PAAVAI ENGINEERING COLLEGE, NAMAKKAL – 637 018

(AUTONOMOUS)

B.E. MECHATRONICS ENGINEERING

REGULATONS - 2015

CURRICULUM

SEMESTER V

Course Code	Course Title	L	T	P	C
MT15501	Design of Machine Elements	3	2	0	4
EE15501	Power Electronics	3	0	0	3
MT15502	Sensors and Instrumentation	3	0	0	3
MT15503	CNC Technology	3	0	0	3
CH15501	Environmental Science and Engineering	3	0	0	3
MT1515*	Elective I	3	0	0	3
EE15506	Power Electronics Laboratory	0	0	4	2
MT15504	Sensors and Signal Processing Laboratory	0	0	2	1
MT15505	CNC Programming Laboratory	0	0	2	1
EN15501	Career Development Laboratory I	0	0	2	1
	Total	**18**	**2**	**10**	**24**

SEMESTER VI

Course Code	Course Title	L	T	P	C
BA15151	Professional Ethics and Human Values	3	0	0	3
MT15601	PLC and Microcontrollers	3	0	0	3
MT15602	Hydraulics and Pneumatics	3	0	0	3
MT15603	Thermodynamics and Heat Transfer	3	2	0	4
IT15605	Object Oriented Programming With C++	3	0	0	3
*******	Elective II	3	0	0	3
MT15604	PLC and Microcontrollers Laboratory	0	0	2	1
IT15608	Object Oriented Programming with C++ Laboratory	0	0	4	2
MT15605	Hydraulics and Pneumatics control Laboratory	0	0	2	1
EN15601	Career Development Laboratory II	0	0	2	1
	Total	**18**	**2**	**10**	**24**

LIST OF ELECTIVES

ELECTIVE I

Course Code	Course Title	L	T	P	C
MT15151	Advanced Manufacturing Processes	3	0	0	3
MT15152	Digital Signal Processing	3	0	0	3
MT15153	Maintenance Engineering	3	0	0	3
MT15154	Modeling and Simulation in Engineering	3	0	0	3
MT15155	Product Design and Costing	3	0	0	3

ELECTIVE II

Course Code	Course Title	L	T	P	C
MT15251	Industrial Engineering	3	0	0	3
MT15252	Design of Material Handling System	3	0	0	3
MT15253	Embedded System Design	3	0	0	3
BA15255	Entrepreneurship Development	3	0	0	3
MT15254	Non – Destructive Testing	3	0	0	3

SEMESTER V

DESIGN OF MACHINE ELEMENT

MT15501 **3 2 0 4**

(Use of PSG Design Data Book is permitted)

COURSE OBJECTIVES

- To describe the various steps involved in the design process.
- To identify the principles involved in evaluating the shape and dimensions of a component and to satisfy functional and strength requirements.
- To propose the standard practices and standard data.
- To extend the uses of catalogues and standard machine components.
- To design the simple machine elements shaft, coupling, joint, lever, spring, flywheel and bearing.

UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 15

Introduction to the design process - factor influencing machine design, selection of materials based on mechanical properties - Direct, Bending and Torsional stress equations - Impact loading - Calculation of principle stresses for various load combinations- Design of curved Beams - Crane hook and C frame - Factor of safety - The theories of Failure.

UNIT II DESIGN OF SHAFTS AND COUPLINGS 15

Design of solid and hollow shafts based on strength, rigidity and critical speed - Design of keys and key ways - Design of rigid and flexible couplings - Muff, Clamp, Rigid Flange, Bushed-pin flexible couplings .

UNIT III DESIGN OF JOINTS 15

Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints – Welded joints, Riveted joints for structures - theory of bonded joints.

UNIT IV DESIGN OF SPRINGS AND FLYWHEEL 15

Design of helical, multi- leaf and torsional springs under constant loads and varying loads - End conditions and length of springs - Stresses in Helical springs of circular wire - Wahl stress factor - Design of flywheels involving Stresses in rim and arm.

UNIT V DESIGN OF BEARINGS 15

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings - Somerfield Number - Raimondi And Boyd graphs - Selection of Rolling Contact bearings.

TOTAL PERIODS 75

COURSE OUTCOMES

At the end this course, students will be able to

- acquire knowledge about design process and the factors influencing it and design the simple components for static loading.
- categories the knowledge of life of the components subjected to varying loads.
- encompass grasped the concept the welded joints, threaded joints and springs subjected to static loads.
- formulate the design procedure for springs and flywheel.
- understand the rolling contact bearings for static and cyclic loads, select the lubricants and bearing dimensions for hydrodynamic lubrication.

TEXT BOOKS

1. Bhandari V, “Design of Machine Elements”, 3rd Edition, Tata McGraw-Hill Book Co, (2010).
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett “Mechanical Engineering Design”, 8th Edition, Tata McGraw-Hill, (2008).

REFERENCES

1. Sundararajamoorthy T. V. Shanmugam .N, “Machine Design”, Anuradha Publications, Chennai, (2003).
2. Robert C. Juvinall and Kurt M. Marshek, “Fundamentals of Machine Design”, 4th Edition, Wiley, (2005).
3. Alfred Hall, Halowenko, A and Laughlin, H., “Machine Design”, Tata McGraw-Hill Book Co (2011).
4. Bernard Hamrock, Steven Schmid,Bo Jacobson, “Fundamentals of Machine Elements”,2nd Edition, Tata
5. McGraw-Hill Book Co., (2006).
6. Orthwein W, “Machine Component Design”, Jaico Publishing Co, (2003).

WEB LINKS

1. https://mech.iitm.ac.in/meiitm/course/design-of-machine-elements/
2. http://www.readorrefer.in/article/Design-of-Shafts-and-Couplings_5901/
3. https://www.rroij.com/open-access/design-and-development-of-dual-mass- flywheel system.php?aid=54289

EE15501 POWER ELECTRONICS 3 0 0 3

COURSE OBJECTIVES

- To access knowledge on different types of power semi-conductor devices and their switching characteristics.
- To identify with the operation of converter and their firing circuits and different commutation techniques of power converters.
- To identify with the operation of various chopper conversion techniques and basics of resonance converter.
- To propose the mode of inverters and different modulation techniques.
- To propose the types of ac voltage controllers and basics of matrix converters.

UNIT I POWER SEMICONDUCTOR DEVICES 9

Study of switching devices, Diode, SCR, TRIAC, GTO, BJT, MOSFET, IGBT-Static and Dynamic Characteristics - Commutation: Natural Commutation, Forced commutation, self-commutation. snubber circuit.

UNIT II PHASE - CONTROLLED CONVERTERS 9

2-pulse, 3-pulse and 6-pulseconverters– performance parameters –Effect of source inductance— Gate Circuit Schemes for Phase Control–Dual converters.

UNIT III CHOPPER 9

Step-down and step-up chopper - control strategy–Forced commutated chopper–Voltage commutated, Current Commutated, switched mode regulators - Buck, boost, buck- boost converter. Introduction to Resonant Converters.

UNIT IV INVERTERS 9

Single phase and three phase voltage source inverters (both 120^0mode and 180^0mode) –PWM techniques: Current Sinusoidal PWM, modified sinusoidal PWM - multiple PWM – Introduction to space vector modulation – Source inverter - Introduction to multilevel inverter.

UNIT V AC VOLTAGE CONTROLLERS 9

Single phase and Three phase AC voltage controllers – Control strategy - Power Factor Control – Multistage Sequence control - single phase and three phase cyclo converters – Introduction to Matrix converters.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- identify and select the switching devices for different power converter applications.
- investigate the different converter based on the application.
- design a suitable dc power supply for given load specification from dc supply.
- design and analyze the single and three phase inverter.
- design an ac voltage controller electromagnetic compatibility of power converters.

TEXT BOOKS

1. M.H.Rashid, Power Electronics: Circuits, Devices Applications, Pearson, 2013.
2. M.D. Singh and Khanchandani K.B., Power Electronics, Tata Mc.Graw Hill., 2016
3. P. S. Bimbra, Power Electronics, Khanna Publishers, New Delhi, 2012.

REFERENCES

1. L.Umanand, Power Electronics Essentials and Applications, Wiley India Pvt Ltd,Reprint,2010.
2. G.K. Dubey, S.R. Doradla, A. Joshi and R.M.K. Sinha, Thyristorised Power Controllers, New Age International Publishers, 2012.
3. Ned Mohan,Tore M. Undeland and William P.Robins, Power Electronics – Converters, Applications and Design Third Edition, John Wiley and Sons, 2008.
4. R.S. Ananda Murthy and V. Nattarasu, Power Electronics: A Simplified Approach, Pearson/Sanguine Technical Publishers,2009
5. Daniel W.Hart, Power Electronics, McGraw-Hill Publishing Company Ltd, 2011.

WEB LINKS

1. http://www.completepowerelectronics.com/
2. http://www.irf.com/

MT15502 SENSORS AND INSTRUMENTATION 3 0 0 3

COURSE OBJECTIVES

- To achieve a knowledge of the basic laws governing the operation of electrical instruments and the measurement techniques.
- To discuss about units, standards, error analysis and characteristics of measurement systems.
- To plan and purpose of this course is to a make the students to get adequate knowledge about virtual instrumentation.

