With Effect from the Academic Year 2019 – 2020

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

CHOICE BASED CREDIT SYSTEM

B.E. (PRODUCTION ENGINEERING)

SEMESTER – VII & SEMESTER - VIII

With Effect from the Academic Year 2019 – 2020

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

CHOICE BASED CREDIT SYSTEM

B.E. (PRODUCTION ENGINEERING)

SEMESTER – VII

S. No.	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration in Hours	Maximum Marks		
			L/T	P/Dg.		CIE	SEE	
THEORY								
1	16ME C33	Metrology and Instrumentation	3	--	3	30	70	3
2	16ME C34	Operations Research	3	--	3	30	70	3
3	16PE C10	Production Drawing	1	2	3	30	70	2
4	16PE C11	Production and Operations Management	3	--	3	30	70	3
5	16PE C12	Tool Engineering	3/1	--	3	30	70	4
6		Professional Elective - V	3	--	3	30	70	3
PRACTICALS								
7	16ME C36	Metrology and Instrumentation Lab	--	3	3	25	50	2
8	16PE C13	Manufacturing Engineering Lab	--	3	3	25	50	2
9	16PE C14	Project Seminar	--	3	--	50	--	2
TOTAL			**17**	**11**		**280**	**520**	**24**

L: Lecture T: Tutorial D: Drawing P: Practical

CIE - Continuous Internal Evaluation SEE – Semester End Examination

Professional Elective-V (3/3)		
S. No.	**Subj. Code**	**Name of the Subject**
1	16ME E10	Renewable Energy Sources
2	16ME E11	Energy Conservation, Management and Audit
3	16ME E12	Engineering Research Methodology
4	16ME E14	Finite Element Methods

16ME C33

METROLOGY AND INSTRUMENTATION

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To familiarize with limits, fits & tolerances and fundamental concepts of linear and angular measurements.
2. To have knowledge of various precision measuring instruments and concept of limit gauges.
3. To learn the importance of Geometric form and how to measure form errors.
4. To have knowledge in the concepts of classification of instrument errors and their characteristics.
5. To understand the working principles of various instruments used for the measurement of displacement, pressure and temperature.

Outcomes: At the end of the course, students are able to

1. Learn and understand the need for measurement and fundamental concepts of measurement.
2. Demonstrate sound knowledge in gauges design and gauge selection for inspection.
3. Demonstrate an ability to select and use the appropriate measuring instruments to measure surface roughness.
4. Recognize the concepts of errors, strain measurement, classification and instrument characteristics.
5. Apply the skills in measuring various quantities like displacement, pressure & temperature.

UNIT-I

Limits, Fits and Tolerances: Interchangeability, nominal size, limits , tolerances, allowance, fundamental deviation, unilateral and bilateral tolerances, Types of fits, alpha numeric designation of limits/fits, hole and shaft basis systems, selective assembly.

Linear and Angular Measurement: line and end standards, Slip gauges, Tomlinson gauges and Sine bar.

UNIT-II

Design of Limit Gauges: Taylor's Principle for plan limit gauges, Design of GO and NO GO gauges, Use of Plug, Ring and Snap gauges.

Comparators: Introduction, Dial indicator, Sigma Mechanical comparator, Back pressure type Pneumatic comparator.

Optical Measuring Instruments: Optical projector principle and its uses, Tool maker's Microscope principle and its uses, interferometry.

UNIT-III

Straightness, Flatness and Roundness Measurement: Definitions, measurement by beam comparator, straight edge, spirit level, and bench centers.

Surface Roughness Measurements: Roughness and waviness, numerical assessment of surface roughness by CLA, RMS, Rz values, Surface roughness measurement by Profilometer, Taylor Hobson Talysurf, ISI symbols for indication of surface finish.

UNIT-IV

Screw Thread Metrology: Basic terminology of screw thread, measurement of effective diameter by 2 wire and 3 wire methods, Best wire size.

Gear Tooth Metrology: Spur Gear nomenclature, Gear tooth thickness measurement by gear tooth vernier.

Instrumentation: Static and Dynamic characteristics of instruments, Types of errors, Strain measurement with strain gauges, gauge factor, Rosette Gauges.

UNIT-V

Transducers: Displacement measurement by L.V.D.T, Pressure measurement by Bourdon pressure gauge, bulk modulus pressure gauge, pirani gauge, Temperature measurement by thermo couples, Laws of thermo electricity, Types of materials used in thermocouples.

Text Books:

1. R.K. Jain, Engineering Metrology, Khanna Publications, 1996.
2. Doeblin, "Measurement Systems Application and Design", TMH, 5/e., 2004.
3. Beckwith, Buck, Lienhard, "Mechanical Measurements", PEA, 3rd Indian Reprint, 2001.
4. Anand Bewoore & Vinay Kulkarni , "Metrology & Management", McGrawhill Education India, 2014.
5. B.C. Nakra & K.K. Chaudhary , "Instrumentation Measurement and Analysis", 3/e., McGrawhill, 2014

Suggested Reading:

1. IC Gupta., "Engineering Metrology", Dhanpat Rai Pub., New Delhi, 1984.
2. Rega Rajendra," Principles of Engineering Metrology", Jaico Publishing House, Mumbai, 2008.
3. VSR Murti, "Metrology and Surface Engineering", Frontline Publications, 2011.

16ME C34

OPERATIONS RESEARCH

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. Students will come to know the formulation of LPP models
2. Students will understand the Algorithms of Graphical and Simplex Methods
3. Students will understand the Transportation and Assignment techniques
4. Students will come to know the procedure of Project Management along with CPM and PERT techniques
5. Students will understand the concepts of sequencing and queuing theory

Outcomes: At the end of the course, the students were able to

1. Formulate a managerial decision problem into a mathematical model;
2. Apply transportation problems in manufacturing industries;
3. Build and solve sssignment models and travelling salesmen problems.
4. Apply project management techniques like CPM and PERT to plan and execute project successfully
5. Apply sequencing and queuing theory concepts in industry applications

UNIT-I

Introduction: Definition and Scope of Operations Research.

Linear Programming: Introduction, Formulation of linear programming problems, graphical method of solving LP problem, simplex method, Degeneracy in Simplex, Duality in Simplex.

UNIT-II

Transportation Models: Finding an initial feasible solution - North West Corner Method, Least Cost Method, Vogel's Approximation Method, Finding the optimal solution, Special cases in Transportation problems - Unbalanced Transportation problem, Degeneracy in Transportation, Profit Maximization in Transportation.

UNIT-III

Assignment Techniques: Introduction, Hungarian technique of Assignment techniques, unbalanced problems, problems with restrictions, Maximization in Assignment problems, Travelling salesman problems

UNIT-IV

Project Management: Definition, Procedure and Objectives of Project Management, Differences between PERT and CPM, Rules for drawing Network diagram, Scheduling the activities, Fulkerson's rule, Earliest and Latest times, Determination of ES and EF times in forward path, LS & LF times in backward path, Determination of critical path, duration of the project, Free float, Independent float and Total float, Crashing of network.

UNIT-V

Sequencing Models: Introduction, General assumptions, processing 'n' jobs through two machines, processing 'n' jobs through three machines.

Queuing Theory: Introduction, Kendal's Notation, single channel - poisson arrivals - exponential service times

Text Books:

1. Hamdy, A. Taha, "Operations Research-An Introduction", 6/e, Prentice Hall of India Pvt. Ltd., 1997.
2. S.D. Sharma, "Operations Research", Kedarnath, Ramnath & Co., Meerut, 2009.
3. V.K. Kapoor, "Operations Research", S. Chand Publishers, New Delhi, 2004.

Suggested Reading:

1. Harvey M. Wagner, "Principles of Operations Research", 2/e, Prentice Hall of India Ltd., 1980.
2. R. Paneer Selvam, "Operations Research", 2/e, PHI Learning Pvt. Ltd., New Delhi, 2008.
3. Nita H. Shah, Ravi M. Gor, Hardik Soni, "Operations Research", PHI Learning Private Limited, 2013.

16PE C10

PRODUCTION DRAWING

Instruction	1 Lecture + 2 Drawing Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	2

Objectives: Students will understand

1. The need and the importance of production drawing
2. How to make part drawing from given assembly drawings and prepare process sheets.
3. Indication of size, form and positional tolerances on the drawing sheets
4. Surface finish and heat treatment process on the drawing sheets.
5. Notations, symbols and abbreviations on production drawings

Outcomes: On completion of the course the students will develop abilities to

1. Draw part drawings from given assembly drawings of machine parts.
2. Indicate tolerance values on the parts drawn on sheet as per alpha numeric codes for given assembly drawings
3. Indicate form tolerances and position tolerances on the parts drawn on the sheet as per universally accepted norms for a given assembly drawing
4. Indicate values of surface finish and heat treatment process on the parts drawn for a given assembly drawings.
5. Write process sheet for the part that is drawn from given assembly drawing and interpret production drawing and process sheet.

UNIT-I

Parts-I: Format of drawing sheet, title block, columns for materials, Processes, parts list, conventional representation of parts: screwed joints, welded joints, springs, gears.

UNIT-II

Parts II: Elements of electrical, hydraulic and pneumatic circuits, machine tool elements, methods of indicating notes on drawing

UNIT-III

Limits and Fits: Basic definition of terms, alpha numeric designation of limits/fits, types of fits, Interchangeability and selective assembly, Exercises involving selection/interpretation of fits and calculation of limits, dimensional chains.

UNIT-IV

Production Drawing: Conventional practices of indicating tolerance on size and geometrical form, position, surface finish, surface treatments, part drawing from assembled drawings (Stuffing box, Screw jack, I.C engine connecting rod, Revolving center, Square tool post, Single tool post, Universal coupling, Flange coupling, Steam engine cross head, Drill jig (plate type), Eccentric, Hydraulic cylinder), specification and indication of above features on the drawings, calculation of limits suggesting suitable fits for mating parts

UNIT-V

Assignments: Sketches of conventional representation of parts described with syllabus at (1) process sheets, tolerances and finishes obtainable from different processes. Study of IS 2709 on limits and fits

NOTE: Tolerance charts to be provided in the examination hall for calculation of limits

Text Books:

1. K.L. Narayana, P. Kannaiah and K. Venkat Reddy, “Production Drawing”, New Age Intl., (P) Ltd., Revised Edition, 1997.
2. P. Narasimha Reddy, T.A. Janardhan Reddy and C. Srinivasa Rao, “Production Drawing Practice”, Hitech Publishers, 2001.

Suggested Reading:

1. R.L. Murthy, “Precision Engineering in Manufacturing”, New Age International Private Ltd., 1996
2. Venkata Reddy, “Production Drawing”, New Age International, ISBN 978-81-224-2288-7, 2009
3. Farazdak Haideri, “Machine Drawing & Computer Graphics”, Nirali Prakashan, ISBN 978-93-8072-527-7
4. Doeblin, “Measurement Systems Application and Design”, TMH, 5/e, 2004.

