

KUMARAGURU COLLEGE OF TECHNOLOGY : COIMBATORE
AUTONOMOUS CURRICULUM 2007
B.E MECHATRONICS ENGINEERING

SEMESTER – I

Code No	Course Title	L	T	P	M
THEORY					
07 HS 101	English - I	3	1	0	100
07 MA 101	Mathematics – I	3	1	0	100
07 PH 101	Physics – I	3	0	0	100
07 CY 101	Chemistry – I	3	0	0	100
07 GE 101	Engineering Graphics 1	3	0	3	100
07 GE 102	Fundamentals of computing	3	0	0	100
PRACTICAL					
07 PH 102	Physics Laboratory	0	0	2	100
07 CY 102	Chemistry Laboratory	0	0	2	100
07 GE 103	Engineering Practices Laboratory	0	0	3	100
07 GE 104	Computer Practice I	0	0	3	100

SEMESTER – II

Code No	Course Title	L	T	P	M
THEORY					
07 HS 201	English II	3	1	0	100
07 MA 201	Mathematics – II	3	1	0	100
07 PH 203	Physics – II	3	0	0	100
07 CY 203	Chemistry – II	3	0	0	100
07GE 201	Engineering Mechanics	3	1	0	100
07 MH 201	Fundamentals of Mechatronics Engineering	3	0	0	100
07 EC 203	Electronics Devices & Circuits	3	0	3	100
PRACTICAL					
07 GE 202	Computer Practice II	0	0	3	100
07 EC 204	Electronics Laboratory	0	0	3	100

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B.E. MECHATRONICS ENGINEERING

SEMESTER III

Code No.	Course Title	L	T	P	M
THEORY					
U07MA 301	Mathematics - III	3	1	0	100
U07MH 301	Engineering materials and metallurgy	3	1	0	100
U07MH 302	Fluid Mechanics and Machinery	3	1	0	100
U07MH 303	Digital Electronics	3	0	0	100
U07MH 304	Power Electronics	3	0	0	100
U07MH 305	Kinematics of Machinery	3	1	0	100
PRACTICAL					
U07MH 306	Fluid Mechanics and Machinery Lab	0	0	3	100
U07MH 307	Power Electronics Lab	0	0	3	100
U07MH 308	Computer Aided Machine Drawing	0	0	3	100

SEMESTER IV

Code No.	Course Title	L	T	P	M
THEORY					
U07 MA 401	Numerical Methods	3	1	0	100
U07 MH 401	Manufacturing Technology	3	0	0	100
U07 MH 402	Dynamics of Machinery	3	1	0	100
U07 GM 401	Environmental Science and Engineering	3	1	0	100
U07 MH 403	Electrical Machines and Drives	3	0	0	100
U07 MH 404	Control Systems	3	1	0	100
PRACTICAL					
U07MH 405	Manufacturing Technology Lab	0	0	3	100
U07MH 406	Machine Dynamics Lab	0	0	3	100
U07MH 407	Electrical Machines and Drives Lab	0	0	3	100
U07GM 403	Technical Seminar -I	0	0	3	**

** No Examination

**KUMARAGURU COLLEGE OF TECHNOLOGY
COIMBATORE-641006**

AUTONOMOUS CURRICULUM 2007

B.E MECHATRONICS ENGINEERING

SEMESTER V

Code No.	Course Title	L	T	P	M
THEORY					
U07MH501	Strength of Materials	3	1	0	100
U07MH502	Micro processors and Micro Controller	3	0	0	100
U07MH503	Instrumentation and Control System	3	0	0	100
U07MH504	CNC Technology	3	0	0	100
U07MH505	Dimensional Metrology	3	1	0	100
U07MH506	Design of Machine Elements	3	1	0	100
PRACTICAL					
U07MH507	Microprocessors Laboratory	0	0	3	100
U07MH508	Instrumentation and Controls Laboratory	0	0	3	100
U07GM501	Communication skills Laboratory	2	0	2	100
U07GM502	Technical Seminar II	0	0	3	**

SEMESTER VI

Code No.	Course Title	L	T	P	M
THEORY					
U07MH601	Sensors and Signal Processing	3	0	0	100
U07MH602	Applied Hydraulics and Pneumatics	3	0	0	100
U07GM601	Professional Ethics and Human Values	3	0	0	100
U07MH603	Design of Mechatronics System	3	0	0	100
U07MH604	Thermodynamics and Heat Transfer	3	1	0	100
E1****	Elective – I	3	0	0	100
PRACTICAL					
U07MH605	Sensors and Signal Processing Laboratory	0	0	3	100
U07MH606	Computer Aided Design, Analysis and Manufacturing Laboratory	0	0	3	100
U07MH607	Hydraulics and Pneumatics Laboratory	0	0	3	100
	Industrial Training & Project	0	0	3	**

**** No Examinations**

SEMESTER VII

Code No.	Course Title	L	T	P	M
THEORY					
U07GM 701	Principles of Management	3	0	0	100
U07MH 701	Robotics and Machine Vision System	3	0	0	100
U07MH 702	Automobile Engineering	3	0	0	100
U07MH 703	Programmable Logic Controller	3	0	0	100
E2****	Elective – II	3	0	0	100
E3****	Elective – III	3	0	0	100
PRACTICAL					
U07MH 704	Micro Controller and PLC Lab	0	0	3	100
U07MH 705	Robotics Lab	0	0	3	100
U07MH 706	Mechatronics System Design Lab (Mini Project)	0	0	3	100
U07GM 702	Technical Seminar **	0	0	3	0

SEMESTER VIII

Code No.	Course Title	L	T	P	M
THEORY					
U07GM 801	Total Quality Management	3	0	0	100
U07MH 801	Automotive Electronics				
E4****	Elective – IV	3	0	0	100
E5****	Elective – V	3	0	0	100
PRACTICAL					
U07MH 802	Comprehension & Technical Seminar**	0	0	3	0
U07MH 803	Project Work	0	0	6	200

**** No Examinations**

KUMARAGURU COLLEGE OF TECHNOLOGY
AUTONOMOUS CURRICULUM 2007

B.E. MECHATRONICS ENGINEERING

**LIST OF ELECTIVES
ELECTIVES FOR VI SEMESTER**

Code No.	Course Title	L	T	P	M
U07 MHE 01	Operations Research	3	0	0	100
U07 MHE 02	Embedded System and Design	3	0	0	100
U07 MHE 03	Plant Layout and Material Handling	3	0	0	100
U07 MHE 04	Intellectual Property Rights (IPR)	3	0	0	100
U07 MHE 05	Indian Constitution and Society	3	0	0	100
U07 MHE 06	Modeling and Simulation	3	0	0	100

ELECTIVES FOR VII SEMESTER

Code No.	Course Title	L	T	P	M
U07 MHE 07	Computer Integrated Manufacturing	3	0	0	100
U07 MHE 08	Product Design and Costing	3	0	0	100
U07 MHE 09	Digital Image Processing	3	0	0	100
U07 MHE 10	Artificial Intelligence	3	0	0	100
U07 MHE 11	Finite Element Analysis	3	0	0	100
U07 MHE 12	Virtual Instrumentation	3	1	0	100
U07 MHE 13	Networking of Computers	3	0	0	100
U07 MHE 14	MEMS and NEMS	3	0	0	100

ELECTIVES FOR VIII SEMESTER

Code No.	Course Title	L	T	P	M
U07 MHE 15	Marketing Management	3	0	0	100
U07 MHE 16	Product Data Management	3	0	0	100
U07 MHE 17	Digital Signal Processing	3	0	0	100
U07 MHE 18	Rapid Prototyping	3	0	0	100
U07 MHE 19	Statistical Quality Control	3	1	0	100
U07 MHE 20	Medical Mechatronics	3	0	0	100
U07 MHE 21	Non-Conventional Machining Processes	3	0	0	100

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Solution of standard types of first order partial differential equations (excluding the types of reducible to standard types) – Lagrange’s linear equation – Linear homogeneous partial differential equations of second and higher order with constant coefficients.

UNIT II FOURIER SERIES 12

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

UNIT III BOUNDARY VALUE PROBLEMS 12

Classification of second order quasi linear partial differential equations – Solutions of one dimensional wave equation – One dimensional heat equation (excluding insulated ends) – Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

UNIT IV FOURIER TRANSFORM 12

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

UNIT V Z –TRANSFORM 12

Z-transform - Elementary properties – Inverse Z – transform (by using partial fraction and Residue methods) – Convolution theorem – Solution of difference equations using Z - transform.

TOTAL : 60

TEXT BOOK:

1. Veerarajan, T. “Engineering Mathematics” (for semester III), Third Edition, Tata McGraw Hill, New Delhi (2007)

REFERENCES

1. Grewal, B.S., “Higher Engineering Mathematics”, Thirty Sixth Edition, Khanna Publishers, Delhi, 2001.
2. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., “Engineering Mathematics Volume III”, S. Chand & Company Ltd., New Delhi, 1996.

OBJECTIVE:

To Impart knowledge on the structure, properties, treatment, testing and applications of metals and on non-metallic materials so as to identify and select suitable materials for various engineering applications.

1. INTRODUCTION AND CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS (9)

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

2. HEAT TREATMENT (9)

Definition – Full annealing, stress relief, recrystallisation and spheroidizing – normalising, hardening and Tempering of steel. Isothermal transformation diagrams – cooling curves Hardenability, Jominy end quench test — case hardening, carburising, nitriding, cyaniding, carbonitriding.

3. FERROUS AND NON FERROUS METALS (9)

Effect of alloying additions on steel (Mn, Si, Cr, Mo, V Ti & W) - stainless and tool steels – High strength Low Alloy steels (HSLA) .

Copper and Copper alloys – Brass, Bronze and Cupronickel – Aluminium and Al-Cu – precipitation strengthening treatment – Bearing alloys.

4. NON-METALLIC MATERIALS (9)

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE Polymers PU Teflon – Urea and Phenol formal deliydes – Engineering Ceramics – Properties and applications of Al₂O₃, SiC, SiC, Si₃N₄, PSZ and Sialon – Fibre and particulate reinforced composites.

5. MECH. PROPERTIES AND TESTING (9)

Mechanism of plastic deformation – Slip and Twinning Types of fracture – Fatigue and creep mechanisms - Testing of materials under tension, compression and shear loads – Hardness Tests (Brinell, Vickers and Rockwell) – Impact Tests – Izod and charpy – Fatigue & Creep Tests.

TOTAL : 45**Text Books**

1. Kenneth G.Budinski and Michael K.Budinski “Engineering Materials” Prentice-Hall of India Private Limited, 4th Indian print 2002.
2. Donald R. Askeland and Pradeep P. Pbulé “The Science and Engineering of Materials” 4th Edition – Thomson Engineering, 2002.