UNIT I SCIENCE OF MEASUREMENT 9

Units and Standards - Calibration techniques - Errors in Measurements - Generalized Measurement System - Static and dynamic characteristics of transducers - Generalized Performance of Zero Order and First Order Systems - Response of transducers to different Time varying inputs. Classification of transducers

UNIT II MECHANICAL MEASUREMENTS 9

Temperature measurement: Filled thermometer - bimetallic thermometer - Pressure measurement: manometers - elastic transducers - Bourdon gauge – bellows – diaphragm - Vacuum measurement: McLeod gauge - thermal conductivity gauge - Ionization gauge - Flow Measurement: orifice – venture – nozzle - pilot tube - turbine flow Meter -hot wire Anemometer.

UNIT III ELECTRICAL MEASUREMENTS 9

Potentiometer - RTD - Thermistor - Thermocouple - Strain gauges - LVDT - RVDT – Capacitive transducers - Piezo electric transducer - Pyrometers - load cell - Hall effect Transducers – Photoelectric transducers - Fiber Optic transducers -Electromagnetic Transducers - Anemometers – hygrometer.

UNIT IV SIGNAL CONDITIONING AND DATA ACQUISITION 9

Amplification, Filtering – Level conversion – Linearization - Buffering – Sample and Hold circuit –Multiplexer-Demultiplexer – Analog to Digital converter – Digital to Analog converter- Data Acquisition -Data Logging – Data conversion – Introduction to Digital Transmission system.

UNIT V VIRTUAL INSTRUMENTATION 9

Introduction to Lab VIEW - Graphical user interfaces - Data types - Data flow programming - Graphical programming - Palettes and tools Front panel objects - Functions and libraries - FOR Loops - WHILE Loops - Arrays and Clusters - Attribute modes Local and Global Variables - Data acquisition using DAQ card.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- identify the units and standards, their conversions, characteristics and error analysis of systems.
- describe the different devices available in mechanical measurements.
- classify and describe resistive, inductive and capacitive transducers which are used for measuring various parameters like displacement, temperature, humidity etc.
- design a signal conditioning circuit and data acquisition system.
- construct the lab view program for various applications and to know the use of lab view and daq card.

TEXT BOOKS

1. A.K.Sawhney and P.Sawhney, A Course on Mechanical Measurement Instrumentation and Control, Dhanpat Rai and Co, New Delhi, 2011.
2. Garry M. Johnson, Labview Graphical Programming, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2006.

REFERENCES

1. D. Patranabis, "Sensors and Transducers", PHI, New Delhi, 2nd Edition, 2010.
2. Ernest O. Doebelin, "Measurement Systems – Applications and Design", Tata McGrawHill, 2009
3. D. Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Company Limited, New Delhi, 2011

WEB LINKS

1. http://www.mfg.mtu.edu/cyberman/machtool/machtool/sensors/fundamental.html
2. http://sensorsandinstrumentation.co.uk/

MT15503 **CNC TECHNOLOGY** **3 0 0 3**

COURSE OBJECTIVES

- To identify the evolution and principle of CNC machine tools.
- To describe the constructional features of CNC machine tools.
- To construct the simple programs for CNC turning and machining centres.
- To describe the tooling and work holding devices for Cnc machine tools.
- To explain the CNC programs for popular CNC controllers.

UNIT I INTRODUCTION TO CNC MACHINE TOOLS 9

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

UNIT II STRUCTURE OF CNC MACHINE TOOL 9

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

UNIT III DRIVES AND CONTROLS 9

Spindle drives - DC shunt motor, 3 phase - AC induction motor - Feed drives - Stepper motor – Servo principle - DC and AC servomotors - Open loop and closed loop control - Axis measuring system - synchro, synchro-Resolver, gratings, moiré fringe gratings, encoders.

UNIT IV CNC PROGRAMMING 9

Coordinate system - Structure of a part program - G & M Codes - Tool length compensation – Cutter radius and tool nose radius compensation - Do loops, subroutines, canned cycles, mirror image, parametric programming - Machining cycles and programming for machining - Generation of CNC codes from CAM packages.

UNIT V TOOLING AND WORK HOLDING DEVICES 9

Introduction to cutting tool materials: Carbides, Ceramics, CBN, PCD inserts classification - PMK, NSH, holding qualified, semi qualified and preset tooling - Tooling system for machining centre and turning centre - Work Devices for rotating and fixed work parts - Economics of CNC - maintenance of CNC machines.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- identify the evolution, principles, classification and applications of cnc machine tools.
- define the basic structure, construction, working and control of cnc machines.
- identify the fundamentals of drive system and control modules of cnc technology.
- expand the program for cnc machines.
- propose the knowledge about different tooling and working holding devices of cnc.

TEXT BOOKS

1. P. Radhakrishnan, Computer Numerical Control Machine & Computer Aided Manufacturing, New Academic Science Limited.
2. Tilak Raj, CNC Technology & Programming, Dhanpat Rai publishing company(p) ltd., New Delhi

REFERENCES

1. P. N. Rao and N. K. Tiwari, Numerical Control and Computer Aided Manufacturing, Tata McGraw-Hill Publishing company, New Delhi
2. M. Adithan & B. S. Pabla, CNC Machines, New Age International Publishers , New Delhi
3. HMT Limited, "Mechatronics", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.

WEB LINKS

1. http://www.brighthubengineering.com/manufacturing-technology
2. https://www.scribd.com/doc/29051586/Introduction-of-CNC-Machine

CH15501 ENVIRONMENTAL SCIENCE AND ENGINEERING 3 0 0 3

COURSE OBJECTIVES

- To know the constituents of the environment and the precious resources in the environment.
- To conserve all biological resources.
- To understand the role of human being in maintaining a clean environment and useful environment for the future generations
- To acquire knowledge about ecological balance and preserve bio-diversity.
- To understand the role of government and non-government organizations in environment management.

UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES 9

Environment: Definition- scope - importance – need for public awareness. Forest resources: Use –over Exploitation- deforestation - case studies- mining - effects on forests and tribal people. Water resources: Use – Over utilization of surface and ground water- floods – drought - conflicts over water. Mineral resources: Use – 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. Land resources: Land as resource - land degradation - soil erosion. Role of an Individual in conservation of natural resources.

UNIT II ECOSYSTEMS AND BIODIVERSITY 9

Concept of an ecosystem: Structure and function of an ecosystem – producers - consumers –decomposers– Energy flow in the ecosystem – ecological succession – food chains - food webs and ecological pyramids. Types of ecosystem: Introduction - characteristic features - forest ecosystem – grassland ecosystem - desert Ecosystem - aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). Biodiversity: Introduction– Definition (genetic - species –ecosystem) diversity. Value of biodiversity: Consumptive use - productive use – Social values – ethical values - aesthetic values. Biodiversity level: Global - national - local levels- India as a Mega diversity nation- hotspots 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.

UNIT III POLLUTION 9

Pollution: Definition –air pollution - water pollution - soil pollution - marine pollution - noise pollution – thermal pollution – nuclear hazards. Solid waste management: Causes - effects - control measures of urban and industrial wastes. Role of an individual in prevention of pollution - pollution case studies. Disaster management: Floods – earthquake - cyclone - landslides. Electronic waste-Sources-Causes and its effects.

UNIT IV SOCIAL ISSUES AND ENVIRONMENT 9

Sustainable development : Unsustainable to sustainable development – urban problems related to energy. Water conservation - rain water harvesting - watershed management. Resettlement and rehabilitation of people. Environmental ethics: Issues - possible solutions – climate change - global warming and its effects on flora and fauna - acid rain - ozone layer depletion - nuclear accidents - nuclear holocaust - wasteland reclamation - consumerism and waste products. Environment protection act: Air (Prevention and Control of Pollution) act – water (Prevention and control of Pollution) act – wildlife protection act – forest conservation act – issues involved in enforcement of environmental legislation.

UNIT V HUMAN POPULATION AND ENVIRONMENT 9

Human population: Population growth - variation among nations – population explosion – family welfare programme and family planning – environment and human health – Human rights – value education – HIV / AIDS, Swine flu – women and child welfare. Role of information technology in environment and human health.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- explain the relationship between the human population and environment.
- elaborate the basic concepts of environment studies and natural resources.
- gain the knowledge about ecosystem and biodiversity.
- have knowledge about causes, effects and control measures of various types of pollution.
- understand the social issues and various environmental acts.

TEXT BOOKS

1. Raman Sivakumar, Introduction to Environmental Science and Engineering, 2nd Edn, TataMcGraw Hill Education Private Limited, New Delhi,(2010).
2. Benny Joseph, "Environmental Science and Engineering", Tata McGraw Hill, (2010).

REFERENCES

1. BharuchaErach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad India,2010 .
2. S. Divan, Environmental Law and Policy in India, Oxford University Press, New Delhi, 2001.
3. K.D. Wager, Environmental Management, W.B. Saunders Co., Philadelphia, USA, 1998.
4. W.P. Cunningham, Environmental Encyclopedia, JaicoPublising House, Mumbai, 2004.
5. Clair Nathan Sawyer, Perry L. McCarty, Gene F. Parkin, "Chemistry for Environmental

WEB LINKS

1. www.chegg.com
2. www.vidhyarathiplus.com

EE15506 POWER ELECTRONICS LABORATORY 0 0 4 2

COURSE OBJECTIVES

- To study the characteristics of switching devices and its applications of rectifiers, inverters, choppers and ac voltage controllers, and it's controlling techniques.