16PE C11

PRODUCTION AND OPERATIONS MANAGEMENT

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. Understand plant layout design to facilitate material flow and processing of a product in the most efficient manner
2. Gain some ability to recognize situations in a production system environment that suggests the use of certain quantitative methods to assist in decision making on operations management and strategy.
3. Understand how Materials Requirement Planning and MRPII systems are used in managing operations
4. Recognize the importance of Inventory control to ensure their availability with minimum capital lock up.
5. Evaluate the quality processes in manufacturing and service sector to improve the operational performance

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

1. Identify and evaluate the processes, tools and principles of production and operations management to better understand the logistics and supply chain operations
2. Demonstrate the ability to apply mathematical forecasting techniques
3. Identify future challenges and directions that relate to production and operations management to effectively and efficiently respond to market changes
4. Apply the tasks, tools and underlying principles of operations management in the manufacturing and service sectors to improve organizational performance
5. Explain and evaluate the quality process in manufacturing and service sector to improve the operational performance

UNIT-I

Production & Operations Management: Introduction: Types of Production Systems, job shop, batch, flow shop

Plant Location and Layout: Factors affecting plant location, plant layout objectives, types of layouts, merits and demerits.

Work Study: Introduction to method study and work measurement, standard time calculations, work sampling, wages and incentives, types of incentive plans.

UNIT-II

Forecasting: Introduction, forecasting objectives and uses, demand patterns, qualitative models, market survey, Delphi method, quantitative models, moving average, weighted moving average, simple exponential smoothing, trend adjusted exponential smoothing, simple regression.

Forecast Errors: Mean Absolute Deviation (MAD), Mean Square Error (MSE), Mean Forecast Error (MFE), Mean Absolute Percentage Error (MAPE)

UNIT-III

Aggregate Planning and Master Scheduling: Introduction, objectives of aggregate planning, cost in aggregate planning, strategies in aggregate planning, master production scheduling

Materials Requirement Planning (MRP): Importance of MRP, MRP system inputs and outputs, bill of materials.

UNIT-IV

Inventory Control: Importance of inventory control, types of inventory models, inventory costs, deterministic inventory models, basic EOQ model, production model without shortages, purchase model with instantaneous replenishment and with shortages, production model with shortages, inventory model with price breaks, fixed order quality system, periodic review system .

UNIT-V

Quality Control: Introduction, quality gurus and their contributions, quality tools, process capability, quality control by control charts, control charts for variables and attributes, sampling plans, operating characteristic curve, introduction to total quality management

Text Books:

1. Stevenson, "Operation Management", Mc-Graw Hill International.
2. Joseph Monks, "Operations Management", TMH Publishers, New Delhi, 2004.
3. Buffa Elwood S, "Modern Production /Operations Management", John Wiley Publishers, Singapore, 2002.

Suggested Reading:

1. Everrete E. Adama & Ronald J. Ebert, "Production & Operations Management", 5/e, Prentice Hall of India, 2005.
2. Panneer Selvam R, "Production and Operations Management," 2/e, PHI Learning Pvt. Ltd., New Delhi, 2006.
3. S.D. Sharma, "Operations Research", Kedarnath, Ramnath & Co., Meerut,2009
4. S.N. Chary, "Production and Operations Management", 3/e, Tata McGraw Hill, 2006.

16PE C12

TOOL ENGINEERING

Instruction	3 Lecture + 1 Tutorial Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	4

Objectives:

Students will understand

1. Various tool materials available including new materials like plastics
2. How to design simple tools independently as required by the industry like single point cutting tool, milling cutter, form tool and broaching tool
3. Design principles related to common tools used in manufacturing practices like drilling, reaming and tapping
4. The fundamentals of Tool Design that apply to different areas of sheet metal forming like blanking, drawing , plastics and mould design etc.
5. The fundamental concepts of Jigs and fixtures along with design principles

Outcomes:

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

1. Understand the importance of cutting tool materials
2. Design simple tools independently like single point cutting tool, milling cutter, form tool and broaching tool
3. Suggest appropriate tool geometry, tool material for manufacturing process like drilling, reaming and tapping
4. Design the tools for various operations like blanking, piercing, drawing and forging, mould design etc.
5. Design jigs and fixtures based on requirements.

Unit-I

Introduction to Tool Engineering: Role and importance of tool engineering in industries, tool engineering functions, duties of a tool engineer.

Tools : Types, classification, features and applications**,** Properties of Cutting tool materials, types of cutting tool material -- Major constituents , relative characteristics and their applications, ISO classification and coding of carbide tools, coated tools, modern cutting tool materials and their applications, Introduction to plastics, their properties and commonly used plastics as tooling materials and their applications.

Unit-II

Design of Tools: Design of single point cutting tools, Design of flat and circular form tools, Design elements of a milling cutter, types of milling cutters, forces and power estimation, , Design of milling cutters.

Introduction to Broaching Operation: Types of broaches - pull, push broach, geometry of broach, and design of broaching tool and manufacturing of broaches.

Unit-III

Twist Drill Geometry: Design and manufacturing of twist drill, effect of variation of angles on torque and thrust forces and sharpening of twist drills.

Reamers: Types of reamers, geometry of a reamer, reaming allowance, tolerance disposition, design and manufacture of reamers

Taps and Dies: Types, geometry, calculation of tapping drill diameters, design and manufacturing of taps and dies.

Unit-IV

Introduction to Press Tools and Various Sheet Metal Forming Operations: Design of die set for blanking and piercing operations, design of bending dies, design of die set for deep drawing operation, design of die set for forging operation, design of dies for metal spinning operation.

Fundamentals of Plastic Products and Mould Design: Plastics product design – Concepts, Essential factors and Principles.

Injection Mould Design- Mould design concepts, mould elements, parting line and parting surface, mould alignment, Feed system- Sprue, runner, gate & position of gate - runner ,
Blow Mould Design - Types of blow moulds - extrusion - injection and stretch blow moulds ,blow ratio - parison design - pinch off design - parting line.
Extrusion Die Design- Principles of Extrusion- Die Geometry – Die swell. Introduction to mould flow software, performing simulations.

Unit-V
Jigs & Fixtures: Design principles and construction features, locating methods associated with flat, cylindrical, internal and external surfaces, type of locating pins, requirements and choice of locating systems, redundant location, fool proofing, setting blocks, types of clamping devices and their basic elements, quick action clamps and nuts, equalizing and multiple clamping pneumatics, hydraulic, magnetic, electrical and vacuum clamping, types of drill jigs and their classification, drilling bushings, indexing jigs, design of fixtures for turning, grinding, welding and milling, economic analysis of jigs and fixtures.

Text Books:

1. Cyril Donaldson, George H. LeCain, V. C. Goold and Joyjeet Ghose, "Tool Design", 4/e, Tata McGraw Hill Education Private Limited, New Delhi, 2012.
2. David Spitler, Jeff Lantrip, John Nee and David A. Smith, "Fundamentals of Tool Design", 5/e, Society of Manufacturing Engineers, 2003.

Suggested Reading:

1. P. C. Sharma, "A Textbook of Machine Tools and Tool Design", S.Chand (G/L) & Company Ltd, 2005.
2. Amitabha Battacharya and Inyong Ham, "Design of Cutting Tools Use of Metal Cutting Theory", ASTME Pub., Michigan, USA.
3. Surender Keshav & Umesh Chandra, "Production Engineering Design (Tool Design)", Satya Prakashan, New Delhi-1994.

16ME E10

RENEWABLE ENERGY SOURCES (Professional Elective – V)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will learn the

1. Need and importance of non-conventional energy resources
2. Extent of solar energy which can be utilized as energy resource
3. Concept of wind energy and its merits and demerits
4. Operating principles of geothermal energy and bio-energy
5. Merits and demerits of tidal energy, wave energy and OTEC

Outcomes: At the end of the course, the students are able to

1. Understand the depletion and of environmental impact conventional sources of energy and will suggest suitable renewable energies in place of conventional energies
2. Determine the principles of absorption
3. Understand the problems associated with utilizing the wind energy
4. Describe the physics of geothermal resources and describe how biomass is currently used as a source of energy
5. Explain the physical principles of wave energy, tides and the environmental impact of OTEC plants

UNIT-I

Energy Sources: Statistics on conventional energy sources and supply in developing countries - Definition-Concepts of RES - Limitations of RES - Classification of RES-Solar, Wind, Geothermal, Bio-mass, Ocean Energy Sources - comparison of these energy sources.

UNIT-II

Solar Energy: Solar Radiation – Solar Thermal Collectors – Flat Plate and Concentrating Collectors and their limitations – Comparison - Solar Applications- Solar thermal power plant – Space based solar power – advantages and limitations of solar thermal energy – PV cells - PV materials - solar satellite system-advantages and disadvantages

UNIT-III

Wind Energy: Merits and demerits-Wind power plant-site selection - Power formula – Bett's limit – Effect of velocity on power generation - classification of wind power plants- Horizontal axis and vertical axis windmills - Working principle - New developments.

UNIT-IV

Geothermal Energy: Layers in earth-Classification of resources of Geothermal Energy – working principle.

Biomass Energy: Biomass-Raw materials-Source, Composition, Conversion technologies – Direct combustion-Pyrolysis–-Gasification, Biomass gasifiers –float and fixed dome types-Common operational problems, causes and remedies relating to a biogas plant-Economical, social, environmental and health benefits of bio gas utilization

UNIT V

Wave, Tidal and OTEC Energy: Difference between tidal and wave power generation-Tidal power plant – principle of Operation-single basin and double basin tidal plants- advantages and limitations, OTEC power plants- Open and closed OTEC Cycles- advantages and limitations -Environmental impacts of OTEC.

Text Books:

1. S. Hasan Saeed and D.K. Sharma, "Non Conventional Energy Resources", S.K. Kataria & Sons, New Delhi, 2014.
2. Dr. R.K. Singal, "Non Conventional Energy Resources", S.K. Kataria & Sons, New Delhi, 2005.
3. G.D. Rai, "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2011.

Suggested Reading:

1. Mittal K M, "Non-Conventional Energy Systems", Wheeler Publishing Co. Ltd, New Delhi, 2003.
2. Shali Habibulla, "Non-Conventional Energy Sources", State Institute of Vocational Education, Hyderabad, 2005.
3. Ashok V Desai, "Non-Conventional Energy", Wiley Eastern Ltd, New Delhi, 2003.