REFERENCES

1. William D Callsber “Material Science and Engineering”, John Wiley and Sons 1997.
2. Raghavan.V. “Materials Science and Engineering”, Prentice Hall of India Pvt. Ltd, 1999.
3. Sydney H.Avner, “Introduction to Physical Metallurgy” McGraw Hill Book Company, 1994.
4. L.H. Vanvlack, “Materials Engineering: concepts and applications”, 1995.
5. Paul Dr. Garmo. E., Black .J.T. and Ronald A. Kohser, “ Materials and Processes in Manufacturing” 8th Edition – Prentice Hall of India, 2005.

OBJECTIVE

- To understand the structure and the properties of the fluid.
- To understand and appreciate the complexities involved in solving the fluid flow problems.
- To understand the mathematical techniques already in vogue and apply them to the solutions of practical flow problems.
- To understand the energy exchange process in fluid mechanics handling incompressible fluids.

1. BASIC CONCEPTS AND PROPERTIES 6

Fluid - definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, temperature, viscosity, compressibility, vapour pressure, capillary and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers and pressure gauges.

2. FLUID KINEMATICS AND FLUID DYNAMICS 12

Fluid Kinematics - Flow visualization - lines of flow - types of flow - velocity field and acceleration - continuity equation (one and three dimensional differential forms)- Equation of streamline - stream function - velocity potential function - circulation - flow net – fluid dynamics - equations of motion - Euler's equation along a streamline - Bernoulli's equation – applications - Venturi meter, Orifice meter, Pitot tube.

3. INCOMPRESSIBLE FLUID FLOW 12

Viscous flow - Navier - Stoke's equation (Statement only) - Shear stress, pressure gradient relationship - laminar flow between parallel plates - Laminar flow through circular tubes (Hagen Poiseuille equation)- Hydraulic and energy gradient - flow through pipes - Darcy -weisbach equation - pipe roughness -friction factor - Moody's diagram-minor losses - flow through pipes in series and in parallel.

4. HYDRAULIC TURBINES 8

Fluid machines: definition and classification - exchange of energy - Euler's equation for turbo machines - Construction of velocity vector diagram's - head and specific work - components of energy transfer - degree of reaction. Hydro turbines: definition and classifications - Pelton turbine - Francis turbine - propeller turbine - Kaplan turbine - working principles - velocity triangles - work done - specific speed - efficiencies -performance curve for turbines.

5. HYDRAULIC PUMPS 7

Pumps: definition and classifications - Centrifugal pump: classifications, working principles, velocity triangles, specific speed, efficiency and performance curves - Reciprocating pump: classification, working principles, indicator diagram, work saved by air vessels and performance curves - cavitations in pumps.

TUTORIALS 15**TOTAL: 60****TEXT BOOKS**

1. Bansal, R.K., “Fluid Mechanics and Hydraulics Machines”, (5th edition), Laxmi publications (P) Ltd., New Delhi, 2006.
2. Kumar, K.L., “Engineering Fluid Mechanics”, Eurasia Publishing House (P) Ltd, New Delhi (7th edition), 2004.

REFERENCES

1. White, F.M., “Fluid Mechanics”, Tata McGraw-Hill, 5th Edition, New Delhi, 2003.
2. Ramamirtham, S., “Fluid Mechanics and Hydraulics and Fluid Machines”, Dhanpat Rai and Sons, Delhi, 2006.
3. Som, S.K., and Biswas, G., “Introduction to fluid mechanics and fluid machines”, Tata McGraw-Hill, 2nd edition, 2004.

OBJECTIVE

To design Microprocessor / Microcontroller / PLC based Mechatronics system it is essential to have the fundamental knowledge of digital circuits and design of digital systems. Hence the subject Digital Electronics is offered in which they study the design of Arithmetic circuits, shift registers and counters etc

1. NUMBER SYSTEM AND BASIC LOGIC**10**

Number systems-Binary, Octal, Hexadecimal, BCD, excess 3, complements conversions and arithmetic. Boolean theorems, Boolean algebra – AND, OR, NOT NAND & NOR operation, sum of product and product of sum forms. Minimization – Karnaugh’s map, tabular minimization procedures.

2. COMBINATIONAL CIRCUITS**10**

Problem formulation and design of combinational circuits, adder / subtractor, Encoder / decoder MUX/DEMUX, comparator, code converter. Design of combinational circuits, ROM, EPROM, EEPROM, introduction to PAL and PLA and their use in design.

3. SEQUENTIAL CIRCUITS**10**

Sequential circuits – SR, JK, D, T flip flops, triggering analysis of clocked sequential circuits, ripple counter, synchronous counters. Registers – shift registers, serial to parallel, parallel to serial conversions. Timing signal, RAM, semiconductor memories.

4. ASYNCHRONOUS SEQUENTIAL CIRCUITS**8**

Stable unstable states, output specifications, cycles and races, Race free assignments, reduction of state and flor tables, hazards, pulse mode sequential circuits.

5. ALGORITHMIC STATE MACHINES**7**

ASM chart-timing considerations-control implementation-design with multiplexers and PLA.

TOTAL : 45**TEXT BOOK**

1. Morris Mano M., “Digital Circuits and Logic Design”, Prentice Hall of India, II Edition, 1996.

REFERENCES

1. W.H.Gothmann, “Digital Electronics-Introduction Theory and Practice”, PHI, 1992.
2. T.L.Floyd, “Digital Fundamentals”, PHI, 1986.
3. S.C.Lee, “Digital Circuits and Logic Design”, PHI, 2000.
4. R.R. Jain, “Modern digital electronics”, Third edition, Tata McGraw-Hill, 3rd edition 2003.
5. Leach and Malvino, “Digital Principles of Electronics & Applications”, Tata McGraw-Hill, 5th Edition, 2003.

OBJECTIVE

The subject is intended to familiarize the Mechatronics students with major aspects of power electronics which has wide spread applications in today's industry such as power supplies, variable speed drives, transportation, robotics etc.

1. POWER SEMI CONDUCTOR DEVICES**9**

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

2. PHASE CONTROLLED CONVERTERS**9**

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

3. DC TO DC CHOPPERS**9**

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

4. INVERTERS**9**

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

5. AC VOLTAGE CONTROLLERS AND CYCLOCONVERTERS**9**

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

TOTAL : 45

TEXT BOOK

1. Rashid, M.H., "Power Electronics – Circuits Devices and Application" Prentice Hall International, New Delhi, 3rd Edition, 2004.
2. Dubey, G.K., Doradia, S.R., Joshi, A. and Singh, R.M., "Thyristorised Power Controllers", Wiley Eastern Limited, 1986.
- 3.

REFERENCES

1. Lander, W., "Power Electronics" McGraw-Hill and Company, 3rd Edition, 1993.
2. Singh, M.D., Khanchandani, K.B., "Power Electronics", Tata McGraw-Hill, 1998.
3. Joseph Vithayathil, "Power Electronics – Principle and Applications", and Robbins, "Power Electronics", McGraw-Hill Inc, New York, 1995.
4. Mohan Undeland and Robbins, "Power Electronics", John Wilry and Sons, New York, 1995.

OBJECTIVES

- To understand the layout of linkages in the assembly of a system / machine.
- To understand the principles involved in assessing the displacement, velocity and acceleration at any point in a link of a mechanism
- To understand the motion resulting from a specified set of linkages in a mechanism.

1. BASICS OF MECHANISMS 7

Terminology and Definitions-Degree of Freedom Mobility-Kutzbach criterion-Grashoff's law-Kinematic Inversions of 4-bar chain and slider crank chains-Mechanical Advantage-Transmission angle-Description of common Mechanisms-Single, double and offset slider mechanisms - Quick return mechanisms - Ratchets and escapements - Indexing Mechanisms - Rocking Mechanisms - Straight line generators-Design of Crank-rocker Mechanisms.

2. KINEMATICS 12

Displacement, velocity and acceleration and analysis in simple mechanisms - Graphical Method velocity and acceleration polygons - Kinematic analysis -Vector Approach, Computer applications in the kinematic analysis of simple mechanisms-Coincident points- Coriolis Acceleration.

3. KINEMATICS OF CAM 8

Classifications - Displacement diagrams-parabolic Simple harmonic and Cycloidal motions - Layout of plate cam profiles - Derivatives of Follower motion - High speed cams - circular arc and tangent cams - Standard cam motion - Pressure angle and undercutting.

4. GEARS 10

Spur gear Terminology and definitions-Fundamental Law of toothed gearing and involute gearing-Inter changeable gears-gear tooth action – Terminology - Interference and undercutting-Non standard gear teeth- Helical, Bevel, Worm, Rack and Pinion gears (Basics only)-Gear trains-Parallel axis gear trains-Epicyclic gear trains-Differentials

5. FRICTION 8

Surface contacts-Sliding and Rolling friction - Friction drives – Friction in screw threads - Friction clutches - Belt and rope drives, Friction aspects in Brakes – Friction in vehicle propulsion and braking

TUTORIALS 15

TOTAL : 60

TEXT BOOKS

1. Rattan S.S, “Theory of Machines”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1998.
2. Shigley J.E and.Uicker J.J, “Theory of Machines and Mechanisms”, McGraw-Hill, Inc. 1995.

REFERENCES

1. Thomas Bevan, “Theory of Machines”, CBS Publishers and Distributors, 1984.
2. Ghosh A and A.K.Mallick, “Theory of Mechanisms and Machines”, Affiliated East - West Pvt. Ltd., New Delhi, 1988.
3. Rao J.S and Dukupati R.V, “Mechanism and Machine Theory”, Wiley-Eastern Ltd., New Delhi, 1992.
4. John Hannah and Stephens R.C, “Mechanics of Machines”, Viva Low-Prices Student Edition, 1999.

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of given Orifice meter.
2. Determination of the Coefficient of discharge of given Venturi meter.
3. Calculation of the rate of flow using Roto meter.
4. Determination of friction factor of given set of pipes.
5. Conducting experiments and drawing the characteristic curves of centrifugal pump / submergible pump
6. Conducting experiments and drawing the characteristic curves of reciprocating pump.
7. Conducting experiments and drawing the characteristic curves of Gear pump.
8. Conducting experiments and drawing the characteristic curves of Pelton wheel.
9. Conducting experiments and drawing the characteristics curves of Francis turbine.
10. Conducting experiments and drawing the characteristic curves of Kaplan turbine.