LIST OF EXPERIMENTS

1. Characteristics of SCR and TRIAC.
2. Characteristics of MOSFET and IGBT.
3. Gate Pulse Generation using R, RC and UJT.
4. Voltage commutation.
5. Current commutation.
6. AC to DC half controlled converter.
7. AC to DC fully controlled converter.
8. Step down and step up MOSFET based choppers.
9. IGBT based single phase PWM inverter.
10. IGBT based three phase PWM inverter.
11. AC Voltage controller.
12. Cyclo converter.

TOTAL PERIODS 60

COURSE OUTCOMES

At the end this course, students will be able to

- compare and contrast the performance and applications of various power semi converter devices.
- design the various phase controlled rectifiers with different loads.
- analyze the chopper circuit using MOSFET and IGBT.
- design and analyze the various PWM inverters.
- evaluate the performance of AC voltage converters.

MT15504 SENSORS AND SIGNAL PROCESSING LABORATORY 0 0 2 1

COURSE OBJECTIVES

- To provide knowledge about sensor and signal processing.
- To provide hand experience to measure different signal using sensor and processing them in required form.

LIST OF EXPERIMENTS

1. Measurement of temperature using thermistor and RTD
2. Measurement of temperature using thermocouple
3. Measurement of displacement using POT & Capacitive transducer
4. Measurement of displacement using LVDT
5. Strain Measurement using strain gauge
6. Servomotor position control using photo electric pickup
7. Load Cell Measurement
8. Torque measurement using torque measuring devices
9. Digital Comparator
10. Analog to Digital Converters
11. Position and velocity measurement using encoders
12. Study on the application of data acquisition system for industrial purposes.

TOTAL PERIODS 30

COURSE OUTCOMES

At the end this course, students will be able to

- choose the sensors for the measurement of different signals.
- analyze the servomotor position control using photo electric pickup.
- create the appropriate design procedure to obtain a required measurement data for displacement.
- identify the signal processing techniques to convert them to useful signal.
- describe the data acquisition system for industrial purposes

TEXT BOOKS

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

MT15505 CNC PROGRAMMING LABORATORY 0 0 2 1

COURSE OBJECTIVES

- To design problems in a systematic manner.
- To instruct the manual and computer assisted part programming, tool path generation operation and control of CNC machines tools.

LIST OF EXPERIMENTS

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

TOTAL PERIODS 30

COURSE OUTCOMES

At the end this course, students will be able to

- program in the cnc machines to generate any contour/ profile.
- generate the part programs for cnc lathe.
- develop the cnc program for machining centre.
- sketch the drawings of standard machine components using any modelling software.
- develop the cnc program for pocket milling, slotting, peck drilling and other fixed canned cycles.

REFERENCES

1. T1. William W. Lugges, CNC A First Look Primer, Delmar Publishers, New York, (1997)
2. Alan Overby, CNC Machining Handbooks: Building, Programming and Implementation, McGraw-Hill Publishing Company Ltd, New York,(2011)

WEB LINKS

1. http://www.sosmath.com/matrix/matrix.html

EN15501 CAREER DEVELOPMENT LABORATORY I 0 0 2 1

COURSE OBJECTIVES

- To understand their capabilities & enhance their grooming and showcasing his/ her capabilities to a prospective employer
- To provide opportunity for the students to become acquainted with corporate opportunities relevant to their academic learning
- To articulate their thoughts on a given topic – in english and also to make decent write ups in english on any given topic
- To practice & score well in aptitude tests conducted by corporates / prospective employers
- To prepare for any group discussion evaluation or presenting their credentials during a face- to-face interview leading to selection and employment
- To become a knowledgeable person on the various evaluation processes leading to employment.

UNIT I PERSONALITY DEVELOPMENT 1 6

Introduction – self explorations – character building – self esteem- self confidence- positive thinking – leadership qualities- time management.

UNIT II PERSONALITY DEVELOPMENT 2 6

Grooming- role play – good etiquettes - extempore - writing skills: email, paragraph – team building- body language - non verbal communication

UNIT III QUANTITATIVE APTITUDE (QA) 1 6

Time , speed and distance -- simple interest & compound interest – percentage – height and distance – time and work – number systems – L.C.M and H.C.F – ratio proportion- area – directions.

UNIT IV LOGICAL REASONING (LR) 1 6

Analogies - letter and symbol series – number series – cause and effect – essential part – verbal reasoning.

UNIT V VERBAL REASONING (VR) 1 6

Blood relation – venn diagrams – analogy – character puzzles – logical sequence – classifiction –verification of truth – seating arrangement

TOTAL PERIODS 30

COURSE OUTCOMES

At the end this course, students will be able to

- demonstrate aptitude and reasoning skills
- enhance verbal & written ability.
- improve his/her grooming and presentation skills.
- interact effectively on any recent event/happenings/ current affairs.
- be a knowledgeable person on the various evaluation processes leading to employment and face the same with confidence.

REFERENCES

1. Agarwal, R.S.” A Modern Approach to Verbal & Non Verbal reasoning”, S.Chand & co ltd, New Delhi.
2. Abhijit guha, “Quantitative Aptitude “, Tata-Mcgraw hill.
3. word power made easy by norman lewis ,W.R.Goyal publications.
4. Johnson, D.W. reaching out – interpersonal effectiveness and self actualization.Boston: Allyn and Bacon.
5. Agarwal, R.S.“ objective general English”,S.Chand & co
6. Infosys campus connect program – students’ guide for soft skills.

SEMESTER VI

BA15151 PROFESSIONAL ETHICS AND HUMAN VALUES 3 0 0 3

COURSE OBJECTIVES

- To understand the basic human values for a professional.
- To discuss the significance of ethics in engineering and the theories related to it.
- To familiarize oneself with the role of engineer as responsible experimenters.
- To expose the students to their roles and responsibilities in assessing safety and reducing risks.
- To describe the global issues in ethics and role of engineers as manager and consultants.

UNIT I HUMAN VALUES 9

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.

UNIT II ENGINEERING ETHICS 9

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 9

Engineering as experimentation - engineers as responsible experimenters - codes of ethics – a balanced outlook on law - the challenger case study.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and risk - assessment of safety and risk - risk benefit analysis and reducing risk – the Three Mile Island and Chernobyl case studies. Collegiality and loyalty - respect for authority - collective bargaining - confidentiality - conflicts of interest - occupational crime - professional rights - employee rights - Intellectual Property Rights (IPR) - discrimination.

UNIT V GLOBAL ISSUES 9

Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers-consulting engineers-engineers as expert witnesses and advisors - moral leadership-sample code of Ethics like ASME, ASCE, IEEE, Institution of Engineers(India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers(IETE),India, etc.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- describe the basic human values for a professionals.
- understand the significance of ethics in engineering and the theories related to it.
- be familiar with the role of engineer as responsible experimenters.
- acquire knowledge about their roles and responsibilities in assessing safety and reducing risks.
- discuss the global issues in ethics and role of engineers as manager and consultants.

TEXT BOOKS

1. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw Hill, New York (2005).
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, “Engineering Ethics –Concepts and Cases”, Thompson Learning, (2000).

REFERENCES

1. Charles D Fleddermann, “Engineering Ethics”, Prentice Hall, New Mexico, (1999).
2. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, (2003).
3. Edmund G Seebauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University Press, (2001).
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, “Business Ethics – An Indian Perspective”,Biztantra, New Delhi, (2004).
5. David Ermann and Michele S Shauf, “Computers, Ethics and Society”, Oxford University Press, (2003).

MT15601 PLC AND MICROCONTROLLERS 3 0 0 3

COURSE OBJECTIVES

- To provide a clear view on programmable logic controllers (PLC).
- To propose the various methods involved in automatic control and monitoring.
- To develop the plc program for various applications.
- To examine the basic features, programs and applications of micro controllers.

UNIT I PROGRAMMABLE LOGIC CONTROLLERS 9

Introduction - Parts of PLC - Principles of operation - PLC sizes - PLC hardware components - I/O section- Analog I/O modules - digital I/O modules CPU processor memory module – PLC programming Simple instructions - Output control devices - Latching relays PLC ladder Diagram, Converting simple relay ladder Diagram in to PLC relay ladder diagram.

UNIT II INSTRUCTIONS 9

Timer instructions ON Delay, OFF Delay and Retentive Timers-UP Counter, DOWN Counter and UP down Counters, program control instructions - Data manipulating instructions-math Instructions.

UNIT III APPLICATION OF PLC 9

Simple materials handling applications, Automatic control of warehouse door, Automatic lubrication of supplier Conveyor belt, motor control, Automatic car washing machine, Bottle Label detection and process control application.

