MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WB

(Formerly West Bengal University of Technology)

Syllabus for B. Sc. In Robotics& 3D Printing (In-house)
(Effective for Students Admitted in Academic Session 2019-2020)
CURRICULUM STRUCTURE

1ST YEAR

SL No	CODE	Paper	Contact Periods per week			Total Contact Hours	Credits
			L	T	P		
SEMESTER I							
Theory							
1	RB-M 101	Engineering Mathematics I	3	1	0	4	3
2	RB-MS 101	Engineering Mechanics	3	1	0	4	3
3	RB-PH 101	Engineering Physics	3	1	0	4	2
4	RB-CH 101	Engineering Chemistry	3	0	0	3	2
5	RB-EE 101	Basic Electrical & Electronics Engineering	3	1	0	4	3
6	RB-HS 101	Communicative English	3	0	0	3	2
Practical							
1	RB-CS 191	Problem Solving with Python	1	0	3	4	1.5
2	RB-MS 191	Engineering Graphics	0	0	3	3	1.5
3	RB-EE 191	Basic Electrical & Electronics Lab	0	0	3	4	2
Total Credits							20
SEMESTER II							
Theory							
1	RB-M 201	Engineering Mathematics - II	3	1	0	4	3
2	RB-EE 201	Electrical Machines	3	1	0	4	3
3	RB-CS 201	Object Oriented Programming and Data Structures	3	1	0	4	2
4	RB-EC 201	Digital Electronics	3	1	0	4	3
5	RB-EC 202	Sensors and Instrumentation	3	1	0	4	2

6	RB-MS 201	Strength of Materials for Mechanical Engineers	**3**	**1**	**0**	**4**	**2**
Practical							
1	RB-EE 291	Electrical Machines Lab	**0**	**0**	**3**	**3**	**2**
2	RB-EC 291	Digital Electronics Lab	**0**	**0**	**0**	**3**	**1.5**
3	RB-EC 292	Sensors & Instrumentation Lab	**0**	**0**	**0**	**3**	**1.5**
Total							**20**

2ND YEAR

SL No	CODE	Paper	Contact Periods per week			Total Contact Hours	Credits
			L	T	P		
SEMESTER III							
Theory							
1	RB-EE 301	Power Electronics and Drives	**3**	**1**	**0**	**4**	**3**
2	RB-EC 301	Microprocessors, Embedded Controllers and Real time Operating Systems	**3**	**1**	**0**	**4**	**3**
3	RB-MS 301	Hydraulics and Pneumatics	**3**	**1**	**0**	**4**	**2**
4	RB-PE 301	Professional Elective I	**3**	**1**	**0**	**4**	**3**
5	RB-EE 302	Control System	**3**	**1**	**0**	**4**	**3**
6	RB-M 301	Engineering Mathematics III	**3**	**1**	**0**	**4**	**3**
Practical							
1	RB-EE 391	Power Electronics & Drives Lab	**0**	**0**	**3**	**3**	**2**
2	RB-EC 391	Embedded System Lab	**0**	**0**	**3**	**3**	**2**
Total Credits							**21**
SEMESTER IV							
Theory							

1	RB-MS 401	Kinematics & Dynamics of Machines	**3**	**1**	**0**	**4**	**3**
2	RB-PE 401	Professional Elective II	**3**	**1**	**0**	**4**	**3**
3	RB-MS 402	Materials Science	**3**	**1**	**0**	**4**	**2**
4	RB-PR 401	Principles of Robotics I	**3**	**1**	**0**	**4**	**3**
5	RB-CS 401	Artificial Intelligence	**3**	**1**	**0**	**4**	**3**
6	RB-CS 402	Computer Architecture	**3**	**0**	**0**	**3**	**2**
Practical							
1	RB-MS 491	Kinematics & Dynamics Lab	0	0	3	3	1.5
2	RB-PR 491	Robotics Lab I	**0**	**0**	**3**	**3**	1.5
3							
Total			**19**				

3RD YEAR

SL No	CODE	Paper	Contact Periods per week			Total Contact Hours	Credits
			L	T	P		
SEMESTER V							
Theory							
1	RB-PR 501	Introduction to Robotics II	**3**	**1**	**0**	**4**	**3**
2	RB-PR 502	Industrial Design & Applied Ergonomics	**3**	**1**	**0**	**4**	**2**
3	RB-PR 503	3D Printing	**3**	**1**	**0**	**4**	**2**
4	RB-CS 501	Machine Vision	**3**	**1**	**0**	**4**	**3**
6	RB-PE 501	Professional Elective III	**3**	**1**	**0**	**4**	**3**
Practical							

1	RB-PR 591	Robotics Lab II	**0**	**0**	**3**	**3**	**2**
2	RB-PR 581	PROJECT I	**0**	**0**	**3**		**5**
3							
Total							**20**
SEMESTER VI							
Theory							
1	RB-PR 601	Environmental Science and Engineering	**3**	**0**	**0**	**3**	**2**
2	RB-PR 602	Virtual Instrumentation	**3**	**1**	**0**	**3**	**2**
3	RB-EC 601	Digital Signal Processing	**3**	**1**	**0**	**4**	**2**
4	RB-HU 601	Values & Ethics	**3**	**0**	**0**	**3**	**2**
5	RB-PE 601	Professional Elective IV	**3**	**1**	**0**	**4**	**3**
	RB-MG 601	Principles of Management	**3**	**0**	**0**	**3**	**2**
Practical							
1	RB-PR 681	PROJECT II					**5**
2	RB-EC691	DSP LAb					**2**
Total							**20**
GRAND TOTAL Credits							**120**

Elective I

1. ADVANCED MICROPROCESSORS AND MICROCONTROLLERS
2. System Software
3. Automobile Engineering
4. Human Rights

Elective II

1. Special Machines & Controllers
2. Advanced Control System
3. Lean Manufacturing

4. PROCESS PLANNING AND COST ESTIMATION
5. INTELLECTUAL PROPERTY RIGHTS

Elective III

1. VLSI DESIGN
2. COMPUTER INTEGRATED MANUFACTURING SYSTEMS
3. DISASTER MANAGEMENT
4. RENEWABLE ENERGY
5. AR/VR

Elective IV

1. TOTALLY INTEGRATED AUTOMATION
2. INDUSTRIAL ROBOTICS AND MATERIAL HANDLING SYSTEMS
3. NEURAL NETWORKS AND FUZZY SYSTEMS
4. MAINTENANCE AND SAFETY ENGINEERING
5. MANAGEMENT OF QUALITY

Semester-I

DETAILED SYLLABUS

Communicative English

Code: RB-HU 101
Contact: 3L
Credits: 2
Allotted Hrs: 36

Detailed contents

Unit I: Grammar:

Correction of sentence, Vocabulary / word formation, Single word for a group of words,

Fill in the blank, transformation of sentences, Structure of sentences – Active / Passive

Voice – Direct / Indirect Narration

Unit II:

Essay – Descriptive – Comparative – Argumentative – Thesis statement- Structure of opening

/ concluding paragraphs – Body of the essay

Unit III:

Reading Comprehension – Global – Contextual – Inferential – Select passages from recommended text

Unit IV:

Business Correspondence – Letter Writing – Formal.Drafting.Biodata- Resume′-

Curriculum Vitae

Unit V:

Report Writing – Structure , Types of report – Practice Writing

Unit VI:

Communication / Public Speaking skills , Features of effective speech, verbal-nonverbal

Unit VII:

Group discussion – principle – practice

Course Outcomes:

Participate effectively in informal conversations; introduce themselves and their friends and express opinions in English.

• Comprehend conversations and short talks delivered in English

• Write short essays of a general kind and personal letters and emails in English

Reference Books:

1. Mark MaCormack : “Communication”

2. John Metchell“ How to write reports”

3. S R Inthira& V Saraswathi“ Enrich your English – a) Communication skills b)

Academic

skills “ Publisher CIEFL & OUP

4. R.C. Sharma and K.Mohan , “Business Correspondence and Report Writing “ , Tata

McGraw Hill , New Delhi , 1994

5. L.Gartside , “Model Business Letters” , Pitman , London , 1992

6. Longman , “Longman Dictionary of Contemporary English” (or ‘Oxford Advanced

Learner’s Dictionary of Current English’ , OUP , 1998.

7. Maxwell Nurnberg and RosenblumMorris , “All About Words” , General Book Depot,

New Delhi , 1995

8. A Text Book for English foe Engineers & Technologists

ENGINEERING MATHEMATICS I

Code:RB-M 101
Contact: 3L+1T
Credits: 3
Allotted Hrs: 36

Detailed contents

UNIT I: Modern algebra

Binary Operation; Addition Modulo n; Multiplication modulo n; semi group; properties of groups; subgroup.

UNIT II: Trigonometry

Radian or circular Measure; Trigonometric Functions; Trigonometric ratios of angle θ when θ is acute; trigonometric ratios of certain standard angles; allied angles; compound angles; multiple and sub- multiple angles.

UNIT III: Limits and Continuity

The real number system; The concept of limit; concept of continuity.

UNIT IV: Differentiation

Differentiation of powers of x; Differentiation of ex and log x; differentiation of trigonometric functions; Rules for finding derivatives; Different types of differentiation; logarithmic differentiation; differentiation by substitution; differentiation of implicit functions; differentiation from parametric equation. Differentiation from first principles.

UNIT V: Integrations

Integration of standard Functions; rules of Integration; More formulas in integration; Definite integrals.

UNIT VI: Differential equations

First order differential equations; practical approach to Differential equations; first order and first degree differential equations; homogeneous equations. Linear equations;

Bernoulli's equation; Exact Differential Equations.

UNIT VII: Complex Numbers

Complex Numbers; Conjugate of a complex number; modulus of a complex

Number; geometrical representation of complex number; De Moivere's theorem;

nthroots of a complex number.

UNIT VIII: Matrices and Determinants

Definition of a matrix; Operations on matrices; Square Matrix and its inverse;

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determinants; properties of determinants; the inverse of a matrix; solution of equations

using matrices and determinants; solving equations using determinants.

UNIT IX: Infinite Series

Convergence and divergence; series of positive terms; binomial series; exponential

series;logarithmic series.

UNIT X: Probability

Concept of probability; sample space and events; three approaches of probability;

kolmogorov's axiomatic approach to probability; conditional probability and

independence of events; bay's theorem.

UNIT XI: Basics Statistics

Measures of central Tendency; Standard Deviation; Discrete series. Methods; Deviation

taken from assumed mean; continuous series; combined standard deviation; coefficient

of variation; variance.

Reference Books:

1. Banerjee A., De S.K. and Sen S.: Mathematical Probability, U.N. Dhur& Sons.

2. Gupta S. C and Kapoor V K: Fundamentals of Mathematical Statistics, Sultan Chand

& Sons.

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Engineering Mechanics

Code: RBMS 101
Contact hours/week: 3L+1T
Credits: 3

OBJECTIVES:
 To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

UNIT I STATICS OF PARTICLES
9+6

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces – Vectorial representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .

UNIT II EQUILIBRIUM OF RIGID BODIES
9+6

Free body diagram – Types of supports –Action and reaction forces –stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT III PROPERTIES OF SURFACES AND SOLIDS
9+6

Centroids and centre of mass – Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula –Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

UNIT IV DYNAMICS OF PARTICLES **9+6**

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

UNIT V FRICTION AND RIGID BODY DYNAMICS
9+6

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction –wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

TOTAL : 45+30=75 PERIODS

OUTCOMES:

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

- illustrate the vectorial and scalar representation of forces and moments
- analyse the rigid body in equilibrium
- evaluate the properties of surfaces and solids
- calculate dynamic forces exerted in rigid body
- determine the friction and the effects by the laws of friction

TEXT BOOKS:

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

REFERENCES:

1. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
2. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
3. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education 2006.
4. Meriam J.L. and Kraige L.G., " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons,1993.
5. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.

ENGINEERING PHYSICS

Course Code: RB-PH101
Course Title: Physics-I Semester : First
L-T-P : 3-1-0 Credit: 2
Pre-Requisites:

Course objectives:

Basic concepts of mechanics, optics and its applications, electricity, magnetism and qualitative

understanding of concepts of quantum physics and statistical mechanics.

1. Mechanics (7L)

Problems including constraints & friction. Basic ideas of vector calculus and partial

differential equations. Potential energy function F = -grad V, equipotential surfaces and meaning

of gradient. Conservative and non-conservative forces. Conservation laws of energy & momentum.

Non-inertial frames of reference. Harmonic oscillator; Damped harmonic motion forced

oscillations and resonance. Motion of a rigid body in a plane and in 3D. Angular velocity vector.

Moment of inertia.

2. Optics (5L)

 Distinction between interference and diffraction, Fraunhofer and Fresnel diffraction, Fraunhofer diffraction at single slit, double slit, and multiple slits (only the expressions for max;min, & intensity and qualitative discussion of fringes); diffraction grating(resolution formulac only), characteristics of diffration grating and its applications.

 Polarisation : Introduction, polarisation by reflection, polarisation by double reflection, scattering of light, circular and elliptical polarisation, optical activity.

 Lasers : Principles and working of laser : population inversion, pumping, various modes, threshold

population inversion with examples .

3. Electromagnetism and Dielectric Magnetic Properties of Materials (8L)

 Maxwell's equations. Polarisation, permeability and dielectric constant, polar and non-polar

dielecrrics, internal fields in a solid, Clausius- Mossotti equation(expression only), applications of

dielectrics.

 Magnetisation , permeability and susceptibility, classificationof magnetic materials, ferromagnetism,

magnetic domains and hysteresis, applications.

4. Quantum Mechanics (16L)

 Introduction to quantum physics, black body radiation, explanation using the photon concept,

Compton effect, de Broglie hypothesis, wave-particle duality, verification of matter waves,

uncertainty principle, Schrodinger wave equation, particle in box, quantum harmonic oscillator,

hydrogen atom.

5. Statistical Mechanics (8L)

 Macrostate, Microstate, Density of states, Qualitative treatment of Maxwell Boltzmann, Fermi-Dirac and Bose-Einstein statistics.

Course outcomes:

Students will be familiar with

 Basic concepts of mechanics

 Bragg's Law and introduction to the principles of lasers, types of lasers and applications.

 Various terms related to properties of materials such as, permeability, polarization,etc.

 Some of the basic laws related to quantum mechanics as well as magnetic and dielectric properties of materials.

 Simple quantum mechanics calculations.

Learning Resources:

1. Introduction to Electrodynamics, David J. Griffiths, Pearson Education India

Learning Private Limited

2. Principles of Physics, 10ed, David Halliday, Robert Resnick Jearl Walker , Wiley

3. Electricity, Magnetism, and Light, Wayne M. Saslow, Academic Press

4. Engineering Mechanics (In SI Units) (SIE), S. Timoshenko, D.H. Young,

J.V. Rao, Sukumar Pati , McGraw Hill Education

5. Classical mechanics, Narayan Rana, Pramod Joag, McGraw Hill Education

6. Introduction to Classical Mechanics, R Takwale, P Puranik, McGraw Hill Education

7. Engineering Mechanics, M.K. Harbola , Cengage India

8. An Introduction to Mechanics (SIE), David Kleppner, Robert Kolenkow, McGraw Hill Education

9. Principles of mechanics, John L. Synge and Byron A. Griffith, New York, McGraw-Hill

10. Mechanics (Dover Books on Physics) , J. P. Den Hartog , Dover Publications Inc.

11. Engineering Mechanics: Dynamics, L.G. Kraige J.L. Meriam, Wiley

12. Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles,

Robert Eisberg, Robert Resnick, Wiley

13. Introduction to Quantum Mechanics, J. Griffiths David , Pearson

ENGINEERING CHEMISTRY

Course Code : RB-CH 101
Course Title : Chemistry-I Semester : First
L-T-P : 3-1-0 Credit:2
Pre-Requisites:

Detailed contents

i) Atomic and molecular structure (10 lectures)

Schrodinger equation. Particle in a box solutions and their applications for simple sample. Molecular orbitals

of diatomic molecules (e.g.H2). Energy level diagrams of diatomic. Pi-molecular orbitals of butadiene and

benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their

magnetic properties. Band structure of solids and the role of doping on band structures.

ii) Spectroscopic techniques and applications (8 lectures)

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in

medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic

resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

iii)Intermolecular forces and potential energy surfaces (4 lectures)

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena.

iv) Use of free energy in chemical equilibria (8 lectures)

First and second laws of thermodynamics and thermodynamic functions: energy, entropy and free energy.

Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and

applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free

energy considerations in metallurgy through Ellingham diagrams.

v) Periodic properties (4 Lectures)

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the

periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and

electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

vi) Stereochemistry (4 lectures)

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurations

And symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and

conformational analysis. Isomerism in transitional metal compound.

vii) Organic reactions and synthesis of a drug molecule (4 lectures)

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and

ring openings. Synthesis of a commonly used drug molecule.

Course Outcomes

The concepts developed in this course will aid in quantification of several concepts in chemistry that have

been introduced at the 10+2 levels in schools. Technology is being increasingly based on the electronic,

atomic and molecular level modifications. Quantum theory is more than 100 years old and to understand

phenomena at nanometer levels, one has to base the description of all chemical processes at molecular levels.

The course will enable the student to:

 Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.

 Rationalise bulk properties and processes using thermodynamic considerations.

 Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy

levels in various spectroscopic techniques

 Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and

electronegativity.

 List major chemical reactions that are used in the synthesis of molecules.

Learning Resources:

1. Engineering Chemistry, Satyaprakash, Khanna Book Publishing, Delhi

2. University chemistry, by B. H. Mahan

3. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane

4. Fundamentals of Molecular Spectroscopy, by C. N. Banwell

5. Engineering Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan

6. Physical Chemistry, by P. W. Atkins

7. Spectroscopy of Organic Compounds, by P.S.Kalsi, New Age International Pvt Ltd Publishers

8. Physical Chemistry, P. C. Rakshit, Sarat Book House

9. Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5th Edition

http://bcs.whfreeman.com/vollhardtschore5e/default.asp

BASIC ELECTRICAL & ELECTRONICS ENGINEERING

Paper Name: Electrical & Electronics Engineering
Code: RB-EE 101
Contact: 3L+1T
Credits: 3
Allotted Hrs: 36

Detailed contents

Unit I: ELECTRICAL CIRCUITS & MEASUREMENTS

Fundamental laws of electric circuits, Steady State Solution of DC Circuits –

Introduction to AC Circuits -Sinusoidal steady state analysis, Power and Power factor -

Single Phase and Three Phase Balanced Circuits. Classification of instruments -

Operating Principles of indicating Instruments

Unit II: ELECTRICAL MACHINES

Construction, Principle of Operation, Basic Equations and Applications of DC

Generators, DC Motors, Single Phase Transformer, single phase induction Motor.

Unit III: SEMICONDUCTOR DEVICES AND APPLICATIONS

Introduction - Characteristics of PN Junction Diode – Zener Effect - Zener Diode and its Characteristics - Half wave and Full wave Rectifiers - Voltage Regulation. Bipolar Junction Transistor - CB, CE, CC Configurations and Characteristics - Elementary Treatment of Small Signal Amplifier.

Unit IV: DIGITAL ELECTRONICS

Binary Number System – Boolean algebra theorems, Digital circuits - Introduction to sequential Circuits, Flip-Flops - Registers and Counters – A/D and D/A Conversion - digital processing architecture.

Unit V: FUNDAMENTALS OF COMMUNICATION ENGINEERING

Introduction - Elements of Communication Systems, Modulation and Demodulation: Principles of Amplitude and Frequency Modulations. Digital Communication - Communication Systems: Radio, Antenna, TV, Fax, ISDN, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

Reference Books:

1. DP Kothari and 1.J Nagarath, "Electrical Machines “Basic Electrical and Electronics Engineering", McGraw Hill Education(India) Private Limited, Third Reprint,2016

2. S.K. Bhattacharya "Basic Electrical and Electronics Engineering", Pearson India, 2011

3. Sedha R.S., “Applied Electronics”, S. Chand & Co., 2006

4. A.E.Fitzgerald, David E Higginbotham and Arvin Grabel, “Basic Electrical Engineering",
McGraw Hill Education(India) Private Limited, 2009

5. Del Toro, “Electrical Engineering Fundamentals”, Pearson Education, New Delhi, 2007

6. “Foundations of Electrical Engineering", Oxford University Press, 2013

7. MahmoodNahvi and Joseph A. Edminister, “Electric Circuits", Schaum' Outline

Series,

McGraw Hill, 2002.

8. Mehta V K, “Principles of Electronics”, S.Chand& Company Ltd, 1994.

PROBLEM SOLVING AND PYTHON PROGRAMMING

Code: RB-CS 191
Contact: 1L+3P
Credits: 1.5

UNIT I ALGORITHMIC PROBLEM SOLVING 9

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA, EXPRESSIONS, STATEMENTS 9

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

UNIT III CONTROL FLOW, FUNCTIONS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings:

string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

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

UNIT V FILES, MODULES, PACKAGES 9

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

OUTCOMES:

Upon completion of the course, students will be able to

- Develop algorithmic solutions to simple computational problems
- Read, write, execute by hand simple Python programs.
- Structure simple Python programs for solving problems.
- Decompose a Python program into functions.
- Represent compound data using Python lists, tuples, dictionaries.
- Read and write data from/to files in Python Programs.

TEXT BOOKS:

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)
2. Guido van Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

REFERENCES:

1. John V Guttag, "Introduction to Computation and Programming Using Python'', Revised and expanded Edition, MIT Press , 2013
2. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.

3. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd.,, 2015.

4. Kenneth A. Lambert, "Fundamentals of Python: First Programs", CENGAGE Learning, 2012.

5. Charles Dierbach, "Introduction to Computer Science using Python: A Computational Problem-Solving Focus, Wiley India Edition, 2013.

6. Paul Gries, Jennifer Campbell and Jason Montojo, "Practical Programming: An Introduction to Computer Science using Python 3", Second edition, Pragmatic Programmers, LLC, 2013.

Engineering Graphics
Code: RB-MS191
Contact Hours/Week: 3P
Credits: 1.5

Sl. No.	Content	Lecture (L)	Practical (P)
1	**INTRODUCTION TO ENGINEERING DRAWING** Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Different types of lines and their use; Drawing standards and codes.	1	4
2	**LETTERING, DIMENSIONING, SCALES** Plain scale, Diagonal scale and Vernier Scales.	1	4

3	**GEOMETRICAL CONSTRUCTION AND CURVES** Construction of polygons, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid, Involute, Archemedian Spiral.	1	4
4	**PROJECTION OF POINTS, LINES, SURFACES** Principles of Orthographic Projections-Conventions - 1st and 3rd angle projection, Projections of Points and lines inclined to both planes; Projections of planes (Rectangle, pentagon, Hexagon etc.) inclined Planes - Auxiliary Planes.	1	4
5	**PROJECTION OF REGULAR SOLIDS** Regular solids inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale (Cube, Pyramid, Prism, Cylinder, Cone).	1	4
6	**COMBINATION OF REGULAR SOLIDS, FLOOR PLANS** Regular solids in mutual contact with each other like Spheres in contact with cones standing on their base. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.	1	4
7	**ISOMETRIC PROJECTIONS** Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions;	1	4
8	**SECTIONS AND SECTIONAL VIEWS OF RIGHT ANGULAR SOLIDS** Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)	1	4
	OVERVIEW OF COMPUTER GRAPHICS, C**USTOMISATION& CAD DRAWING** listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD		

9	software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids]; Set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;	1	4
10	**ANNOTATIONS, LAYERING & OTHER FUNCTIONS** applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer- aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;	2	8
	DEMONSTRATION OF A SIMPLE TEAM DESIGN PROJECT Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies		

11	for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid- modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).	2	8

Course Outcomes

The student will learn:

- Introduction to engineering design and its place in society
- Exposure to the visual aspects of engineering design
- Exposure to engineering graphics standards
- Exposure to solid modelling

General Instructions

1. In every topic some problems are to be done in the class and some are to be given to students as home assignment.
2. The problems for class work are to be prepared on drawing sheet of A1 size in the class/ using AutoCAD software.
3. The problems for home assignments are to be prepared on drawing copy/ using AutoCAD software.
4. Print out of every assignment is to be taken for CAD Drawings on Drawing sheets (A4 Sheets).
5. A title block must be prepared in each sheet/ assignment.

Following is the list of drawing instruments that required for making engineering drawings on paper with perfection.

1. Drawing Board
2. Mini drafter/ Set-squares (45°–45° & 60°–90°), T-square 3. Protractor (180°,

360°)

4. Scales (Plain, Diagonal)
5. Compass (Small and Large)
6. Divider (Small and Large)
7. French Curves
8. Drawing paper (A1 Size)
9. Drawing pencil (H, HB, B)
10. Sharpener
11. Eraser
12. Drawing pins & clips
13. Duster or handkerchief etc.

Learning Resources:

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

Basic Electrical & Electronics Lab
Code: RB-EE191
Contact Hours/Week: 3P
Credits: 2

OBJECTIVE:

- To train the students in performing various tests on electrical drives, sensors and circuits.

LIST OF EXPERIMENTS:

1. Load test on separately excited DC generator

2. Load test on Single phase Transformer

3. Load test on Induction motor

4. Verification of Circuit Laws

5. Verification of Circuit Theorems

6. Measurement of three phase power

7. Load test on DC shunt motor.

8. Diode based application circuits

9. Transistor based application circuits

10. Study of CRO and measurement of AC signals

11. Characteristics of LVDT

12. Calibration of Rotometer

13. RTD and Thermistor

Minimum of 10 Experiments to be carried out :- TOTAL: 60 PERIODS

OUTCOMES:

- Ability to determine the speed characteristic of different electrical machines
- Ability to design simple circuits involving diodes and transistors
- Ability to use operational amplifiers

Semester-II

Subject: Engineering Mathematics - II
Code: RB-M201
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES:

This course is designed to cover topics such as Matrix Algebra, Vector Calculus, Complex Analysis and Laplace Transform. Matrix Algebra is one of the powerful tools to handle practical problems arising in the field of engineering. Vector calculus can be widely used for modelling the various laws of physics. The various methods of complex analysis and Laplace transforms can be used for efficiently solving the problems that occur in various branches of engineering disciplines.

UNIT I MATRICES

Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II VECTOR CALCULUS

Gradient and directional derivative – Divergence and curl - Vector identities – Irrotational and Solenoidal vector fields – Line integral over a plane curve – Surface integral - Area of a curved surface - Volume integral - Green's, Gauss divergence and Stoke's theorems – Verification and application in evaluating line, surface and volume integrals.

UNIT III ANALYTIC FUNCTIONS

Analytic functions – Necessary and sufficient conditions for analyticity in Cartesian and polar coordinates - Properties – Harmonic conjugates – Construction of analytic function - Conformal mapping – Mapping by functions 1 2 z z w = z + c, cz, , - Bilinear transformation.

UNIT IV COMPLEX INTEGRATION

Line integral - Cauchy's integral theorem – Cauchy's integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour.

UNIT V LAPLACE TRANSFORMS

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems -Transforms of derivatives and integrals – Initial and final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

OUTCOMES:

After successfully completing the course, the student will have a good understanding of the following topics and their applications:

- Eigen values and eigenvectors, diagonalization of a matrix, Symmetric matrices, Positive definite matrices and similar matrices.
- Gradient, divergence and curl of a vector point function and related identities.
- Evaluation of line, surface and volume integrals using Gauss, Stokes and Green's theorems and their verification. • Analytic functions, conformal mapping and complex integration.
- Laplace transform and inverse transform of simple functions, properties, various related theorems and application to differential equations with constant coefficients.

TEXT BOOKS :

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 43rd Edition, 2014.
2. Kreyszig Erwin, "Advanced Engineering Mathematics ", John Wiley and Sons, 10th Edition, New Delhi, 2016.

REFERENCES:

1. Bali N., Goyal M. and Watkins C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain R.K. and Iyengar S.R.K., " Advanced Engineering Mathematics ", Narosa Publications, New Delhi , 3rd Edition, 2007.
3. O'Neil, P.V. "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 2007.
4. Sastry, S.S, "Engineering Mathematics", Vol. I & II, PHI Learning Pvt. Ltd, 4 th Edition, New Delhi, 2014.
5. Wylie, R.C. and Barrett, L.C., "Advanced Engineering Mathematics "Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

Subject: Electrical Machines
Code: RB-EE201
Contact Hours/week: 3L+1T

Credits: 3

OBJECTIVES:

- To study about basic electrical prime movers, electrical transmission and distribution systems.
- To study about the transformers
- To study about the different types of induction motors
- To study about the special machines
- To study about the power system

UNIT I D.C. MACHINES

Constructional details – EMF equation – methods of excitation – self and separately excited generators – characteristics of series, and shunt generators – principle of operation of D.C. Motor – back emf and torque equation – characteristics of series and shunt motors - starting of D.C. Motors – types of starters - speed control and braking of DC. motors.

UNIT II TRANSFORMERS

Constructional Details – Principle Of Operation – EMF Equation – Transformation Ratio – Transformer on No Load – Parameters Referred To HV/LV Windings – Equivalent Circuit – Transformer on Load – Regulation - Testing – Load Test - 3- PHASE Transformers connections.

UNIT III INDUCTION MOTORS

Construction – types – principle of operation of three-phase induction motors – equivalent circuit – starting and speed control – single-phase induction motors (only qualitative analysis). UNIT IV SYNCHRONOUS AND SPECIAL MACHINES 8 Construction of Synchronous machines-types – induced emf – brushless alternators – reluctance motor – stepper motor servo motor.

UNIT V INTRODUCTION TO POWER SYSTEM

Structure of electric power systems – generation, transmission, sub-transmission and distribution systems - EHVAC and EHVDC transmission systems – substation layout. (Concepts only).

OUTCOMES:

- Understanding the principles of operations and characteristics of DC machines
- Knowledge of electrical transformers and induction motors
- Know about the different types of induction motors

- Able to visualise the operation of synchronous motors stepper and sevo motors.

- Comprehending the power transmission and distributing systems.

TEXT BOOKS :

1. Murugesh Kumar K. , „Electric Machines Vo I", Vikas Publishing House Pvt Ltd, 2010.
2. Murugesh Kumar K. , „Electric Machines Vol II", Vikas Publishing House Pvt Ltd, 2010
3. Mehta V.K. and Rohit Mehta, „Principles of Power System", S.Chand and Company Ltd, 2003

REFERENCES:

1. Fitzgerald A.E., Charles Kingsley, Stephen.D.Umans, „Electric Machinery", Tata McGraw Hill publishing Company Ltd, 2003.
2. Gupta J.B., „Theory and Performance of Electrical Machines", S.K.Kataria and Sons, 2002
3. Kothari D.P. and Nagrath I.J., „Electric Machines", Tata McGraw Hill Publishing Company Ltd, 2002. 4. Bhimbhra P.S. , „Electrical Machinery", Khanna Publishers, 2003.

Subject: Object Oriented Programming and Data Structures
Code: RB-CS201
Contact Hours/week: 3L+1T
Credits: 2

OBJECTIVES:

- To comprehend the fundamentals of object oriented programming, particularly in C++.
- To use object oriented programming to implement data structures.
- To introduce linear data structures.
- To study about the non-linear data structures
- To understand about the different algorithms

UNIT I DATA ABSTRACTION & OVERLOADING

Overview of C++ – Structures – Class Scope and Accessing Class Members – Reference Variables – Initialization – Constructors – Destructors – Member Functions and Classes – Friend Function – Dynamic Memory Allocation – Static Class Members – Container Classes and Integrators – Proxy Classes – Overloading: Function overloading and Operator Overloading.

UNIT II INHERITANCE & POLYMORPHISM

Base Classes and Derived Classes – Protected Members – Casting Class pointers and Member Functions – Overriding – Public, Protected and Private Inheritance – Constructors and Destructors in derived Classes – Implicit Derived – Class Object To Base – Class Object Conversion – Composition Vs. Inheritance – Virtual functions – This Pointer – Abstract Base Classes and Concrete Classes – Virtual Destructors – Dynamic Binding.