TOTAL : 45**LIST OF EQUIPMENT**

(for a batch of 30 students)

- | | | |
|-----|---|---------|
| 1. | Orifice meter setup | - 1 No. |
| 2. | Venturi meter setup | - 1 No. |
| 3. | Rotometer setup | - 1 No. |
| 4. | Pipe Flow analysis setup | - 1 No. |
| 5. | Centrifugal pump/submergible pump setup | - 1 No. |
| 6. | Reciprocating pump setup | - 1 No. |
| 7. | Gear pump setup | - 1 No. |
| 8. | Pelton wheel setup | - 1 No. |
| 9. | Francis turbine setup | - 1 No. |
| 10. | Kaplan turbine setup | - 1 No. |

LIST OF EXPERIMENTS

1. Study of SCR, MOSFET & IGBT characteristics
2. UJT, R, RC firing circuits for SCR
3. Voltage & current commutated chopper
4. SCR / TRIAC phase control circuits
5. Study of half controlled & fully controller converters
6. Speed control of DC shunt motor using three phase fully controlled converter.
7. SCR single-phase cyclo converter
8. SCR series and parallel inverters
9. IGBT Chopper
10. IGBT based PWM inverter (single phase)

TOTAL : 45

LIST OF EQUIPMENT

(for a batch of 30 students)

S.No	Equipments	Qty
1	Study of SCR, MOSFET & IGBT characteristics module	1
2	IJT, R, RC firing circles for SCR module	1
3	Voltage & current commutated chopper module	1
4	SCR phase control circuit module	1
5	TRIAC phase control circuit module	1
6	Study of half controlled & fully controller converters module	1
7	Study of three phase AC regulator module	1
8	Speed control of DC shunt motor using three phase fully controlled converter module	1
9	SCR single phase cyclo converter module	1
10	SCR series and parallel inverters module	1
11	IGBT chopper module	1
12	IGBT based PWM inverter (single phase) module	1
13	Ammeter (0-5A) MC, (0-2A) MC, (0-2A) MI, (0-5V) MI Voltmeter	1
14	(0-300V) MC, (0-600V) MC, (0-300V) MI, (0-600V) MI	Each 3
15	Multimeter	Each 3
16	CRO	4
17	Transformer 1KVA, 1:1, 230V	5
		4

UNIT I

9

Indian standard code of practice for engineering drawing – general principles of Presentation. Conventional representations of threaded parts, springs, gear and Common features. Abbreviations and symbols for use on technical drawings. Conventions for sectioning and dimensioning.

UNIT II

9

Tolerances – types – representation of tolerances on drawing, fits – types – selection of Fits – allowance. Geometric tolerances – form – and positional tolerances – datum, datum Features. Maximum material principle – symbols and methods of indicating it on drawing Surface finish symbols – welding symbols and methods of indicating it on drawing.

UNIT III (Drafting work using mini drafter)

9

Preparation of part and assembly drawings of Plummer block, screw jack, machine vice, lathe tailstock, Flange Coupling, stuffing box, piston & connecting rod universal joint)

UNIT IV

9

Introduction to the use of 3D modeling and drafting software – creation of simple geometric bodies using basic commands. Assembling of various machine element parts.

UNIT V

9

Preparation of 3-D drawings using PROE software for components and assemblies of Plummer block, screw jack, machine vice, lathe tailstock, universal and flange coupling.

TOTAL : 45

TEXT BOOKS

1. Sadhu Singh & P.L. Sah, Fundamentals of Machine Dynamics, Prentice Hall of India Pvt Ltd, 2003.
2. P.N. Rao, CAD/CAM Principles and Applications, Tata McGraw-Hill 2003

REFERENCE

1. K. Venugopal, Engineering Graphics AutoCAD, John Wiley & Sons, 2002
2. K.R. Gopal Krishanan , Text book of Machine Drawing.

LIST OF EQUIPMENT AND SOFTWARE REQUIRED

(for a batch of 30 students)

1.Computer System	30
VGA Color Monitor, Pentium IV Processor, 20 GB HDD, 256 MB RAM	
2.Laser Printer	01
3.Plotter (A2 size)	01
4. Software: Pro / E or CATIA or IDEAS 30 Licenses or Solidworks	
5. Drawing Boards and Tables in Drawing Hall	30 Nos.

UNIT I

NUMERICAL SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS

12

Linear interpolation methods (method of false position) – Newton’s method –iteration method – Solution of linear system by Gaussian elimination and Gauss-Jordon methods- Iterative methods: Gauss Jacobi and Gauss-Seidel methods.

UNIT II

INTERPOLATION

12

Newton’s forward and backward difference formulas – Divided differences – Lagrange’s interpolation– Interpolation with natural cubic spline for equal intervals.

UNIT III

NUMERICAL DIFFERENTIATION AND INTEGRATION

12

Numerical differentiation: Derivatives by using Newtons forward , backward and divided differences – Numerical integration by trapezoidal and Simpson’s 1/3 and 3/8 rules – Two and Three point Gaussian quadrature formulas – Double integrals using trapezoidal and Simpson’s 1/3 rules.

UNIT IV

INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS

12

Single step methods: Taylor series method – Euler and improved Euler methods – Fourth order Runge – Kutta method for solving first and second order equations – Multistep methods: Milne’s and Adam’s predictor and corrector methods.

UNIT V

BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS

12

Finite difference solution of second order ordinary differential equation – Finite difference solution of one dimensional heat equation by Bender Schmidt and Crank Nicholson methods – One dimensional wave equation by explicit method and two dimensional Laplace and Poisson equations.

TOTAL : 60

TEXT BOOK:

Kandasamy, P., Thilagavathy, K. and Gunavathy, K., “Numerical Methods”, S.Chand Co. Ltd., New Delhi, 2007.

REFERENCES

- 1.Gerald, C.F, and Wheatley, P.O, “Applied Numerical Analysis”, Sixth Edition, Pearson Education Asia, New Delhi, 2002.
- 2.Sastry, S.S, “ Introductory Methods of Numerical Analysis”, Third Edition, Prentice – Hall of India Pvt Ltd, New Delhi, 2003.

OBJECTIVE

This course aims to impart the knowledge about various production processes. It deals with Metal Casting, Metal Forming, Metal Machining and Metal Joining Processes. After this course, a Mechatronics student will have a good exposure about the manufacturing processes and various operations and machinery. This also gives the recent trends in these processes also.

1. **FOUNDRY TECHNOLOGY** **9**

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

2. **FORMING– PROCESSES** **9**

Hot and Cold Working

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

Forging : Introduction – Related Forging Operations – Drop forging

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

3. **CONVENTIONAL MACHINING PROCESS** **9**

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

4. **SPECIALIZED MACHINING AND SUPER FINISHING PROCESS** **9**

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

Grinding Process – Abrasives – Finishing Operations – Lapping, Honing Burnishing .

5. **PRINCIPLES & APPLICATIONS OF JOINING PROCESSES** **9**

Gas welding, Basic Arc Welding Processes, Thermit Welding, Electron – Beam Welding, Laser – Beam Welding.

Solid State Welding: Cold Welding, Ultrasonic Welding, Friction Welding, Resistance Welding and Explosive Welding.

Principles and applications of Brazing and Soldering.

TOTAL : 45

TEXT BOOK

1. KALPAKJIAN, S., “Manufacturing Engineering and Technology”, Pearson education India, 4th edition, 2001 (ISBN 81 78081 571)

REFERENCES

1. Hajra Choudhury, S.K., and Haqjra Choudhury, A.K., “Elements of Workshop Technology”, Volume I and II, Media Promoters and Publishers Private Limited, Mumbai, 1997.
2. Paul Degarma E, Black J.T. and Ronald A. Kosher, Eighth edition, Materials and Processes in Manufacturing Prentice – Hall of India, 1997.
3. Sharma P.C. A Textbook of Production Technology, S. Chand and Co., Ltd., 1999.

OBJECTIVE

- To understand the force-motion relationship in components subjected to External Forces
- To understand the force-motion analysis of standard mechanisms
- To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.
- To understand the effect of Dynamics of Undesirable Vibrations
- To understand the principles in mechanisms used for governing of machines.

1. FORCE ANALYSIS**10**

Rigid Body dynamics in general plane motion – Equations of motion.-Dynamic force analysis - Inertia force and Inertia torque - D'Alembert's principle - The principle of superposition - Dynamic Analysis in Reciprocating Engines – Gas Forces - Equivalent masses - Bearing loads - Crank shaft Torque - Turning moment diagrams - Fly wheels – Engine shaking Forces - Cam dynamics - Unbalance, Spring, Surge and Windup.

2. BALANCING**9**

Static and dynamic balancing - Balancing of rotating masses - Balancing a single cylinder Engine Balancing Multi-cylinder Engines - Partial balancing in locomotive Engines - Balancing linkages - balancing machines

3. FREE VIBRATION**10**

Basic features of vibratory systems - idealized models Basic elements and lumping of parameters - Degrees of freedom - Single degree of freedom - Free vibration - Equations of motion - natural frequency - Types of Damping - Damped vibration critical speeds of simple shaft - Torsional systems; Natural frequency of two and three rotor systems.

4. FORCED VIBRATION**6**

Response to periodic forcing - Harmonic Forcing - Forcing caused by unbalance - Support motion – Force transmissibility and amplitude transmissibility Vibration isolation.

5. MECHANISM FOR CONTROL**10**

Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors – Characteristics - Effect of friction - Controlling Force other Governor mechanisms.
Gyroscopes - Gyroscopic forces and Torques - Gyroscopic stabilization - Gyroscopic effects in Automobiles, ships and airplanes.

TUTORIAL**15***TOTAL : 60***TEXT BOOK**

1. Rattan S.S., "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1994.
2. R.S.Khurmi, J.K.Gupta "Theory of machines", S.Chand & company ltd New Delhi.

REFERENCES

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
2. Ghosh A. and Mallick A.K., "Theory of Mechanisms and Machines", Affiliated East-West Press Pvt. Ltd., New Delhi, 1988.
3. Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", McGraw-Hill, Inc., 1995.
4. Rao J.S. and Dukkipati R.V., "Mechanism and Machine Theory", Wiley-Eastern Limited, New Delhi, 1992.
5. John Hannah and Stephens R.C., "Mechanics of Machines", Viva low-Priced Student Edition, 1999.
6. Sadhu Singh "Theory of Machines", Pearson Education, 2002.

AIM

The aim of this course is to create awareness in every engineering graduate about the importance of environment, the effect of technology on the environment and ecological balance and make him/her sensitive to the environment problems in every professional endeavour that he/she participates.

OBJECTIVE

At the end of this course the student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity.

UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES 10

Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.