UNIT IV INTRODUCTION TO MICROCONTROLLER 9

8051 Architecture: Memory map - Addressing modes, I/O Ports –Counters and Timers – Serial data - I/O – Interrupts –Instruction set, Data transfer instructions, Arithmetic and Logical Instructions, Jump and Call Instructions, Assembly Language Programming tools.

UNIT V MICROCONTROLLER PROGRAMMING AND ITS APPLICATIONS 9

8051 Assembly Language Programming- arithmetic operations-Interfacing of Keyboards – Interfacing of Display Devices – Pulse measurement – Interfacing Hardware Circuit – Serial Data Communication – Network Configuration.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- identify the different parts of plc and its functions.
- analyze the use of timers and counters in plc.
- develop the plc program for various applications.
- know about the architecture of microcontroller.
- learn the theory, programming and application of microcontroller.

TEXT BOOKS

1. Petruzella Frank D, Programmable Logic Controllers, Tata McGraw-Hill Publishing (p) Ltd., New Delhi, 2010.
2. Muhammad Ali Mazdi ,J.G.Mazdi & R.D.McKinlay “The 8051 Microcontroller& Embedded systems Using assembly & C “ 2nd Edition Pearson Education , Inc ,2006.

REFERENCES

1. Parr, "Programmable Controllers: An Engineers Guide", 3rd Edition, Elsevier, Indian Reprint, 2013.
   Bolton , "Programmable Logic Controllers 5th Edition Newnes,2009.
2. Singh. B.P., "Microprocessors and Microcontrollers", Galcotia Publications (P) Ltd, First Edition, New Delhi, 1997.

WEB LINKS

1. http://electrical-engineering-portal.com/basic-steps-in-plc-programming
2. http://www.plcmanual.com/

MT15602 HYDRAULICS AND PNEUMATICS 3 0 0 3

COURSE OBJECTIVES

- To identify the concepts of fluid power.
- To examine the fundamental knowledge of hydraulic and pneumatic system.
- To design and operation of hydraulic and pneumatic components and systems.
- To use application in manufacturing and mechanical systems.
- To identify the design of hydraulic and pneumatic circuits applied in industries.

UNIT I FLUID POWER SYSTEMS 9

Introduction to Fluid power- Advantages and Applications- Fluid Power ANSI Symbols- Types of fluids- Properties of fluids – Pascal's law and Applications–Basics of Hydraulics – Principles of flow –Pump Classification- Pump characteristics- Construction, Working, Performance, Selection criteria of pumps, Advantages, Disadvantages.

UNIT II HYDRAULIC ACTUATORS AND VALVES 9

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.

UNIT III HYDRAULIC SYSTEMS 9

Intensifiers, Industrial hydraulic circuits- Regenerative, Pump Unloading, Double-pump, Pressure Intensifier, Air-over oil, Reciprocation, Synchronization, Sequencing, Fail-safe, Speed Control, Hydrostatic transmission, Electro Hydraulic circuits.

UNIT IV PNEUMATIC SYSTEMS 9

Properties of air– Perfect Gas Laws- Filter, Regulator, Lubricator-Pneumatic actuators, Design of pneumatic Circuit cascade method-Electro pneumatic circuits. Accumulators: types and applications.

UNIT V TROUBLE SHOOTING AND APPLICATIONS 9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems-Case studies and Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift Applications. Design of Pneumatic circuits for a Pick and Place application - Case studies.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- illustrate symbols used in hydraulic and pneumatic systems.
- identify the appropriate components for hydraulic and pneumatic circuits .
- operate and maintain various pneumatic and hydraulic systems in industrial environments.
- design the hydraulic and pneumatic circuits for simple application.
- construct the fluid power circuits applied in industries.

TEXT BOOKS

1. Anthony Esposito, "Fluid Power with Applications", Pearson, (2009).
2. S. R. Majumdar, "Pneumatic systems - Principles and maintenance", Tata McGraw Hill, (2014).

REFERENCES

1. James L. Johnson, “Introduction to Fluid Power”, Delmar Thomson Learning, (2013).
2. Andrew Parr, “Hydraulics and Pneumatics”, Jaico Publishing House, (2015).
3. Illangov Soundarrajan, “Introduction to Hydraulics and Pneumatics, Prentice hall of India, New Delhi, (2015)
4. S. R. Majumdar, “Oil Hydraulics”,Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi, (2014).
5. Pinches, “Industrial Fluid Power”, Prentice hall, New Delhi, (2008).

WEB LINKS

1. http://www.jmpeng.com/wp-content/uploads/2014/03/PickFlex-CaseStudy.pdf
2. http://www.arozone.com/en/products/diaphragm-pumps.html
3. http://hydraulicspneumatics.com/datasheet/bluetooth-and-smartphones-configure-hard-reach-hydraulic- valves-pdf-download

MT15603 **THERMODYNAMICS AND HEAT TRANSFER** **3 2 0 4**

(Approved Heat and Mass Transfer Data Book is Allowed)

COURSE OBJECTIVES

- To access the knowledge on laws of thermodynamics concepts, principles and mechanism for physical systems.
- To identify the applications of air standard cycles.
- To familiar the application of various experimental heat transfer correlations in engineering calculations.

UNIT I LAWS OF THERMODYNAMICS 15

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

UNIT II AIR STANDARD CYCLES 15

Air standard cycles: Carnot cycle - Otto cycle - Diesel cycle - Brayton cycle - Rankine cycle- cycle efficiency – IC Engine: two stroke and four stroke engines.

UNIT III HEAT TRANSFER: CONDUCTION 15

Basic Concepts- Mechanism of Heat Transfer - Conduction, Convection and Radiation - Fourier Law of Conduction - General Differential equation of Heat Conduction -Cartesian and Cylindrical Coordinates - One Dimensional Steady State Heat Conduction

UNIT IV CONVECTION 15

Convection: Basic Concepts -Heat Transfer Coefficients - Boundary Layer Concept - Types of Convection - Forced Convection - External Flow and Internal Flow - Flow over Plates, Cylinders and Spheres.

UNIT V RADIATION 15

Basic Concepts, Laws of Radiation - Stefan Boltzmann Law, Kirchhoff's Law -Black Body Radiation and Radiation Between different surfaces.

TOTAL PERIODS 75

COURSE OUTCOMES

At the end this course, students will be able to

- examine the laws and basic concept of thermodynamics.
- draw pv diagram and obtain the performance of air standard cycles.
- examine the one dimensional heat transfer through conduction for a given system.
- explain the types of convection and determine heat transfer coefficient.
- justify the radiation effect among different surfaces.

TEXT BOOKS

1. P. K. Nag, Engineering Thermodynamics, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2008.
2. C. P. Kothandaraman , Fundamentals of Heat and Mass Transfer, 3rd edition, New Age International publishers, New Delhi, 2006.
3. Using assembly & C " 2nd Edition Pearson Education , Inc ,2006.

REFERENCES

1. Yunus A. Cengel and Michael A. Boles, Thermodynamics - An Engineering Approach in SI Units, Tata McGraw Hill Publishing Company, New Delhi, 2010.
2. T. D. Eastop and McConkey, Applied Thermodynamics for Engineering Technologists, Pearson, New Delhi, 2004.
3. C. P. Kothandaraman and S. Subramanya, 8th Edition Heat and Mass Transfer Data Book, New Age International publishers, New Delhi, 2014.

IT15605 OBJECT ORIENTED PROGRAMMING WITH C++ 3 0 0 3

COURSE OBJECTIVES

- To learn the basic concepts of Object Oriented Programming.
- To learn the basics of C++ language..
- To know about C++ data types, access modifiers, classes and objects.
- To work on identifying the relationship between classes.
- To know about master of Object Oriented Programming using C++.

UNIT I INTRODUCTION TO C++ 9

Object oriented programming concepts - Introduction to C++ - Tokens – Keywords – Identifiers and constants– Basic data types– User defined data types – Derived data types – Symbolic constants – Declaration of variables – Dynamic initialization of variables – Reference variables – Operators in C++ – Scope resolution operator – Manipulators – Expressions and their types – Control structures - The main function – Function prototyping – Call by reference – Return by reference – Inline functions – Default arguments –Function overloading.

UNIT II CLASSES AND OBJECTS 9

Specifying a class – Defining member functions – Private member functions –Arrays within a class – Memory allocation for objects – Static data members – Static member functions – Arrays of objects – Objects as function arguments –Friendly functions – Returning objects. Constructors: Parameterized constructors – Multiple constructors in a class – Constructors with default arguments – Dynamic initialization of objects – Copy constructor – Dynamic constructors – Destructors.

UNIT III OPERATOR OVERLOADING AND INHERITANCE 9

Defining operator overloading: Overloading unary, binary operators. Manipulation of strings using operators – Rules for overloading operators – Type Conversions - Defining derived classes – Single inheritance – Multilevel Inheritance – Multiple inheritance –Hierarchical inheritance – Hybrid inheritance – Virtual base classes – Abstract classes.

UNIT IV POLYMORPHISM AND TEMPLATES 9

Introduction to pointers to objects: This pointer – Pointers to derived classes – Virtual functions – Pure virtual functions. Function templates, user defined template arguments, class templates.