16ME E11

ENERGY CONSERVATION, MANAGEMENT AND AUDIT (Professional Elective – V)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To make the students to know the importance of energy sector in country's development
2. To identify various auditing services
3. To prepare the organizational structure energy policy
4. To get the concept of management in process industries
5. To explain how to take tax considerations

Outcomes: Students will be able to

1. Know energy scenario both India and world
2. Review and asses the various audit tools
3. Understand energy policy planning and take energy management as a profession
4. Analyze energy security, codes, standards,
5. Arrange the financial arrangements for industries

UNIT-I

Global & Indian Energy Scenario: Basics of Energy and its various forms - Classification of Energy sources- Applications of Non - Conventional and Renewable Energy Sources - Energy needs of growing economy- Energy sector reform, Energy and Environment: Global Environmental Concerns

UNIT-II

Energy Audit: Material and Energy Balance - Energy Action Planning - Energy Monitoring and Targeting - Types of energy audit, Energy Auditing Services Basic Components of an Energy Audit Specialized Audit Tools Industrial Audits Commercial Audits Residential Audits Indoor Air Quality

Energy Management: Program Organizational Structure Energy Policy Planning Audit Planning Educational Planning Strategic Planning, The Value of Energy Management The Energy Management Profession Some Suggested Principles of Energy Management, Energy Management Systems Justification of EMCSs Systems Integration

UNIT-III

Energy Efficiency in Thermal Utilities - Fuels and Combustion - Boilers -Steam System - Furnaces - Insulation and Refractory - FBC Boilers -Cogeneration -Waste heat recovery- Compressed Air System. - Diesel Generating System

Energy Efficiency in Electrical Utilities - Electrical Systems -Electric Motors - Lighting System - Energy Efficient Technologies in Electrical Systems

Energy Performance Assessment for Equipment and Utility systems - Turbines (Gas, Steam) - Heat Exchangers - Fans and Blowers - Pumps and Pumping System- Water Pumps - Compressors.
HVAC Systems - Refrigeration System. - Cooling Tower

UNIT-IV

Waste Heat Recovery: Waste Minimization and Resource Conservation - Energy Management in Process Industries, Energy Security, Codes, Standards, Electricity Act, Energy Conservation Act. Economics of Waste-Heat Recovery, Energy management in water and waste water treatment – solid waste treatment- air pollution control systems . Energy Management in Boilers and Fired systems – Steam and condensate systems – cogeneration –

UNIT-V

Performing Financial Analysis: Introduction General Characteristics of Capital Investments Sources of Funds Tax Considerations Time Value of Money Concepts Project Measures of Worth Economic Analysis-Financing Energy Management Projects Introduction Financial Arrangements: A Simple Example Financial Arrangements: Details and Terminology Applying Financial Arrangements: A Case Study "Pros" & "Cons"

Text Books:

1. CB Smith, “Energy Management Principles”, Pergamon Press.. New York, 1981
2. W R Murphy, G McKay, “Energy Management”, Butterworth Heinemann, 2007.
3. “Energy Management Handbook”, W.C. Turner, 5/e, Marcel Dekker, Inc, New York, 2005.
4. “Guide to Energy Management, B. L. Capehart”, W. C. Turner, W. J. Kennedy, CRC Press, New York, 2005.

Suggested Reading:

1. Trivedi, PR, Jolka KR, “Energy Managemnent”, Con-Lin_onwealth Publication, Nei...Cell-1i, 1997
2. Witte, Larry C, “Industrial Energy Management & Utilization”, Hemisphere Publishers, Washington, 1988.
3. Diamant, RME, “Total Energy”, Pergamon, Oxford, 1970.
4. Guide book for National Certification Examination for Energy Managers and Energy Auditors, Bureau of energy efficiencies, 200.5.
5. Han-ides, “Energy Auditing and Conservation; Methods Measurements, Management & Case study,” Hemisphere, Washington, 1980.
6. “General Aspects of Energy Management and Audit”, National Productivity Council of India, Chennai (Course Material- National Certification Examination for Energy Management)

16ME E12

ENGINEERING RESEARCH METHODOLOGY (Professional Elective – V)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To make the students to formulate the research problem
2. To identify various sources for literature review and data collection.
3. To prepare the research design
4. To equip the students with good methods to analyze the collected data
5. To explain how to interpret the results and report writing

Outcomes: At the end of the course, the students are able to

1. Define research problem
2. Review and asses the quality of literature from various sources.
3. Understand and develop various research designs.
4. Analyze problem by statistical techniques: ANOVA, F-test, Chi-square
5. Improve the style and format of writing a report for technical paper/ Journal report

UNIT – I:

Research Methodology: Objectives and Motivation of Research, Types of Research- Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, Research Approaches, Significance of Research, Research Methods verses Methodology, Research process, Criteria of Good Research, Problems Encountered by Researchers in India, Technique involved in defining a problem.

UNIT–II

Literature Survey: Importance of Literature Survey, Sources of Information-primary, secondary, tertiary, Assessment of Quality of Journals and Articles, Information through Internet.

UNIT – III

Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Steps in sample design

UNIT – IV

Data Collection: Collection of primary data, Secondary data, Measures of central tendency-mean, mode, median, Measures of dispersion- Range, Mean deviation, Standard deviation, Measures of asymmetry (skewness), Important parametric tests -z, t, F, Chi-Square, ANOVA significance

UNIT – V

Research Report Writing: Format of the Research report, Synopsis, Dissertation, Thesis its Differentiation, References/Bibliography/Webliography, Technical paper writing/Journal report writing, making presentation, Use of visual aids. Research Proposal Preparation- Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

Text Books:

1. C.R Kothari, “Research Methodology Methods & Technique”, New Age International Publishers, 2004.
2. R. Ganesan, “Research Methodology for Engineers”, MJP Publishers, 2011

Suggested Reading:

1. Vijay Upagade and Aravind Shende, “Research Methodology”, S. Chand & Company Ltd., New Delhi, 2009.
2. G. Nageswara Rao, “Research Methodology and Quantitative methods”, BS Publications, Hyderabad, 2012.
3. Naval Bajjai, “Business Research Methods”, Pearson, 2011.

16ME E14

FINITE ELEMENT METHODS (Professional Elective – V)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. Equip the students with the Finite Element Analysis fundamentals and formulations
2. Enable the students to formulate the axial, truss and beam problems
3. Enable the students to formulate 2D problems with special cases
4. Enable the students to formulate quadrilateral element, use of numerical integration, Gaussian quadrature and one dimensional dynamic problems
5. Enable the students to understand the convergence requirements, heat transfer , formulate 3D problems and perform engineering simulations using Finite Element Analysis software (ANSYS)

Outcomes: At the end of the course a student will be able to

1. Apply FE method for solving field problems using Virtual work and Potential energy formulations
2. Analyze linear problems like axial, trusses and beam problems
3. Analyze 2D structural problems using CST element and analyze plane stress, plane strain and axi-symmetric problems with triangular elements.
4. Write shape functions for 4 node quadrilateral isoparametric elements, apply numerical integration, Gaussian quadrature and to estimate natural frequencies for stepped bar
5. Check for convergence requirements, Solve linear 1D and 2D heat conduction and convection heat transfer problems, formulate 3D elements, apply finite element analysis software for engineering solutions

UNIT - I

Fundamental Concepts: Introduction to finite element method, stresses and equilibrium, boundary conditions, strain – displacement and stress – strain relationship

One Dimensional Problem: Different co-ordinate systems and shape functions, virtual work and potential energy approach, Assembly of global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, analysis of axial element and quadratic element

UNIT - II

Analysis of Trusses: Element stiffness matrix for a truss member, Analysis of plane truss with two degrees of freedom at each node

Analysis of Beams: element stiffness matrix for two nodes (two degrees of freedom per node),

Analysis of Frames: Analysis of frames with two translations and rotational degrees of freedom per node

UNIT - III

2D Triangular Elements: plane stress, plane strain and axisymmetry, finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions, Finite element modeling of axisymmetric solids subjected to axisymmetric loading with triangular elements

UNIT - IV

Quadrilateral Elements and Numerical Integration: Two dimensional four noded isoparametric elements, numerical integration and Gauss quadrature

Dynamic Analysis: Formulation of finite element model, element mass matrices, Evaluation of Eigen values and Eigen vectors for a stepped bar

UNIT - V

Heat Transfer Analysis: Steady state heat transfer analysis: One dimensional analysis of a fin and two dimensional analysis of thin plate

3 D Elements and FEA Software: Introduction to finite element formulation of three dimensional problems in stress analysis, convergence requirements

Introduction to Finite Element Analysis Software: Modeling, analysis and post processing

Text Books:

1. Ramamurthy, G., "Applied Finite Element Analysis", I.K. International Publishing House Pvt. Ltd., New Delhi, 2009.
2. Tirupathi R., Chandraputla and Ashok D. Belagundu, "Introduction to Finite Elements in Engineering", Practice Hall of India, 1997.
3. Daryl L. Logan, "A First Course in the Finite Element Method", Cengage Learning, 2011.

Suggested Reading:

1. Rao S. S., "The Finite Element Method in Engineering", Pergamon Press, 1989.
2. Segerlind L. J., "Applied Finite Element Analysis", Wiley Eastern, 1984.
3. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt., "Concepts and Applications of Finite Element Analysis", 4th Edition. Wiley

16ME C36

METROLOGY AND INSTRUMENTATION LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	50 Marks
CIE	25 Marks
Credits	2

Objectives:

1. To choose the proper measuring instrument for the precise measurement of Length, Height and diameter
2. To select the proper measuring instrument for the angular measurement.
3. To indentify gear & screw thread parameters using optical projector and tool makers microscope.
4. To familiarize with limits, fits and tolerances for gauge selection and design.
5. To understand the working principles in the measurement of Flatness, Roundness and Surface roughness.

Outcomes: At the end of the course, the students were able to

1. Identify methods and devices for measurement of length, height and diameter.
2. Acquire the knowledge about angular measurement and various measuring instruments.
3. Recognize & measure the gear and screw thread parameters using profile projector and tool maker microscope.
4. Demonstrate the sound knowledge in gauges selection, design and measurement.
5. Acquire adequate knowledge in the measurement of flatness, roundness and surface roughness.

Experiments:

1. Measurement with inside, outside and depth micrometers.
2. Measurement with height gauges, height masters.
3. Measurement of Linear and Angular dimensions with Tool Maker's Microscope – Diameter of thin wire and single point cutting tool angle.
4. Measurement with Dial Indicator and its calibration.
5. Measurement of angles with Sine bar and clinometers.
6. Measurement of roundness errors with bench centers.
7. Measurement of flatness errors of a surface plate with precision spirit level.
8. Measurement with optical profile projector.
9. Design of Plug gauge for a given hole.
10. Design of Snap gauge for a given shaft.
11. Surface roughness measurement by Taylor Hobson -Talysurf.
12. Measurement of Gear tooth thickness by gear tooth vernier.
13. Displacement measurement with LVDT.

Note: Student should complete a minimum of 10 experiments.

Suggested Reading:

1. IC Gupta, "Engineering Metrology", Dhanpat Rai Pub., New Delhi, 1984.
2. Bcnakra & K.K. Chaudhary , "Instrumentation Measurement and Analysis", 3/e, McGrawhill, 2014

16PE C13

MANUFACTURING ENGINEERING LAB

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	50 Marks
CIE	25 Marks
Credits	2

Objectives:

Students will learn

1. Various concepts of Manufacturing Processes and selection of right manufacturing process and materials
2. The concepts of process sheets
3. Various CAD packages
4. The Bill of Materials and MRP concepts
5. Limits, tolerances and fits in manufacturing

Outcomes:

Students able to

1. Apply right manufacturing techniques and choose the right material
2. Operate different machine tools
3. Prepare process sheets and Bill of Material
4. Apply limits, fits and tolerances while manufacturing components
5. Prepare CAD drawings

Part-1: **Manufacturing Mini Product**: Study of all manufacturing facilities available in various manufacturing related laboratories, manufacturing canon.

Part-2: **Manufacturing Major Product:** One/two of the following items have to be manufactured by a group of maximum two members using all the production facilities and processes as far possible and assembly techniques with fits and tolerances using CAD system, various exercises have to be allotted to different groups of students by the lab faculty

1. V block with U clamp
2. Dia test indicator stand
3. Simple Jig
4. Simple fixture
5. Simple die set
6. Simple tail stock mechanism
7. Lathe tool post
8. Milling Machine Arbor
9. Pipe vice
10. Paper Punch (double punch)
11. Hydraulic Cylinder
12. Gear box (Spur, Helical or Worm)

Suggested Reading:

1. P. N. Rao, “Manufacturing Technology – Metal Culling & Machine Tool”, Vol. 2, Tata McGraw Hill Education Pvt. Ltd, 2010.
2. Jain K.C., Chitale, A.K., “Production Engineering”, 2/e, PHI, 2014.