UNIT II ECOSYSTEMS AND BIODIVERSITY 14

Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) Forest ecosystem (b) Grassland ecosystem (c) Desert ecosystem (d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity – Biogeographical classification of India – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT III ENVIRONMENTAL POLLUTION 8

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – Soil waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT

7

From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns, case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – Wasteland reclamation – Consumerism and waste products – Environment Protection Act – Air (Prevention and Control of Pollution) Act – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness

UNIT V HUMAN POPULATION AND THE ENVIRONMENT

6

Population growth, variation among nations – Population explosion – Family Welfare Programme – Environment and human health – Human Rights – Value Education – HIV / AIDS – Women and Child Welfare – Role of Information Technology in Environment and human health – Case studies.

Suggested field work

Visit to local area to document environmental assets- river/grassland/ hill/ mountain, visit to local polluted site- urban/ rural / industrial/agricultural, study of common plants, insects, birds, study of simple ecosystems-pond, river, hill slopes etc.,

TOTAL : 45

TEXT BOOKS

1. Deswal.S and Deswal.A, “ A basic course in Environmental studies” Dhanpat Rai & Co, 2006.
2. Gilbert M.Masters, Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., Second Edition, ISBN 81-297-0277-0, 2004.
3. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co.

REFERENCES

1. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad India, Email: mapin@icenet.net
2. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media.
3. Cunningham, W.P.Cooper, T.H.Gorhani, Environmental Encyclopedia, Jaico Publ., House, Mumbai, 2001.
4. Wager K.D., Environmental Management, W.B. Saunders Co., Philadelphia, USA, 1998.

5. Townsend C., Harper J and Michael Begon, “ Essentials of Ecology”, Blackwell science
6. Trivedi R.K and P.K. Goel “ Introduction to Air pollution” Techno-science Publications.
7. Yamuna R.T “ Environmental Science” Inter Publications

OBJECTIVES

- To study the basic concept of D.C. and A.C. circuits and to learn the concept of transformers and do simple problems.
- To study the performance characteristics of D.C. motors, three phase induction motor and single phase induction motor.
- To study the methods of speed control of D.C. and A.C. motors and methods of starting of D.C. and A.C. motors.
- To study the basics of selection of drive for a given application.
- To study the concept of controlling the speed of D.C. and A.C. motors using solid state devices.

1. CIRCUITS AND TRANSFORMERS**6**

D.C. Voltage, current, power - Magnetic Field Intensity – Flux Density - Faraday’s Law of Electromagnetic Induction - mesh analysis – A.C. voltage – sinusoidal waves, phasor representation – power factor – complex power - basic idea of transformers – simple problems.

2. ELECTRICAL MOTORS**12**

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

3. SPEED CONTROL AND STARTING**9**

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

4. ELECTRICAL DRIVES**9**

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

5. SOLID STATE DRIVES (QUALITATIVE TREATMENT ONLY)**9**

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

TOTAL : 45**TEXT BOOK**

1. N.K.De.,P.K.Sen “Electric Drives”, Prentice Hall, First edition 1999.
2. I.J. Nagrath, T.P. Kothari., “Basic Electrical Engineering”, McGraw-Hill Publishing company Ltd., Second edition, 2002

REFERENCES

1. B.L Theraja, A.K.Therja, “A Textbook of Electrical Technology Volume II, S.Chand & Company Ltd., New Delhi.
2. S.K. Bhattacharya “ Electrical Machines” second edition 1999, Tata McGraw-Hill Pvt. Company Ltd., Second edition, 1999.
3. G.K. Dubey “Fundamental Electrical Drives” second edition 2002, Narosa Publications, Second edition, 2002.
4. Pillai, S.K., “A Seish course on Electrical Drives”, Wilay Eastern Ltd., New Delhi, 1982.

OBJECTIVE

To study the response and stability of mechanical and electrical systems so as to design for stable operation.

1. SYSTEMS AND THEIR REPRESENTATION 9

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

2. TIME RESPONSE 9

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

3. FREQUENCY RESPONSE ANALYSIS AND DESIGN 9

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

4. STABILITY OF CONTROL SYSTEMS 9

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

5. COMPENSATION DESIGN 9

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

TUTORIALS 15

MATLAB applications: Partial Fraction expansion, Transformation of Mathematical models, Transient response analysis, Root locus, Bode diagrams, Nyquist plots with MATLAB. Simple MATLAB applications to analysis and compensator design problems.

TOTAL : 60**TEXT BOOKS**

1. Katsuhiko Ogata, "Modern Control Engineering", 4th Edition, Pearson Education 2002 (ISBN 81-7808-579-8)
2. Gopal M. "Control System Principles and Design", Tata McGraw-Hill, 1998

REFERENCES

1. Chesmond C.J. "Basic Control System Technology", Viva Low Priced Student Edition, 1998.
2. Dutton K., Banaclough W. and Thompson S., "The Art of Control Engineering", Addison Wesley 2000
3. Dorf R.C. and Bishop R.H., "Modern Control systems", Addison – Wesley, 1995 (MATLAB reference)
4. Leonard N.E. and William Levine, "Using MATLAB to Analyze and Design Control Systems", Addison Wesley, 1995.

OBJECTIVE

Demonstration and study of the following machines. The Main emphasis will be on a complete understanding of the machine capabilities and processes.

LIST OF EXPERIMENTS

UNIT 1 LATHE PRACTICE

- a. Plain Turning
- b. Taper Turning
- c. Thread Cutting

Estimation of machining time for the above turning processes.

UNIT II DRILLING PRACTICE

- a. Drilling
- b. Tapping
- c. Reaming

UNIT III MILLING

- a. Surface Milling
- b. Gear Cutting
- c. Contour Milling

UNIT IV PLANNING AND SHAPING

- a. Cutting Key Ways
- b. Dove tail machining.

TOTAL : 45

LIST OF EQUIPMENT

(for a batch of 30 students)

- | | | |
|----|------------------|-----------|
| 1. | Lathe | - 15 Nos. |
| 2. | Drilling Machine | - 1 Nos. |
| 3. | Milling Machine | - 2 Nos. |
| 4. | Planning Machine | - 1 Nos. |
| 5. | Shaping Machine | - 2 Nos. |

LIST OF EXPERIMENTS

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

TOTAL : 45LIST OF EQUIPMENT

(for a batch of 30 students)

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

OBJECTIVE

To expose the students the operation of electric drives and give them hands on experience.

LIST OF EXPERIMENTS

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

TOTAL : 45**LIST OF EQUIPMENT**

(for a batch of 30 students)

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

U07GM403 Technical Seminar 1
IV Semester:

Content		Methodology		Evaluation criteria	Marks
Topic	Sub-topics	Teacher's Part	Student's Part		
Reading skills	<ul style="list-style-type: none"> Mind training for better reading (SQ3R-technique) Training the eyes for better reading 	<p>Theory to be handled.</p> <p>Use of emphasizing, voice modulation, pause etc to be demonstrated.</p>	<p>Exercise 1: Each student has to read an article (preferably technical) for 5 to 7 minutes. (05 students in one hour)</p>	The effectiveness of the student in reading is to be evaluated	20 Marks
Writing skills	<ul style="list-style-type: none"> Less is more In words of one syllable Ways to improve writing style Letter writing tips Writing application letter, cover letters, business letters, memos, reports 	<p>Theory to be handled with examples for each topic.</p>	<p>Exercise 2: Writing an application letter</p> <p>Exercise 3: Writing a covering letter</p> <p>Exercise 4: Writing a business letter</p> <p>Exercise 5: Writing a memo</p> <p>Exercise 6: Writing a report</p>	The letter has to be evaluated for correctness	25 Marks (5 Marks / exercise)

Speaking skills	<ul style="list-style-type: none"> • Writing a speech (structure, begin, end) • Persuasive speech 	Theory to be handled with examples	Exercise 7: Each student has to prepare (written) a speech (on a general or technical topic). Maximum 5 sides of an A4 sheet (if printed with font size 10 – Tahoma font)	The written material is to be evaluated for content, structure, beginning and ending	25 Marks
			Exercise 8: The material prepared in exercise 7 is to be delivered in 8 to 10 minutes (05 students in one hour)	Evaluate the speech for articulation, style and effectiveness of delivery	30 Marks
Total					100 Marks

Report to be maintained by each student

- a. Cover page
- b. Bonafied certificate
- c. Content with marks awarded for each exercise
- d. Evaluated exercises

OBJECTIVES

- Gain knowledge of simple stresses, strains and deformation in components due to external loads.
- Assess stresses and deformations through mathematical models of beams, twisting bars or combinations of both.
- Understand the effect of component dimensions and shape on stresses and deformations
- Provide knowledge to be applied in the design courses

1. STRESS STRAIN AND DEFORMATION OF SOLIDS 9

Stresses: Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load –Elastic constants – Strain energy and unit strain energy.

2. BEAMS - LOADS AND STRESSES 9

Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported – Stresses in beams – Theory of simple bending – Stress variation along the length and in the beam section – Effect of shape of beam section on stress induced – Shear stresses in beams .

3. TORSION 9

Analysis of torsion of circular bars – Shear stress distribution – Bars of Solid and hollow circular section –Twist and torsion stiffness – Compound shafts – Fixed and simply supported shafts – Application to close-coiled helical springs – Maximum shear stress in spring section including Wahl Factor – Design of helical coil springs.

4. BEAM DEFLECTION 9

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

5. ANALYSIS OF STRESSES IN TWO DIMENSIONS 9

Biaxial state of stresses – Thin cylindrical and spherical shells – Deformation in thin cylindrical and spherical shells – Biaxial stresses at a point – Mohr’s circle for biaxial stresses – Maximum shear stress.

TUTORIALS 15
TOTAL: 60

TEXT BOOKS

1. Popov, E.P, “Engineering Mechanics of Solids”, Prentice-Hall of India, New Delhi, 2003.
2. Beer, F. P. and Johnston, R., “Mechanics of Materials”, 3rd edition, McGraw-Hill, 2002.
3. Rajput, R. K, “A textbook of Strength of Materials”, S. Chand, 2005.

REFERENCES

1. Nash, W.A., “Theory and problems in Strength of Materials”, Schaum Outline Series, McGraw-Hill, New York, 1995
2. Kazimi, S.M.A., “Solid Mechanics”, Tata McGraw-Hill, New Delhi, 1981
3. Ryder G.H, “Strength of Materials”, 3rd edition, Macmillan India Ltd., 2002.
4. Ray Hulse, Keith Sherwin and Jack Cain, “Solid Mechanics”, Palgrave ANE Books, 2004.
5. Singh D.K., “Mechanics of Solids”, Pearson Education 2002.
6. Timoshenko S.P., “Elements of Strength of Materials”, Tata McGraw-Hill, New Delhi 1997.