UNIT V EXCEPTION HANDING AND GENERIC PROGRAMMING 9

Exception Handling: Exception handling mechanism, multiple catch, nested try, rethrowing the exception – Namespaces – std namespace- Standard Template Library.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- identify and apply object oriented concepts like abstraction, encapsulation, modularity, hierarchy, typing, concurrency and persistence.
- relate real world object into entity.
- create reusable system components.
- estimate various metrics specific to object oriented development.

- predict runtime error using exception handling technology.

TEXT BOOK

1. E.Balagurusamy, “Object Oriented Programming with C++”, Tata McGraw Hill, Sixth Edition, 2013.

REFERENCES

1. Ira Pohl, “Object Oriented Programming using C++”, Pearson Education, Second Edition Reprint 2004.
2. S. B. Lippman, JoseeLajoie, Barbara E. Moo, “C++ Primer”, Fourth Edition, Pearson Education, 2005.
3. B. Stroustrup, “The C++ Programming language”, Third edition, Pearson Education, 2004.
4.

WEB LINKS

1. http://nptel.ac.in/courses/106105151/
2. https://www.tutorialspoint.com/cplusplus/cpp_object_oriented.htm
3. http://www.studytonight.com/cpp/cpp-and-oops-concepts.php

MT15604 PLC AND MICROCONTROLLERS LABORATORY 0 0 2 1

COURSE OBJECTIVES

- To provide a clear view on programmable logic controllers and learn the various methods involved in automatic control and monitoring.
- To describe the uses of microcontroller.

LIST OF EXPERIMENTS

1. Study of Programmable Logic Controllers
2. Linear actuation of hydraulic cylinder with counter and speed control.
3. Hydraulic rotation with timer and speed control.
4. Sequential operation of pneumatic cylinders
5. Traffic light controller
6. Linear actuation of hydraulic cylinder with counter and speed control.
7. Automate the tank water level and flow control using PLC
8. Bottle filling process using PLC
9. Study of Microcontroller Kits.
10. 8051 / 8031 Programming (Addition and subtraction)
11. 8051 / 8031 Programming (Multiplication and Division)
12. Stepper Motor interface

TOTAL PERIODS 30

COURSE OUTCOMES

At the end this course, students will be able to

- compose the plc program for various applications like bottle filling, cylinder actuation and elevator control.
- choose plc software packages.
- choose plc to control different motor/equipment.
- choose microcontroller for interfacing.
- compose the microcontroller programming.

IT15608	OBJECT ORIENTED PROGRAMMING WITH C++ LABORATORY	0	0	4	2

COURSE OBJECTIVES

- To know fundamental knowledge of object oriented programming.
- To demonstrate C++ syntax and semantics.
- To solve simple engineering problems.
- To know the development of solution for complex problems in the real world.

LIST OF EXPERIMENTS

1. Write C++ Programs using Classes and Objects.
2. Design C++ Classes with static members, methods with default arguments, friend functions.
3. Develop C++ Programs using Operator Overloading.
4. Develop C++ Programs using constructor, destructor, and copy constructor.
5. Develop C++ Programs Overload the new and delete operators.
6. Develop C++ Programs using Inheritance, Polymorphism and its types.
7. Develop C++ Programs using Arrays and Pointers.
8. Develop C++ Programs using Dynamic memory allocation.
9. Develop C++ Programs using Function Templates.
10. Develop C++ Programs using Exceptions Handling.
11. Write C++ Programs using Classes and Objects.
12. Design C++ Classes with static members, methods with default arguments, friend functions.

TOTAL PERIODS 60

COURSE OUTCOMES

At the end this course, students will be able to

- understand object-oriented concepts and how they are supported by C++.
- demonstrate the ability to analyze, use, and create functions, classes, to overload operators.
- create and initialize real world entities using constructors.
- understand and use Exception handling and file handling mechanism.
- apply the concepts of data encapsulation, inheritance, and polymorphism to develop large scale software.

RECOMMENDED SYSTEM/SOFTWARE REQUIREMENTS

Software: Turbo C++.

Hardware: Flavor of any WINDOWS or LINUX and Standalone desktops 30 Nos.

MT15605 HYDRAULICS AND PNEUMATICS CONTROL LABORATORY 0 0 2 1

COURSE OBJECTIVES

- To invent and provide hand on experience to students to design and test hydraulic circuit to control press, flow.
- To gain to design and test hydraulic, pneumatic circuits.
- To design and test the pneumatic circuit to perform basic operations.

LIST OF EXPERIMENTS

1. Fluid power standards.
2. Study of Hydraulics systems components.
3. Study of Pneumatic systems components.
4. Design of pressure control of Pneumatic circuit
5. Design of Meter in Circuit.
6. Design of Meter out Circuit.
7. Design of Speed control circuit for double acting Pneumatic cylinder.
8. Design of Hydraulic press Circuit.
9. Design of Hand operated Pneumatic Double Acting Cylinder using fluid power simulation software
10. Design of Hydraulic cylinder reciprocating system using fluid power simulation software
11. Design and Testing of two Pneumatic Double Acting Cylinder Sequencing circuit (A+ B+ B- A-) using fluid
12. Design and Testing of Pneumatic two Double Acting Cylinder Synchronization circuits. (Cylinders connected in Series and Parallel) using fluid power simulation software.

TOTAL PERIODS 30

COURSE OUTCOMES

At the end this course, students will be able to

- find the experience of common hydraulics & pneumatic machine used in the industries.
- get to use hydraulic actuators
- construct the fluid system for various applications.
- know the use of automation studio software for simulation of hydraulic circuits.
- know the use of automation studio software for simulation of pneumatic circuits.

EN15601 CAREER DEVELOPMENT LABORATORY II 0 0 2 1

COURSE OBJECTIVES

- To enhance career competency and employability skills
- To demonstrate effective leadership and interpersonal skills
- To improve professional capabilities through advanced study and researching current market strategy.
- To develop problem solving and decision making capabilities

UNIT I CORPORATE READINESS 6

Business Communication – Inter and Intra Personal skills – Business Etiquettes – Corporate ethics – Communication media Etiquette.

UNIT II INTERVIEW SKILLS 6

Resume building – Group discussions – Presentation skills – Entrepreneur skills – Psychometric assessment – Mock interview.

UNIT III QUANTITATIVE APTITUDE (QA) 2 6

Profit and Loss – Clock – Power and Square roots – Train – Boats and streams – Probability – Calendars – Permutations and Combinations - Partnership – Simplification – Pipes and Cisterns – Puzzles.

UNIT IV LOGICAL REASONING (LR) 2 6

Statements and Assumptions – Matching Definitions – Logical Games – Making judgments – Statements and conclusions – Verbal classifications.

UNIT V VERBAL REASONING (VR) 2 6

Syllogisms – Data sufficiency – Dice – Series completion – Character puzzles – cube and cuboids – Arithmetic Reasoning.

TOTAL PERIODS 30

COURSE OUTCOMES

At the end this course, students will be able to

- develop team work capabilities
- boost their problem solving skills
- enhance the transformation from college to corporate.

REFERENCES

1. Agarwal, r.s.” a modern approach to verbal & non verbal reasoning”, , S.Chand & co ltd, New Delhi.
2. Abhijit guha, “quantitative aptitude for competitive examinations “, Tata Mcgraw hill
3. Word power made easy by norman lewis ,wr.goyal publications.
4. Johnson, d.w. (1997). Reaching out – interpersonal effectiveness and self Actualization -- Boston: Allyn and bacon.
5. Infosys Campus Connect Program – students’ guide for soft skills.
6. Mitra ,barun.k, “ Personalaity Development & Softskills “ , Oxford University.

MT15151 ADVANCED MANUFACTURING PROCESSES 3 0 0 3

COURSE OBJECTIVES

- To identify the several non-traditional machining process in micro and precision manufacturing field.
- To select the suitable machining process for materials considering their merits and demerits.
- To strengthen the graduates' ability to work productively in a global manufacturing environment.

UNIT I ADVANCED MACHINING PROCESSES 9

Introduction - Classification - process economy - Mechanical machining - Types - Ultrasonic machining (USM) - Abrasive Jet Machining (AJM) - Abrasive Flow Machining (AFM) - Water Jet Machining (WJM) - Operating principle - Process parameters - Applications - Limitations.

UNIT II ELECTRO CHEMICAL MACHINING 9

Electro chemical machining - Chemical material removal - Types - Electro chemical machining (ECM) - Electro chemical drilling (ECD) - Electro chemical grinding (ECG) - Electro chemical honing (ECH) - Shaped tube electrolytic machining - Operating principle - Process parameters - Applications - Limitations.

UNIT III THERMO ELECTRICAL MACHINING 9

Thermo electrical machining - Types – Electrical discharge machining (EDM) - Electrical discharge wire cutting (EDWC) - Electron beam machining (EBM) - Ion Beam Machining (IBM) - Plasma Arc Machining (PAM) - Operating principle - Process parameters - Applications - Limitations

UNIT IV LASER MATERIALS PROCESSING 9

Laser materials processing - Laser types - Processes - Laser beam machining (LBM) – Laser cutting (LC) – Laser drilling (LD) - Laser marking and engraving (LM) - Laser micromachining (LMM) - Laser engineered net shaping (LENS) - Applications - Limitations.