16PE C14

PROJECT SEMINAR

Instruction	3 Hours per week
Duration of Semester End Examination	----
SEE	----
CIE	50 Marks
Credits	2

The objective of 'Project Seminar' is to enable the student take up investigative study in the broad field of Engineering / Technology, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis or two/three students in a group, under the guidance of a supervisor. This is expected to provide a good initiation for the student(s) towards R&D. The work shall include:

1. Survey and study of published literature on the assigned topic;
2. Working out a preliminary Approach to the Problem relating to the assigned topic;
3. Conducting preliminary Analysis/Modelling/Simulation/Experiment/Design/Feasibility;
4. Preparing a Written Report on the Study conducted for Presentation to the Department;
5. Final Seminar, as oral Presentation before a departmental Committee.

Guidelines for the award of Marks:

Max. Marks: 50

Evaluation by	Max .Marks	Evaluation Criteria / Parameter
Supervisor	20	Project Status / Review
	5	Report
Department Committee	5	Relevance of the Topic
	5	PPT Preparation
	5	Presentation
	5	Question and Answers
	5	Report Preparation

With effect from academic year 2019-2020

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

CHOICE BASED CREDIT SYSTEM

B.E. (PRODUCTION ENGINEERING)

SEMESTER – VIII

S. No.	Course Code	Title of the Course	Scheme of Instruction		Scheme of Examination			Credits
			Hours per week		Duration in Hours	Maximum Marks		
			L/T	P/Dg.		CIE	SEE	
THEORY								
1		Professional Elective – VI	3	--	3	30	70	3
2		Open Elective – I	3	--	3	30	70	3
3		Open Elective – II	3	--	3	30	70	3
PRACTICALS								
7	16PE C15	Seminar	--	3	--	50	--	2
8	16PE C16	Project	6	--	--	50	100	6
TOTAL			**15**	**3**		**190**	**310**	**17**

L: Lecture T: Tutorial D: Drawing P: Practical
CIE - Continuous Internal Evaluation SEE – Semester End Examination

Professional Elective-VI (3/3)		
SNO	**Subj. Code**	**Name of the Subject**
1	16ME E15	Power Plant Engineering
2	16ME E16	Principles of Entrepreneurship
3	16ME E17	Innovations, Protection and Legal Aspects
4	16PE E11	Supply Chain Management
5	16PE E12	Total Quality Management

Open Elective – I (3/3)			**Open Elective – II (3/3)**		
SNO	**Subj. Code**	**Name of the Subject**	**SNO**	**Subj. Code**	**Name of the Subject**
1	16CE O02	Disaster Mitigation and Management	1	16IT O01	Object Oriented Programming using JAVA
2	16IT O02	Principles of Internet of Things	2	16PY O01	History of Science and Technology
3	16EE O03	Energy Auditing	3	16EE O05	Waste Management
4	16EC O07	System Automation and Control	4	16EC O05	MEMS and its Applications
5	16CS O09	Basics of Artificial Intelligence	5	16CS O07	Basics of Cyber Security

16ME E15

POWER PLANT ENGINEERING (Professional Elective – VI)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will learn

1. Different types of power plants and their site selection criteria
2. Operation of thermal power plant
3. About hydraulic power plants, dams and spillways
4. Different types of nuclear power plants including Pressurized water reactor, Boiling water reactor, Liquid metal fast breeder reactor and Gas cooled reactor
5. The power plant economics, environmental and safety aspects of power plant operation.

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

1. Select the suitability of site for a power plant.
2. Propose ash handling, coal handling method in a thermal power plant
3. Understand the water cycle, flow-sheet of hydro-power plant and types of dams and spillways
4. Explain working principle of different types of nuclear power plant.
5. Know the various factors of plant load and economy and safety aspects of power plants

UNIT - I

Introduction: Power plant, classification of power plants, conventional and non-conventional power plants
Steam power plant: Plant Layout, types of coals, coal handling equipment, Ash and Dust handling systems

UNIT II

Steam Power Plant: Combustion Process - Overfeed and Underfeed stokers-traveling grate stokers, spreader stokers, retort stokers- single retort and multi-Retort - Pulverized fuel burning systems – components – burners – Unit and Bin - working

UNIT III

Hydro Electric Power Plant: Hydrological cycle, flow measurement, Hydrographs – flow/mass duration curve - drainage area characteristics, Types of hydroelectric power plants- working - storage and pondage - classification and working of dams and spill ways.

UNIT - IV

Nuclear Power Plant: Nuclear fuel - breeding and fertile materials - types of reactors: Pressurized water reactor, Boiling water reactor, sodium-graphite reactor, fast Breeder Reactor, Gas cooled Reactor-Radioactive waste disposal.

UNIT - V

Power Plant Economics and Environmental Considerations:

Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor - related exercises-Fixed cost and variable cost-methods to find depreciation cost, Effluents from power plants and Impact on environment – pollutants - Pollution control.

Text Books:

1. R.K. Rajput, “A Text Book of Power Plant Engineering”, 4/e, Laxmi Publications (P) Ltd., New Delhi, 2015
2. P.K. Nag, “Power Plant Engineering”, 4/e, McGraHill Education(India) Private Limited, New Delhi, 2014.
3. S.C. Arora and S. Domukundwar, “A Course in Power Plant Engineering”, Dhanpat Rai & Sons, New Delhi, 2005.

Suggested Reading:

1. R. Yadav, “Fundamentals of Power Plant Engineering”, Central Publishing House, Allahabad, 2012.
2. R.K. Hegde, “Power Plant Engineering”, Pearson Education India, 2015.
3. P.C. Sharma, “A Text Book of Power Plant Engineering”, S.K. Kataria & sons, New Delhi, 2016.

16ME E16

` **PRINCIPLES OF ENTREPRENEURSHIP** (Professional Elective - VI)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will understand

1. Concept and procedure of idea generation
2. The nature of industry and related opportunities and challenges
3. Elements of business plan and its procedure
4. Project management and its techniques
5. Behavioral issues and Time management

Outcomes: After completing this course, students will be able to:

1. Analyse ideas for new and innovative products or services
2. Identify opportunities and deciding nature of industry
3. Analyze the feasibility of a new business plan and preparation of Business plan
4. Use project management techniques like PERT and CPM
5. Analyze behavioral aspects and use time management matrix

UNIT-I

Entrepreneurship: Definition, functions of entrepreneurship, qualities of entrepreneurs, Entrepreneur vs intrapreneur, First generation entrepreneurs, women entrepreneurs, need of innovation in entrepreneurial journey, Conception and evaluation of ideas and their sources,

UNIT-II

Indian Industrial Environment: Competence, Opportunities and Challenges, Entrepreneurship and Economic growth, Entrepreneurship and Engineering, Small Scale Industry in India, Objectives, Linkage among small, medium and large scale industries, Types of enterprises, Corporate Social Responsibility

UNIT-III

Formulation of Business Plan: Introduction, Elements of Business Plan and its salient features, Technical Analysis, Profitability and Financial Analysis, Marketing Analysis, Feasibility studies, Executive Summary. Selection of Technology, Collaborative interaction for Technology development

UNIT-IV

Project Management: During construction phase, project organization, project planning, execution and control using CPM, PERT techniques, Human aspects of project management, Assessment of tax burden, environmental issues.

UNIT-V

Behavioral Aspects of Entrepreneurs: Personality, determinants, Maslow's Hierarchy of needs, Leadership concepts and models, Values and attitudes, Motivation aspects, Change behavior

Time Management: Approaches of time management, their strengths and weaknesses. Time management matrix and the urgency addiction

Text Books:

1. Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, 1997.
2. Prasanna Chandra, "Project-Planning, Analysis, Selection, Implementation and Review", Tata Mcgraw-Hill Publishing Company Ltd. 1995.
3. S.S. Khanka, "Entrepreneurial Development", S. Chand & Co. Pvt. Ltd., New Delhi

Suggested Reading:

1. Robert D. Hisrich, Michael P. Peters, "Entrepreneurship", 5/e, Tata Me Graw Hill Publishing Company Ltd., 2005
2. Stephen R. Covey and A. Roger Merrill, "First Things First", Simon and Schuster Publication, 1994.
3. G.S. Sudha, "Organizational Behavior", National Publishing House, 1996.

16ME E17

INNOVATIONS, PROTECTION AND LEGAL ASPECTS (Professional Elective - VI)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will learn

1. Fundamental aspects of IP
2. Aspects of IPR acts.
3. Awareness of multi disciplinary audience
4. Awareness for innovation and its importance
5. The changes in IPR culture and techno-business aspects of IPR

Outcomes: At the end of the course, a student

1. Will respect intellectual property of others
2. Learn the art of understanding IPR
3. Develop the capability of searching the stage of innovations.
4. Will be capable of filing a patent document independently.
5. Completely understand the techno-legal business angle of IPR and converting creativity into IPR and effectively protect it.

UNIT-I

Overview of Intellectual Property: Introduction and the need for intellectual property right (IPR), IPR in India – Genesis and Development, IPR abroad, Some important examples of IPR. Importance of WTO, TRIPS agreement, International Conventions and PCT

Patents: Macro economic impact of the patent system, Patent and kind of inventions protected by a patent, Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Why protect inventions by patents. Searching a patent, Drafting of a patent, Filing of a patent, the different layers of the international patent system, (national, regional and international options), compulsory licensing and licensers of right & revocation, Utility models, Differences between a utility model and a patent. Trade secrets and know-how agreements

UNIT-II

Industrial Designs: What is an industrial design. How can industrial designs be protected? What kind of protection is provided by industrial designs? How long does the protection last? Why protect industrial designs?

UNIT-III

Trademarks: What is a trademark, Rights of trademark? What kind of signs can be used as trademarks. Types of trademark, function does a trademark perform, How is a trademark protected? How is a trademark registered. How long is a registered trademark protected for? How extensive is trademark protection. What are well-known marks and how are they protected? Domain name and how does it relate to trademarks? Trademark infringement and passing off.

UNIT-IV

Copyright: What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights. Distinction between related rights and copyright. Rights covered by copyright? Copy rights in computer programming.

UNIT-V

Geographical indications: Introduction, definition, difference between GI and trademark, difference between GI and appellation of origin, GI as factors of rural development, developing a geographical indication and protection

Enforcement of Intellectual Property Rights: Infringement of intellectual property rights Enforcement Measures Emerging issues in Intellectual property protection. Case studies of patents and IP Protection.

Unfair Competition: What is unfair competition. Relationship between unfair competition and intellectual property laws.

Text Books:

1. Ajit Parulekar and Sarita D' Souza, "Indian Patents Law – Legal & Business Implications"; Macmillan India ltd , 2006
2. B. L.Wadehra;" Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications"; Universal law Publishing Pvt. Ltd., India 2000
3. P. Narayanan; "Law of Copyright and Industrial Designs"; Eastern law House, Delhi 2010

Suggested Reading:

1. Cronish W.R1 "Intellectual Property; Patents, copyright, Trad and Allied rights", Sweet & Maxwell, 1993.
2. P. Narayanan, "Intellectual Property Law", Eastern Law Edn., 1997.
3. Robin Jacob and Daniel Alexander, "A Guide Book to Intellectual Property Patents, Trademarks, Copy rights and designs", 4/e, .Sweet, Maxwell

16PE E11

SUPPLY CHAIN MANAGEMENT (Professional Elective – VI)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will understand

1. The awareness about transportation and warehouse management systems.
2. The designing supply chain networks.
3. The concept of demand and supply and integrating it with supply chain management.
4. The planning and managing inventories.
5. The pricing and revenue management

Outcomes: At the end of the course, the student is able to

1. Plan an effective transportation and warehouse management systems
2. Design an effective supply chain networks
3. Integrate and optimize demand and supply gaps
4. Apply inventory management techniques
5. Understand and design pricing and revenue management systems

UNIT-I

Concept of SCM: Concept of Logistics Management, Supply Chain, Types of supply chain, functions in SCM, Transportation Management, Warehousing Management, Warehouse management systems.