OBJECTIVE

Most of the Mechatronics systems control is based on Microprocessor and Microcontroller. So it is necessary to include this subject in the syllabus so that students will be exposed to the knowledge of Microprocessor based systems and design of these systems.

1. 8085 MICROPROCESSOR**9**

Organization of Micro Computers – Organization of 8085: Architecture, Internal Register Organization and Pin Configuration – Instruction Set of 8085 – addressing modes - instruction and machine cycles with states and timing diagram. Methods of 8085 programs and 8085 assembly language.

2. INTERFACING AND I/O DEVICES**9**

Need for Interfacing – Memory Interfacing: address space partitioning – address map – Address decoding – Designing decoder circuit for the given address map – Bus connection and Z – line Control – Access Time Computations. I/O Interfacing: Data transfer schemes – programmed Synchronous and asynchronous – Interrupt driven Transfer – Multiple devices and multiple interrupt levels – enabling disabling and masking of interrupts. DMA transfer: Cycle stealing – Burst mode – Multiple DMA devices –serial data transfer.

3. DESIGN USING PERIPHERAL DEVICES**9**

Interfacing A/D and D/A converters – Matrix Keyboard design using 8255 using 8085 programs – Design of Keyboard and display interfacing using 8279 – Design of digital transmission with modems and telephone lines using 8251 A.

4. 8051 ARCHITECTURE**9**

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

5. 8051 APPLICATIONS**9**

Interfacing of Keyboards – Interfacing of Display Devices – Pulse measurement – Analog to Digital and Digital to Analog Converter – Interfacing Hardware Circuit – Multiple interrupts – Serial Data Communication – Network Configuration.

TOTAL: 45**TEXT BOOKS**

4. Aditya P Mathur, “Introduction to Microprocessor”, 3rd edition, Tata McGraw Hill, New Delhi 2003
5. Kenneth J. Ayala, “The 8051 Microcontroller Architecture, Programming and Applications”, 2nd edition, Penram International (India), Mumbai, year.

REFERENCES

1. B.P. Singh, Microprocessors and Microcontrollers, 1st Edition, Galcotia, New Delhi, 1997.
2. Ramesh Goankar, “Microprocessor Architecture. Programming and Applications with the 8085”, 5th edition- Penram International (India), place, year.
3. Embedded Controller Hand book, Intel Corporation, USA, year.
4. Microcontroller Hand Book, INTEL, 1984.

OBJECTIVE

This course provides concepts, characteristics, control and applications of several measurement systems that are required in the mechatronics system design.

1. GENERAL CONCEPTS OF MEASUREMENT**12**

Generalized Measurement System – Performance Characteristics – Static and Dynamic Characteristics – Errors in Measurements – Calibration and Standards – Generalized Performance of Zero Order, First Order and Second Order Systems – Classifications of Transducers.

2. TEMPERATURE MEASUREMENT**9**

Mechanical Type – Filled Thermometers – Liquid Filled – Gas Filled – Vapour Filled – Bimetallic Thermometer – Electric Type – RTD – Thermistor, Thermocouple, IC Thermometer – Non Contact Total Radiation Pyrometer – Optical Pyrometer.

3. PRESSURE, FLOW AND LEVEL MEASUREMENTS**9**

Pressure Measurement: Monometers – Elastic Transducers – Bourdon Gauge – bellows – diaphragm – Calibration of Pressure Gauge using Dead Weight Testers. Vacuum: McLeod Gauge, Thermal Conductivity Gauge – Ionization Gauge.

Flow Measurement: Nozzle, Turbine Flow meter, Hot wire Anemometer.

Level Measurement: Float Level, surge type, Differential Pressure Type, Electrical Type- Resistance and Capacitance.

4. DISPLACEMENT, FORCE, TORQUE and VIBRATION MEASUREMENT**9**

Load Cells – Different Types – Potentiometer – Strain Gauges Resistive and Semiconductor – Different Forms – Measurement Circuits – Use in Displacement, Force and Torque Measurement. LVDT Characteristics – Measurement Circuits – Use in Displacement - RVDT for angular measurement. Piezo Electric Transducer – Different Types – Characteristics – Measurement Circuits – Application in Acceleration and Vibration Measurement. Optical Encoder for Displacement and Velocity Measurement.

5. PNEUMATIC AND ELECTRONIC PID CONTROLLERS**6**

Pneumatic and Electronic PID Controllers – Automatic Speed Control of Drives- Pneumatic Two Step Controller – Machine Tool Control.

TOTAL : 45**TEXT BOOK**

1. Ernest O. Doebelin, "Measurement Systems Application and Design", McGraw-Hill, 1990.
2. Nagrath I. J. and Gopal, M. "Control Systems Engineering", Wiley Eastern Limited, 1995.

REFERENCES

1. Sawney, A.K. and Puneet Sawney, "A course in Mechanical Measurements and Instrumentation and Control," 12th edition, Dhanpat Rai & Co, New Delhi, 2001.
2. Beckwith, T.G. and Buck, N.L. "Mechanical Measurements" Addison Wesley, 1995.
3. Jain R.K. "Mechanical and Industrial Measurements" Khanna, Delhi, 1984.
4. Rangan, Mani and Sharma, "Instrumentation", Tata McGraw-Hill, New Delhi, 1985.
5. Murthy, D.V. S., "Transducers and Instrumentation", Printing Hall of India, New Delhi, 2003.

OBJECTIVE

Study of fundamentals, constructional details and other control systems with programming of CNC machines

1. FUNDAMENTALS OF CNC MACHINES**9**

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

2. CONSTRUCTIONAL FEATURES OF CNC MACHINES AND RETROFITTING**10**

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

3. CONTROL SYSTEMS, FEED BACK DEVICES AND TOOLING**10**

Description of a simple CNC control system. Interpolation systems. Features available in a CNC system – introduction to some widely used CNC control systems.

Types of measuring systems in CNC machines – Incremental and absolute rotary encoders, linear scale – resolver – Linear inductosyn – Magnetic Sensors for Spindle Orientation.

Qualified and pre-set tooling – Principles of location – Principles of clamping – Work holding devices.

4. CNC PART PROGRAMMING**9**

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

5. ECONOMICS AND MAINTENANCE**7**

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

TOTAL : 45**TEXT BOOK**

1. Radhakrishnan P., Computer Numerical Control Machines, New Central Book Agency, 1992.
2. Groover, M.P., Automation, Production Systems and Computer Integrated Manufacturing, Prentice Hall, 1998.

REFERENCES

1. Yorem Koren, "Computer Control of Manufacturing Systems", Pitman, London, 1987.
2. Berry Leatham – Jones, "Computer Numerical Control", Pitman, London, 1987.
3. Steave Krar and Arthur Gill, "CNC Technology and Programming", McGraw Hill, 1990.
4. Hans B. Kief and T. Fredrick Waters, "Computer Numerical Control", Macmillan/McGraw-Hill, 1992.
5. Thyer, G.E., "Computer Numerical Control of Machine Tools", 2nd edition, B/H NEWNES, 1993.
6. Mike Mattson, "CNC Programming", Thomson Learning, 2003.

OBJECTIVE

Understand the principles of Dimensional Metrology, techniques and devices used for quality control in modern Industrial environment.

1. CONCEPT OF MEASUREMENT AND SQC**9**

General Concept – Generalized measurement system – Units and standards Geometric dimensioning , tolerance- types, fits-types, Statistical Quality control- Attribute and variable methods, simple problems in X bar and R chart.

2. LINEAR AND ANGULAR METROLOGY**9**

Definition of metrology – Linear measuring instrument : Vernier, micrometer measurement, dial indicator, Slip gauges and classification, interferometry, optical flats - limit gauges, Comparators - Mechanical, pneumatic and electric types, applications – sine bar, optical bevel protractor, auto collimator, angle Decker – taper measurements.

3. SURFACE MEASUREMENT**9**

Surface evaluation, Stylus method, Numerical values for surface assessment, Surface texture specimens, straightness, flatness and roundness measurement.

4. OPTICAL METROLOGY AND NON-DESTRUCTIVE TESTING**9**

Optical comparator- Principle and application, Pneumatic comparator – Principle and application Profile projector. Ultrasonic test, Dye penetrant and Magnetic particle Inspection

5. ADVANCED TECHNIQUES IN METROLOGY**9**

Coordinate measuring machine – constructional features – types and application, digital devices – computer aided inspection — machine vision systems, Universal Measuring Machine, Laser principles – Laser interferometer – application in linear, angular measurement and machine tool metrology.

TUTORIALS 15
TOTAL 60

TEXT BOOKS

1. Jain R K “ Engineering Metrology” Khanna Publishers, 1994
2. Mahajan, “A textbook of Metrology”, Dhanpat Rai & Co.

REFERENCE

1. Alan S. Morris “ The Essence of Measurement” Prentice Hall of India, 1997
2. Connie Dotson, Ronger Harlow and Richard L Thomson, “Fundamentals of Dimensional Metrology”, 4th edition, Thompson – Delmar, 2003.
3. Gupta S C “ Engineering Metrology “ Dhanpat rai Publications

OBJECTIVE

- To familiarize the various steps involved in the Design Process
- To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data
- To learn to use catalogues and standard machine components

1. STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 11

Introduction to the design process - factor influencing machine design, selection of materials based on mechanical properties – Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – Design of curved beams – crane hook and ‘C’ frame - Factor of safety - theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations

2. DESIGN OF SHAFTS AND COUPLINGS 7

Design of solid and hollow shafts based on strength, rigidity - critical speed – keys and key ways – design of muffle and knuckle joints - Design of rigid and flexible couplings – shock absorbing couplings.

3. DESIGN OF FASTNERS AND WELDED JOINTS 9

Threaded fasteners - Design of bolted joints including eccentric loading – Design of welded joints for pressure vessels and structures - theory of bonded joints.

4. DESIGN OF SPRINGS AND LEVERS 9

Design of helical, leaf, disc and torsional springs under constant loads and varying loads – Concentric torsion springs - Belleville springs – Design of Levers.

5. DESIGN OF BEARINGS AND FLYWHEELS 9

Design of bearings – sliding contact and rolling contact types. – Cubic mean load – Design of journal bearings – Mckeas equation – Lubrication in journal bearings – calculation of bearing dimensions – Design of flywheels involving stresses in rim and arm.