UNIT V SPECIAL PROCESSING TECHNOLOGIES 9

Special processing technologies - Rapid Prototyping - Methods - Fused Deposition Modeling (FDM) - Laminated Object Manufacturing (LOM) - Selective laser sintering (SLA) - Solid Ground curing (SGC) - 3D printing (3DP) - Processing of integrated circuits - Micro and nano fabrication technologies.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- identify the contribution of non-traditional machining process in micro and precision manufacturing.
- select the most appropriate process for a given product design, application requirements and cost constraint..
- summarize the merits and demerits of the non-traditional manufacturing process.
- identify the principles of non-traditional manufacturing system.
- invent subtractive and additive (3d-printing) manufacturing for rapid prototyping.

TEXT BOOKS

1. Abdel, H. and El-Hofy, G. “Advanced Machining Processes”, McGraw-Hill, USA, 2005.
2. Wellar, E.J. "Non-Traditional Machining Processes", Society of Manufacturing Engineers Publications, 2nd Edition, Michigan, 1984.

REFERENCES

1. Steen, W.M. and Watkins, K. “Laser Materials Processing”, Springer London Ltd, 2003.
2. Groover, M.P. “Fundamentals of modern manufacturing processes - Materials, Processes and Systems”, 3rd

MT15152 DIGITAL SIGNAL PROCESSING 3 0 0 3

COURSE OBJECTIVES

- To introduce discrete fourier transform and its applications.
- To list signal processing concepts in systems having more than one sampling frequency.
- To define structure and techniques of IIR filter.
- To define structure and techniques of FIR filter.
- To teach the design of infinite and finite impulse response filters for filtering undesired signals.

UNIT I SIGNALS AND SYSTEMS 9

Basic elements of DSP – concepts of frequency in Analog and Digital Signals – sampling theorem – Discrete – Time signals, systems – Analysis of discrete time LTI systems – Z transform – Convolution–Correlation.

UNIT II FREQUENCY TRANSFORMATIONS 9

Introduction to DFT – Properties of DFT – Circular Convolution - Filtering methods based on DFT – FFT Algorithms – Decimation – in – time Algorithms, Decimation – in – frequency Algorithms – Use of FFT in Linear Filtering – DCT – Use and Application of DCT.

UNIT III IIR FILTER DESIGN 9

Structures of IIR – Analog filter design – Discrete time IIR filter from analog filter – IIR filter design by Impulse Invariance, Bilinear transformation, Approximation of derivatives – (LPF, HPF, BPF,BRF) filter design using Frequency translation.

UNIT IV FIR FILTER DESIGN 9

Structures of FIR – Linear phase FIR filter – Fourier Series - Filter design using windowing techniques (Rectangular Window, Hamming Window, Hanging Window), Frequency sampling techniques

UNIT V FINITE WORD LENGTH EFFECTS IN DIGITAL FILTERS 9

Binary fixed point and floating point number representations – Comparison - Quantization noise –truncation and rounding – quantization noise power- input quantization error- coefficient Quantization error – limit cycle Oscillations-dead band- Overflow error-signal Scaling.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- know the discrete fourier transform and its applications.
- perform frequency transforms for the signals.
- design IIR filters.
- design FIR filters.
- construct finite word length effects in digital filters.

TEXT BOOKS

1. John G. Proakis and DimitrisG.Manolakis, “Digital Signal Processing – Principles, Algorithms& Applications”, Fourth Edition, Pearson Education, Prentice Hall, (2015).

REFERENCES

1. Emmanuel C.Ifeachor, and Barrie.W.Jervis, "Digital Signal Processing", Second Edition, Pearson Education, Prentice Hall, (2012).
2. Sanjit K. Mitra, "Digital Signal Processing – A Computer Based Approach", Third Edition, Tata McGraw Hill, (2012).
3. A.V.Oppenheim, R.W. Schafer and J.R. Buck, Discrete-Time Signal Processing, 8th Indian Reprint, Pearson, (2014).
4. Andreas Antoniou, "Digital Signal Processing", Tata McGraw Hill, (2015).

WEB LINKS

1. http://www. signals and systems .html
2. http://www. filter design.html
3. http://www.digital filters.html
4. http://www. signal Processing.html

MT15153 MAINTENANCE ENGINEERING 3 0 0 3

COURSE OBJECTIVES

- To identify with various types of maintenance, their procedure and defects analysis commonly adopted in manufacturing industries.
- To discriminate preventive, predictive and failure maintenance.
- To distinguish about usage of computers for maintenance management and various condition monitoring techniques.

UNIT I INTRODUCTION TO MAINTENANCE 9

Introduction - Fundamentals of Maintenance Engineering- Scope of industrial preventive/predictive maintenance programs - Definition of terminology- Overview of condition-based maintenance technologies- Maintenance planning, management and designing an effective maintenance organization- Information systems organization and asset management - Evaluating maintenance performance

UNIT II MAINTENANCE SYSTEMS 9

Planned and un-planned maintenance - Breakdown maintenance - Corrective maintenance - Opportunistic Maintenance - Routine maintenance - Preventive maintenance, Predictive maintenance - Condition based Maintenance system selection of maintenance system-TPM.

UNIT III SYSTEMATIC MAINTENANCE 9

Codification and Cataloguing-Instruction manual and operating manual-Maintenance manual and Departmental manual-Maintenance time standard-Maintenance work order and work permit - Feedback and control-Maintenance records and documentation

UNIT IV DEFECTS AND FAILURE ANALYSIS 9

Defect generation-types of failures-Defects reporting and recording-Defect analysis-Failure analysis- Equipment Down time analysis-Breakdown analysis- Root cause analysis- FTA, FMEA.

UNIT V CONDITION MONITORING 9

Condition monitoring techniques-Visual monitoring-Temperature monitoring-vibration monitoring- Lubricant Monitoring-Cracks monitoring-Thickness monitoring-Noise and sound Monitoring- condition monitoring of Hydraulic system. Machine diagnostics-Objectives- Monitoring strategies-Online monitoring.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- classify the maintenance system and select suitable one based on requirement.
- identify the documentation and record updating involved in maintenance systems.
- prepare the maintenance plan and explain the cost benefit analysis.
- analyze the defects and failures encountered in manufacturing system.
- establish the monitoring strategies according to system characteristics.

TEXT BOOKS

1. Keith Mobley, Lindley Higgins and Darrin Wikoff, “Maintenance Engineering Handbook”,McGraw-hill, 2008.

2. Sushil Kumar Srivastava, Industrial Maintenance Management, S. Chand and Company Ltd, New Delhi, 2006.

REFERENCES

1. R. Keith Mobley, Maintenance Fundamentals, Butterworth Heinmann Publications, USA, 2004
2. Don Nyman and Joel Levitt, Maintenance Planning, Scheduling and Coordination, Industrial Press Inc., NewYork, 2010.
3. Manfred Weck and H. Bibring, Handbook of Machine Tools, John Wiley and Sons, New York, 1984.

WEB LINKS

1. https://www.lce.com/Whats-the-role-of-the-Reliability-Engineer-1227.html
2. http://www. defects and failure analysis.html

MT15154 MODELLING AND SIMULATION IN ENGINEERING 3 0 0 3

COURSE OBJECTIVES

- To propose an exposure on how to simulate a system or a process.
- To get elaborate the analysis, optimization and decision making which is essential.

UNIT I SYSTEM AND SYSTEM ENVIRONMENT 9

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

UNIT II RANDOM NUMBER GENERATION 9

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

UNIT III RANDOM – VARIATE GENERATION 9

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

UNIT IV ANALYSIS OF DATA 9

Analysis of simulated Data – Data collection, identifying the distribution, Parameter estimation, Goodness of fit Tests, verification and validation of simulation models.

UNIT V SYSTEM IDENTIFICATION 9

Concepts of System Identification – Identification using normal operating records (Integration method) – Identifiability conditions – System order determination.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- describe the simulation and its importance in creation of models for real time systems.
- describe the different types of systems.
- simulate the real time systems by generating the random numbers and variables.
- design and analyze the model using simulation software packages.
- describe identify system using integration method.

TEXT BOOK

1. Banks J., Carson J.S. and Nelson B.L., “Discrete – Event System Simulation”, 3rd Edition, Pearson Education, Inc 2004 (ISBN 81-7808-505-4).

REFERENCES

1. Geoffrey Gorden, “System Simulation”, Prentice Hall of India, 2003.
2. Narsingh Deo., “System Simulation with Digital Computer”, Prentice Hall of India, 2003.
3. Birta, "Modelling and Simulation: Exploring Dynamic System Behaviour", Springer, Indian Reprint, 2010.

MT15155 PRODUCT DESIGN AND COSTING 3 0 0 3

COURSE OBJECTIVES

- To identify the several aspects of the design process.
- To study the concept of product costing, patenting and manufacturing economics in product design.
- To identify with the relationship between customer desires.
- To propose the functional requirements, product materials and product design.
- To investigate the knowledge about manufacturing process selection.

UNIT I PRODUCT DESIGN AND PLANNING 9

Product Planning - Identifying Opportunities- Allocating Resources and Timing- Pre-Project Planning-Reflect on the Results and the Process-Identifying Customer Needs- Raw Data from Customers- Interpreting Raw Data in Terms of Customer Needs- Organizing the Needs into a Hierarchy-Establishing the Relative Importance of the Needs-Reflecting on the Results and the Process.