UNIT III LINEAR DATA STRUCTURES

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation — singly linked lists –Polynomial Manipulation - Stack ADT – Queue ADT - Evaluating arithmetic expressions

UNIT IV NON-LINEAR DATA STRUCTURES

Trees – Binary Trees – Binary tree representation and traversals – Application of trees: Set representation and Union-Find operations – Graph and its representations – Graph Traversals – Representation of Graphs – Breadth-first search – Depth-first search - Connected

components. UNIT V SORTING AND SEARCHING 8 Sorting algorithms: Insertion sort - Quick sort - Merge sort - Searching: Linear search –Binary Search

OUTCOMES:

Upon completion of the course, students will be able to:

- To know about data abstraction
- Explain the concepts of Object oriented programming.
- Write simple applications using C++.
- To demonstrate different linearity in data structures.
- Discuss the different methods of organizing large amount of data.

TEXT BOOKS:

1. Deitel and Deitel, “C++, How To Program”, Fifth Edition, Pearson Education, 2005.
2. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Third Edition, AddisonWesley, 2007.

REFERENCES:

1. Bhushan Trivedi, “Programming with ANSI C++, A Step-By-Step approach”, Oxford University Press, 2010.
2. Goodrich, Michael T., Roberto Tamassia, David Mount, “Data Structures and Algorithms in C++”, 7th Edition, Wiley. 2004.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Second Edition, Mc Graw Hill, 2002.
4. Bjarne Stroustrup, “The C++ Programming Language”, 3rd Edition, Pearson Education, 2007.
5. Ellis Horowitz, Sartaj Sahni and Dinesh Mehta, “Fundamentals of Data Structures in C++”, Galgotia Publications, 2007.

Subject: Digital Electronics
Code: RB-EC201
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES:

- To present the Digital fundamentals, Boolean algebra and its applications in digital systems
- To familiarize with the design of various combinational digital circuits using logic gates
- To introduce the analysis and design procedures for synchronous and asynchronous sequential circuits
- To explain the various semiconductor memories and related technology
- To introduce the electronic circuits involved in the making of logic gates

UNIT I DIGITAL FUNDAMENTALS

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1‘s and 2‘s complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.

UNIT II COMBINATIONAL CIRCUIT DESIGN

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder.

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS

Flip flops – SR, JK, T, D, Master/Slave FF – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design - Moore/Mealy models, state minimization, state assignment, circuit implementation – Design of Counters- Ripple Counters, Ring Counters, Shift registers, Universal Shift Register.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Pulse mode sequential circuits, Design of Hazard free circuits.

UNIT V MEMORY DEVICES AND DIGITAL INTEGRATED CIRCUITS

Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – Static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using PLA, PAL. Digital integrated circuits: Logic levels, propagation delay, power dissipation, fan-out and fan-in, noise margin, logic families and their characteristics-RTL, TTL, ECL, CMOS

OUTCOMES:

At the end of the course:

- Use digital electronics in the present contemporary world
- Design various combinational digital circuits using logic gates
- Do the analysis and design procedures for synchronous and asynchronous sequential circuits
- Use the semiconductor memories and related technology
- Use electronic circuits involved in the design of logic gates

TEXT BOOK:

1. M. Morris Mano and Michael D. Ciletti, “Digital Design”, 5th Edition, Pearson, 2014.

REFERENCES

1. Charles H.Roth. “Fundamentals of Logic Design”, 6th Edition, Thomson Learning, 2013.
2. Thomas L. Floyd, “Digital Fundamentals”, 10th Edition, Pearson Education Inc, 2011
3. S.Salivahanan and S.Arivazhagan“Digital Electronics”, Ist Edition, Vikas Publishing House pvt Ltd, 2012.
4. Anil K.Maini “Digital Electronics”, Wiley, 2014.
5. A.Anand Kumar “Fundamentals of Digital Circuits”, 4th Edition, PHI Learning Private Limited, 2016.
6. Soumitra Kumar Mandal “ Digital Electronics”, McGraw Hill Education Private Limited, 2016.

Subject: Sensors and Instrumentation
Code: RB-EC202
Contact Hours/week: 3L+1T
Credits: 2

OBJECTIVES:

• To understand the concepts of measurement technology.
• To learn the various sensors used to measure various physical parameters.
• To learn the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

UNIT I INTRODUCTION

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

UNIT II MOTION, PROXIMITY AND RANGING SENSORS

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

UNIT III FORCE, MAGNETIC AND HEADING SENSORS

Strain Gage, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magneto resistive – Hall Effect – Current sensor Heading Sensors – Compass, Gyroscope, Inclinometers. UNIT IV OPTICAL, PRESSURE AND TEMPERATURE SENSORS 11 Photo conductive cell, photo voltaic, Photo resistive, LDR – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, RTD, Thermocouple. Acoustic Sensors – flow and level measurement, Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors, LASER sensors.

UNIT V SIGNAL CONDITIONING AND DAQ SYSTEMS

Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.

OUTCOMES:

Upon Completion of the course the students will be able to

CO1: Familiar with various calibration techniques and signal types for sensors.

CO2: Apply the various sensors in the Automotive and Mechatronics applications

CO3: Describe the working principle and characteristics of force, magnetic and heading sensors.

CO4: Understand the basic principles of various pressure and temperature, smart sensors.

CO5: Ability to implement the DAQ systems with different sensors for real time applications.

TEXT BOOKS:

1.Ernest O Doebelin, “Measurement Systems – Applications and Design”, Tata McGraw-Hill, 2009 2.Sawney A K and Puneet Sawney, “A Course in Mechanical Measurements and Instrumentation and Control”, 12th edition, Dhanpat Rai & Co, New Delhi, 2013.

REFERENCES

1.C. Sujatha ... Dyer, S.A., Survey of Instrumentation and Measurement, John Wiley & Sons, Canada, 2001

2.Hans Kurt Tönshoff (Editor), Ichiro , “Sensors in Manufacturing” Volume 1, Wiley-VCH April 2001.

3.John Turner and Martyn Hill, “Instrumentation for Engineers and Scientists”, Oxford Science Publications, 1999.

4.Patranabis D, “Sensors and Transducers”, 2nd Edition, PHI, New Delhi, 2011.

5.Richard Zurawski, “Industrial Communication Technology Handbook” 2nd edition, CRC Press, 2015

Subject: Strength of Materials for Mechanical Engineers
Code: RB-MS201
Contact Hours/week: 3L+1T
Credits: 2

OBJECTIVES:

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- To study the stresses and deformations induced in thin and thick shells.

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains –Stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress.

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending– bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

UNIT III TORSION

Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

UNIT IV DEFLECTION OF BEAMS

Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell's reciprocal theorems.

UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lame's theorem.

OUTCOMES

Students will be able to

- Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.
- Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
- Apply basic equation of simple torsion in designing of shafts and helical spring
- Calculate the slope and deflection in beams using different methods.
- Analyze and design thin and thick shells for the applied internal and external pressures.

TEXT BOOKS:

1. Bansal, R.K., "Strength of Materials", Laxmi Publications (P) Ltd., 2016
2. Jindal U.C., "Strength of Materials", Asian Books Pvt. Ltd., New Delhi, 2009

REFERENCES:

1. Egor. P.Popov "Engineering Mechanics of Solids" Prentice Hall of India, New Delhi, 2002
2. Ferdinand P. Been, Russell Johnson, J.r. and John J. Dewole "Mechanics of Materials", Tata McGraw Hill Publishing 'co. Ltd., New Delhi, 2005.
3. Hibbeler, R.C., "Mechanics of Materials", Pearson Education, Low Price Edition, 2013

4. Subramanian R., "Strength of Materials", Oxford University Press, Oxford Higher Education Series, 2010.

Practical

Subject: Electrical Machines Lab
Code: RB-EE291
Contact Hours/week: 3P
Credits: 2

OBJECTIVES:

- To impart hands on experience in verification of circuit laws and theorems
- To measure the circuit parameters, study of circuit characteristics and simulation of time response. • To expose the students to the basic operation of electrical machines and help them to develop experimental skills.
- To construct Induction Motors with Loading Arrangement
- To verify the circuit laws and theorems and measure the circuit parameters.

LIST OF EXPERIMENTS:

1. Open circuit characteristics of D.C. shunt generator.
2. Load characteristics of D.C. shunt generator.
3. Load test on D.C. shunt motor.
4. Load test on D.C. series motor.
5. Swinburne‟s test
6. speed control of D.C. shunt motor.
7. Load test on single phase transformer
8. open circuit and short circuit tests on single phase transformer(Determination of equivalent circuit parameters).
9. Load test on single phase induction motor.
10. No load and blocked rotor tests on three phase induction motor (Determination of
11. equivalent circuit parameters)
12. Load test on Three phase induction motor.
13. Study of Starters

OUTCOMES:

- Knowledge about the basic operation of electrical machines and help them to develop experimental skills.
- Ability to verify the circuit laws and theorems and measure the circuit parameter.
- Ability to operate electrical machines.
- Ability to construct a Single Phase ,Three Phase Induction Motor with Loading Arrangement and to operate switchs
- Ability to determination the equivalent circuit parameters.

Subject: Digital Electronics Lab
Code: RB-EC291
Contact Hours/week: 3P
Credits: 1.5

OBJECTIVE:

- To practically train the student to study the characteristics of electronic components and circuits.

LIST OF EXPERIMENTS:

1. Characteristics of diode and clipper circuits.
2. Characteristics of Zener diode and Zener voltage regulator
3. Characteristics of BJT.
4. Characteristics of JFET
5. Application of BJT as an amplifier and switch.

6. Study of Basic Digital ICs.
7. Implementation of Adder and Subtractor circuits
8. Design of Code converters.
9. Study of Multiplexer and Demultiplexer.
10. Design and Implementation of Counters and registers

OUTCOME:

- Ability to use the electronics components and use of them to built electronic circuits for process the signals.

REFERENCES:

1. Poornachandra Rao S and Sasikala B, "Handbook of Experiments in Electronics and Communication Engineering", Vikas Publishing House Pvt. Ltd., New Delhi 2003.
2. Laboratory Manual Prepared by R&AE Department.

Subject: Sensors & Instrumentation Lab
Code: RB-EC292
Contact Hours/week: 3P
Credits: 1.5
Laboratory Experiments :

1 Temperature measurement using AD590 IC sensor.

2 Displacement measurement by using a capacitive transducer.

3 Pressure and displacement measurement by using LVDT.

4 Study of a load cell with tensile and compressive load.

5 Torque measurement Strain gauge transducer.

6 Speed measurement using magnetic proximity sensor.

7 Speed measurement using a Stroboscope.

8 Study of the characteristics of a LDR.

9 Mandatory Design and Implementation of Mini Project

Semester-III

Subject: Power Electronics and Drives
Code: RB-EE301
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES

- Comprehensive introduction to various power electronic devices, their structure, operating principle and characteristics
- Give exposure to Various topologies, working principle and analysis of controlled rectifiers and ac controllers
- Detailed knowledge on Classifications, structure, operating principle of dc choppers
- Introduction to different types of Inverters , their principle of operation and waveform control
- Overview on dc and ac drives and their control using power electronic circuits.

UNIT I POWER SEMICONDUCTOR DEVICES AND CHARACTERISTICS

Operating principle and switching Characteristics: Power diodes, Power BJT, Power MOSFET, IGBT, SCR, TRIAC, GTO, MCT, Power integrated circuits (PIC) – Drive and Protection circuits – Series and parallel operation – Commutation – Simulation tools.

UNIT II CONTROLLED RECTIFIERS AND AC CONTROLLERS

Single phase – Three phase – Half controlled – Fully controlled rectifiers – Dual converters - Effect of source and load inductance - AC voltage controllers –Introduction to Cycloconverters, Matrix converters.

UNIT III DC TO DC CONVERTERS

Step up and Step down Chopper – Chopper classification - quadrant of operation – Switching mode Regulators – Buck, Boost, Buck-Boost, and Cuk Regulators.

UNIT IV INVERTERS

Voltage source Inverters – Half bridge – Full bridge – Three Phase Bridge Inverters – Voltage control– PWM Techniques – Current Source Inverters: Capacitor Commutated Inverter- Resonant inverters: Series, Parallel, ZVS, ZCS – Introduction to multilevel Inverters.

UNIT V DRIVES AND CONTROL

Static and Dynamic equations of dc and ac machines – Electrical breaking – Rectifier and chopper control of DC drives – Principles of v/f control of AC drives – Open loop and Closed loop schemes for DC and AC drives(Block diagram approach only) – Introduction to vector control of AC drives.

COURSE OUTCOMES (COs)

1. Ability to explain various devices and their structure, operating characteristics in the field of electronics.
2. Ability to classify, analyze and design, Control rectifier, chopper and inverter.
3. Will have ability to apply power electronic circuits for the control of popular applications.
4. Exposure to design and analyze PE circuit using simulation software.

TEXT BOOKS:

1. Rashid, M.H., "Power Electronics – Circuits, Devices and Applications", PHI, 3rd Edition, 2004.
2. Mohan, Udeland and Robbins., "Power Electronics", John Wiley and Sons, New York, 1995.

REFERENCES:

1. Singh, M.D., and Khanchandani, K.B., "Power Electronics", 2nd Edition., Tata McGraw-Hill, 2011.
2. Bose, B.K., "Modern Power Electronics and AC Drives", Pearson Education, 2002.
3. Bimbra, P.S., "Power Electronics", Khanna Publishers, 2006.
4. Moorthi, V.R., "Power Electronics - Devices, Circuits and Industrial Applications", Oxford University Press, 2005.
5. NPTEL Lecture Series on "Power Electronics" by Dr.B.G.Fernandes, IIT Bombay.

Subject: Microprocessors, Embedded Controllers and Real time Operating Systems
Code: RB-EC301
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES:

The student should be made to:

- Study the Architecture of 8085 microprocessor.
- Study the Architecture of 8086 microprocessor.
- Learn the design aspects of I/O and Memory Interfacing circuits.
- Study about communication and bus interfacing.
- Study the Architecture of 8051 microcontroller.

UNIT I 8086 MICROPROCESSOR

Architecture – Pin description – Operating modes – Registers – Interrupts – Bus cycle – Addressing modes – Typical configuration of 8086 system – Overview of Instruction set.

UNIT II 80286 MICROPROCESSOR

Functional block diagram - Modes of operation – Real and protected mode – Memory management and protection features.

UNIT III 80386, 80486 PROCESSORS

80386: Functional block diagram - Programming model - Addressing modes and instruction set overview – Address translation - Modes of operation - 80486 processor - Functional block diagram - Comparison of 80386 and 80486 processors.

UNIT IV PENTIUM MICROPROCESSOR

Introduction – Architecture – Special Pentium registers – Memory management.

UNIT V PIC MICROCONTROLLER

Architecture – Memory structure – Register File – Addressing modes – Interrupts – Timers: Modes of operation PIC PERIPHERAL FUNCTIONS AND SPECIAL FEATURES: PWM output – Analog to Digital converter – UART – Watchdog timer – RESET Alternatives – Power Down mode – I2C Bus operation

OUTCOMES:

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

- Design and implement programs on 8085 microprocessor.
- Design and implement programs on 8086 microprocessor.
- Design I/O circuits.
- Design Memory Interfacing circuits.
- Design and implement 8051 microcontroller based systems.

TEXT BOOKS:

1. Barry B Brey, "The Intel Microprocessor 8086/8088, 80186/80188, 80286, 80386, 80486 Pentium and Pentium processor, Pentium II,III,4 , Prentice Hall of India, New Delhi, 2005.
2. Douglas V Hall, "Microprocessors and Interfacing: Programming and Hardware", McGraw Hill, New Delhi, 2005.
3. John B Peatman, “Design with PIC Microcontroller, McGraw Hill, Singapore, 1st Reprint, 2001

REFERENCES:

1. Mohammed Rafiquzzaman, "Microprocessors and microcomputer based system design", CRC Press, 2005.
2. Walter A Triebel, Avtar Singh .”The 8088 and 8086 microprocessors Programming Interfacing software, Hardware and Applications”,Pearson Education ,2009
3. Myke Pred ko, “Programming and Customising the PIC Microcontroller, “McGraw Hill, USA, 1998

Subject: Hydraulics and Pneumatics
Code: RB-MS301
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES:

- To provide student with knowledge on the application of fluid power in process, construction and manufacturing Industries.
- To provide students with an understanding of the fluids and components utilized in modern industrial fluid power system.
- To develop a measurable degree of competence in the design, construction and operation of fluid power circuits.