UNIT-II

Designing the Supply Chain Network: Designing the distribution network, Network Design, Network Design in an uncertain environment.

UNIT-III

Planning and Demand: Planning demand & supply in a supply chain, demand forecasting, aggregate planning, planning supply & demand.

UNIT-IV

Planning & Managing Inventories in a Supply Chain: managing economies of scale, cycle inventory, and managing uncertainty safety inventory optimal level of product availability

UNIT-V

Sourcing, Transporting & Pricing Products: sourcing decisions, transportation, pricing & revenue management. Coordination & technology in the supply chains, coordination in supply chain, information technology and supply chain.

Text Books:

1. N. J. Kumar & Mukesh Bhatia, "Supply Chain Management", Neha publishers & Distributors, 2010.
2. Michael H. Hugos, "Essentials of Supply Chain Management", 3/e, John Wiley & Sons, Inc, Hoboken, New Jersy, 2011.
3. Sunil Chopra & Peter Meindl, "Supply Chain Management – Strategy, Planning and Operation", Pearson Education, Inc., Upper Saddle River, New Jersey, 2003.

Suggested Reading:

1. Martin Christopher, "Logistics & Supply Chain Management", 5/e, Financial Times Series, 2010.
2. Dobler Donald. W, David.N.Burt, "Purchasing & supply Management Text & Cases", McGraw-Hill, 1996.
3. Chitale A.K. Gupta R.C, "Materials Management-Text and Cases", Prentice-Hall Of India Pvt. Limited, 2007.

16PE E12

TOTAL QUALITY MANAGEMENT (Professional Elective – VI)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

Student will understand

1. The essence of total quality management in design and manufacturing a product
2. The various principles and concepts of total quality management
3. The various technical tools of quality like control charts and ANOVA etc
4. The quality information system
5. The awareness about measuring and satisfying customer needs

Outcomes:

At the end of the course, the student is able to

1. Apply TQM techniques in engineering applications
2. Use various theories and principles related to TQM
3. Use statistical techniques in TQM
4. Have awareness and use quality information system and innovative systems
5. Deal with customer grievances and satisfying the customers

UNIT-I

Strategic Quality Management: Quality policies, quality goals, obstacle to achieving successful strategic quality management, Organization for quality role of {Top, middle, work force team (Quality Circles)}, Developing a quality work culture, Maslow need theory, Herzberg two factor theory, Theory X, Y & Z methods to create and maintain awareness of quality, provide evidence of management leadership, types of self development and empowerment programmes, methods of participations means of inspiring action, recognition and rewards, Supplier quality rating plans (lot plot plan, OC curve, parent analysis), assignment of supplier capability, methods of evaluating supplier products, contract management (Joint economic plan, joint technological forecasting

UNIT-II

Design for Quality: Basic functional requirements of quality, design for (reliability, safety, cost and product performance), concurrent engineering (DFMA) value engineering, support for quality improvement processes (block diagram, brain storming, cause effect analysis, pareto analysis), quality function deployment, reliability analysis, failure rate, failure pattern of complex products (bath tub curve), weibull distribution relationship between part and the system, exponential reliability, availability, FMEA (Fracture Mode and Effect Analysis), Design for experiments: Factorial experiments, construction fractional designs

UNIT-III

Technical Tools for Quality: Analysis of variance (ANOVA), 4 factor ANOVA experiment, 2 levels, analysis of means, Techniques for online quality: data collection plan, variable and attribute charts, interpreting the control charts, Techniques for offline quality control: background to Taguchi method (quality loss and loss function, controllable factor, and non controllable factors in parameter performance, tolerance design

Taguchi analysis techniques: net variation and contribution ratio, estimation of process performance, accumulating analysis, performance measures, Taguchi tolerance design and tolerance (re) design

UNIT-IV

Quality Information System: Scope of Quality Information System, differences between QIS and MIS, creating new software (steps, types, defects) reports on quality (operational and executive reports), features of QIS software, software for inspection

Inspection System: Operational sorting and correlation sorting, AQL, LTPD, AOQL, Nondestructive test, Audit systems: (quality improvement planning and implementation, describing quality function, process control system, control of measurement system, material identification and control, drawing and specification control, process corrective action), the concept of POKAYOKE

UNIT-V

Measure of Customer Needs: The need to measure customer satisfaction, importance of proper packaging, customer processing and installation of product, dealing with customer complaints, using weibull analysis, field feedback, parameter to measure customer (dis)satisfaction, problems with the customer satisfaction system

Beyond TOM: Difficulties in implementing TOM system, rating your quality system, JIT system, the people side of TOM system, system integration, Kansei engineering and flexibility in manufacturing

Text Books:

1. L. Suganthi, Aanand A. Samuel, "Total Quality Management", PHI Learning Pvt. Ltd., 2004.
2. H.G. Menon, "TQM in view Production Manufacturing", McGraw Hill Publishers

Suggested Reading:

1. Joel E. Ross & Susan Perry, "Total Quality Management: Text, Cases, and Readings", 3/e, CRC Press, 1999
2. John S Oakland, "Total Quality Management: The route to improving performance", A Butterworth-Heinemann Title, 2/e, 1994
3. Jankiraman, "Total Quality Management: Text and Cases", PHI Learning Private Limited-New Delhi; 1 edition (2006)

16CE O02

DISASTER MITIGATION AND MANAGEMENT (Open Elective – I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To equip the students with the basic knowledge of hazards, disasters, risks and vulnerabilities including natural, climatic and human induced factors and associated impacts
2. To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters
3. To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters
4. To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.
5. To equip the students with the knowledge of the chronological phases ina disaster management cycle and to create awareness about the disaster management framework and legislations in the context of national and global conventions

Outcomes: At the end of the course the students are able to

1. Analyze and critically examine existing programs in disaster management regarding vulnerability, risk and capacity at different levels
2. Understand and choose the appropriate activities and tools and set up priorities to build a coherent and adapted disaster management plan
3. Understand various mechanisms and consequences of human induced disasters for the participatory role of engineers in disaster management
4. Understand the impact on various elements affected by the disaster and to suggest and apply appropriate measures for the same
5. Develop an awareness of the chronological phases of disaster preparedness, response and relief operations for formulating effective disaster management plans and ability to understand various participatory approaches/strategies and their application in disaster management

UNIT- I:

Introduction: Basic definitions- Hazard, Disaster, Vulnerability, Risk, Resilience, Mitigation, Management; classification of types of disaster- Natural and man-made; International Decade for natural disaster reduction (IDNDR); International strategy for disaster reduction (ISDR), National disaster management authority (NDMA).

UNIT- II:

Natural Disasters: Hydro meteorological disasters: Causes, Early warning systems- monitoring and management, structural and non-structural measures for floods, drought and Tropical cyclones; Geographical based disasters: Tsunami generation, causes, zoning, Early warning systems- monitoring and management, structural and non-structural mitigation measures for earthquakes, tsunami, landslides, avalanches and forest fires. Case studies related to various hydro meteorological and geographical based disasters.

UNIT- III:

Human induced hazards: Chemical disaster- Causes, impacts and mitigation measures for chemical accidents, Risks and control measures in a chemical industry, chemical disaster management; Case studies related to various chemical industrial hazards eg: Bhopal gas tragedy; Management of chemical terrorism disasters and biological disasters; Radiological Emergencies and case studies; Case studies related to major power break downs, fire accidents, traffic accidents, oil spills and stampedes, disasters due to double cellar construction in multi-storeyed buildings.

UNIT- IV:

Disaster Impacts: Disaster impacts- environmental, physical, social, ecological, economical, political, etc.; health, psycho-social issues; demographic aspects- gender, age, special needs; hazard locations; global and

national disaster trends; climate change and urban disasters.

UNIT- V:

Concept of Disaster Management: Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; risk analysis, vulnerability and capacity assessment; Post-disaster environmental response- water, sanitation, food safety, waste management, disease control; Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Text Books:

1. Pradeep Sahni, "Disaster Risk Reduction in South Asia", Prentice Hall, 2003.
2. B. K. Singh,"Handbook of Disaster Management: techniques & Guidelines", Rajat Publication, 2008.

Suggested Reading:

1. Ministry of Home Affairs, "Government of India, "National disaster management plan, Part I and II"
2. K. K. Ghosh,"Disaster Management", APH Publishing Corporation, 2006.
3. "Hazards, Disasters and your community: A booklet for students and the community", Ministry of home affairs.

Online Resources:

1. http://www.indiaenvironmentportal.org.in/files/file/disaster_management_india1.pdf
2. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs)

16IT O02

PRINCIPLES OF INTERNET OF THINGS (Open Elective – I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To provide an overview of Internet of Things, building blocks of IoT and real-world applications.
2. To explore various IOT enabling technologies.
3. To facilitate students, understand Python scripts for IoT platform.
4. To identify steps in IOT design Methodology.
5. To introduce about the Raspberry Pi device, its interfaces and Django Framework.

Outcomes:

Upon completing this course, students will be able to:

1. Comprehend the terminology, protocols and communication models of IoT.
2. Define the various IoT enabling technologies and differentiate between M2M and IoT.
3. Acquire the basics of Python Scripting Language used in developing IoT applications.
4. Describe the steps involved in IoT system design methodology.
5. Design simple IoT systems using Raspberry Pi board and interfacing sensors with Raspberry Pi.

UNIT-I

Introduction & Concepts: Introduction to Internet of Things- Definitions & Characteristics ofIoT, Physical Design of IOT-Physical Layer, Network Layer, Transport Layer, Application Layer, Things in IoT, IoT Protocols, Logical Design of IOT-IoTFunctional Blocks, IoT Communication Models-Request-reponse,Publisher-Subscriber,Push-Pull,Exclusive Pair, IoT Communication APIs-REST API, Websocket API,

UNIT-II

IOT Enabling Technologies: Wireless Sensor Networks, Cloud Computing, Big Data Analytics, Communication Protocols, Embedded Systems, IOT Levels & Deployment Templates. Differences and similarities between IOT and M2M, Domain Specific IoT's – IoT applications for Home Automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, health and Lifestyle.

UNIT-III

Introduction to Python–Motivation for using Python for designing IoT systems, Language features of Python, Data types- Numbers, Strings, Lists, Tuples, Dictionaries, Type Conversions, Data Structures: Control of flow-if, for, while, range, break/continue, pass, functions, modules, packaging, file handling, data/time operations, classes, Exception handling,

UNIT-IV

IoT Platforms Design Methodology: Introduction, IoT Design Methodology Steps-Purpose and Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specifications, IoT Level Specification, Functional View Specification, Operational View Specification, Device and Component Integration, Application Development, Case Study on IoT System for Weather Monitoring.