UNIT II PRODUCT SPECIFICATIONS AND CONCEPT GENERATION 9

Specifications - Specifications Established - Establishing Target Specifications-Setting the Final Specifications-Concept Generation-The Activity of Concept Generation-Clarify the Problem- External search – Internal search – Systematic exploration- Reflect on the Results and the Process.

UNITIII PRODUCT DEVELOPMENT ECONOMICS 9

Elements of economic analysis -Quantitative analysis, Qualitative analysis - Building a Base- Case Financial Model - Sensitivity analysis -Development cost and time with examples - Project tradeoffs - Six potential, Trade off rules, Limitations - Influence of qualitative factor on project success - Qualitative analysis

UNITIV COST ESTIMATION 9

DFM Cross functional team-Estimate the manufacturing cost, Reduce the Cost of components, Reduce the cost of assembly, Rescue the cost of supporting production-Impact of DFM decisions- Development time, Development Cost, Product quality, External factors.

UNIT V PATENTS AND INTELLECTUAL PROPERTY 9

Overview of patents, Utility patents, preparing a disclosure - Formulate strategy plan- Study of Prior invention-Outline claims - Description of inventions - Refine claims - Pursue application- Reflect of result and process.

TOTAL PERIODS 45

COURSEOUTCOMES

At the end this course, students will be able to

- identify the customer requirements to start new project and carryout product planning.
- generate and select suitable ideas to pursue successful design.
- quantify and access the manufacturing process and cost to make well defined component.
- express the process of patenting the intellectual property.
- apply the economic reasoning to analysis the contemporary problem for newly developed product.

TEXT BOOKS

1. Karl T. Ulrich and Stephen D. Eppinger, “Product Design and Development”, McGraw- Hill Book Company, New Delhi, (2009).
2. Benjamin W. Niebeland Alanb.Draper, “Product Design and Process Engineering”, Tata Publishing Company Ltd, New Delhi, (1976).

REFERENCES

1. George E. Dieter, “Engineering Design - Materials and Process Approach”, Tata McGraw- Hill Publishing Company Limited, New Delhi, (2008).
2. S. Dalela and MansoorAli, “Industrial Engineering and Management Systems”, Standard Publishers Distributors Pvt. Ltd., New Delhi, (2006).
3. Harry Nystrom,“Creativity and Innovation”, John Wiley and Sons Pvt. Ltd., Singapore, McGraw-Hill, (1988)
4. S. B. Srivastava, "Industrial Management",I. K. International Publishing House Pvt. Ltd., New Delhi, (2012).

ELECTIVE II

MT15251 INDUSTRIAL ENGINEERING 3 0 0 3

COURSE OBJECTIVES

- To identify the use of forecasting, control of inventory, process of routing and scheduling for improving productivity.
- To construct and solve linear programming problem.
- To investigate deterministic and probabilistic models of problems related to networks and queuing.

UNIT I PRODUCTION PLANNING AND CONTROL 9

Productivity - Productivity index -Productivity measurement - Job design - Job standard - Work study - Method - study - Operation process chart - Motion study - Motion economy - SIMO chart – Work measurement - PMTS Ergonomics - Industrial safety: losses due to accidents, causes, preventive measures Forecasting - Types - Accuracy of forecast -Sales forecasting techniques - Time series method: simple moving average, weighted Moving average, exponential smoothing.

UNIT II INVENTORY CONTROL 9

Inventory control - Purpose - Inventory costs - EOQ - Deterministic models - Shortage model - Classification: ABC analysis, FSN analysis - Material Requirement Planning (MRP)

UNITIII SCHEDULING AND QUEUING 9

Introduction -Rules - Factors affecting - Master schedule - Gantt chart - Sequencing problem: Models with n jobs with 2 machines Models with n jobs with 3 machines Queuing models - Basic Queuing systems and models - Notation - Parameter - Poisson arrival - Exponential service - Constant rate service - Infinite population

UNITIV LINEAR PROGRAMMING 9

Introduction - Formulation - Graphical method, Simplex method Artificial Variable techniques: Big M and Two phase method - Transportation Problems: North West corner method, Least cost method, Vogel's approximation Method - MODI method - Assignment problems with Hungarian algorithm.

UNIT V NETWORK MODELS 9

Network models - Shortest route - Minimal spanning tree - Maximum flow models - Project network - CPM and PERT networks - Critical path scheduling

TOTAL PERIODS 45

COURSEOUTCOMES

At the end this course, students will be able to

- explain the ways of improving productivity by job design, work study, ergonomics, forecasting techniques and following safety.
- explain the inventory control techniques and the need for material requirement planning.
- solve the sequencing of ‘n’ jobs with two and more machines and also compute the characteristics of single server queuing models.
- formulate the linear programming problems and find the optimum solution.
- construct the network model and identify the critical path of deterministic and probabilistic models.

TEXT BOOKS

1. Prem Kumar Gupta and D. S. Hira, "Operations Research", S. Chand and Co., New Delhi, 2014.
2. S. B. Srivastava, "Industrial Management", I. K. International Publishing House Pvt. Ltd., New Delhi, 2012.
3. T. R. Banga, N. K. Agarwal and S. C. Sharma, "Industrial Engineering and Management Science", Khanna Publishers, Delhi.

REFERENCES

1. Hamdy A. Taha, "Operation Research: An introduction", Pearson Publications., New Delhi, (2010).
2. Frederick S. Hiller and Gerald J. Liberman, Operations Research: Concepts and cases, Tata McGraw-Hill Publishing Company Pvt Ltd., New Delhi, 2010.

WEB LINKS

1. http://www. industrial management.html
2. http://www.operation research.html

MT15252 **DESIGN OF MATERIAL HANDLING EQUIPMENTS** **3 0 0 3**

(Use of Approved Data Book Is Permitted)

COURSE OBJECTIVES

- To access uses, application and design of different material handling techniques, equipments and machines used in common use and in industrial sector.
- To identify the concept of material handling equipments.
- To propose the idea for selection of proper material handling equipments.
- To propose the evaluation and design of material handling equipments.
- To access the knowledge on conveyors and elevators.

UNIT I INTRODUCTION 9

Objectives of material handling system - Principal groups of materials handling equipment and classification Scope of Material Handling - Criteria for selection of Material Handling Equipment's - Basic kind of material Handling problems.

UNIT II DESIGN OF HOISTS 9

Design of hoisting elements: Welded and roller chains - Hemp and wire ropes - Design of forged hooks and eye Hooks – crane grabs -Systems, sprockets and drums, Load handling Attachments. lifting magnets - Grabbing attachments.

UNITIII DRIVES OF HOISTING GEAR 9

Hand and power drives - Traveling gear - Rail traveling mechanism - cantilever and monorail Cranes - slewing, jib and buffing gear - cogwheel drive - selecting the motor ratings.

UNITIV CONVEYORS 9

Types - description - design and applications of Belt conveyors, apron conveyors and Escalators Pneumatic Conveyors, Screw conveyors and vibratory conveyors.

UNIT V ELEVATORS 9

Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, Guides, counter Weights, hoisting machine, safety devices - Design of fork lift trucks.

TOTAL PERIODS 45

COURSEOUTCOMES

At the end this course, students will be able to

- achieve the knowledge about material handling equipments.
- define the gained a well- found knowledge of hoists designing processes.
- predict the grasped the concept of drives of hoisting gear.
- plan the obtained capacity of conveyor design.
- state the knowledge on elevator designing processes.

TEXT BOOKS

1. Rudenko, N., "Materials handling equipment" ELnvee Publishers, (1970).
2. Spivakovsy, A.O. and Dyachkov, V.K., "Conveying Machines" Volumes I and II, MIR Publishers, (1985).

REFERENCES

1. Alexandrov, M., “Materials Handling Equipments” MIR Publishers, (1981).
2. Boltzharol, A., “Materials Handling Handbook” The Ronald Press Company, (1958).
3. P.S.G. Tech., “Design Data Book”, Kalaikathir Achchagam, Coimbatore, (2003).
4. Lingaiah. K. and Narayana Iyengar, “Machine Design Data Hand Book”, Vol. 1 & 2, Suma Publishers, Bangalore, (1983).

WEB LINKS

1. http://www.thomasnet.com/articles/materials-handling/material-handling-equipment
2. http://www.mccue.com/content/types-of-material-handling-equipment
3. http://www.mechanicalengineeringblog.com/2342-classification-of-material-handling-equipment-types-of- material-handling-equipment-loads/

MT15253 EMBEDDED SYSTEM DESIGN 3 0 0 3

COURSE OBJECTIVES

- To understand an embedded system and compare with general purpose system.
- To identify the comprehensively processor and internal memory architecture.
- To identify the the i/o devices and network protocols.
- To identify the information about rtos.
- To identify with comprehensively the technologies and techniques underlying in building an embedded solution to a wearable, mobile and portable system.

UNIT I INTRODUCTION TO EMBEDDED SYSTEM 9

System Design: Definitions - Classifications and brief overview of micro-controllers - Microprocessors and DSPs - Embedded processor architectural definitions - Typical Application - scenarios of embedded systems.