UNIT I FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids - Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow - Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power : Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps – Problems.

UNIT II HYDRAULIC ACTUATORS AND CONTROL COMPONENTS

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components : Direction Control, Flow control and pressure

control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories : Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols – Problems.

UNIT III HYDRAULIC CIRCUITS AND SYSTEMS

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, DoublePump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT IV PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS

Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, Introduction to fluidics and pneumatic logic circuits.

UNIT V TROUBLE SHOOTING AND APPLICATIONS

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools – Low cost Automation – Hydraulic and Pneumatic power packs.

OUTCOMES:
Upon the completion of this course the students will be able to
CO1 Explain the Fluid power and operation of different types of pumps.
CO2 Summarize the features and functions of Hydraulic motors, actuators and Flow control valves
CO3 Explain the different types of Hydraulic circuits and systems
CO4 Explain the working of different pneumatic circuits and systems
CO5 Summarize the various trouble shooting methods and applications of hydraulic and pneumatic systems.

TEXT BOOKS:
1. Anthony Esposito, “Fluid Power with Applications”, Pearson Education 2005.
2. Majumdar S.R., “Oil Hydraulics Systems- Principles and Maintenance”, Tata McGraw-Hill, 2001.

REFERENCES:
1. Anthony Lal, “Oil hydraulics in the service of industry”, Allied publishers, 1982.
2. Dudelyt, A. Pease and John T. Pippenger, “Basic Fluid Power”, Prentice Hall, 1987.

3. Majumdar S.R., "Pneumatic systems – Principles and maintenance", Tata McGraw Hill, 1995
4. Michael J, Prinches and Ashby J. G, "Power Hydraulics", Prentice Hall, 1989.
5. Shanmugasundaram.K, "Hydraulic and Pneumatic controls", Chand & Co, 2006

Subject: Control System
Code: RB-EE302
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES:

- To study the basics of control system and its response .stability of mechanical and electrical systems . Use of MATLAB to design a stable control system.
- To introduce the elements of control system and their modeling using various Techniques.
- To introduce methods for analyzing the time response.
- To impart knowledge about the frequency response and the stability of systems
- To introduce the state variable analysis method

UNIT I INTRODUCTION

Open loop and closed loop systems - Examples - Elements of closed loop systems - Transfer function - Modeling of physical systems – Mechanical, Thermal, Hydraulic systems and Electric Networks - Transfer function of DC generator, DC servomotor, AC servomotor ,Potentiometer, Synchros, Tachogenerator, Stepper motor - Block diagram - reduction techniques, Signal flow graph – Mason‟ gain formula. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT II TIME DOMAIN ANALYSIS

Standard Test signals – Time response of second order system - Time domain specifications - Types of systems - Steady state error constants - Introduction to P, PI and PID modes of feed back control. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT III FREQUENCY DOMAIN ANALYSIS

Frequency domain specifications - Time and frequency response correlation – Polar plot – Bode plot – All pass minimum phase and non-minimum phase systems. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT IV SYSTEM STABILITY

Characteristic equation - Routh Hurwitz criterion of stability - Absolute and Relative stability - Nyquist stability - Nyquist stability criterion - Assessment of relative stability – Gain and Phase Margin. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

UNIT V ROOT LOCUS METHOD

Root locus concepts - Construction of root loci – Root contours. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions) STATE SPACE ANALYSIS: Limitations of conventional control theory - Concepts of state, state variables and state model – state model for linear time invariant systems - Introduction to state space representation using physical - Phase and canonical variables. (Related Tutorials Using MATLAB/ Simulink – Toolboxes & Functions)

OUTCOMES:

- To understand the basic of the control system
- Ability to know about the time and frequency domain analysis
- To know about the different stability of the systems
- To expose students to the state space representation and its analysis.
- To introduce non-linear systems and their control and to impart knowledge on advanced control techniques

TEXT BOOKS:

1. Nagrath I J, and Gopal, M, 'Control Systems Engineering" Prentice Hall of India, New Delhi, 2008.

2. Richard C Dorf and Robert H Bishop, "Modern Control Systems.", Addison-Wesley -2007

REFERENCES:

1. Ogata K, "Modern Control Engineering", Pearson Education, New Delhi, 2006.
2. Kuo B C, "Automatic Control Systems", Prentice-Hall of India Pvt. Ltd, New Delhi, 2004.
3. Norman C. Nise S, "Control system Engineering", John Wiley & Sons, Singapore, 2004.

Subject: Engineering Mathematics III
Code: RB-M301
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES:

- To introduce the basic concepts of PDE for solving standard partial differential equations.

- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS

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

UNIT II FOURIER SERIES

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier series – Parseval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS

Classification of PDE – Method of separation of variables - Fourier Series Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction.

UNIT IV FOURIER TRANSFORMS

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS

Z-transforms - Elementary properties – Inverse Z-transform (using partial fraction and residues) – Initial and final value theorems - Convolution theorem - Formation of difference equations – Solution of difference equations using Z - transform.

OUTCOMES : Upon successful completion of the course, students should be able to: • Understand how to solve the given standard partial differential equations. • Solve differential equations using Fourier series analysis which plays a vital role in engineering applications. • Appreciate the physical significance of Fourier series techniques in solving one and two

dimensional heat flow problems and one dimensional wave equations. • Understand the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering. • Use the effective mathematical tools for the solutions of partial differential equations by using Z transform techniques for discrete time systems.

TEXT BOOKS : 1. Grewal B.S., “Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, New Delhi, 2014. 2. Narayanan S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students", Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.

REFERENCES : 1. Andrews, L.C and Shivamoggi, B, "Integral Transforms for Engineers" SPIE Press, 1999. 2. Bali. N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 9th Edition, Laxmi Publications Pvt. Ltd, 2014. 3. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016. 4. James, G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007. 5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016. 6. Wylie, R.C. and Barrett, L.C., “Advanced Engineering Mathematics “Tata McGraw Hill Education Pvt. Ltd, 6th Edition, New Delhi, 2012.

Practical

Subject: Power Electronics & Drives Lab
Code: RB-EE391
Contact Hours/week: 3P
Credits: 2

OBJECTIVES:

- To provide hands on experience with power electronic converters and testing.

LIST OF EXPERIMENTS

1 Gate Pulse Generation using R, RC and UJT.
2 Characteristics of SCR and TRIAC
3 Characteristics of MOSFET and IGBT
4 AC to DC half controlled converter
5 AC to DC fully controlled Converter
6 Step down and step up MOSFET based choppers
7 IGBT based single phase PWM inverter
8 IGBT based three phase PWM inverter
9 AC Voltage controller
10 Switched mode power converter.
11 Simulation of PE circuits (1Φ & 3Φ semi converters, 1Φ & 3Φ full converters, DC-DC converters, AC voltage controllers).
12 Characteristics of GTO & IGCT.
13 Characteristics of PMBLDC motor

OUTCOMES:

- Ability to practice and understand converter and inverter circuits and apply software for engineering problems.
- Ability to experiment about switching characteristics various switches.
- Ability to analyze about AC to DC converter circuits.
- Ability to analyze about DC to AC circuits.
- Ability to acquire knowledge on AC to AC converters
- Ability to acquire knowledge on simulation software.

Subject: Embedded System Lab
Code: RB-EC391
Contact Hours/week: 3P
Credits: 2

List of Experiments:

1. LED Interfacing using ARM/ATMEL/PIC microcontroller
2. LCD Interfacing using ARM/ATMEL/PIC microcontroller
3. Keyboard Interfacing using ARM/ATMEL/PIC microcontroller
4. Temperature sensor Interfacing using ARM/ATMEL/PIC microcontroller
5. Stepper Motor Interfacing using ARM/ATMEL/PIC microcontroller
6. Flashing of LEDs using ARM/ATMEL/PIC microcontroller
7. ADC Interfacing using ARM/ATMEL/PIC microcontroller
8. DAC Interfacing using ARM/ATMEL/PIC microcontroller
9. Interrupt pooling using ARM/ATMEL/PIC microcontroller
10. EPROM Interfacing using ARM/ATMEL/PIC microcontroller.
11. Real Time Clock Interfacing using ARM/ATMEL/PIC microcontroller.
12. Implementing zigbee protocol with ARM/ATMEL/PIC microcontroller.
13. Study of one type of Real Time Operating Systems (RTOS) with ARM/ATMEL/PIC microcontroller.
14. Study of basic image processing algorithm using Single board computers such as Raspberry Pi/aurdino, BeagleBone block etc.

Semester-IV

Subject: Kinematics & Dynamics of Machines
Code: RB-MS401
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES:

- To understand the basic knowledge about kinematics of machines.
- To understand the basic components and layout of linkages in the assembly of a system/ machine. • To understand the principles in analyzing the assembly with respect to 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, design few linkage mechanisms and cam mechanisms for specified output motions.
- To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.

UNIT I KINEMATIC OF MACHINES

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons – Analytical methods – computer approach – cams – classifications – displacement diagrams - layout of plate cam profiles – derivatives of followers motion – circular arc and tangent cams.

UNIT II GEARS and GEAR TRAINS

Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains.

UNIT III FRICTION

Sliding and Rolling Friction angle – friction in threads – Friction Drives –Belt and rope drives .

UNIT IV FORCE ANALYSIS

Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D‟Alembert‟s principle – superposition principle – dynamic Force Analysis in simple machine members.

UNIT V BALANCING AND VIBRATION

Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – free vibrations – Equations of motion – natural Frequency – Damped Vibration – bending critical speed of simple shaft .

OUTCOMES:

Upon completion of this course,

- the students be able to understand the basic knowledge of kinematics of machines
- Students can able to apply fundamentals of mechanism for the design of new mechanisms
- Able to know about the linkages, design few linkage mechanisms and cam mechanisms for specified output motions.
- Impart knowledge about the gears and gear trains.
- Ability to analyse them for optimum design.

TEXT BOOKS:

1. Ambekar A.G., “Mechanism and Machine Theory” Prentice Hall of India, New Delhi, 2007
2. Shigley J.E., Pennock G.R and Uicker J.J., “Theory of Machines and Mechanisms”, Oxford University Press, 2003

REFERENCES:

1. Thomas Bevan, “Theory of Machines”, CBS Publishers and Distributors, 1984.
2. Ghosh. A, and A.K. Mallick, “Theory and Machine”, Affiliated East-West Pvt. Ltd., New Delhi, 1988. 3. Rao.J.S. and Dukkipatti R.V. “Mechanisms and Machines”, Wiley-Eastern Ltd., New Delhi, 1992.
4. John Hannah and Stephens R.C., “Mechanics of Machines”, Viva Low Prices Student Edition, 1999. 5. V.Ramamurthi, Mechanisms of Machine, Narosa Publishing House, 2002.
6. Robert L.Norton, Design of Machinery, McGraw-Hill, 2004.

Subject: Materials Science
Code: RB-MS402
Contact Hours/week: 3L+1T
Credits: 2

OBJECTIVES:

- To introduce the essential principles of materials science for mechanical and related engineering applications.

UNIT I PHASE DIAGRAMS

Solid solutions - Hume Rothery's rules – the phase rule - single component system - one-component system of iron - binary phase diagrams - isomorphous systems - the tie-line rule - the lever rule - application to isomorphous system - eutectic phase diagram - peritectic phase diagram - other invariant reactions – free energy composition curves for binary systems - microstructural change during cooling.

UNIT II FERROUS ALLOYS

The iron-carbon equilibrium diagram - phases, invariant reactions - microstructure of slowly cooled steels - eutectoid steel, hypo and hypereutectoid steels - effect of alloying elements on the Fe-C system - diffusion in solids - Fick's laws - phase transformations - T-T-T-diagram for eutectoid steel – pearlitic, baintic and martensitic transformations - tempering of martensite – steels – stainless steels – cast irons.

UNIT III MECHANICAL PROPERTIES

Tensile test - plastic deformation mechanisms - slip and twinning - role of dislocations in slip - strengthening methods - strain hardening - refinement of the grain size - solid solution strengthening - precipitation hardening - creep resistance - creep curves - mechanisms of creep - creep-resistant materials - fracture - the Griffith criterion - critical stress intensity factor and its determination - fatigue failure - fatigue tests - methods of increasing fatigue life - hardness - Rockwell and Brinell hardness - Knoop and Vickers microhardness.

UNIT IV MAGNETIC, DIELECTRIC AND SUPERCONDUCTING MATERIALS

Ferromagnetism – domain theory – types of energy – hysteresis – hard and soft magnetic materials – ferrites - dielectric materials – types of polarization – Langevin-Debye equation – frequency effects on polarization - dielectric breakdown – insulating materials – Ferroelectric materials - superconducting materials and their properties.

UNIT V NEW MATERIALS

Ceramics – types and applications – composites: classification, role of matrix and reinforcement, processing of fiber reinforced plastics – metallic glasses: types , glass forming ability of alloys, melt spinning process, applications - shape memory alloys: phases, shape memory effect, pseudoelastic effect, NiTi alloy, applications – nanomaterials: preparation (bottom up and top down approaches), properties and applications – carbon nanotubes: types.

OUTCOMES:

Upon completion of this course,

- the students will have knowledge on the various phase diagrams and their applications
- the students will acquire knowledge on Fe-Fe3C phase diagram, various microstructures and alloys • the students will get knowledge on mechanical properties of materials and their measurement
- the students will gain knowledge on magnetic, dielectric and superconducting properties of materials
- the students will understand the basics of ceramics, composites and nanomaterials.

TEXT BOOKS:

1. Balasubramaniam, R. “Callister's Materials Science and Engineering”. Wiley India Pvt. Ltd., 2014.
2. Raghavan, V. “Physical Metallurgy: Principles and Practice”. PHI Learning, 2015.
3. Raghavan, V. “Materials Science and Engineering : A First course”. PHI Learning, 2015.

REFERENCES

1. Askeland, D. "Materials Science and Engineering". Brooks/Cole, 2010.
2. Smith, W.F., Hashemi, J. & Prakash, R. "Materials Science and Engineering", Tata McGraw Hill Education Pvt. Ltd., 2014.
3. Wahab, M.A. "Solid State Physics: Structure and Properties of Materials", Narosa Publishing House, 2009.

Subject: Principles of Robotics I
Code: RB-PR401
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES:

- To introduce the functional elements of Robotics
- To impart knowledge on the direct and inverse kinematics
- To introduce the manipulator differential motion and control
- To educate on various path planning techniques
- To introduce the dynamics and control of manipulators

UNIT I BASIC CONCEPTS

Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and controlissues- Various manipulators – Sensors - work cell - Programming languages.

UNIT II DIRECT AND INVERSE KINEMATICS

Mathematical representation of Robots - Position and orientation – Homogeneous transformationVarious joints- Representation using the Denavit Hattenberg parameters - Degrees of freedom-Direct kinematics-Inverse kinematics- SCARA robots- Solvability – Solution methods-Closed form solution.

UNIT III MANIPULATOR DIFFERENTIAL MOTION AND STATICS

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse - Wrist and arm singularity - Static analysis - Force and moment Balance.

UNIT IV PATH PLANNING

Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation planning.

UNIT V DYNAMICS AND CONTROL

Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model – Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator.

UNIT VI INTRODUCTION TO ROBOTIC PROCESS AUTOMATION & BOT CREATION

Introduction to RPA and Use cases – Automation Anywhere Enterprise Platform – Advanced features and capabilities – Ways to create Bots – Conclusion.

UNIT VII WEB CONTROL ROOM AND CLIENT

Introduction - Features Panel - Dashboard (Home, Bots, Devices, Audit, Workload, Insights) - Features Panel – Activity (View Tasks in Progress and Scheduled Tasks) - Bots (View Bots Uploaded and Credentials) - Devices (View Development and Runtime Clients and Device Pools) - Workload (Queues and SLA Calculator) - Audit Log (View Activities Logged which are associated with Web CR) - Administration (Configure Settings, Users, Roles, License and Migration) - Demo of Exposed API's – Conclusion – Client introduction and Conclusion.