TUTORIAL 15
TOTAL 60

Note: (Use of P S G Design Data Book is permitted in the University examination)

TEXT BOOKS

1. Patil, R.B, “Design of Machine Elements”, Tech-Max, 2006.

REFERENCES

1. Juvinall, R.C. and Marshek, K.M, “Fundamentals of Machine Component Design”, 3rd edition, John Wiley & Sons, 2002.
2. Bhandari, V.B, “Design of Machine Elements”, Tata McGraw-Hill, 2003.
3. Norton, R.L, “Design of Machinery”, Tata McGraw-Hill, 2004.
4. Orthwein, W., “Machine Component Design”, Jaico, 2003.
5. Ugural, A.C., “Mechanical Design – An Integral Approach”, McGraw-Hill, 2004.
6. Spotts M.F. and Shoup, T.E., “Design and Machine Elements” Pearson Education, 2004.

OBJECTIVE

Exposure to the knowledge of real time programming in Microprocessor based systems and to verify the output by interfacing the devices.

LIST OF EXPERIMENTS

I.	PROGRAMMING	21
	Addition and subtraction of two 8-bit numbers.	
	Additional of two 16-bit numbers	
	Multibyte addition and subtraction	
	To arrange a series of numbers in Ascending order and Descending order	
	8-bit Multiplication.	
	8-bit Division.	
	Decimal to hexadecimal conversion and hexadecimal number to decimal number conversion.	
II.	INTERFACING	15
	Analog to digital conversion	
	Digital to analog conversion	
	Stepper motor controller.	
	Temperature controller	
	Study of 8253 and 8251	
	Study of 8255	
III.	RIDE SOFTWARE SIMULATION OF 8085 PROGRAMMING	9

LIST OF EQUIPMENTS

1. Dual Trace Oscilloscope
2. Digital Function Generator
3. Decade Resistance Box
4. Decade Capacitance Box
5. Decade Inductance Box
6. Digital Multimeter
7. Multi Output Power Supply
8. Digital and Linear Circuit Builder Kit
9. 8085 Microprocessor Trainer Kit
10. 8051 Microcontroller Trainer Kit
11. DAC Interfacing Board
12. ADC Interfacing Board
13. Stepper Motor Interfacing Board
14. Stepper Motor
15. DC Motor Interfacing Board
16. 89C51 CPU Card
17. 8051 Micro controller Trainer Kit
18. 8085 Micro processor Trainer Kit
19. Stepper motor interfacing Board
20. Stepper motor 2 kg
21. Dc motor interfacing Board
22. PIC Embedded Trainer Kit

OBJECTIVE

- To correlate the concepts studied in the instrumentation and control subject for the real world applications.
- To understand the concept of controlling the parameters based on measurement.

LIST OF EXPERIMENTS

1. Calibration of pressure gauge using dead weight pressure gauge tester
2. Calibration of vacuum sensor using vacuum measurement set-up
3. Measurement and control of temperature using thermocouple
4. Measurement and control of temperature using RTD and thermistor
5. Speed measurement using tachometer and stroboscope
6. Force measurement using proving ring and load cell
7. Torque measurement using strain gauge
8. Power measurement using Prony-brake dynamometer
9. Strain measurement using strain gauge
10. Displacement measurement using LVDT
11. Speed measurement and control of DC servo motor using PI controller
12. Noise measurement using sound-level meter
13. Study of flow measurement techniques
14. Study of level measurement techniques

TOTAL : 45**LIST OF EQUIPMENTS**

1. Vacuum measurement set-up
2. Prony-brake dynamometer with motor and accessories
3. Temperature measuring devices – thermocouple, RTD and thermistor.
4. Speed measurement system with accessories
5. DC-servo motor with PI controller interface
6. Digital sound-level meter
7. Dead weight pressure gauge tester
8. Displacement measurement set-up – LVDT
9. Strain measurement set-up
10. Torque measurement set-up
11. Force measurement set-up with load cell and proving ring

Globalization has brought in numerous opportunities for the teeming millions, with more focus on the students' overall capability apart from academic competence. Many students, particularly those non-English medium schools, find that they are not preferred due to their inadequacy of communication skills and soft skills, despite possessing sound knowledge in their subject area along with technical capability. Keeping in view their pre-employment needs and career requirements, this course on Communication Skills Laboratory will prepare students to adapt themselves with ease to the Industry environment, thus rendering them as prospective assets to Industries. The course will equip the student with the necessary communication skills that would go a long way in helping them in their profession.

OBJECTIVES :

- * To equip students of engineering and technology with effective speaking and listening skills in English
- * To help them develop their soft skills and people skills, which will make the transition from college to workplace smoother and help them to excel in their jobs.
- * To enhance students' performance at Placement Interviews, Group Discussions and other recruitment exercises.

1. PC based session	(weight age-40%)	24 periods
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A. English Language Laboratory (18 Periods)

1. Listening Comprehension (6)

Listening – Listening and sequencing of sentences – Filling in the Blanks – Listening and answering the question

2. Reading Comprehension and Vocabulary (6)

Filling in the blanks – Cloze Exercises – Vocabulary building – Reading and Answering questions

3. Speaking: (6)

Phonetics : Intonation – Ear Training – Correct Pronunciation – Sound Recognition exercises – Common Errors in English

Conversations: Face to face Conversation – Telephone conversation - Role play Activities (Students take on roles and engage in conversation)

B. Career Laboratory (6 Periods)

(Samples are available to learn and practice in the class room session)

1. Resume / Report Preparation / Letter Writing (1)

Structuring the resume / report – Letter writing / E-mail communication – Samples

2. Presentation Skills (1)

Elements of an effective presentation – Structure of a presentation –Presentation Tools – Voice Modulation – Audience analysis – Body Language

3. Soft Skills (2)

Time Management – Articulateness – Assertiveness – Innovation and Creativity – Stress Management and Poise

4. Group Discussion (1)

Why is GD part of selection process? – Structure of a GD- Moderator-led and Other GDs – Strategies in GD – team work – Body Language –Mock GD

5. Interview Skills

Kinds of Interviews –Required Key Skills – Corporate culture- Mock Interviews

II. Class Room Session	(weightage-60%)	24 periods
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1. Resume / Report Preparation /Letter writing : Students prepare their own resume and report. (2)

2. Presentation Skills : Students make presentations on given topics. (8)

3. Group Discussion : Students participate in group discussions (8)

4. Interview Skills : Students participate in Mock Interviews. (8)

Note: Classroom sessions are practice sessions

References:

Books:

1. Meenakshi Raman and Sangeetha Sharma, Technical Communication- Principles and Practice, Oxford University Press. New Delhi (2004)
2. Barker. A – Improve your communication skills – Kogan page India Pvt Ltd. New Delhi (2006)
3. Adrian Doff and Christopher Jones- Language in Use (Upper- Intermediate). Cambridge University Press. First South Asian Edition (2004)
4. John Seely, the Oxford Guide to writing and speaking, Oxford University Press, New Delhi (2004)
5. Customize yourself to corporate life Dr. K. Devadoss and P. Malathy Inder Publications, Coimbatore (2007)

CD's

1. Train2sucess series 1.Telephone Skills.2. Interviewing Skills 3. Negotiation Skills by Zenith Global Consultants Ltd. Mumbai
2. BEC Series
3. Look Ahead by Cambridge University Press

OBJECTIVE

Aim is to introduce the concept and principle of operation of various sensors, which finds and extensive application in the field of automation and the processing of the signals are also dealt.

1. SENSORS AND TRANSDUCERS**9**

Sensors and classifications – Characteristics environmental parameters – Selection and specification of sensors – Ultrasonic sensors, Sound sensor – sound level meter, microphone – types, jerk pickups, Humidity sensor, and Nuclear radiation sensor – types, Rosettes.

2. SMART SENSORS**9**

Introduction, primary sensors, characteristic, Information coding / processing, Data communication. Recent trends in sensors and Technology - Film sensor, MEMS and Nano Sensors.

3. SIGNAL CONDITIONING**9**

Amplification, Filtering – Level conversion – Linearization - Buffering – Sample and Hold circuit – Quantization – Multiplexer / Demultiplexer – Analog to Digital converter – Digital to Analog converter.

4. DATA ACQUISITION**9**

Data Acquisition conversion-General configuration-single channel and multichannel data acquisition – Digital filtering – Data Logging – Data conversion – Introduction to Digital Transmission system.

5. DISPLAY DEVICES AND RECORDERS**9**

Digital Display methods and units – Segmental Displays – DOT matrices – LED, LCD – Resolution and Sensitivity of Digital meters – Recorders – Recording requirements – Analog recorders, Graphic recorders, X-Y recorders – Magnetic tape recorders – Digital tape recorders – CRO, CRT.

TOTAL : 45**TEXT BOOKS**

1. Patranabis. D, “Sensors and Transducers”, 2nd edition, PHI, New Delhi, 2003.
2. A.K.Sawney and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, Dhanpat Rai & Co, New Delhi, 2001.

REFERENCES

1. David G. Alciatore and Michael B. Histan, “Introduction to Mechatronics and Measurement systems”, 2nd edition Tata McGraw-Hill, 2003.
2. Ernest O.Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2004.
3. Murthy DVS, “Transducers and Instrumentation”, PHI, New Delhi – 2003.
4. C.S. Rangan, G.R. Sarma, VSV.Mani, “Instrumentation Devices and Systems”, 2nd edition, Tata McGraw-Hill, 2002.

OBJECTIVE

To expose the students to the technology that deals with the generation, control and transmission of power using pressurized fluids and to design a setup for low cost Automation.

Review (Not for Exam):

Basics of hydraulics – Applications of Pascal’s Law-Laminar and turbulent flow – Reynolds’s number-Darcy’s equation.

1. FLUID POWER SYSTEMS AND FUNDAMENTALS 6

Introduction to fluid power, Advantages of fluid power, Application of fluid power system. Types of fluid power systems, Properties of hydraulic fluids – General types of fluids. Fluid power symbols.

2. HYDRAULIC SYSTEM AND COMPONENTS (PUMPS and ACTUATORS) 9

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

Linear hydraulic actuators – Types of hydraulic cylinders – Single acting, Double acting special cylinders like tandem, Rodless, Telescopic - Construction and application. Cushioning mechanism, Rotary actuators - Gear, Vane and Piston motors.

3. HYDRAULIC VALVES, ACCUMULATORS AND CIRCUITS 10

Directional control valve – 3/2 way valve – 4/2, 4/3 way valve – Shuttle valve – check valve. Pressure control valves, Flow control valve – Fixed and adjustable, electrical control solenoid valves.

Types of accumulators, Accumulators circuits, Intensifier – Circuit and Application, Speed control circuits, synchronizing circuit and industrial application circuits – copying circuit and press circuit.

4. PNEUMATIC SYSTEMS, COMPONENTS AND CIRCUITS 10

Properties of air – Compressors – Filter, Regulator, and Lubricator Unit – Air control valves, Quick exhaust valves and pneumatic actuators.

