

REFERENCE BOOKS

1. Tom Denton, "*Automobile Electrical and Electronics Systems*", Edward Arnold Publishers, 2000.
2. Barry Hollembeak, "*Automotive Electricity, Electronics & Computer Controls*", Delmar Publishers, 2001.
3. Richard K. Dupuy "*Fuel System and Emission controls"*, Check Chart Publication, 2000.
4. Ronald. K. Jurgon, "*Automotive Electronics Handbook"*, McGraw-Hill, 1999.

SUB CODE: MH8EI **FACTORY AUTOMATION** **Sem:VIII**

Branch: MECHATRONICS **(For Students admitted from 2014 onwards)** **Credit: 3**

Prerequisite: Rapid Manufacturing Technologies

Aim

To provide an overview of the concepts involved Factory Automation.

Objectives

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

1. To know about the Flexible Manufacturing System.
2. To know about the Material Handling System.

Outcome

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

1. Develop through basic knowledge about Flexible Manufacturing System.
2. Acquire knowledge on the applications of computer control systems.
3. Learn the usage of Material Handling System.

UNIT - I - PRODUCTION OPERATIONS AND AUTOMATION STRATEGIES

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

UNIT - II - GROUP TECHNOLOGY & FLEXIBLE MANUFACTRUING SYSTEMS

Group Technology - Introduction, part families, parts classification and coding system - OPITZ and MI CLASS system. Production flow analysis, cellular manufacturing - advantages, disadvantages and applications. FMS - Introduction, workstations, scope, components, types, benefits, typical FMS layout configuration, function of FMS computer Control System, FMS data files.

UNIT - III - COMPUTER CONTROL SYSTEMS & AUTOMATED PROCESS

Computer control systems - Introduction, Architecture, Factory Communication, Local Area Networks - Characteristics, factory networks, open system interconnection model. Network to network interconnections, manufacturing automation protocol, Data Base Management System - Introduction. Computer aided shop floor control. Automated process planning - introduction, structure, information requirement, CAPP, application, programs in CAPP.

UNIT - IV - COMPUTER CONTROLLED MACHINES & MATERIAL HANDLING SYSTEMS

NC machines - Part Programming, CNC, DNC, Adaptive Control, Pallets & Fixtures, Machine centers, Automated inspection systems. Material handling systems - Introduction, Conveyors, Industrial Robots, Automated Guided Vehicles.

UNIT - V - COMPUTER INTEGRATED MANUFACTURING

CIM - Introduction, definition, scope, benefits, elements, CIM cycle or wheel. Introduction to Jurt-in-Time(JIT), Kanban System, Business Process Re-engineering (BPR), Materials requirement planning (MRP), Manufacturing Resource Planning (MRP II), Enterprise Resource Planning (ERP), Supply Chain Management (SCM).

TEXT BOOKS

1. Mikell Groover .P, "*Automation, Production Systems and Computer Integrated Manufacturing*", Prentice Hall of India Pvt. Ltd., 2001
2. Viswanathan .N, Navahari .Y *"Performance Modeling of Automated Manufacturing Systems"*, Prentice Hall of India Pvt. Ltd., 1998

REFERENCE BOOKS

1. Rao .P.N., "*Computer Aided Manufacturing*", Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2001
2. Kant Vajpayee .S, "*Principles of Computer Integrated Manufacturing*", Prentice Hall of India Pvt. Ltd., 1995
3. Radhakrishnan .P, Subramaniyan .S, "*CAD/CAM/CIM*", New Age International Limited, 1994

SUB CODE: MH8EJ PROCESS PLANNING AND COST ESTIMATION Sem:VIII

Branch: MECHATRONICS (For Students admitted from 2014 onwards) Credit: 3

Prerequisite: Manufacturing Technology & Computer Integrated Manufacturing

Aim

To provide an overview of the concepts involved process planning and cost estimation.

Objectives

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

1. To know about the Process Planning.
2. To know about the Costing and Estimation.

Outcome

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

1. Develop through basic knowledge about Process Planning.
2. Acquire knowledge on the applications of Costing and Estimation.
3. Learn the usage of Costing and Estimation.

UNIT - I - PROCESS PLANNING

Process Planning, selection and analysis - Manual, Experienced based planning - CAPP, Variant, Generative - Processes analysis - Types of Production.

UNIT - II - COSTING, ESTIMATION, COSTS AND EXPENSES

Aims of costing and Estimation - Functions and Procedure - Introduction to Costs, Computing Material cost, Direct Labor cost, Analysis of Overhead costs, Factory expenses, Administrative expenses, Selling and Distributing expenses - Cost Ladder - Cost of Product - Depreciation - Analysis of Depreciation.

UNIT - III - ESITMATION OF COSTS IN DIFFERENT SHOPS

Estimation in Foundry shop - Pattern cost Casting cost - Illustrative examples. Estimation in Forging Shop - Losses in forging - Forging cost - Illustrative examples.

UNIT - IV - ESTIMATION OF COSTS IN FABRICATION SHOPS

Estimation in welding shop - Gas cutting - Electric Welding - Illustrative examples. Estimation in sheet metal shop - Shearing and Forming - Illustrative examples.

UNIT - V - ESITMATION OF MACHINING TIMES AND COSTS

Estimation of machining time for lathe operations - Estimation of machining time for drilling, boring, shaping, planning, milling and grinding operations - Illustrative examples.

TEXT BOOKS

1. Adithan. M. S. and Pabla., "*Estimating and Costing*", Konark Publishers Pvt., Ltd, 1989
2. Chitale. A. K. and Gupta R.C., "*Product Design and manufacturing*", Prentice Hall Pvt. Ltd., 1997

REFERENCE BOOKS

1. Nanua Singh, "*System Approach to Computer Integrated Design and Manufacturing*", John Wiley & sons, Inc., 1996
2. Joseph G. Monks., "*Operations Management, Theory and Problems*", McGraw Hill Book Company, 1982
3. G.B.S. Narang . and Kumar. V., "*Production and Planning*", Khanna Publishers, 1995
4. Banga. T.R., and Sharma S.C., "*Estimating and Costing*", Khanna publishers, 1986