UNIT-V

IoT Physical Devices and End Points: Basic building blocks of an IoT device, Raspberry Pi about the Raspberry Pi board, Raspberry Pi interfaces-Serial, SPI, I2C, Other IoT Devices pcDuino, BeagleBone Black, Cubieboard. Python Web Application Framework: Django Framework-Roles of Model, Template andView

Text Books:

1. Arshdeep Bahga and Vijay Madisetti, "Internet of Things - A Hands-on Approach, Universities Press, 2015.
2. Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014.

Suggested Reading:

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014.
2. Francis da Costa, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013.
3. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", Willy Publications.

Web Resources:

1. The Internet of Things - Article
   https://dl.acm.org/citation.cfm?id=1862541
2. Internet of Things - Tutorial
   http://archive.eurescom.eu/~pub/about-eurescoiem/message_2009_02/Eurescom_message_02_2009.pdf
3. Publications on The Internet of Things.
   http://www.itu.int/osg/spu/publications/internetofthings/InternetofThings_summary.pdf

16EE O03

ENERGY AUDITING (Open Elective – I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To know the concept of Energy auditing
2. To understand the formulation of efficiency for various engineering systems
3. To explore the different ways to design various technologies for efficient engineering systems.

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

1. Know the current energy scenario and importance of energy auditing.
2. Understand the concepts of energy auditing.
3. Evaluate the performance of existing engineering systems
4. Explore the methods of improving energy efficiency in different engineering systems
5. Design different energy efficient devices.

UNIT-I

Basics of Energy and its Various Forms: Overview of engineering, elements Solar energy, electricity generation methods using solar energy, PV cell, elements of wind energy, electricity generation using wind energy, elements of bio energy, bio mass energy conservation, elements of geothermal energy, sources of geothermal energy, sources of chemical energy, fuel cells, Energy Scenario in India

UNIT-II

Energy Auditing-1: Introduction: Need for energy audit, directions for the study of energy auditing, inclusions for energy auditing, types of energy audit: preliminary audit, general/mini audit, investment-grade/ comprehensive audit. Major energy consuming equipments and systems, energy audit team, energy auditing methodology: preliminary and detailed. Process flow diagram, energy audit report format

UNIT-III

Energy Auditing-2: For Buildings: Energy auditing instruments, energy efficiency, energy auditing for buildings: stages in programs, surveying, measurements and model analysis. Energy audit form of commercial buildings, checklist for energy saving measures

UNIT –IV

Energy Efficient Technologies-I: Importance of energy efficiency for engineers, Energy efficient technology in mechanical engineering: Heating, ventilation and air-conditioning, boiler and steam distribution systems Energy efficient technology in civil engineering: future of roads, harnessing road and transport infrastructure;

UNIT-V

Energy Efficient Technologies-II: Energy efficient technology in electrical engineering: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors; Energy efficient technology in chemical engineering: green chemistry, low carbon cements, recycling paper

Text Books:

1. Umesh Rathore, 'energy management', Kataria publications, 2nd ediiton, 2014.
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects
3. Hargroves, K., Gockowiak, K., Wilson, K., Lawry, N., and Desha, C. (2014) An Overview of Energy Efficiency Opportunities in Mechanical/civil/electrical/chemical Engineering, The University of Adelaide and Queensland University of Technology.

Suggested reading:

1. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

16EC O07

SYSTEM AUTOMATION AND CONTROL (Open Elective – I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: This course aims to
1. Learn the concepts industrial control systems
2. Learn how to measure the physical parameters in industry
3. Learn the applications of Robots in industry.

Outcomes: After completion of this course, students will be able to:
1. Understand various process control systems.
2. Measure the physical parameters in the industry.
3. Design PID controllers
4. Understand the role of digital computers in automation
5. Understand the applications of Robots.

UNIT-I

Introduction to Automatic Control Systems: Purpose of Automatic Control, How an Industrial Control System is implemented, Introduction to Automatic Control theory.
Sensors: Motion, Position, Force, Level sensors and Thermo couples.

UNIT-II

Theory of Measurements: Measurement goals and concepts, Scale factor, Linearity, accuracy, Range, Resolution, Precision and repeatability.
Measurement Techniques and Hardware: Typical Sensor outputs, Bridgemeasurements, Resistance balanced Wheatstone bridge, Variable voltage type measurements, Frequency type measurements.

UNIT-III

Process Controllers: What is a Controller, uses of Controllers, Open loop and closed loop Control, proportional, PD, PI, PID Controllers, Analog and Digital methods of Control.
Controller Hardware: Analog and Digital Controllers.

UNIT-IV

Digital Computers as Process Controllers: Use by Digital Computer for process control, Information required by the computer, Information required by the process, Computer Interface electronics, Digital Computer input-output, computer processing of data, Digital Process control computer design, Computer programming.
Actuators: Electro mechanical - Linear motion and rotary motion solenoids, DC motors, AC motors and Stepped motors.

UNIT-V

Robots: What are robots, Robots and process Control systems, Degrees of freedom, factories of the future, Delivery, Disposal and transport systems, Sensing elements, Robot Classifications and Applications.
Trouble shooting System failures: Preliminary stepsand other troubleshooting aids.

Text Books:

1. Ronald P. Hunter, "Automated process control systems – concepts and Hardware", 2/e, PHI, 1987.
2. Norman A. Anderson, "Instrumentation for process measurement and Control", 3/e, CRC Press, 2005.

Suggested reading:

1. Kuo BC, "Automatic Control Systems", 9/e
2. AK Sawhney, "A course on Electrical and Electronic Measurements and Instrumentation".

16CS O09

BASICS OF ARTIFICIAL INTELLIGENCE (Open Elective – I)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: The objectives of this course are

1. Provide a strong foundation of fundamental concepts in Artificial Intelligence.
2. Discuss the various paradigms involved in solving an AI problems which involve perception, reasoning and learning
3. Apply the AI concepts to build an expert system to solve the real-world problems.

Outcomes: On Successful completion of this course, student will be able to

1. Differentiate between a rudimentary Problem and an AI problem, it's Characteristics and problem-solving Techniques.
2. Compare and contrast the various knowledge representation schemes of AI.
3. Understand and analyze the various reasoning and planning techniques involved in solving AI problems.
4. Understand the different learning techniques.
5. Apply the AI techniques to solve the real-world problems.

UNIT - I

Introduction: Definition, history, applications.

Problem Solving: AI problems, AI Technique, Defining problem as a State-Space Search, Problem Characteristics. Heuristic Search Techniques: Generate–and–test, Hill Climbing, Constraint Satisfaction.

UNIT - II

Knowledge Representation (Logic): Representing facts in logic, proposition logic, predicate logic, resolution and unification.

Knowledge Representation (Structured): Declarative representation, Semantic nets, procedural representation, frames.

UNIT - III

Reasoning: Probability and Bayes theorem, Certainty factors and Rule based systems, Bayesian Networks, Dempster-Shafer Theory.

Planning: Components, goal stack planning, nonlinear planning, hierarchical planning.

UNIT - IV

Learning: Introduction, Rote learning, learning by taking advice, learning in problem solving and learning from examples: Decision tree.

Intelligent Agents: Classification, Working of an agent, single agent and multi agent systems, multi agent application.

UNIT - V

Expert System: Representing and Using Domain Knowledge, Expert systems shells, Explanation, Knowledge Acquisition.

Perception and Action: Real Time Search, Vision, Speech Recognition, **Action:** Navigation, Manipulation, Robot architectures.

Text Books:

1. Elaine Rich, Kevin Night, Shivashankar B Nair, "Artificial Intelligence", 3/E, 2008
2. Russell Norvig, "Artificial Intelligence-Modern Approach", 3/E, 2010.

Suggested Reading:

1. Saroj Kaushik, "Artificial Intelligence", Cengage Learning India, 2012.
2. Nelson M. Mattos, "An Approach to Knowledge Base Management", Springer Berlin Heidelberg, 1991.

Online Resources / Weblinks / NPTEL Courses:

1. http://nptel.ac.in/courses/106106126/
2. http://nptel.ac.in/courses/106105077/

16IT O01

OBJECT ORIENTED PROGRAMMING USING JAVA (Open Elective – II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To familiarize with fundamentals of object-oriented programming paradigm.
2. To impart the knowledge of string handling, interfaces, packages and inner classes.
3. To facilitate learning Exception handling and Multithreading mechanisms.
4. To gain knowledge on collection framework, stream classes.
5. To familiarize with event driven GUI programming and Database connectivity.

Outcomes:

Upon completing this course, students will be able to

1. Understand Object-Oriented concepts.
2. Create Java applications using sound OOP practices e.g. Inheritance, Interfaces, Packages, and Inner classes.
3. Implement Exception Handling and Multithreading concepts in java programs.
4. Develop programs using the Java Collection API and Stream classes.
5. Design and Develop GUI applications with the integration of event handling, JDBC.

UNIT-I

OOP concepts - Data abstraction, encapsulation, inheritance, benefits of inheritance, polymorphism, classes and objects, Procedural and object oriented programming paradigms.

Introduction to Java: Java's Magic: The Byte code, The Java Buzzwords, Simple Java Programs, Java Primitive Types, Arrays: How to create and define arrays, Basic Operators, Control statements.

Introducing Classes: Declaring objects, methods, Constructors, this keyword, Method Overloading and Constructor Overloading, Objects as parameters, Returning objects, Use of static and final keywords.

UNIT-II

Inheritance: super and subclasses , Member access rules ,super keyword**,** Method overriding, Dynamic method dispatch , Abstract classes, using final with inheritance , Introduction to Object class.

Packages: Defining, Creating and Accessing a Package, Understanding CLASSPATH, importing packages.

Interfaces : Defining and implementing interfaces, Nested Interfaces.

Strings Handling: String & StringBuffer classes, StringTokenizer class and Wrapper classes and conversion between Objects and primitives.

Inner classes in Java: Types of inner classes, Creating static / non-static inner classes, Local and anonymous inner classes.

UNIT-III

Exception Handling in Java: what are Exceptions? Exception types**,** Usage of try, catch, throw, throws and finally clauses, writing your own exception classes.

Multithreading in Java: The java Thread Model, How to create threads, Thread class in java, Thread priorities, Thread synchronization.

Generics: What are Generics? Generic classes, bounded types, Generic methods and interfaces.

UNIT-IV

Collections Framework: Overview of Collection Framework, Commonly used Collection classes – ArrayList, LinkedList, HashSet, LinkedHashSet, TreeSet, Collection Interfaces –Collection, List, Set, SortedSet, Accessing a collection via an Iteration,Storing user-defined classes in collections, Map Interfaces and Classes, Using a comparator. Legacy classes – Vector, Hashtable, The Enumeration interface.

Input/Output : How to read user input (from keyboard) using scanner class,Stream classes, InputStream, OutputStream, FileInputStream, FileOutputStream, Reader and Writer, FileReader, FileWriter cl asses. File class.

UNIT-V

GUI Design and Event Handling: Component, Container, window, Frame classes. Working with Frame window GUI Controls, Layout Managers, Introduction to Swings, Delegation Event Model, Event Classes, Source of Events, Event Listener Interfaces, Handling button click events, Adapter classes. Writing GUI Based applications.

Database Handling in Java: Java Database Connectivity (JDBC) using MySQL.