Pneumo hydraulic circuit, Sequential circuit design for simple applications using cascade method

5. FLUID LOGIC CONTROL SYSTEMS AND MAINTENANCE 10

Hydro Mechanical servo systems, Electro-hydraulic and Electro-pneumatic systems and proportional valves.

Introduction to fluidic devices, simple circuits, PLC applications in fluid power control, Maintenance - Failure and trouble shooting in fluid power systems.

TOTAL 45 hours

TEXT BOOKS

1. Anthony Esposito, “Fluid Power with Applications”, Pearson Education Inc., 2008
2. Majumdar S.R., “Pneumatic systems – Principles and maintenance”, Tata McGraw-Hill, 2007

REFERENCES

1. Michael J. Pinches and John G. Ashby, “Power Hydraulics”, Prentice-Hall, 1989
2. Andrew Parr, “Hydraulics and Pneumatics (HB)”, Jaico Publishing House, 2005
3. James A. Sullivan, “Fluid Power: Theory and Applications”, 4th edition, C.H.I.P.S, 2005

OBJECTIVE

To create an overall knowledge required to design complex systems involving integrated approaches of electrical, mechanical and computer engineering.

1. MECHATRONICS SYSTEM DESIGN**10**

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

2. REAL TIME INTERFACING**7**

Introduction - Elements of data acquisition and control - Overview of I/O process, Analog signals, discrete signals and Frequency signals, Overframing.

3. DATA ACQUISITION CASE STUDIES**10**

Introduction – Cantilever Beam Force Measurement system–Testing of Transportation bridge surface materials – Transducer calibration system for Automotive applications – Strain gauge weighing system – Solenoid Force-Displacement calibration system – Rotary optical encoder – Controlling temperature of a hot/cold reservoir – pick and place robot.

4. DATA ACQUISITION AND CONTROL CASE STUDIES**10**

Introduction – Thermal cycle fatigue of a ceramic plate – pH control system – De-Icing Temperature Control system – Skip control of a CD Player – Autofocus Camera, exposure control. Case studies on Flexible Manufacturing system.

5. ADVANCED APPLICATIONS IN MECHATRONICS**8**

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

TOTAL: 45**TEXT BOOK**

1. Devdas Shetty and Richard A. Kolk, “Mechatronics System Design”, Thomson Asia Pte. Ltd., Singapore, 2001.

REFERENCES

1. W.Bolton, “Mechatronics - Electronic Control systems in Mechanical and Electrical Engineering”, 3rd Edition, Pearson Education Ltd., 2003.
2. Brian Morriss, “Automated Manufacturing Systems - Actuators, Controls, Sensors and Robotics”, McGraw Hill International, 1995.
3. Bradley, D.Dawson, N.C. Burd and A.J. Loader, “Mechatronics: Electronics in Products and Processes”, Chapman and Hall, London, 1991.

Use of approved steam and refrigeration tables and charts are permitted.

Use of approved heat and mass transfer data book is permitted

OBJECTIVE

To provide clear and detailed exposition of basic principles of thermodynamics and heat transfer and their application to various engineering systems.

APPLICATIONS

The concepts of thermodynamics and heat transfer are widely used in many domestic and industrial systems and applications like refrigerators, aerospace, automobiles, power generation, etc.

1. LAWS OF THERMODYNAMICS

9

Systems-closed and open systems –properties, processes and cycles- equilibrium- work and heat transfers-first law for a closed system and flow processes - enthalpy - second law –entropy- entropy change- reversibility.

2. AIR COMPRESSORS AND AIR-STANDARD CYCLES

9

Reciprocating air compressors: calculation of volumetric, isothermal and isentropic efficiencies- Introduction to multi-stage compression and its advantages (descriptive treatment only).
Air standard cycles: Carnot cycle - Otto cycle - Diesel cycle - Brayton cycle - air standard efficiency - two stroke and four stroke engines - SI, and CI engines (Working principle only).

3. VAPOUR POWER AND VAPOUR COMPRESSION CYCLES

9

Steam and Refrigerant properties - use of steam / refrigerant tables and charts – Layout of thermal power plants. Fire tube and water tube boilers, Schematic diagram of locomotive, Babcock Wilcox and Benson boilers – basic Rankine Cycle
Standard vapour compression refrigeration cycle and COP calculation

4. CONDUCTION HEAT TRANSFER

9

Modes of heat transfer, Conduction – Fourier law, resistance concept, heat transfer across plane wall and hollow cylinder, convection resistance, simple and composite walls, 1-D steady state heat conduction, simple problems, Different type of fins, simple problems.

5. CONVECTION AND RADIATION HEAT TRANSFER

9

Introduction to Free and Forced Convection - empirical relations- problems in forced convection flow through circular tubes and across cylinders – problems in free convection over vertical plates and horizontal cylinder. Radiation - Black body and gray body concept, problems using radiation exchanges between two gray bodies

TUTORIALS 15

TOTAL 60

TEXT BOOKS

1. Yunus A. Cengel and Michael A Boles, “Thermodynamics – An Engineering Approach, in SI Units”, 5th edition, Tata McGraw Hill, New Delhi, 2006.
2. Frank P. Incropera and David P. DeWitt, “Fundamentals of Heat and Mass Transfer”, 5th edition, John Wiley, Singapore, 2006.

REFERENCES

1. Nag P. K, ‘Engineering Thermodynamics’ Tata McGraw-Hill, 1995.
2. Eastop, T. D. and McConkey, “Applied Thermodynamics for Engineering Technologists”, 5th Edition, Pearson, New Delhi, 2004.
3. C. P. Kothandaraman, S.Domkundwar and A.V.Domkundwar, “A course in Thermal Engineering” Dhanpatrai & Co, 5th edition, 2000.
4. Ganesan, V, “Internal Combustion Engines”, 2nd edition, Tata McGraw Hill, New Delhi, 2006.
5. Thipse, S. S. , “Refrigeration and Air Conditioning”, Jaico, New Delhi, 2005.

OBJECTIVE

Aim is to expertise the concept and principle of operation of various sensors which finds extensive application in the field of automation and the processing of signals practically.

LIST OF EXPERIMENTS

1. Wave Shaping circuit
2. Analog to Digital Converters
3. Digital Comparator
4. Speed measurement using Inductive pickup / Proximity sensor
5. Voltage to frequency converter
6. Frequency to Voltage Converter
7. Design of Multiplexer and Demultiplexer using Logic Gates or ICs
8. Design of Sample and Hold Circuit.
9. Design of Instrumentation amplifier using OP-AMP.
10. Position and velocity measurement using encoders
11. Position measurement using linear scales
12. Absolute encoders
13. Study on Medical Diagnostics.
14. Study on the application of data acquisition system for industrial purposes.

TOTAL : 45**LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS**

S.No	Equipment	Qty
1	Cathode Ray Oscilloscope	5
2	Function Generator	5
3	Regulated power supply	7
4	Displacement Measurement Trainer using LVDT	1
5	Capacitive pickup trainer module (dielectric)	1
6	Position and Velocity measurement using encoder kit	1
7	Position measurement using linear scales kit	1
8	Speed Measurement uses inductive pickup /Proximity sensor kit	1
9	Speed measurement and closed loop control of DC Motor using photo electric pickup kit	1
10	Absolute encoder	1
11	PC based data acquisition unit (optional)	1
12	OP-AMP ICs	10

U07MH606 COMPUTER AIDED DESIGN, ANALYSIS AND MANUFACTURING LAB 0 0 3 100

OBJECTIVE

To train the students in various CAD/CAM and analysis software, operations and control of CNC Machines.

COMPUTER AIDED DESIGN AND ANALYSIS LAB

LIST OF EXPERIMENTS

1. Solid modeling using Ideas / Pro Engineering / CATIA software of gives components / products (at least 2 components)
2. Analysis of Engineering problems using FEA package (any 2 components)

LIST OF EQUIPMENTS

(for a batch of 30 students)

1. Any CAD software – 10 licenses
2. Any FEA software – 10 licenses
3. Computer nodes – 15 Numbers.

COMPUTER AIDED MANUFACTURING LAB

LIST OF EXPERIMENTS

1. Manual part programming using G and M codes for Turning, step turning, Taper turning, thread cutting and radius turning on cylindrical components.
2. Programming and Simulation of machining using the following features Linear and Circular Interpolation
3. Given a component drawing to write the manual part programming and execute on CNC Lathe and Milling Machine.
4. Generation of NC codes using Master CAM software.

LIST OF EQUIPMENTS

(for a batch of 30 students)

- | | | |
|---|---|-------------|
| 1. CNC Lathe with Fanuc control | - | 1 No. |
| 2. CNC Milling Machine with Fanuc control | - | 1 No. |
| 3. Master CAM software | - | 2 Licenses |
| 4. EMCO CNC Simulation software for turning and milling | - | 15 Nos. |
| 5. Computer nodes | - | 15 Numbers. |

TOTAL: 45 Hours

OBJECTIVE

Expose the students to technology of generation, control and transmission of power using pressurized fluids, with hands on training

LIST OF EXPERIMENTS

1. Design and testing of the following hydraulic circuits:
 - i) Pressure control
 - ii) Flow control
 - iii) Direction control
 - iv) Circuit with programmed logic sequence using an Electro hydraulic Trainer kit.
2. Design and testing of the following pneumatic circuits:
 - i) Pressure control
 - ii) Flow control
 - iii) Direction control
 - iv) Circuits with logic controls
 - v) Circuits with multiple cylinder sequences in Pneumatic, Electro pneumatic Trainer kits.
3. Simulation of basic hydraulic, pneumatic and electrical circuits using Automation Studio software and Hydrosim and Pneumosim Simulation Software.

TOTAL 45 hours**LIST OF EQUIPMENTS**

(For a batch of 30 students)

Equipments	Qty
<u>Hydraulic equipments</u>	
1 Pressure relief valve	2
2 Flow control valves	2
3 Limit switches	2
4 Linear actuator	4
5 Rotary actuator	2
6 Double solenoid actuated DCV	3
7 Single solenoid actuated DCV	2
8 Hydraulic power pack with pump and pressure relief valve	1
<u>Pneumatics equipments</u>	
1 Pneumatic trainer kit with FRL Unit, Single acting cylinder, push button actuated DCV and manually actuated DCV	1
2 Pneumatic training kit with FRL unit, Double acting cylinder, pilot actuated DCV	1
3 Pneumatic trainer kit with FRL unit, Double acting cylinder, Double solenoid actuated DCV with sensors/ magnetic reed switches	1
4 Pneumatic trainer kit with FRL unit with PLC with Interface card	1
5 Automation studio software	1 license
6 Hydrosim and Pneumosim simulation software	20 licenses

OBJECTIVE

- To create awareness about optimization in utilization of resources.
- To understand and apply operations research techniques to industrial operations.