OUTCOMES:

- Ability to understand basic concept of robotics.
- To analyze Instrumentation systems and their applications to various
- To know about the differential motion add statics in robotics
- To know about the various path planning techniques.

- To know about the dynamics and control in robotics industries.

TEXT BOOKS:

1. R.K.Mittal and I.J.Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005. 2. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 3. 2009.
3. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996.
4. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath: Create Software robots. with the leading RPA tool – UiPath Kindle Edition
5. Robotic Process Automation A Complete Guide - 2020 Edition Kindle Editio

REFERENCES:

1. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.
2. K. K.Appu Kuttan, Robotics, I K International, 2007.
3. Edwin Wise, Applied Robotics, Cengage Learning, 2003.
4. R.D.Klafter,T.A.Chimielewski and M.Negin, Robotic Engineering–An Integrated Approach, Prentice Hall of India, New Delhi, 1994.
5. B.K.Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers,Chennai, 1998.
6. S.Ghoshal, " Embedded Systems & Robotics" – Projects using the 8051 Microcontroller", Cengage Learning, 2009.

Subject: Artificial Intelligence
Code: RB-CS402
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES:

The student should be made to:

- Study the concepts of Artificial Intelligence.
- Learn the methods of solving problems using Artificial Intelligence.

- Introduce the concepts of Expert Systems and machine learning.
- Learn about planning and reasoning artificial intelligence.
- Solve the risk in artificial intelligence.

UNIT I INTRODUCTION

History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents. PROBLEM SOLVING: Solving problems by searching – Informed search and exploration–Constraint satisfaction problems–Adversarial search, knowledge and reasoning– knowledge representation – first order logic.

UNIT II PLANNING

Planning withforward and backward State space search – Partial order planning – Planning graphs– Planning with propositional logic – Planning and acting in real world.

UNIT III REASONING:

Uncertainity – Probabilistic reasoning–Filtering and prediction–Hidden Markov models– Kalman filters– Dynamic Bayesian Networks, Speech recognition, making decisions. UNIT IV LEARNING: 8 Forms of learning – Knowledge in learning – Statistical learning methods –reinforcement learning, communication, perceiving and acting, Probabilistic language processing, perception.

UNIT V AI IN ROBOTICS:

Robotic perception, localization, mapping- configuring space, planning uncertain movements, dynamics and control of movement, Ethics and risks of artificial intelligence in robotics.

OUTCOMES:

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

- Identify problems that are amenable to solution by AI methods.
- Identify appropriate AI methods to solve a given problem.
- Formalise a given problem in the language/framework of different AI methods.
- Implement basic AI algorithms.
- Design and carry out an empirical evaluation of different algorithms on a problem formalisation, and state the conclusions that the evaluation supports.

TEXT BOOKS:

1. Stuart Russell, Peter Norvig, “Artificial Intelligence: A modern approch”, Pearson Education, India2003.
2. Negnevitsky, M, “Artificial Intelligence: A guide to Intelligent Systems”,. Harlow: Addison-Wesley, 2002.

REFERENCE: 1. David Jefferis, "Artificial Intelligence: Robotics and Machine Evolution", Crabtree Publishing Company, 1992.

Subject: Computer Architecture
Code: RB-CS403
Contact Hours/week: 3L
Credits: 3

OBJECTIVES:

• To learn the basic structure and operations of a computer.
• To learn the arithmetic and logic unit and implementation of fixed-point and floating point arithmetic unit.
• To learn the basics of pipelined execution.
• To understand parallelism and multi-core processors.
• To understand the memory hierarchies, cache memories and virtual memories.
• To learn the different ways of communication with I/O devices.

UNIT I BASIC STRUCTURE OF A COMPUTER SYSTEM

Functional Units – Basic Operational Concepts – Performance – Instructions: Language of the Computer – Operations, Operands – Instruction representation – Logical operations – decision making – MIPS Addressing.

UNIT II ARITHMETIC FOR COMPUTERS

Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operations – Subword Parallelism

UNIT III PROCESSOR AND CONTROL UNIT

A Basic MIPS implementation – Building a Datapath – Control Implementation Scheme – Pipelining – Pipelined datapath and control – Handling Data Hazards & Control Hazards – Exceptions.

UNIT IV PARALLELISIM

Parallel processing challenges – Flynn's classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures - Hardware multithreading – Multi-core processors and other Shared Memory Multiprocessors - Introduction to Graphics Processing Units, Clusters, Warehouse Scale Computers and other Message-Passing Multiprocessors.

UNIT V MEMORY & I/O SYSTEMS

Memory Hierarchy - memory technologies – cache memory – measuring and improving cache performance – virtual memory, TLB's – Accessing I/O Devices – Interrupts – Direct Memory Access – Bus structure – Bus operation – Arbitration – Interface circuits - USB.

OUTCOMES: On Completion of the course, the students should be able to:

- Understand the basics structure of computers, operations and instructions.
- Design arithmetic and logic unit.
- Understand pipelined execution and design control unit.
- Understand parallel processing architectures.
- Understand the various memory systems and I/O communication.

TEXT BOOKS: 1. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Fifth Edition, Morgan Kaufmann / Elsevier, 2014. 2. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, Computer Organization and Embedded Systems, Sixth Edition, Tata McGraw Hill, 2012.

REFERENCES 1. William Stallings, Computer Organization and Architecture – Designing for Performance, Eighth Edition, Pearson Education, 2010. 2. John P. Hayes, Computer Architecture and Organization, Third Edition, Tata McGraw Hill, 2012. 3. John L. Hennessey and David A. Patterson, Computer Architecture – A Quantitative Approach‖, Morgan Kaufmann / Elsevier Publishers, Fifth Edition, 2012.

Practical

Subject: Kinematics & Dynamics Lab
Code: RB-MS491

Contact Hours/week: 3P

Credits: 1.5

OBJECTIVES:

• To supplement the principles learnt in kinematics and Dynamics of Machinery.
• To understand how certain measuring devices are used for dynamic testing.

LIST OF EXPERIMENTS

1. a) Study of gear parameters. b) Experimental study of velocity ratios of simple, compound, Epicyclic and differential gear trains.

2. a) Kinematics of Four Bar, Slider Crank, Crank Rocker, Double crank, Double rocker, Oscillating cylinder Mechanisms. b) Kinematics of single and double universal joints.

3. a) Determination of Mass moment of inertia of Fly wheel and Axle system. b) Determination of Mass Moment of Inertia of axisymmetric bodies using Turn Table apparatus. c) Determination of Mass Moment of Inertia using bifilar suspension and compound pendulum.

4. Motorized gyroscope – Study of gyroscopic effect and couple.

5. Governor - Determination of range sensitivity, effort etc., for Watts, Porter, Proell, and Hartnell Governors.

6. Cams – Cam profile drawing, Motion curves and study of jump phenomenon

7. a) Single degree of freedom Spring Mass System – Determination of natural Frequency and verification of Laws of springs – Damping coefficient determination. b) Multi degree freedom suspension system – Determination of influence coefficient.

8. a)Determination of torsional natural frequency of single and Double Rotor systems.- Undamped and Damped Natural frequencies. b) Vibration Absorber – Tuned vibration absorber.

9. Vibration of Equivalent Spring mass system – undamped and damped vibration.

10. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.

11. a) Balancing of rotating masses. (b) Balancing of reciprocating masses.

12. a) Transverse vibration of Free-Free beam – with and without concentrated masses. b) Forced Vibration of Cantilever beam – Mode shapes and natural frequencies. c) Determination of transmissibility ratio using vibrating table.

OUTCOMES:

- Ability to demonstrate the principles of kinematics and dynamics of machinery
- Ability to use the measuring devices for dynamic testing.

Subject: Robotics Lab I
Code: RB-PR491
Contact Hours/week: 3P
Credits: 1.5

OBJECTIVES:

- To introduce different types of robotics and demonstrate them to identify different parts and components.
- To write programming for simple operations.

LIST OF EXPERIMENTS

1. Determination of maximum and minimum position of links.
2. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system 3. Estimation of accuracy, repeatability and resolution.
4. Robot programming and simulation for pick and place
5. Robot programming and simulation for Colour identification
6. Robot programming and simulation for Shape identification
7. Robot programming and simulation for machining (cutting, welding)
8. Robot programming and simulation for writing practice
9. Robot programming and simulation for any industrial process (Packaging, Assembly)
10. Robot programming and simulation for multi process.

OUTCOME:

Upon Completion of the course, the students will be able to:
CO1:Use of any robotic simulation software to model the different types of robots and calculate work volume for different robots

Semester-V

Subject: Introduction to Robotics II
Code: RB-PR501
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES:

- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study about the localization, planning and navigation.
- To study the control of robots for some specific applications.
- To study about the humanoid robots.

UNIT I INTRODUCTION

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

UNIT II LOCALIZATION

Introduction-Challenges of Localization- Map Representation- Probabilistic Map based LocalizationMonte carlo localization- Landmark based navigation-Globally unique localization- Positioning beacon systems- Route based localization.

UNIT III PLANNING AND NAVIGATION

Introduction-Path planning overview- Road map path planning- Cell decomposition path planningPotential field path planning-Obstacle avoidance - Case studies: tiered robot architectures. UNIT IV FIELD ROBOTS 9 Ariel robots- Collision avoidance-Robots for agriculture, mining, exploration, underwater, civilian and military applications, nuclear applications, Space applications.

UNIT V HUMANOIDS:

Wheeled and legged, Legged locomotion and balance, Arm movement, Gaze and auditory orientation control, Facial expression, Hands and manipulation, Sound and speech generation, Motion capture/Learning from demonstration, Human activity recognition using vision, touch, sound, Vision, Tactile Sensing, Models of emotion and motivation. Performance, Interaction, Safety and robustness, Applications, Case studies.

UNIT VI BOT CREATOR

Introduction – Recorders – Smart Recorders – Web Recorders – Screen Recorders - Task Editor – Variables - Command Library – Loop Command – Excel Command – Database Command - String Operation Command - XML Command - Terminal Emulator Command -

PDF Integration Command - FTP Command - PGP Command - Object Cloning Command - Error Handling Command - Manage Windows Control Command - Workflow Designer - Report Designer - Best Practices – Summary

UNIT VII META BOT AND BOT INSIGHT

Introduction - MetaBot Designer - MetaBot With AI Sense - Bot Insight -Transactional Analytics - Operational Analytics - Course Key Points.

OUTCOMES: Upon completion of the course, the student should be able to: • Explain the basic concepts of working of robot • Analyze the function of sensors in the robot • Write program to use a robot for a typical application • Use Robots in different applications • Know about the humanoid robots.

TEXT BOOKS: 1. Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, „Introduction to Autonomous Mobile Robots", Bradford Company Scituate, USA, 2004

2. Riadh Siaer, „The future of Humanoid Robots- Research and applications", Intech Publications, 2012.

3. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool - UiPath: Create Software robots. with the leading RPA tool – UiPath Kindle Edition

4. Robotic Process Automation A Complete Guide - 2020 Edition Kindle Editio

REFERENCES: 1. Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 2006. 2. Kelly, Alonzo; Iagnemma, Karl; Howard, Andrew, "Field and Service Robotics ", Springer, 2011

Subject: Industrial Design & Applied Ergonomics
Code: RB-PR502
Contact Hours/week: 3L+1T
Credits: 2

OBJECTIVES:

- To explain the general principles that governs the interaction of humans in their working environment
- To improve improving worker performance and safety.
- To know about the environmental conditions in the industry.
- To know about bio thermodynamics and bioenergetics
- To know about the human factors in industrial aspects

UNIT I INTRODUCTION

Definition, human technological system, multidisciplinary engineering approach, human–machine system, manual, mechanical, automated system, human system reliability, conceptual design, advanced development, detailed design and development. INFORMATION INPUT: Input and processing, text, graphics, symbols, codes, visual display of dynamic information, auditory, tactual, olfactory displays, speech communications.

UNIT II HUMAN OUTPUT AND CONTROL

Physical work, manual material handling, motor skill, human control of systems, controls and data entry devices, hand tools and devices. WORKPLACE DESIGN: Applied anthropometry, workspace design and seating, arrangement of components within a physical space, interpersonal aspects of work place design, design of repetitive task, design of manual handling task, work capacity, stress, and fatigue.

UNIT III ENVIRONMENTAL CONDITIONS

Illumination, climate, noise, motion, sound, vibration, colour and aesthetic concepts. BIOMECHANICS: Biostatic mechanics, statics of rigid bodies, biodynamic mechanics, human body kinematics, kinetics, impact and collision.

UNIT IV BIOTHERMODYNAMICS AND BIOENERGETICS

Biothermal fundamentals, human operator heat transfer, human system bioenergetics, thermoregulatory physiology, human operator thermo regularity, passive operator, active operator, heat stress.

UNIT V HUMAN FACTORS APPLICATIONS

Human error, accidents, human factors and the automobile, organizational and social aspects, steps according to ISO/DIS6385, OSHA‟s approach, virtual environments.

OUTCOMES:

The Student should

- Know about ergonomic principles to design workplaces
- improve human performance • judge the environmental conditions in the work place.
- know about biothermodynamics and bioenergetics
- implement latest occupational health and safety to the work place.

TEXT BOOK:

1. Chandler Allen Phillips, “Human Factors Engineering”, John Wiley and Sons, New York, 2000.

REFERENCES:

1. Bridger R S, "Introduction to Ergonomics", Taylor and Francis, London, 2003.
2. Mayall W H, "Indus trial Design for Engineers", London ILIFFEE Books Ltd., UK, 1998.
3. Mark S Sanders, "Human Factors in Engineering and Design", McGraw Hill, New York, 1993.

Subject: 3D Printing
Code: RB-PR503
Contact Hours/week: 3L+1T
Credits: 2

PRE-REQUISITES

- Computer Aided Design
- Engineering Materials

OBJECTIVES

The course is designed to impart knowledge and skills related to 3D printing technologies, selection of material and equipment and develop a product using this technique in Industry

4.0
environment.

LEARNING OUTCOMES

After completion of this course, the students will be able to:

- Develop CAD models for 3D printing.
- Import and Export CAD data and generate .stl file.
- Select a specific material for the given application.
- Select a 3D printing process for an application.
- Produce a product using 3D Printing or Additive Manufacturing (AM).

DETAIL CONTENTS

1. 3D Printing (Additive Manufacturing) (3 Hours)

Introduction, Process, Classification, Advantages, Additive V/s Conventional Manufacturing processes, Applications.

2. CAD for Additive Manufacturing (4 Hours)

CAD Data formats, Data translation, Data loss, STL format.

3. Additive Manufacturing Techniques (12 Hours)

3.1 Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology.

3.2 Process, Process parameter, Process Selection for various applications.

3.3 Additive Manufacturing Application Domains: Aerospace, Electronics, Health Care, Defence, Automotive, Construction, Food Processing, Machine Tools

4. Materials (8 Hours)

4.1 Polymers, Metals, Non-Metals, Ceramics

4.2 Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties.

4.3 Support Materials

5. Additive Manufacturing Equipment (10 Hours)

5.1 Process Equipment- Design and process parameters

5.2 Governing Bonding Mechanism

5.3 Common faults and troubleshooting

5.4 Process Design

6. Post Processing: Requirement and Techniques (4 Hours)

7. Product Quality (4 Hours)

7.1 Inspection and testing

7.2 Defects and their cause

Subject: Machine Vision
Code: RB-CS501
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES:

- To know about the principles and applications of vision system in modern manufacturing environment
- To learn about the algorithms in vision
- To know about the recognition of object
- To be familiar about the applications regarding vision

- To know about the components used for vision

UNIT I VISION SYSTEM

Basic Components – Elements of visual perception, Lenses: Pinhole cameras, Gaussian Optics – Cameras – Camera-Computer interfaces

UNIT II VISION ALGORITHMS

Fundamental Data Structures: Images, Regions, Sub-pixel Precise Contours – Image Enhancement : Gray value transformations, image smoothing, Fourier Transform – Geometric Transformation - Image segmentation – Segmentation of contours, lines, circles and ellipses – Camera calibration – Stereo Reconstruction.