UNIT II PROCESSOR AND MEMORY ORGANIZATION 9

Bus Organization - Memory Devices and their Characteristics - Instruction Set Architecture [RISC, CISC] -Basic Embedded Processor/Microcontroller Architecture [8051, ARM, DSP,PIC] – Memory system architecture [cache, virtual, MMU and address translation] - DMA, Co-processor and Hardware Accelerators - Pipelining

UNIT III I/O DEVICES AND NETWORKS 9

I/O Devices[Timers, Counters, Interrupt Controllers, DMA Controllers, A/D and D/A Converters, Displays ,Keyboards, Infrared devices] - Memory Interfacing - I/O Device Interfacing [GPIB, FIREWIRE, USB, IRDA] Networks for Embedded (CAN, I2C,SPI, USB, RS485, RS232)-Wireless Applications [Bluetooth, Zigbee].

UNIT IV OPERATING SYSTEMS 9

Basic Features of an Operating System - Kernel Features [polled loop system, interrupt driven system, multi rate system] -Processes and Threads - Context Switching - Scheduling[RMA, EDF, fault tolerant scheduling]- Inter-process Communication - Real Time memory management [process stack management, dynamic allocation] - I/O[synchronous and Asynchronous I/O, Interrupts Handling, Device drivers] - RTOS [Vx Works,RT-LINUX].

UNIT V EMBEDDED SYSTEM DEVELOPMENT 9

Design Methodologies[UML as Design tool, UML notation, Requirement Analysis and Use Modeling] - Design Examples [Telephone PBX, Inkjet Printer, PDA, Elevator Control System, ATM System] - Fault-tolerance Techniques - Reliability Evaluation Techniques

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- identify an embedded system and compare with general purpose system.
- identify the various embedded processor and internal memory architecture.
- identify the various input and output devices and network protocols.
- introduce rtos and related mechanisms.
- choose the design methodologies for the real time application.

TEXT BOOK

1. Raj Kamal, “Embedded systems Architecture, Programming and design”, Second Edition, (2015)

REFERENCES

1. Jane W. S., Liu, “Real time systems”, Pearson Education, (2012).
2. Robert Ashby, “Designer's Guide”, Cypress PSoCNewnes,(2012)
3. Microblaze processor Reference guide, Xilinx(2013)
4. Wayne Wolf Computers as components “Principles of Embedded Computing System design”, The Morgan Kaufmann Series in Computer Architecture and Design, (2014).

WEB LINKS

1. http://www. processor and memory.html
2. http://www. operating systems.html
3. http://www. embedded system development.html

BA15255 ENTREPRENEURSHIP DEVELOPMENT 3 0 0 3

COURSE OBJECTIVES

- To demonstrate an understanding of entrepreneurial concepts and processes.
- To plan to know the entrepreneurship analysis and opportunities.
- To identify with legal issues and government policies.
- To describe with start-ups of new business.
- To inculcate knowledge on small scale business.

UNIT I INTRODUCTION TO ENTREPRENEURSHIP 9

Concept of entrepreneur and entrepreneurship; entrepreneurial and managerial characteristics; Distinction between an entrepreneur and a Manager, Agri-entrepreneurship-concept, need and scope - Ethics in Entrepreneurship. Managing an enterprise; motivation and entrepreneurship development; importance of planning, budgeting, monitoring, evaluation and follow up in running an enterprise

UNIT II ENTREPRENEURSHIP ANALYSIS AND OPPORTUNITIES 9

Innovation - principles of innovation, SWOT analysis. Sources of innovative opportunities - the unexpected and success /failure, unsatisfied needs, process improvement, changes in industry structure, changes in demography perception, new knowledge. Create a customer - utility, pricing, adaptation to customer needs and deliver value to customer - Market research - customer needs, competitors

UNIT III FINANCING, ACCOUNTING, GST 9

Finance - government policies, Government Schemes and Incentives for Promotion of Entrepreneurship -Venture capital financing - concept, purpose and schemes, Role of financial institutions for funding enterprises, Capital markets - shares and securities Accounting - concepts and conventions of accounting, double entry system of book keeping, Problems in Accounting Systems, National agricultural policy, Government policies and regulations for agribusiness, Principles of taxation and tax structure in India, Legal issues in agribusiness, Role of regulations for agribusiness, GST, Role of District Small Industry Association.

UNIT IV BUSINESS 9

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT V SUPPORT TO ENTREPRENEURS 9

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures- Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- identify with the entrepreneurial concepts and processes.
- attain knowledge on entrepreneurship analysis and opportunities.

- identify with legal issues and government policies.
- start a new business.
- plan to know the supports of entrepreneurs in starting small scale business.

TEXT BOOKS

1. Robert D Hisrich and Michael P Peters, Entrepreneurship, Irwin Mc Graw - Hill Inc. Boston, 4th edition, 1998.
2. Vasant Desai, Dynamics of Entrepreneurial Development and Management, Himalaya Publishing House, 3rd edition, 1997.

REFERENCES

1. Jeffry A. Timmons, New Venture Creation: Entrepreneurship for the 21st Century, Fifth Edition, Irwin McGraw-Hill Publishers, Boston, MA (ISBN 0-356-19756-3).
2. Poornima M. Charantimath. (2014). Entrepreneurship Development and Small Business Enterprises. Pearson publishers.
3. Sulakshan Mohan, Making of an Entrepreneur, how to set up your own enterprise and manage it successfully, Indian Publishers distributors, Delhi, 2000
4. P.Saravanavel (1997). Entrepreneurial Development, Ess Pee kay Publishing House, Chennai.
5. Prasanna Chandra (1996). Projects – Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill.

MT15254 NON - DESTRUCTIVE TESTING 3 0 0 3

COURSE OBJECTIVES

- To explain the concept of non destructive evaluation.
- To access knowledge on various types of non destructive evaluation methods.
- To identify the principles and working of different nde methods.
- To compose knowledge on selection of such different methods for testing and evaluation of various components minimum values.
- To identify the concept of ultrasonic testing methods.

UNIT I INTRODUCTION AND LIQUID PENETRANTS TESTING 9

Non-destructive testing (NDT) and its importance–NDT vs. Destructive Testing – Visual Examination – Basic Principles, optical aids used and applications .Liquid Penetrants– Principles, Procedure for penetrants testing ,Penetrants testing methods, Post emulsification, properties of liquid penetrants, sensitivity, applications andLimitations – Standards.

UNIT II MAGNETIC PARTICLE TESTING 9

Magnetic Particle Testing –Principles, Magnetizing techniques, Procedures, Equipments, Sensitivity, Applications and Limitations– Standards. Case studies.

UNIT III ULTRASONIC TESTING 9

Properties of sound beam, Transducers, inspection methods, Techniques for Normal and angle beam inspection, Flaw characterization–equipments, and methods of display– A – Scan– B – Scan - C–Scan –Immersion testing– Application, advantages and limitations–standards.

UNIT IV RADIOGRAPHY 9

Electromagnetic radiation sources–X-ray production & gamma ray sources ,properties, radiation–attenuation and effects in film, Exposure charts – radiographic imaging – inspection techniques–applications and limitations – Safety in industrial radiography–neuron radiography–Standards. Case studies.

UNIT V EDDY CURRENT 9

Principles, Instrumentation, Techniques, Probe, Sensitivity, Advanced Test Methods, applications & Limitations Standards. Other Techniques: Acoustic Emission Testing Principle, Techniques, Instrumentations, Applications and Standards, Homography Thermography –Principles, Equipments, Techniques, Applications and Standards, Leak testing-methods, detection and Standards. Selection of NDT Methods: Defects in material–Selection of NDT and Instrumentation–Some Case studies.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- access the knowledge about working liquid penetrants testing.
- identify the non destructive evaluation methods for magnetic particle testing.
- identify the ultrasonic testing methods and working processes.
- relate the knowledge about the sources, process and safety precautions of x-ray radiography.
- locate the test performance on eddy current techniques.

TEXT BOOKS

1. Baldev Raj, T. Jayakumar and M. Thavsimuthu, "Practical Non-Destructive Testing" 3rd Edition,
2. NarosaPublishingHouse, NewDelhi, 2009.
3. Shull Peter J.,―Non Destructive Evaluation: Theory-Techniques and Applications‖, Marcel Dekkar Inc., New York, USA, 2002.

REFERENCES

1. Baldev Rajand Venkatraman B.,―Practical Radiology‖, Narosa Publishing House, NewDelhi, 2004.
2. Hull Barryand JohnVernon, ―Non Destructive Testing‖, 1stEdition, Macmillan, London, 1988.
3. Brichan D., ―Non Destructive Testing‖, Oxford Press, 1975.
4. ASM Handbook, ―Non Destructive Evaluation andQualityControl‖,Vol.17, 9thEdition, 1989.

WEB LINKS

1. http://www.asnt.org/MinorSiteSections/AboutASNT/Intro-to-NDT
2. http://www.trainingndt.com/what-is-nondestructive-testing
3. http://www.twi-global.com/capabilities/integrity-management/non-destructive-testing/ndt- techniques