1. LINEAR MODEL 9

The phases of OR study – formation of an L.P model- graphical solution – simplex algorithm – artificial variables technique– Big M method, two phase method.

2. TRANSPORTATION PROBLEM 9

Optimal solution by north west corner method- least cost method – Vogel’s approximation method – optimality test – MODI method.

Assignment problem – formulation – Hungarian method - unbalanced assignment problem. Traveling salesman problem.

3. NETWORK MODELS 9

Shortest route – minimal spanning tree - maximum flow models – project network- CPM and PERT network-critical path scheduling – Crashing.

4. REPLACEMENT MODELS 9

Replacement of items that deteriorate with time – value of money changing with time –not changing with time – optimum replacement policy – individual and group replacement. Sequencing problem: models with n jobs with 2 machines – problem with n jobs with 3 machines.

5. QUEUING THEORY AND INVENTORY CONTROL 9

Inventory Control – Purchase Model and Manufacturing Model , ABC Analysis, Queuing models – queuing systems and structures – notation –parameter – single server and multiserver models – Poisson input – exponential service – constant rate service – infinite population. Introduction to Genetic Algorithm, Ant Colony Optimization, Simulated Annealing.

TUTORIALS 15
TOTAL 60

TEXT BOOK

Taha H.A, “Operation Research -An Introduction ”,7th edition, Prentice Hall of India, 2003.
Panneerselvam, “Operations Research” Prentice Hall of India, 2003.

REFERENCES

1. Hira and Gupta “Introduction to Operations Research”, S.Chand and Co.2002
2. Wagner, “Operations Research”, Prentice Hall Of India, 2000.

OBJECTIVE

To provide detailed knowledge of embedded system architecture and its application in mechatronics system design.

1. REVIEW OF EMBEDDED HARDWARE**9**

Gates – Timing diagram – Memory – Microprocessors Buses – Direct Memory Access – Interrupts – Built-in functions on the Microprocessor – Conventions used on Schematic – schematic. Interrupts Microprocessor Architecture – Interrupt basics – Shared data Problem – Interrupt latency.

2. MICROCHIP PIC MICRO CONTROLLER**9**

Introduction, CPU Architecture – Registers – Instruction sets addressing modes – Loop timing – Timers – Interrupts, Interrupt timing, I/O Expansion, I²C Bus Operation Serial EEPROM, Analog to Digital converter, UART – Baud Rate – Data Handling – Initialization, special features- Serial Programming – Parallel Slave Port.

3. EMBEDDED MICROCOMPUTER SYSTEMS**9**

Motorola MC68H11 Family Architecture, Registers, Addressing modes Programs, Interfacing methods parallel I/O interface, parallel port interfaces, Memory Interfacing, High Speed I/O Interfacing.

4. INTERRUPTS**9**

Interrupts – Interrupt service routine – Features of interrupts – Interrupt vector and Priority, Timing Generation and Measurements, Input capture, Output compare, frequency Measurement, Serial I/O devices RS 232, RS485.

5. SYSTEM DESIGN USING MICROCONTROLLERS**9**

Interfacing LCD display – Keypad interfacing – AC load control – PID control of DC motor – stepper motor control – brush less DC motor control.

TOTAL : 45**TEXT BOOK**

1. Jonarthan W. Valvano “Embedded Microcomputer Systems”, Real Time Interfacing”, Thomson learning, 2001.
2. Michael Khevi, “The M68HC11 Microcontroller Applications in control, Instrumentation and communication”, Prentice Hall, New Jersey, 1997.

REFERENCES

1. David E. Simon, “An Embedded Software Primer”, Pearson Education Asia, 2001.
2. John B Pitman, “Design with PIC Micro controllers”, Pearson Education Asia, 1998.
3. Burns, Alan and Wellings, “Real – Time Systems and Programming Languages”, 2nd edition. Harlow: Addison Wesley – Longman, 1997.
4. Grehan Moore and Cyliax, “Real Time Programming: A guide to 32 bit Embedded Development”, Addison Wesley – Longman, 1998.
5. Heath Steve, “Embedded Systems Design”, Newnes, 1997.

OBJECTIVE

To prepare the learner to organize layouts of industrial plants, plan and lead material handling improvements

1. PLANT LOCATION AND PHYSICAL FACILITIES**9**

Factors to be considered – Influence of location on plant layout, selection of plant site, consideration in facilities planning and layout – Equipment required for plant operation, Capacity, Serviceability and flexibility and analysis in selection of equipments, space and man power requirements

2. PLANT LAYOUT**9**

Need for layout, types of layout, factors influencing product, process, fixed and combination layout, tool and techniques for developing layout, process chart, flow diagram, string diagram, template and scale models – machine data. Layout planning procedure – visualization of layout, revision and improving existing layout, balancing of fabrication and assembly lines.

3. INDUSTRIAL BUILDINGS AND UTILITIES**9**

Centralized electrical, pneumatic, water line systems. Types of buildings, lighting, heating, air-conditioning and ventilation utilities – planning and maintenance, waste handling, statutory requirements, packing and storage of materials: Importance of packaging, layout for packaging – packaging machinery – wrapping and packing of materials, cushion materials.

4. MATERIAL HANDLING**9**

Importance and Scopes – Principles of material handling – engineering and economic factors - planning, relationship to plant layout – types and selection of material handling systems, factors influencing their choice – concept of containerization and palletization.

5. ANALYSIS OF MATERIAL HANDLING**9**

Factors involved – motion analysis, flow analysis, graphical analysis, safety analysis, equipment cost analysis, palletization analysis, analysis of operation, material handling surveys – Designing of material handling systems – System equation - Planning chart, Unit load design – principle - efficiency of containers, pallet sizes

TOTAL 45**TEXT BOOKS**

1. Govindan, K. R., “Plant Layout and Material Handling”, Anuradha, Kumbakonam, 2001.
2. Khanna, O. P., “Industrial Engineering and Management”, Dhanpatrai and Sons, 2003.

REFERENCES

1. Fred E Meyers, “Plant Layout and Material Handling”, 2nd edition, Prentice Hall, 1999.
2. James A. Tompkins , John A. White, Yavuz A. Bozer and J. M. A. Tanchoco “Facilities Planning”, 3rd edition , John Wiley & Sons, 2003.

1. UNIT I**9**

Introduction - Invention and Creativity - Intellectual Property (IP) - Importance - Protection of IPR - Basic types of property (i. Movable Property ii. Immovable Property and iii. Intellectual Property).

2. UNIT II**9**

IP - Patents - Copyrights and related rights - Trade Marks and rights arising from Trademark registration - Definitions - Industrial Designs and Integrated circuits - Protection of Geographical Indications at national and International levels - Application Procedures.

3. UNIT III**9**

International convention relating to Intellectual Property - Establishment of WIPO - Mission and Activities - History - General Agreement on Trade and Tariff (GATT).

4. UNIT IV**9**

Indian Position Vs WTO and Strategies - Indian IPR legislations - commitments to WTO-Patent Ordinance and the Bill - Draft of a national Intellectual Property Policy - Present against unfair competition.

5. UNIT V**9**

Case Studies on - Patents (Basumati rice, turmeric, Neem, etc.) - Copyright and related rights - Trade Marks - Industrial design and Integrated circuits - Geographic indications - Protection against unfair competition.

Total: 45**TEXT BOOK**

1. Subbaram N.R., "Handbook of Indian Patent Law and Practice", S. Viswanathan (Printers and Publishers) Pvt. Ltd., 1998.

REFERENCES

1. Eli Whitney, United States Patent Number: 72X, Cotton Gin, March 14, 1994.
2. Intellectual Property Today: Volume 8, No. 5, May 2001, [www.iptoday.com].
3. Using the Internet for non-patent prior art searches, Derwent IP Matters, July 2000. [www.ipmatters.net/features/000707_gibbs.html.]

1. UNIT I**9**

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

2. UNIT II**9**

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

3. UNIT III**9**

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

4. UNIT IV**9**

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

5. UNIT V**9**

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

Total 45**TEXT BOOKS**

1. Durga Das Basu, " Introduction to the Constitution of India ", Prentice Hall of India, New Delhi.
2. R.C.Agarwal, " Indian Political System ", S.Chand and Company, New Delhi, 1997.
3. Maciver and Page, " Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.
4. K.L.Sharma, " Social Stratification in India: Issues and Themes ", Jawaharlal Nehru University, New Delhi, 1997.

REFERENCES

1. Sharma, Brij Kishore, " Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
2. U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalandhar, 1998.
3. R.N. Sharma, " Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.
4. Yogendra Singh, "Social Stratification and Charge in India ", Manohar, New Delhi, 1997.

OBJECTIVE

To provide an exposure on how to simulate a system or a process or an activity for detailed analysis, optimization and decision making which is essential to reduce the product design and development cost and time.

1. SYSTEM AND SYSTEM ENVIRONMENT 9

Component of a System – Continuous and discrete systems – Types of model; Steps in Simulation study; Simulation of an event occurrence using random number table – Single server queue –two server queue – inventory system.

2. RANDOM NUMBER GENERATION 9

Properties of random numbers – Generation of Pseudo – random numbers – techniques of generating pseudo random numbers; Test for random numbers: the Chisquare test-the kolmogrov Smirnov test – Runs test – Gap test – poker test.

3. RANDOM – VARIATE GENERATION 9

Inverse transform technique for Exponential, Uniform, triangular, weibull, empirical, uniform and discrete distribution, Acceptance rejection method for Poisson and gamma distribution; Direct Transformation for normal distribution.

4. ANALYSIS AND EVALUATION OF MODEL 9

Data collection, identifying the distribution, Parameter estimation, goodness of fit tests, verification and validation of simulation models.

5. SIMULATION SOFTWARES 9

Comparison and selection of GPSS, SIMSCRIPT, SLAM, Arena simulation language, Modeling basic operations using Arena – An Electronic Assembly and testing system, Development of simulation models using Arena simulation package for queuing system, Production system, inventory system, Arena Integration and customization.

TOTAL : 45**TEXT BOOK**

1. Banks J., Carson J.S. and Nelson B.L., “Discrete – Event System Simulation”, 3rd Edition, Pearson Education, Inc 2004
2. David Kelton.W. and Randall P. Sowdowski, “Simulation with Arena”, 2nd Edition , McGraw Hill, 2002.

REFERENCES

1. Geoffrey Gorden, “System Simulation”, Prentice Hall of India, 2003.
2. Narsingh Deo., “System Simulation with Digital Computer”, Prentice Hall of India, 2003.

WEB SITES REFERENCES

1. www.arenasimulation.com
2. www.gpss.co.uk
3. www.caciasl.com