UNIT III OBJECT RECOGNITION

Object recognition, Approaches to Object Recognition, Recognition by combination of views – objects with sharp edges, using two views only, using a single view, use of dept values.

UNIT IV APPLICATIONS

Transforming sensor reading, Mapping Sonar Data, Aligning laser scan measurements - Vision and Tracking: Following the road, Iconic image processing, Multiscale image processing, Video Tracking - Learning landmarks: Landmark spatiograms, K-means Clustering, EM Clustering.

UNIT V ROBOT VISION

Basic introduction to Robotic operating System (ROS) - Real and Simulated Robots - Introduction to OpenCV, Open NI and PCL, installing and testing ROS camera Drivers, ROS to OpenCV - The cv_bridge Package.

OUTCOMES:

- Knowledge or gadgets of vision systems
- Ability to understand the image capturing and processing techniques
- Ability to apply the vision system in other machines
- Knowledge for recognizing the objects.
- Knowledge in application of vision and image processing in robot operations.

TEXT BOOKS:

1. Carsten Steger, Markus Ulrich, Christian Wiedemann, “Machine Vision Algorithms and Applications”, WILEY-VCH, Weinheim,2008.
2. Damian m Lyons,“Cluster Computing for Robotics and Computer Vision”, World Scientific, Singapore, 2011.

REFERENCES:

1. Rafael C. Gonzalez and Richard E.woods, "Digital Image Processing", Addition - Wesley Publishing Company, New Delhi, 2007.
2. Shimon Ullman, "High-Level Vision: Object recognition and Visual Cognition", A Bradford Book, USA, 2000.
3. R.Patrick Goebel, " ROS by Example: A Do-It-Yourself Guide to Robot Operating System – Volume I", A Pi Robot Production, 2012.

Practical

Subject: Robotics Lab II
Code: RB-PR591
Contact Hours/week: 3P
Credits: 2
LIST OF PRACTICALS

1. 3D Modelling of a single component.
2. Assembly of CAD modelled Components
3. Exercise on CAD Data Exchange.
4. Generation of .stl files.
5. Identification of a product for Additive Manufacturing and its AM process plan.
6. Printing of identified product on an available AM machine.
7. Post processing of additively manufactured product.
8. Inspection and defect analysis of the additively manufactured product.
9. Comparison of Additively manufactured product with conventional manufactured counterpart.

10. Software Installation Procedure – Installation of AA Control Room, SQL Server and AA Client.

- Bot Creation using recorders (Smart, Web and Screen).
- Bot Creation using command library – (Loop Command).
- Bot Creation to invoke database automation
- Bot Creation for automating excel operations
- Bot Creation for PDF Integrations.
- Bot Creation and working on error handling.
- Bot Development using Object Cloning Command.
- FTP and PGB Command Execution by Bots
- MetaBot Designing with AI Sense.

Subject: Project I
Code: RB-PR581
Contact Hours/week: 3P
Credits:5

Semester-VI

Subject: Environmental Science and Engineering
Code: RB-PR601
Contact Hours/week: 3L+1T
Credits: 2

OBJECTIVES:

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth‟s interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY

Definition, scope and importance of environment – need for public awareness - 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. Field study of common plants, insects, birds; Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION

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 – solid waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides. Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES

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. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT

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 – role of non-governmental organizationenvironmental 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 production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT

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.

OUTCOMES:

- Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.
- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

TEXTBOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.

REFERENCES:

1. Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD,New Delhi, 2007.
2. Erach Bharucha, "Textbook of Environmental Studies", Universities Press(I) PVT, LTD, Hydrabad, 2015.
3. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.
4. G. Tyler Miller and Scott E. Spoolman, "Environmental Science", Cengage Learning India PVT, LTD, Delhi, 2014.

Subject: Virtual Instrumentation
Code: RB-PR602
Contact Hours/week: 3L+1T
Credits: 2

OBJECTIVE:

- Introduce the principle, programming technique with instrument interfaces and applications of virtual instruments and to understand the basics of data acquisition are introduced in mechatronics systems.

UNIT I REVIEW OF VIRTUAL INSTRUMENTATION

Historical perspectives, advantages, block diagram and architecture of a virtual instrument, data - flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT II VI PROGRAMMING TECHNIQUES

VIS and sub-VIS loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, string and file I/O.

UNIT III DATA ACQUISTION BASICS

AOC.OAC. 010. Counters & timers. PC Hardware structure, timing. Interrupts OMA, software and hardware installation

UNIT IV COMMON INSTRUMENT INTERFACES

Current loop, RS.232C/RS.485, GPIB, System buses, interface buses: USB, PCMCIA, VXI, SCXI, PXI, etc., networking basics for office &.Industrial applications, Visa and IVI, image acquisition and processing. Motion control.

UNIT V USE OF ANALYSIS TOOLS

Fourier transforms, power spectrum correlation methods, windowing & filtering, VI application in various fields.

OUTCOMES:
CO1: Understand the evolution, advantages, techniques, architecture and applications of visual instrumentation
CO2: Acquiring knowledge on VI programming techniques
CO3: Study about the basics of data acquisition
CO4: Understanding the concept of common instrument interfaces with industrial applications
CO5: Study about the use of analysis tools with various applications.

TEXT BOOK: 1. Gupta ," Virtual Instrumentation Using Lab view" 2nd Edition, Tata McGraw-Hill Education, 2010

REFERENCES:
1. Gary Jonson, "Labview Graphical Programming", Fourth Edition, McGraw Hill, New York, 2006
2. Gupta.S., Gupta.J.P., "PC interfacing for Data Acquisition & Process Control", Second Edition, Instrument Society of America, 1994.
3. Sokoloff; "Basic concepts of Labview 4", Prentice Hall Inc., New Jersey 1998

Subject: Digital Signal Processing
Code: RB-EC601
Contact Hours/week: 3L+1T
Credits: 2

OBJECTIVES:

- To understand the concept of information, types of channels
- To understand the capabilities of various source coding theorems and the fundamental limit of transmission over the channel.
- To understand the various concepts of signal processing with its applications.
- To understand the capabilities of various channel coding theorems.
- To develop the knowledge on pass band communication and spread spectrum.

UNIT I ARCHITECTURE OFTMS320C5X

Introduction -Bus structure-Central Arithmetic Logic unit(CALU)-Auxiliary Register ALU(ARAU)-Index register(INDX)-Auxiliary register compare register-Block move address register-,Block repeat registers-parallel logic unit-memory mapped registers-program controllers-on chip features.

UNIT II TMS320C5X PROGRAMMING

Assembly language syntax-Addressing modes, Load/store instructions-Addition/subtraction instructions-Move instructions-Multiplication instruction-NORM instruction-Program control instructions-Peripheral instructions-Instruction Pipelining inC5x-Pipeline structure, Pipeline operationNormal pipeline Operation.

UNIT III APPLICATIONS

C50 based starter kit-Programs for familiarization of the addressing modes-Program for familiarization of Arithmetic Instructions-Programs in C5x for Processing Real time signals.

UNIT IV ARCHITECTURE OF TMS320C54X

Introduction-Architecture-Buses-Memory Organization-CPU-ALU-Barrel shifter-Multiplier/Adder unitCompare, Select and store unit-Exponent Encoder-C54X pipeline-On chip Peripherals-Data Address Generation logic-Program address generation logic.

UNIT V TMS320C54X PROGRAMMING

Data Addressing-Arithmetic instructions-Move instructions-Load/Store instructions-Logical instructions-Control instructions-Conditional store instructions-Repeat instructions-I/o instructions-Bit manipulation instructions-parallel instructions-special instructions-Application programs.

OUTCOMES: Upon completion of the course, students will be able to

- Know about the various concepts of signal processing with its applications
- Discuss the representation of signals and the process of sampling, quantization and coding that are fundamental to the digital transmission of analog signals.
- Know about the capabilities of various source coding theorems and the fundamental limit of transmission over the channel.
- Design the baseband and band pass signal transmission and reception techniques.
- Explain error control coding which encompasses techniques for the encoding and decoding of digital data streams for their reliable transmission over noisy channels.

TEXT BOOK: 1. Venkataramani B., Bhaskar M. ”Digital Signal Processors: Architecture, Programming and Applications “Tata McGraw Hill, 2008

REFERENCES:

1. Sem.M.Kuo Woon-Seng.s.Gan "Digital Signal Processors: Architectures, Implementations, and Applications "Pearson Education,2005.
2. Steven W smith "Scientist and Engineer"s Guide to Digital signal processing", 200

Subject: Values & Ethics
Code: RB-HU601
Contact Hours/week: 3L
Credits: 3

OBJECTIVE: • To enable the students to create an awareness on Engineering Ethics and Human Values to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V GLOBAL ISSUES

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social Responsibility.

OUTCOME: • Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

TEXT BOOKS: 1. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004. 2. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.

REFERENCES: 1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004. 2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009. 3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003 4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001. 5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education,

India Pvt. Ltd.,New Delhi, 2013. 6. World Community Service Centre, ' Value Education', Vethathiri publications, Erode, 2011.

Web sources: 1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

Subject: Principles of Management
Code: RB-MG601

Contact Hours/week: 3L
Credits: 2

OBJECTIVE:

- To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

UNIT IV DIRECTING

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication – communication and IT.

UNIT V CONTROLLING

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

OUTCOME:

- Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling and have same basic knowledge on international aspect of management

TEXT BOOKS: 1. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson Education, 2004. 2. Stephen P. Robbins & Mary Coulter, "Management", Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009.

REFERENCES: 1. Harold Koontz & Heinz Weihrich, "Essentials of Management", Tata McGraw Hill, 1998. 2. Robert Kreitner & Mamata Mohapatra, "Management", Biztantra, 2008. 3. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management", 7 th Edition, Pearson Education, 2011. 4. Tripathy PC & Reddy PN, "Principles of Management", Tata Mcgraw Hill, 1999

Practical

Subject: DSP Lab
Code: RB-PR691
Contact Hours/week:
Credits: 2

Sampling and data reconstruction process. Z transforms.

Discrete linear systems. Frequency domain design of digital filters.

Quantization effects in digital filters.

Discrete Fourier transform and FFT algorithms.

High Speed convolution and its applications to digital filtering. Multi-rate filtering.

Suggested Text Books & References

Rabiner, L.R. & Gold, B., "Theory and Application of Digital signal Processing", Prentice Hall, 1989. Oppenheim & Schafer, "Digital Signal Processing", Prentice Hall, 1995.

Sessional

Subject: Project II
Code: RB-PR681
Contact Hours/week:
Credits: 5

Elective I

Subject: ADVANCED MICROPROCESSORS AND MICROCONTROLLERS
Code: RB-PE301
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES: The student should be made to:

- Study the Architecture of 8085 microprocessor.
- Study the Architecture of 8086 microprocessor.
- Learn the design aspects of I/O and Memory Interfacing circuits.
- Study about communication and bus interfacing.
- Study the Architecture of 8051 microcontroller.

UNIT I 8086 MICROPROCESSOR

Architecture – Pin description – Operating modes – Registers – Interrupts – Bus cycle – Addressing modes – Typical configuration of 8086 system – Overview of Instruction set.

UNIT II 80286 MICROPROCESSOR

Functional block diagram - Modes of operation – Real and protected mode – Memory management and protection features.

UNIT III 80386, 80486 PROCESSORS

80386: Functional block diagram - Programming model - Addressing modes and instruction set overview – Address translation - Modes of operation - 80486 processor - Functional block diagram - Comparison of 80386 and 80486 processors.

UNIT IV PENTIUM MICROPROCESSOR

Introduction – Architecture – Special Pentium registers – Memory management.

UNIT V PIC MICROCONTROLLER

Architecture – Memory structure – Register File – Addressing modes – Interrupts – Timers: Modes of operation PIC PERIPHERAL FUNCTIONS AND SPECIAL FEATURES: PWM output – Analog to Digital converter – UART – Watchdog timer – RESET Alternatives – Power Down mode – I2C Bus operation

OUTCOMES: At the end of the course, the student should be able to: • Design and implement programs on 8085 microprocessor. • Design and implement programs on 8086 microprocessor. • Design I/O circuits. • Design Memory Interfacing circuits. • Design and implement 8051 microcontroller based systems.

TEXT BOOKS: 1. Barry B Brey, "The Intel Microprocessor 8086/8088, 80186/80188, 80286, 80386, 80486 Pentium and Pentium processor, Pentium II,III,4 , Prentice Hall of India, New Delhi, 2005. 2. Douglas V Hall, "Microprocessors and Interfacing: Programming and Hardware", McGraw Hill, New Delhi, 2005. 3. John B Peatman, “Design with PIC Microcontroller, McGraw Hill, Singapore, 1st Reprint, 2001

REFERENCES: 1. Mohammed Rafiquzzaman, "Microprocessors and microcomputer based system design", CRC Press, 2005. 2. Walter A Triebel, Avtar Singh .”The 8088 and 8086 microprocessors Programming Interfacing software, Hardware and Applications”,Pearson Education ,2009 3. Myke Pred ko, “Programming and Customising the PIC Microcontroller, “McGraw Hill, USA, 1998

Subject: System Software
Code: RB-PE301
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES: The student should be made to: • Understand the phases in a software project. • Understand fundamental concepts of requirements engineering and Analysis Modelling. • Understand the major considerations for enterprise integration and deployment. • Learn various testing and maintenance measures. • Learn about various parsing techniques.

UNIT I ASSEMBLERS

General Design procedures – Design of an Assembler – data structures – format of databases – algorithm – flow chart – PASS structures – modular functions. MACRO LANGUAGE AND MACRO PROCESSORS: Macro instructions, features of a macro facility – implementation.

UNIT II LOADERS

Loader schemes – compile and go loaders , general load scheme – absolute loaders – direct linking loaders and their design. Other loading schemes : linking loaders, overlays, dynamic binders.

UNIT III COMPILERS

Introduction – Structure of a compiler – phases of a compiler - compiler writing tools. LEXICAL ANALYSIS: Role of a lexical analyzer – finite automata –regular expressions to finite automata – minimizing the number of states of a deterministic finite automata – implementation of a lexical analyzer.

UNIT IV PARSING TECHNIQUES

Context free grammars – derivations and parse trees – ambiguity – capabilities of context free grammars. Top down and bottom up parsing – handles – shift reduce parsing – operator precedence parsing – recursive descent parsing – predictive parsing.

UNIT V INTERMEDIATE CODE GENERATION

Postfix notation, Quadruples, triples , indirect triples – Representing information in a symbol table – introduction to code optimization – basic blocks – DAG representation – error detection and recovery - code generation.

OUTCOMES: At the end of the course, the student should be able to • Identify the key activities in managing a software project. • Compare different process models. • Concepts of requirements engineering and Analysis Modeling. • Apply systematic procedure for software design and deployment. • Compare and contrast the various testing and maintenance.

TEXT BOOKS: 1. Leland Beck - “System Software – An Introduction to Systems Programming”, Third Edition, Pearson Education, Inc., 2008 2. Srimanta Pal, “ Systems Programming “ , Oxford University Press, 2011.

REFERENCES: 1. John J Donovan, “ Systems Programming”, McGraw Hill , 1999. 2. Dhamdhere D M, “Systems Programming”, Tata McGraw Hill, 2001. 3. Aho A V, Sethi R and Ullman J D, “Compilers: Principles, Techniques and Tools”, Addison Wesley, Longman, 1999. 4. Dhamdhere D M, “Compiler Construction Principles and Practice”, Macmillan Company, 1997. 5. Holub Allen I, “Compiler Design in C”, Prentice Hall, 2001.

Subject: Automobile Engineering
Code: RB-PE301
Contact Hours/week: 3L+1T

Credits: 3

OBJECTIVES:

- To understand the construction and working principle of various parts of an automobile.
- To have the practice for assembling and dismantling of engine parts and transmission system

UNIT I VEHICLE STRUCTURE AND ENGINES

Types of automobiles vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics (various resistances and moments involved), IC engines –components-functions and materials, variable valve timing (VVT).