Text Books:

1. Herbert Schildt, "Java: The Complete Reference", 8/e, Tata McGraw Hill Publications, 2011.
2. Cay S. Horstmann, Gary Cornell, "Core Java, Volume I, Fundamentals", 8/e, Prentice Hall, 2008.

Suggested Reading:

1. Sachin Malhotra & Saurabh Choudhary, "Programming in Java", 2/e, Oxford University Press, 2014.
2. C. Thomas Wu, "An introduction to Object-oriented programming with Java", 4/e, Tata McGraw-Hill Publishing company Ltd., 2010.
3. Kathy Sierra, Bert Bates, "Head First Java: A Brain-Friendly Guide" 2/e, O'Reilly, 2005

Web Resources:

1. https://www.cse.iitb.ac.in/~nlp-ai/javalect_august2004.html.
2. http://nptel.ac.in/courses/106106147/
3. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-092-introduction-to-programming-in-java-january-iap-2010/lecture-notes/

16PY O01

HISTORY OF SCIENCE AND TECHNOLOGY (Open Elective – II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To enable students to understand science as a socio-cultural product in specific socio-historical contexts.
2. To expose students to philosophical, historical and sociological perspectives to look atscience as a practice deeply embedded in culture and society.
3. To inculcate the scientific culture and ethics in the development of technologies.

Outcomes:

1. Demonstrate knowledge of broad concepts in the history of science, technology ranging over time, space and cultures.
2. Recognize the values of a wide range of methodologies, conceptual approaches and the impact of competing narratives within the history of science, technology.
3. Identify, locate and analyze relevant primary and secondary sources in order to construct evidence-based arguments.
4. Think independently and critically, using appropriate methodologies and technologies to engage with problems in the history of science, technology.
5. Demonstrate academic rigor and sensitivity to cultural and other diversity, and understanding of the ethical implications of historical and scientific enquiry within a global context.

UNIT- I

Science - The Beginning (through 599 BC): The Stone Ages, Knowledge among hunter gatherers, Agricultural Revolution and other revolutions,Civilization,Major advances.

Science in Antiquity (600 BC - 529 AD): Philosophy, a precursor to science, Hellenistic world and the Roman Empire, Other cultures of the period, major advances.

UNIT- II

Medieval Science (530 AD - 1452 AD): The decline of science in Europe , Science in China, Science and mathematics in India, Arab science, revival of science in Europe, technology revolution of the Middle ages, Major advances.

The Renaissance and the Scientific Revolution (1453 AD – 1659 AD): Renaissance, Scientific Revolution, Technology, Major advances.

UNIT- III

Scientific Method: Measurement and Communication (1660 AD – 1734): European domination, The scientific method, Major advances.

The Industrial Revolution (1735 AD – 1819 AD): Industrial Revolution, Rise of the engineer, Major Advances.

UNIT- IV

Science and Technology in the 19th Century (1820 AD – 1894 AD): philosophical basis of 19th-century science, Science and the public, Science and technology, Major advances.

Rise of Modern Science and Technology (1895 AD – 1945 AD): The growth of 20thcentury science, Newphilosophies, Quantum reality, Energy sources, Electricity: a revolution intechnology, Majoradvances.

UNIT- V

Big Science and the Post-Industrial Society (1946 AD – 1972 AD): Big science, Specialization and changing categories, Technology changes society, Major advances.

The Information Age (1973 AD – 2015 AD): Information and society, Globalization, The post-industrial society,Problems of the Information age, Major Advances

Text Books:

1. Bryan Bunch and Alexander Hellemans, “The History of Science and Technology”, Houghton Mifflin Company (New York), 2004
2. JD Bernal, “Science in History”, 4 Volumes, Eklavya Publishers, 2012

Suggested Readings:

1. “The 100 Most Influential Scientists of All Time”, Edited by Kara Rogers, Britannica Educational Publishing, 2010
2. Alberto Hernandez, “A Visual History of Science and Technology”, The Rosen Publishing Group, 2016

16EE O05

WASTE MANAGEMENT (Open Elective – II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To imbibe the concept of effective utilization of any scrap
2. To Become familiar with the processes of all disciplines of engineering.
3. To learn the technique of connectivity from waste to utility.

Outcomes:

After completion of this course, students will be able to

1. Understand the various processes involved in allied disciplines of engineering
2. Infer the regulations of governance in managing the waste
3. Distinguish the nature of waste materials concerned to the particular branch of engineering
4. Explore the ways and means of disposal of waste material
5. Identify the remedies for the disposal of a selected hazardous waste material

UNIT-I

Introduction to Waste Management: Relevant Regulations Municipal solid waste (management and handling) rules; hazardous waste (management and handling) rules; biomedical waste handling rules; fly ash rules; recycled plastics usage rules; batteries (management and handling) rules. Municipal Solid Waste Management – Fundamentals Sources; composition; generation rates; collection of waste; separation, transfer and transport of waste; treatment and disposal options.

UNIT-II

Hazardous Waste Management : Fundamentals Characterization of waste; compatibility and flammability of chemicals; fate and transport of chemicals; health effects, Radioactive Waste Management – Fundamentals Sources, measures and health effects; nuclear power plants and fuel production; waste generation from nuclear power plants; disposal options.

UNI-III

Environmental Risk Assessment: Defining risk and environmental risk; methods of risk assessment; case studies, Physicochemical Treatment of Solid and Hazardous Waste Chemical treatment processes for MSW (combustion, stabilization and solidification of hazardous wastes); physicochemical processes for hazardous wastes (soil vapor extraction, air stripping, chemical oxidation); ground water contamination and remediation

UNIT-IV

Biological Treatment: Solid and Hazardous Waste Composting; bioreactors; anaerobic decomposition of solid waste; principles of biodegradation of toxic waste; inhibition; co-metabolism; oxidative and reductive processes; slurry phase bioreactor; in-situ remediation.

UNIT-V

Landfill design aspects: Landfill design for solid and hazardous wastes; leachate collection and removal; landfill covers; incineration

Text Books:

1. John Pichtel, “Waste Management Practices”, CRC Press, Taylor and Francis Group 2005.
2. LaGrega, M.D.Buckingham, P.L. and Evans, J.C., “Hazardous Waste Management”, McGraw Hill International Editions, New York, 1994
3. Richard J. Watts, “Hazardous Wastes - Sources, Pathways, Receptors”, John Wiley and Sons, New York, 1997

Suggested Reading:

1. Kanti L.Shah, “Basics of Solid and Hazardous Waste Management Technology”, Prentice Hall, 1999.
2. S.C.Bhatia, “Solid and Hazardous Waste Management”, Atlantic Publishers & Dist, 2007

16EC O05

MEMS AND ITS APPLICATIONS (Open Elective – II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:
This course aims to:
1. Provide knowledge of semiconductors, various materials used for MEMS.
2. Introduce various Electrostatic and Thermal Sensors and Actuators.
3. Educate on the applications of MEMS to various disciplines.

Outcomes:
Upon completion of this course, students will be able to:
1. Select various materials used for MEMS.
2. Design the micro devices and systems using the MEMS fabrication process.
3. Understand the operation of different Sensors and Actuators.
4. Design the micro devices and systems using Polymer MEMs.
5. Apply different MEMS devices in various disciplines.

UNIT- I
Introduction: The History of MEMS Development, The Intrinsic Characteristics of MEMS: Miniaturization, Microelectronics Integration, Parallel Fabrication with Precision, Devices: Sensors and Actuators- Energy Domains and Transducers, Sensors Considerations, Sensor Noise and Design Complexity: Actuators Considerations.

UNIT- II
Introduction to Micro Fabrication: Overview of Micro fabrication, Overview of Frequently used Micro fabrication Processes: Photolithography, Thin Film Decomposition, Thermal Oxidation of Silicon, Wet Etching, Silicon Anisotropic Etching, Plasma Etching and Reactive Etching, Doping, Wafer Dicing, Wafer Bonding, Microelectronics Fabrication Process Flow, Silicon based MEMS Processes, Packaging and Integration, Process Selection and Design.

UNIT- III
Electrostatic Sensing and Actuation: Introduction to Electrostatic Sensors and Actuators, Parallel: Plate Capacitor, Applications of Parallel Plate Capacitors, Interdigitated Finger Capacitors, Applications of Combo-Drive Devices: Inertia Sensors, Actuators.
Thermal Sensing and Actuation: Introduction to Thermal Sensors, Thermal Actuators, Fundamentals of Thermal Transfer, Sensors and Actuators Based on Thermal Expansion, Thermal Couples, Thermal Resistors, Applications- Inertia Sensors, Flow Sensors, Infrared Sensors.

UNIT- IV
Piezoresistive Sensors: Origin and Expression of Peizoresistivity, Piezoresistive Sensor Materials: Metal Strain Gauges, Single crystal Silicon, Polycrystalline Silicon, Applications of Piezoresistive Sensors:Inertial sensors, Pressure Sensors, Tactile Sensors, flow Sensors.
Piezoelectric Sensors: Introduction, Properties of Piezoelectric Materials, Applications- Inertia Sensors, Acoustic Sensors, Tactile Sensors, Flow Sensors.

UNIT- V
Polymer MEMS: Introduction, Polymers in MEMS- Polyimide, SU-8, Liquid Crystal Polymer(LCP), Representative Applications- Acceleration Sensors, Pressure Sensors, Flow Sensors, Tactile Sensors.
Case Studies of Selected MEMS Products: Blood Pressure (BP) Sensor, Microphone, Acceleration Sensor and Gyros.

Text Books:
1. Chang Liu, "Foudations of MEMS", 2/e, Pearson Education Inc., 2012.
2. Tai Ran Hsu, "MEMS & Micro Systems Design and Manufacture", Tata McGraw Hill, 2002.

Reference Books:

1. P. Rai-Choudary, “MEMS and MOEMS Technology and Applications”, PHI publications, 2009.
2. Mohamed Gad-el-Hak, “The MEMS Handbook”, CRC press, 2001.

16CS O07

BASICS OF CYBER SECURITY (Open Elective – II)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: The main objectives of this course are:

1. To Identify and present indicators that a cybercrime has occurred and understand methods and tools used in cybercrimes.
2. To collect, Process, Analyze and Present Computer Forensics Evidence.
3. To understand the legal perspectives and Organizational implications of Cyber Security

Outcomes: On Successful completion of this course, student will be able to:

1. Discuss different types of cybercrimes and analyze legal frameworks to deal with these cybercrimes.
2. Describe Tools used in cybercrimes and laws governing cyberspace.
3. Analyze and resolve cyber security issues.
4. Recognize the importance of digital evidence in prosecution.
5. Analyze the commercial activities in the event of significant information security incidents in the Organization.

UNIT - I

Introduction to Cyber Crime: Cyber Crime: Definition and Origins of the Word, Cyber crime and Information Security, Classification of Cyber Crimes, Cyber Crime: The Legal Perspective, Cyber Crime: An Indian Perspective, A Global Perspective of Cyber Crime.

UNIT - II

Cyber Offenses: Introduction, How Criminals plan the Attacks, Social Engineering, Cyber stalking, Cyber cafe and Cybercrimes, Botnets: The Fuel for Cybercrime, Attack Vector. **Tools and Methods Used in Cybercrime:** Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horse and Backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow.

UNIT - III

Cyber Security: The Legal Perspectives**:** Cyber Crime and the Legal Landscape around the World, Need of Cyber laws: the Indian Context, The Indian IT Act, Challenges to Indian Law and Cyber Crime Scenario in India, Digital Signatures and the Indian IT Act, Cyber Crime and Punishment, Cyber Law, Technology and Students: The Indian Scenario.