UNIT II ENGINE AUXILIARY SYSTEMS

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type and common rail direct injection system), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

UNIT III TRANSMISSION SYSTEMS

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive.

UNIT IV STEERING, BRAKES AND SUSPENSION SYSTEMS

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.

UNIT V ALTERNATIVE ENERGY SOURCES

Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance, Combustion and Emission Characteristics of SI and CI engines with these alternate fuels - Electric and Hybrid Vehicles, Fuel Cell Note: Practical Training in dismantling and assembling of Engine parts and Transmission Systems should be given to the students.

OUTCOMES: Upon the completion of this course the students will be able to CO1 recognize the various parts of the automobile and their functions and materials. CO2 discuss the engine auxiliary systems and engine emission control. CO3 distinguish the working of

different types of transmission systems. CO4 explain the Steering, Brakes and Suspension Systems. CO5 predict possible alternate sources of energy for IC Engines.

TEXT BOOKS: 1. Jain K.K. and Asthana .R.B, "Automobile Engineering" Tata McGraw Hill Publishers, New Delhi, 2002. 2. Kirpal Singh, "Automobile Engineering", Vol 1 & 2, Seventh Edition, Standard Publishers, New Delhi, 13th Edition 2014..

REFERENCES: 1. Ganesan V. "Internal Combustion Engines", Third Edition, Tata McGraw-Hill, 2012. 2. Heinz Heisler, "Advanced Engine Technology," SAE International Publications USA, 1998. 3. Joseph Heitner, "Automotive Mechanics," Second Edition, East-West Press, 1999. 4. Martin W, Stockel and Martin T Stockle , "Automotive Mechanics Fundamentals," The Good heart - Will Cox Company Inc, USA ,1978. 5. Newton ,Steeds and Garet, "Motor Vehicles", Butterworth Publishers,1989.

Subject: Human Rights
Code: RB-PE301
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVE: • To sensitize the Engineering students to various aspects of Human Rights.

UNIT I

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance. UNIT IV 9 Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

OUTCOME : • Engineering students will acquire the basic knowledge of human rights.

REFERENCES: 1. Kapoor S.K., "Human Rights under International law and Indian Laws", Central Law Agency, Allahabad, 2014. 2. Chandra U., "Human Rights", Allahabad Law Agency, Allahabad, 2014. 3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

Elective II

Subject: Special Machines & Controllers
Code: RB-PE401
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES: • To know about stepper motors. • To know about switched reluctance motors • To know about permanent magnet brushless d.c. Motors • To know about permanent magnet synchronous motors • To know about linear motors

UNIT I STEPPER MOTORS

Types - Constructional features – principle of operation – variable reluctance motor – single and Multi stack configurations – Permanent Magnet Stepper motor – Hybrid stepper motor.

Different modes of Excitation - theory of torque predictions – Drive systems and circuit for open loop and closed loop control of stepper motor.

UNIT II SWITCHED RELUCTANCE MOTORS

Constructional features – principle of operation –Torque Equation - Power Converters for SR Motor – Rotor Sensing Mechanism & Logic Controller – Sensorless Control of SR motor - Applications.

UNIT III PERMANENT MAGNET BRUSHLESS D.C. MOTORS

Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations – Power controllers – Motor characteristics and control – Applications. UNIT IV PERMANENT MAGNET SYNCHRONOUS MOTORS 8 Principle of operation, EMF, power input and torque expressions, Phasor diagram, Power Controllers, Torque speed characteristics, Self control, Vector control, Current control Schemes – Applications.

UNIT V LINEAR MOTORS:

Linear Induction motor (LIM) classification – construction – Principle of operation – Concept of current sheet – goodness factor – DC Linear motor (DCLM) types – circuit equation - DCLM control applications – Linear Synchronous motor(LSM) – Types– Applications SERVOMOTORS: Servomotor – Types – Constructional features, principle of operation - control applications

OUTCOMES: • Understanding principles of operation, types and applications of stepper motors • Understanding principles of operation, types and applications of switched reluctance motors • Knowledge in evaluating the performance of dc motors • To evaluate knowledge in permanent magnet synchronous motors. • Ability to understand the working and applications linear motors and servo motors. 93

TEXT BOOKS: 1. K. Venkataratnam," Special Electrical Machines", Universities Press (India) Private Limited, India, 2009. 2. Kenjo, T and Naganori, S "Permanent Magnet and brushless DC motors", Clarendon Press, Oxford, 1989

REFERENCES: 1. Kenjo T, "Stepping Motors and their Microprocessor Controls", Clarendon Press London, 2003. 2. Miller T J E, "Brushless Permanent Magnet and Reluctance Motor Drives", Clarendon Press, Oxford, 1989 . 3. Naser A and Boldea L,"Linear Electric Motors: Theory Design and Practical Applications", Prentice Hall Inc., New Jersey 1987. 4. Floyd E Saner," Servo Motor Applications", Pittman USA, 1993. 5. WILLIAM H YEADON, ALAN W YEADON, Handbook of Small Electric Motors, McGraw Hill, INC, 2001 RO8005

Subject: Advanced Control System
Code: RB-PE401

Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES • To provide knowledge on design in state variable form • To provide knowledge in phase plane analysis. • To give basic knowledge in describing function analysis. • To study the design of optimal controller. • To study the design of optimal estimator including Kalman Filter

UNIT I STATE VARIABLE DESIGN

Introduction to state Model- effect of state Feedback- Necessary and Sufficient Condition for Arbitrary Pole-placement- pole placement Design- design of state Observers- separation principle- servo design: -State Feedback with integral control

UNIT II PHASE PLANE ANALYSIS

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearization Concept of phase portraits – Singular points – Limit cycles – Construction of phase portraits – Phase plane analysis of linear and non-linear systems – Isocline method.

UNIT III DESCRIBING FUNCTION ANALYSIS

Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – limit cycles – Stability of oscillations.

UNIT IV OPTIMAL CONTROL

Introduction - Time varying optimal control – LQR steady state optimal control – Solution of Ricatti‟s equation – Application examples.

UNIT V OPTIMAL ESTIMATION

Optimal estimation – Kalman Bucy Filter-Solution by duality principle-Discrete systems-Kalman FilterApplication examples..

OUTCOMES: At the end of the course, the student should be able to: • Design in state variable form • Knowledge in phase plane analysis. • To describe function analysis. • Know the design of optimal controller. • Know about the design of optimal estimator including kalman filter

TEXT BOOKS 1. Mohandas K. P., “Modern Control Engineering”, Sanguine Technical Publishers, 2006 2. Thaler G.J., “Automatic Control Systems”, Jaico Publishing House, 1993 3. Gopal ,M. Modern control system theory, New Age International Publishers, 2002.

REFERENCES 1. William S Levine, “Control System Fundamentals,” The Control Handbook, CRC Press, Tayler and Francies Group 2011. 2. Ashish Tewari, „Modern control Design with Matlab and Simulink, John Wiley, New Delhi, 2002. 3. Ogata K., „Modern

Control Engineering", 4th edition, PHI, New Delhi, 2002. 4. Glad T. and Ljung L. "Control theory –Multivariable and Non-linear methods", Taylor & Francis, 2002 5. Naidu D.S., "Optimal Control Systems" First Indian Reprint, CRC Press, 2009.

Subject: Lean Manufacturing
Code: RB-PE401
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES:

- To introduce the students the lean manufacturing concepts
- To understand group technology and use of it for part identification
- To understand value stream mapping in lean manufacturing.
- To teach the tools and method used in lean manufacturing
- To introduce concept of Total Productive Maintenance and other system

UNIT I INTRODUCTION:

Origins and objectives of lean manufacturing – lean process,3M concept key principles and implications of lean manufacturing – traditional Vs lean manufacturing characteristics– roadmap for lean implementation and lean benefits - study of Ford and Toyota production systems - JIT manufacturing, Lean building blocks. LEAN MANUFACTURING CONCEPTS: Value creation and waste elimination – seven types of waste – pull production-different models of pull production -the Kanban system-continuous flow-the continuous improvement process / Kaizen-Worker involvement. Design of Kanban quantities – Leveled production - tools for continuous improvement.

UNIT II GROUP TECHNOLOGY AND CELLULAR LAYOUT

JIT with cell manufacturing – part families- production flow analysis – Composite part concept – machine cell design – quantitative analysis – case studies – single piece flow

UNIT III VALUE STREAM MAPPING

The value stream– benefits mapping process - the current state map–mapping icons - mapping steps.VSM exercises - Takt time calculations.

UNIT IV LEAN MANUFACTURING TOOLS AND METHODOLOGIES

Standardized work–standard work sequence timing and working progress .Quality at source – Autonomation /Jidoka, Visual management system, Mistake proofing / Poka-Yoke. 5S technique – Elements and waste elimination through 5S, advantages and benefits - 5S-audit - visual control aids for improvement, flexible work force

UNIT V TOTAL PRODUCTIVE MAINTENANCE

Goals and benefits – Hidden factory, the six big losses, types of maintenance. Overall equipment effectiveness - pillars of TPM and implementation. Change over and set up timer education techniques. Temple of quality, OEE calculations. RECONCILING LEAN WITH OTHER SYSTEMS: Study of lean Six-sigma and lean design – lean and ERP- lean with ISO9001:2000 - administrative lean.

OUTCOMES: • Ability to implement lean manufacturing concepts in industries • Ability to group the parts in manufacturing • Ability to apply value stream in mapping. • Ability to use the lean manufacturing tools and method • Ability to apply total productive maintenance concepts in industries.

TEXT BOOKS: 1. Micheal Wader, "Lean Tools: A Pocket guide to Implementing Lean Practices", Productivity and Quality Publishing, 2002. 2. William M Feld, "Lean Manufacturing: Tools, Techniques and How to use them", APICS, 2001 3. Dennis P Hobbs, "Lean Manufacturing Implementation" ,Narosa Publications, 2004 4. Gopalakrishnan N, "Simplified Lean Manufacture", PHI Learning Pvt Ltd, 2010 84

REFERENCES: 1. Richard B Chase" Production and Operations Management", McGraw Hill, 2003 2. Taiichi Ohno, "Toyoto Production Systems: Beyond Large Scale Production", Productivity Press, 1988. 3. Askin R G and Goldberg J B," Design and Analysis of Lean Production Systems", John Wiley and Sons, 2003. 4. Mahadevan B," Operations Management", Pearson,2010

Subject: PROCESS PLANNING AND COST ESTIMATION
Code: RB-PE401
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVE: • To introduce the process planning concepts to make cost estimation for various products after process planning

UNIT I INTRODUCTION TO PROCESS PLANNING

Introduction- methods of process planning-Drawing interpretation-Material evaluation – steps in process selection-.Production equipment and tooling selection

UNIT II PROCESS PLANNING ACTIVITIES

Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies

UNIT III INTRODUCTION TO COST ESTIMATION

Importance of costing and estimation –methods of costing-elements of cost estimation – Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of over head charges- Calculation of depreciation cost

UNIT IV PRODUCTION COST ESTIMATION

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

UNIT V MACHINING TIME CALCULATION

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations ,Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.

OUTCOMES: Upon the completion of this course the students will be able to CO1 select the process, equipment and tools for various industrial products. CO2 prepare process planning activity chart. CO3 explain the concept of cost estimation. CO4 compute the job order cost for different type of shop floor. CO5 calculate the machining time for various machining operations.

TEXT BOOKS: 1. Peter scalon, “Process planning, Design/Manufacture Interface”, Elsevier science technology Books, Dec 2002. 2. Sinha B.P, “Mechanical Estimating and Costing”, Tata-McGraw Hill publishing co, 1995.

REFERENCES: 1. Chitale A.V. and Gupta R.C., “Product Design and Manufacturing”, 2nd Edition, PHI, 2002. 2. Ostwalal P.F. and Munez J., “Manufacturing Processes and systems”, 9th Edition, John Wiley, 1998. 3. Russell R.S and Tailor B.W, “Operations Management”, 4th Edition, PHI, 2003. 4. Mikell P. Groover, “Automation, Production, Systems and Computer Integrated Manufacturing”, Pearson Education 2001. 5. K.C. Jain & L.N. Aggarwal, “Production Planning Control and Industrial Management”, Khanna Publishers 1990.

Subject: INTELLECTUAL PROPERTY RIGHTS

Code: RB-PE401
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVE: • To give an idea about IPR, registration and its enforcement.

UNIT I INTRODUCTION

Introduction to IPRs, Basic concepts and need for Intellectual Property - Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR.

UNIT II REGISTRATION OF IPRs

Meaning and practical aspects of registration of Copy Rights, Trademarks, Patents, Geographical Indications, Trade Secrets and Industrial Design registration in India and Abroad UNIT III AGREEMENTS AND LEGISLATIONS 10 International Treaties and Conventions on IPRs, TRIPS Agreement, PCT Agreement, Patent Act of India, Patent Amendment Act, Design Act, Trademark Act, Geographical Indication Act.

UNIT IV DIGITAL PRODUCTS AND LAW

Digital Innovations and Developments as Knowledge Assets – IP Laws, Cyber Law and Digital Content Protection – Unfair Competition – Meaning and Relationship between Unfair Competition and IP Laws – Case Studies.

UNIT V ENFORCEMENT OF IPRs

Infringement of IPRs, Enforcement Measures, Emerging issues – Case Studies.

OUTCOME: • Ability to manage Intellectual Property portfolio to enhance the value of the firm.

TEXT BOOKS 1. V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India pvt Ltd, 2012 2. S.V. Satarkar, Intellectual Property Rights and Copy Rights, Ess Ess Publications, New Delhi, 2002

REFERENCES 1. Deborah E. Bouchoux, “Intellectual Property: The Law of Trademarks, Copyrights, Patents and Trade Secrets”, Cengage Learning, Third Edition, 2012. 2. Edited by Derek Bosworth and Elizabeth Webster, The Management of Intellectual Property, Edward Elgar Publishing Ltd., 2013. 3. Prabuddha Ganguli,”Intellectual Property Rights: Unleashing the Knowledge Economy”, McGraw Hill Education, 2011.

Elective III

Subject: VLSI Design
Code: RB-PE501
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES: • Study the fundamentals of CMOS circuits and its characteristics. • Learn the design and realization of combinational & sequential digital circuits. • Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed • Learn the different FPGA architectures and testability of VLSI circuits.

UNIT I INTRODUCTION TO MOS TRANSISTOR

MOS Transistor, CMOS logic, Inverter, Pass Transistor, Transmission gate, Layout Design Rules, Gate Layouts, Stick Diagrams, Long-Channel I-V Charters tics, C-V Charters tics, Non ideal I-V Effects, DC Transfer characteristics, RC Delay Model, Elmore Delay, Linear Delay Model, Logical effort, Parasitic Delay, Delay in Logic Gate, Scaling.

UNIT II COMBINATIONAL MOS LOGIC CIRCUITS

Circuit Families: Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Dual Rail Domino, CPL, DCVSPG, DPL, Circuit Pitfalls. Power: Dynamic Power, Static Power, Low Power Architecture.

UNIT III SEQUENTIAL CIRCUIT DESIGN

Static latches and Registers, Dynamic latches and Registers, Pulse Registers, Sense Amplifier Based Register, Pipelining, Schmitt Trigger, Monostable Sequential Circuits, Astable Sequential Circuits. Timing Issues : Timing Classification Of Digital System, Synchronous Design.

UNIT IV DESIGN OF ARITHMETIC BUILDING BLOCKS AND SUBSYSTEM

Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, Case Study: Design as a tradeoff. Designing Memory and Array structures: Memory Architectures and Building Blocks, Memory Core, Memory Peripheral Circuitry.

UNIT V IMPLEMENTATION STRATEGIES AND TESTING

FPGA Building Block Architectures, FPGA Interconnect Routing Procedures. Design for Testability: Ad Hoc Testing, Scan Design, BIST, IDDQ Testing, Design for Manufacturability, Boundary Scan.

OUTCOMES: UPON COMPLETION OF THE COURSE, STUDENTS SHOULD be ABLE TO • Realize the concepts of digital building blocks using MOS transistor. • Design combinational MOS circuits and power strategies. • Design and construct Sequential Circuits and Timing systems. • Design arithmetic building blocks and memory subsystems. • Apply and implement FPGA design flow and testing.

TEXT BOOKS: 1. Neil H.E. Weste, David Money Harris "CMOS VLSI Design: A Circuits and Systems Perspective", 4th Edition, Pearson , 2017 (UNIT I,II,V) 2. Jan M. Rabaey ,Anantha Chandrakasan, Borivoje. Nikolic, "Digital Integrated Circuits:A Design perspective", Second Edition , Pearson , 2016.(UNIT III,IV). 90

REFERENCES 1. M.J. Smith, "Application Specific Integrated Circuits", Addisson Wesley, 1997 2. Sung-Mo kang, Yusuf leblebici, Chulwoo Kim "CMOS Digital Integrated Circuits:Analysis & Design",4th edition McGraw Hill Education,2013 3. Wayne Wolf, "Modern VLSI Design: System On Chip", Pearson Education, 2007 4. R.Jacob Baker, Harry W.LI., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India 2005.

Subject: DISASTER MANAGEMENT
Code: RB-PE501
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES: • To provide students an exposure to disasters, their significance and types. • To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction • To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR) • To enhance awareness of institutional processes in the country and • To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban

disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR)

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders - Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies. 88

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

OUTCOMES: The students will be able to • Differentiate the types of disasters, causes and their impact on environment and society • Assess vulnerability and various methods of risk reduction measures as well as mitigation. • Draw the hazard and vulnerability profile of India, Scenarious in the Indian context, Disaster damage assessment and management.

TEXTBOOKS: 1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423 2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. ISBN-10: 1259007367, ISBN-13: 978-1259007361] 3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for

Disaster Risk Management, NIDM, New Delhi, 2011 4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES 1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005 2. Government of India, National Disaster Management Policy,2009.

Subject: Computer Integrated Manufacturing Systems
Code: RB-PE501
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVE: • To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

UNIT I INTRODUCTION

Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control- Introduction to CAD/CAM – Concurrent Engineering-CIM concepts – Computerised elements of CIM system – Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production.

UNIT II PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor

Control-Inventory Control – Brief on Manufacturing Resource Planning-II (MRP-II) & Enterprise Resource Planning (ERP) - Simple Problems.

UNIT III CELLULAR MANUFACTURING

Group Technology(GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.

UNIT IV FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS)

Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control – Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.

UNIT V INDUSTRIAL ROBOTICS

Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability – Simple Problems.

OUTCOMES: CO1 Explain the basic concepts of CAD, CAM and computer integrated manufacturing systems CO2 Summarize the production planning and control and computerized process planning CO3 Differentiate the different coding systems used in group technology CO4 Explain the concepts of flexible manufacturing system (FMS) and automated guided vehicle (AGV) system CO5 Classification of robots used in industrial applications 113

TEXT BOOKS: 1. Mikell.P.Groover “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India, 2008. 2. Radhakrishnan P, Subramanyan S.and Raju V., “CAD/CAM/CIM”, 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.

REFERENCES: 1. Gideon Halevi and Roland Weill, “Principles of Process Planning – A Logical Approach” Chapman & Hall, London, 1995. 2. Kant Vajpayee S, “Principles of Computer Integrated Manufacturing”, Prentice Hall India. 3. Rao. P, N Tewari &T.K. Kundra, “Computer Aided Manufacturing”, Tata McGraw Hill Publishing Company, 2000.

Subject: Renewable Energy
Code: RB-PE501
Contact Hours/week: 3L+1T
Credits: 3
Course Outcomes:

At the end of this course, students will demonstrate the ability to

- Understand the energy scenario and the consequent growth of the power generation from

renewable energy sources.

- Understand the basic physics of wind and solar power generation.
- Understand the power electronic interfaces for wind and solar generation.
- Understand the issues related to the grid-integration of solar and wind energy systems.

Module 1: Physics of Wind Power: (5 Hours)

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Module 2: Wind generator topologies: (12 Hours)

Review of modern wind turbine technologies,Fixed and Variable speed wind turbines,

Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent Magnet Synchronous Generators, Power electronics converters. Generator-Converter

configurations, Converter Control.

Module 3: The Solar Resource: (3 Hours)

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles,

solar day length, Estimation of solar energy availability.

Module 4: Solar photovoltaic: (8 Hours)

Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms.Converter Control.

Module 5: Network Integration Issues: (8 Hours)

Overview of grid code technical requirements. Fault ride-through for wind farms - real and reactive power regulation, voltage and frequency operating limits, solar PV and wind farm behavior during grid disturbances. Power quality issues. Power system interconnection experiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Module 6: Solar thermal power generation: (3 Hours)

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

Text / References: 1. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005. 2. G. M. Masters, “Renewable and Efficient Electric Power Systems”, John Wiley and Sons, 2004. 3. S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, McGraw Hill, 1984. 4. H. Siegfried and R. Waddington, “Grid integration of wind energy conversion systems” John Wiley and Sons Ltd., 2006. 5. G. N. Tiwari and M. K. Ghosal, “Renewable Energy Applications”, Narosa Publications, 2004. 6. J. A. Duffie and W. A. Beckman, “Solar Engineering of Thermal Processes”, John Wiley & Sons, 1991.

Subject: AR/VR
Code: RB-PE501
Contact Hours/week: 3L+1T
Credits: 3

Elective IV

Subject: MAINTENANCE AND SAFETY ENGINEERING
Code: RB-PE601
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES: • To impart knowledge in maintenance • To know about the fundamentals of maintenance and to implement it. • To study about safety engineering practices. • To analyze the hazards in protection. • To know about the safety in machine operation.

UNIT I MAINTENANCE: 6 Types – breakdown, preventive, predictive, TPM; elements of preventive maintenance – checklist, schedule, procedure. 97

UNIT II TOTAL PRODUCTIVE MAINTENANCE: 12 Principles; preparatory stages of implementation – TPM organisation structure, creation; basic TPM policies and aids, master plan. TPM IMPLEMENTATION: Small group activities, autonomous maintenance, establishing planned maintenance, training, developing equipment management program.

UNIT III SAFETY SYSTEMS ANALYSIS: 6 Definitions, safety systems; safety information system: basic concept, safety cost / benefit analysis; industrial safety engineering, OSHA regulations.

UNIT IV HAZARD ANALYSIS: 10 General hazard analysis: electrical, physical and chemical hazard, detailed hazard analysis. Cost effectiveness in hazard elimination. Logical analysis: map method, tabular method, fault tree analysis and hazop studies. FIRE PROTECTION SYSTEM: Chemistry of fire, water sprinkler, fire hydrant, alarm and detection system. Suppression system: CO2 system, foam system, Dry Chemical Powder (DCP) system, halon system, portable extinguisher.

UNIT V SAFETY IN MACHINE OPERATION: 10 Design for safety, lock out system, work permit system, safety in use of power press, cranes. Safety in foundry, forging, welding, hot working and cold working, electroplating and boiler operation. SAFETY AND LAW: Provisions in factory act for safety, explosive act, workmen compensation act, compensation calculation. Boiler act and pollution control act.

OUTCOMES:

Students must be able to • Maintain the industry without any risk in its operation • Improve the production • Analyze the hazards in maintenance and to solve it. • Identify and prevent chemical, environmental mechanical, fire hazard through analysis • Apply proper safety techniques on safety engineering and management.

TEXT BOOKS: 1. John Ridley, "Safety at Work", Butter Worth Publisher, Oxford, 1997. 2. Robinson C J and Ginder A P, "Implementing TPM", Productivity Press, USA, 1995.

REFERENCES: 1. Dhillon B S, "Maintainability, Maintenance and Reliability for Engineers", CRC Press, 2006. 2. Heinrich H W, "Industrial Accident Prevention", National Safety Council, Chicago, 1998. 3. National Safety Council, "Personal Protective Equipment", Bombay, 1998. 4. National Safety Council, "Accident Prevention Manual for Industrial Operations", Chicago, 1995. 5. Patrick A Michaud, "Accident Prevention and OSHA Compliance", CRC Press, 1995. 6. Derek James, "Fire Prevention Handbook", Butter Worth & Co., Oxford, 1991. 7. Dan Peterson, "Techniques of Safety Management", 1990.

Subject: NEURAL NETWORKS AND FUZZY SYSTEMS
Code: RB-PE601
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES: The student should be made to: • Learn the various soft computing frame works • Be familiar with design of various neural networks • Be exposed to fuzzy logic • Learn genetic programming • Be exposed to hybrid systems 98

UNIT I INTRODUCTION TO NEURAL NETWORKS 7 Differences between Biological and Artificial Neural Networks - Typical Architecture, Common Activation Functions, McCulloch - Pitts Neuron, Simple Neural Nets for Pattern Classification, Linear Separability - Hebb Net, Perceptron, Adaline, Madaline - Architecture, algorithm, and Simple Applications.

UNIT II PATTERN ASSOCIATION 7 Training Algorithms for Pattern Association - Hebb rule and Delta rule, Heteroassociative, Autoassociative and Iterative Auto associative Net, Bidirectional Associative Memory - Architecture, Algorithm, and Simple Applications.

UNIT III COMPETITION, ADAPTIVE RESONANCE AND BACK PROPAGATION NEURAL NETWORKS 13 Kohonen Self Organising Maps, Learning Vector Quantization, Counter Propagation - Architecture, Algorithm and Applications - ART1 and ART2 - Basic Operation and Algorithm, Standard Backpropagation Architecture, derivation of Learning Rules, Boltzmann Machine Learning - Architecture, Algorithm and Simple Applications.

UNIT IV CLASSICAL AND FUZZY SETS AND RELATIONS 6 Properties and Operations on Classical and Fuzzy Sets, Crisp and Fuzzy Relations - Cardinality, Properties and Operations, Composition, Tolerance and Equivalence Relations, Simple Problems.

UNIT V MEMBERSHIP FUNCTIONS 15 Features of membership function, Standard forms and Boundaries, fuzzification, membership value assignments, Fuzzy to Crisp Conversions, Lambda Cuts for fuzzy sets and relations, Defuzzification methods. APPLICATIONS: Neural Networks: Robotics, Image compression, Control systems - Fuzzy Logic: Mobile robot navigation, Autotuning a PID Controller.

OUTCOMES: Upon completion of the course, the student should be able to: • Apply various soft computing frame works • Design of various neural networks • Use fuzzy logic • Apply genetic programming • Discuss hybrid soft computing

TEXT BOOKS: 1. Sivanandam S N, Sumathi S, Deepa S N," Introduction to Neural Networks using Mat lab 6.0," Tata McGraw Hill Publications, New Delhi, 2006. 2. Timothy Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill, Singapore, 2002.

REFERENCES: 1. John Yen and Rezalangari, "Fuzzy Logic, Intelligence, Control and Information ", Pearson Education, New Delhi, 2007. 2. Mohammad H Hassoun, "Fundamentals of Neural Networks", Prentice hall of India, New Delhi, 2002.

Subject: INDUSTRIAL ROBOTICS AND MATERIAL HANDLING SYSTEMS
Code: RB-PE601
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES: • To introduce the basic concepts, parts of robots and types of robots. • To make the student familiar with the various drive systems for robot, sensors and their applications in robots and programming of robots. • To select the robots according to its usage. • To discuss about the various applications of robots, justification and implementation of robot. • To know about material handling in a system.

UNIT I INTRODUCTION

Types of industrial robots, Load handling capacity, general considerations in Robotic material handling, material transfer, machine loading and unloading, CNC machine tool loading, Robot centered cell.

UNIT II ROBOTS FOR INSPECTION

Robotic vision systems, image representation, object recognition and categorization, depth measurement, image data compression, visual inspection, software considerations.

UNIT III OTHER APPLICATIONS 8 Application of Robots in continuous arc welding, Spot welding, Spray painting, assembly operation, cleaning, robot for underwater applications.

UNIT IV END EFFECTORS 11 Gripper force analysis and gripper design, design of multiple degrees of freedom, active and passive grippers. SELECTION OF ROBOT: Factors influencing the choice of a robot, robot performance testing, economics of robotisation, Impact of robot on industry and society.

UNIT V MATERIAL HANDLING 12 Concepts of material handling, principles and considerations in material handling systems design, conventional material handling systems - industrial trucks, monorails, rail guided vehicles, conveyor systems, cranes and hoists, advanced material handling systems, automated guided vehicle systems, automated storage and retrieval systems(ASRS), bar code technology, radio frequency identification technology.

OUTCOMES: The Student must be able • Learn about the basic concepts, parts of robots and types of robots. • To design automatic manufacturing cells with robotic control using the principle behind robotic drive system, end effectors, sensor, machine vision robot kinematics and programming. • Ability in selecting the required robot • Know various applications of robots • Apply their knowledge in handling the materials.

TEXT BOOKS: 1. Richaerd D Klafter, Thomas Achmielewski and Mickael Negin, “Robotic Engineering – An integrated Approach” Prentice HallIndia, New Delhi, 2001. 2. Mikell P. Groover,”Automation, Production Systems, and Computer Integrated Manufacturing“, 2nd Edition, John Wiley & sons, Inc, 2007

REFERENCES: 1. James A Rehg, “Introduction to Robotics in CIM Systems”, Prentice Hall of India, 2002. 2. Deb S R, "Robotics Technology and Flexible Automation", Tata McGraw Hill, New Delhi, 1994

Subject: TOTALLY INTEGRATED AUTOMATION
Code: RB-PE601
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVES: • To gain knowledge in automation in industries. • To gain knowledge in various electrical and electronic programmable automations and their applications. • To know about the basic in SCADA and DCS systems. • To gain knowledge in communication protocols in an integrated system • To know about the advanced in automation industries

UNIT I TOTALLY INTEGRATED AUTOMATION: 9 Need, components of TIA systems, advantages, Programmable Automation Controllers (PAC), Vertical Integration structure.

UNIT II HMI SYSTEMS: 9 Necessity and Role in Industrial Automation, Need for HMI systems. Types of HMI- Text display - operator panels - Touch panels - Panel PCs - Integrated displays (PLC & HMI). Check with PLC 502 and remove

UNIT III SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA) 9 Overview – Developer and runtime packages – architecture – Tools – Tag – Internal &External graphics, Alarm logging – Tag logging – structured tags– Trends – history– Report generation, VB & C Scripts for SCADA application.

UNIT IV COMMUNICATION PROTOCOLS of SCADA 9 Proprietary and open Protocols – OLE/OPC – DDE – Server/Client Configuration – Messaging – Recipe – User administration – Interfacing of SCADA with PLC, drive, and other field device

UNIT V DISTRIBUTED CONTROL SYSTEMS (DCS) : 9 DCS – architecture – local control unit- programming language – communication facilities – operator interface – engineering interfaces. APPLICATIONS OF PLC & DCS: Case studies of Machine automation, Process automation, Introduction to SCADA Comparison between SCADA and DCS.

OUTCOMES: • Knowledge of PLC & PAC automation • Knowledge in HMI systems and to integrate it with other systems. • Ability to apply SCADA and usage of C programming for report generation • Acquiring information's on communication protocols in automation systems • Ability to design and develop automatic control system using distributed control systems.

TEXT BOOKS: 1. John.W.Webb & Ronald A. Reis, "Programmable logic controllers: Principles and Applications", Prentice Hall India, 2003. 2. Michael P. Lukas, "Distributed Control systems", "Van Nostrand Reinfold Company"1995 .

REFERENCES: 1. Win C C Software Manual, Siemens, 2003 2. RS VIEW 32 Software Manual, Allen Bradly, 2005 3. CIMPLICITY SCADA Packages Manual, Fanuc India Ltd, 2004

Subject: Total Quality Management
Code: RB-PE601
Contact Hours/week: 3L+1T
Credits: 3

OBJECTIVE: • To facilitate the understanding of Quality Management principles and process.

UNIT I INTRODUCTION

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention.

UNIT II TQM PRINCIPLES

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY MANAGEMENT SYSTEM

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration--ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001— Benefits of EMS.

OUTCOME: • The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXT BOOK: 1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.

REFERENCES: 1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8 th Edition, First Indian Edition, Cengage Learning, 2012. 2. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006. 3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006. 4. ISO 9001-2015 standards