UNIT - IV

Understanding Cyber Forensics: Introduction ,Digital Forensics Science, Need for Computer Forensics, Cyber Forensics and Digital Evidence, Forensics Analysis of Email, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Cyber Forensics Investigation, Challenges in Computer Forensics.

UNIT - V

Cyber Security: Organizational Implications: Introduction, Cost of Cybercrimes and IPR issues, Web threats for Organizations, Security and Privacy Implications, Social media marketing: Security Risks and Perils for Organizations, Social Computing and the associated challenges for Organizations.

Text Books:

1. Sunit Belpre and Nina Godbole, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives", Wiley India Pvt.Ltd, 2011.
2. Kevin Mandia, Chris Prosise, "Incident Response and Computer Forensics", Tata McGraw Hill, 2006.

Suggested Reading:

1. Alfred Basta, Nadine Basta, Mary Brown, Ravinder Kumar, "Cyber Security and Cyber Laws", Paperback, 2018.
2. Mark F Grady, Fransesco Parisi, "The Law and Economics of Cyber Security", Cambridge University Press, 2006.

Online Resources:

1. https://www.edx.org/learn/cybersecurity
2. https://www.coursera.org/courses?query=cyber%20security
3. https://swayam.gov.in/course/4002-cyber-law

16PE C15

SEMINAR

Instruction	3 Hours per week
Duration of Semester End Examination	----
SEE	----
CIE	50 Marks
Credits	2

The goal of a seminar is to introduce students to critical reading, understanding, summarizing, explaining and preparing report on state of the art topics in a broad area of his/her specialization. Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.

The seminar must be clearly structured and the power point presentation shall include following aspects:

1. Introduction to the field
2. Literature survey
3. Consolidation of available information
4. Summaryand Conclusions
5. References

Each student is required to:

1. Submit a one page synopsis of the seminar talk for display on the notice board.
2. Deliver the seminar for a maximum duration of 30 minutes, where the presentation should be for 20 minutes in PowerPoint, followed by Question and Answers session for 10 minutes.
3. Submit the detailed report of the seminar in spiral bound in a précised format as suggested by the department.

Seminars are to be scheduled from 3rd week to the last week of the semester and any change in schedule shall be discouraged.

For the award of sessional marks students are judged by three (3) faculty members and are based on oral and written presentations as well as their involvement in the discussions during the oral presentation.

Note: Topic of the seminar shall preferably be from any peer reviewed recent journal publications.

Guidelines for awarding marks		
Sl No.	Description	Max Marks
1.	Contents and relevance	10
2.	Presentation skills	10
3.	Preparation of PPT slides	05
4.	Questions and answers	05
5.	Report in a prescribed format	20

16PE C16

PROJECT

Instruction	6 Hours per week
Duration of Semester End Examination	----
SEE	100 Marks
CIE	50 Marks
Credits	6

The object of Project is to enable the student extend further the investigative study, either fully theoretical/practical or involving both theoretical and practical work, under the guidance of a Supervisor from the Department alone or jointly with a Supervisor drawn from R&D laboratory/Industry. This is expected to provide a good training for the student(s) in R&D work and technical leadership. The assignment to normally include:

1. In depth study of the topic assigned;
2. Review and finalization of the Approach to the Problem relating to the assigned topic;
3. Preparing an Action Plan for conducting the investigation, including team work;
4. Detailed Analysis/Modelling/Simulation/Design/Problem Solving/Experiment as needed;
5. Final development of product/process, testing, results, conclusions and future directions;
6. Preparing a paper for Conference presentation/ Publication in Journals, if possible;
7. Preparing a Dissertation in the standard format for being evaluated by the Department.
8. Final Seminar presentation before Departmental Committee.

Guidelines for the award of marks in CIE: (Max. Marks: 50)

CIE (Continuous Internal Evaluation) Max. Marks: 50

Evaluation by	Max .Marks	Evaluation Criteria / Parameter
Department Review Committee	05	Review 1
	08	Review 2
	12	Submission
Supervisor	05	Regularity and Punctuality
	05	Work Progress
	05	Quality of the work which may lead to publications
	05	Report Preparation
	05	Analytical / Programming / Experimental Skills

Guidelines for awarding marks in SEE:

(Max. Marks: 100)

Evaluation by	Max .Marks	Evaluation Criteria / Parameter
External and Internal Examiners together	20	Power Point Presentation
	40	Thesis Evaluation
	20	Quality of the project • Innovations • Applications • Live Research Projects • Scope for future study

	20	Viva-Voce

With Effect from the Academic Year 2019 - 2020

CHAITANYA BHARATHI INSTITUTE OF TECHNOLOGY (A)

OPEN ELEECTIVE subjects offered by MED (to be handled by MED faculty)

S.No.	Semester	Open Elective
UNDER CBCS SCHEME		
1.	SEMESTER – VII & SEMESTER – VIII	16ME O01 : Entrepreneurship 16ME O02 : Robotics 16ME O03 : Human Rights and Legislative Procedure 16ME O04 : Intellectual Property Rights 16ME O05 : Nano Materials and Technology 16ME O06 : Research Methodologies 16ME O07 : Introduction to Operations Research 16ME O08 : Industrial Administration and Financial Management 16ME O09 : Organizational Behaviour 16ME O10 : 3D Printing 16ME O11 : Essentials of Management

16ME O01

ENTREPRENEURSHIP (Open Elective)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will understand

1. The environment of industry and related opportunities and challenges
2. Concept and procedure of idea generation
3. Elements of business plan and its procedure
4. Project management and its techniques
5. Behavioral issues and Time management

Outcomes: After completing this course, students will be able to:

1. Identify opportunities and deciding nature of industry
2. Brainstorm ideas for new and innovative products or services
3. Analyze the feasibility of a new business plan and preparation of Business plan
4. Use project management techniques like PERT and CPM
5. Analyze behavioural aspects and use time management matrix

UNIT-I

Indian Industrial Environment: Competence, Opportunities and Challenges, Entrepreneurship and Economic growth, Small Scale Industry in India, Objectives, Linkage among small, medium and heavy industries, Types of enterprises, Corporate Social Responsibility.

UNIT-II

Identification and Characteristics of Entrepreneurs: First generation entrepreneurs, environmental influence and women entrepreneurs, Conception and evaluation of ideas and their sources, Selection of Technology, Collaborative interaction for Technology development.

UNIT-III

Business Plan: Introduction, Elements of Business Plan and its salient features, Technical Analysis, Profitability and Financial Analysis, Marketing Analysis, Feasibility studies, Executive Summary.

UNIT-IV

Project Management: During construction phase, project organization, project planning and control using CPM, PERT techniques, Human aspects of project management, Assessment of tax burden

UNIT-V

Behavioral Aspects of Entrepreneurs: Personality, determinants, attributes and models, Leadership concepts and models, Values and attitudes, Motivation aspects, Change behavior

Time Management: Approaches of time management, their strengths and weaknesses. Time management matrix and the urgency addiction

Text Books:

1. Vasant Desai, "Dynamics of Entrepreneurial Development and Management", Himalaya Publishing House, 1997.
2. Prasanna Chandra, "Project-Planning, Analysis, Selection, Implementation and Review", Tata Mcgraw-Hill Publishing Company Ltd. 1995.
3. S.S. Khanka, "Entrepreneurial Development", S. Chand & Co. Pvt. Ltd., New Delhi

Suggested Reading:

1. Robert D. Hisrich, Michael P. Peters, "Entrepreneurship", 5/e, TMH Company Ltd., 2005.

2. Stephen R. Covey and A. Roger Merrill, “First Things First”, Simon and Schuster Publication, 1994.
3. Sudha G.S., “Organizational Behavior”, National Publishing House, 1996.

16ME O02

ROBOTICS (Open Elective)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To make the students to learn
1. The configuration, work envelop and motion controls and applications
2. The kinematics and dynamics of robots.
3. Robot end effectors and their design.
4. Robot Programming Languages and Programming methods of robot.
5. Various Sensors and drives and their applications in robots

Outcomes: At the end of the course, the students will be
1. Equipped with the knowledge of robot anatomy, work volume and robot applications
2. Familiarized with the kinematic motions of robot and robot dynamics
3. Having good knowledge about robot end effectors and their design concepts
4. Equipped with the knowledge of Programming methods & drives used in robots
5. Equipped with the principles of various Sensors and their applications in robots.

UNIT - I

Introduction to Robotics: History and evolution of robots, basic configuration, degree of freedom, work envelope, motion control methods. Various applications in industry: material handling, loading & unloading, processing, welding & painting, assembly, and inspection, Requirements and Specifications of Robots.

UNIT- II

Rigid Motions and Homogeneous Transformations: Rotation matrix, Homogenous transformation matrix, Denavit-Hartenberg convention, Euler angles, RPY representation, Direct and inverse kinematics for industrial robots for position and orientation.

UNIT - III

Velocity Kinematics – The Manipulator Jacobian: Joint, End effector velocity, direct and inverse velocity analysis.

Trajectory Planning, interpolation, cubic polynomial, linear segments with parabolic blending, static force and moment transformation, solvability, stiffness, singularities.

UNIT - IV

Robot Dynamics: Lagrangian formulation, link inertia tensor and manipulator inertia tensor, Newton-Euler formulation for RR & RP manipulators.

Control: Individual joint, computed torque.

UNIT - V

End effectors: Position and velocity measurement,

Sensors: Proximity and range, tactile, force and torque, Drives for Robots: Electrical, Hydraulic and Pneumatic.

Robot vision: Introduction to technique, image acquisition and processing, introduction to robot programming languages.

Text Books:

1. Spong and Vidyasagar, “Robot Dynamics and Control”, John Wile and Sons, 1990
2. R.K. Mittal, I.J. Nagrath, “Robotics and control”, Tata Mcgraw-Hill Publishing Company Ltd. 2003
3. Groover, “Industrial Robotics”, Mcgraw-Hill Publishing Company Ltd. 2003

Suggested Reading:

1. Asada and Slotine, “Robot analysis and Intelligence”, Wiley Interscience, 1986
2. K.S. Fu Gon ZalezRC., lEEc.S.G., “Robotics, Control Sensing Vision and Intelligence”, McGraw Hill, Int. Ed., 1987
3. Richard S. Paul, “Robot Manipulators: Mathematics, Programming, and Control”, MIT Press

16ME O03

HUMAN RIGHTS AND LEGISLATIVE PROCEDURE (Open Elective)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: To help students to

1. Understand the value of human rights
2. Understand the Lawful rights available to him and others
3. Create understanding the rights of under privileged and respect them
4. Understand role of an individual in the Civil Society
5. Understand the safety aspects while using technology and to understand the role of NGO's in protecting human rights and environment.

Outcomes: At the end of the course student will understand the

1. Process of evolution of human rights
2. Constitutional protection available
3. Conditions of under privileged persons and will adopt a positive attitude towards.
4. Role of Law in protecting environment and will recognize right to life.
5. Safe means of using advanced technology and become part of NGO's in protecting human rights and environment.

UNIT-I

Meaning and Concept of Human Rights: Notion and classification of Rights, Moral and Legal Rights, Three generations of rights (Civil, and Political Rights, Economic Social and Cultural Rights, Collective/Solidarity Rights), Indian Bill of Rights and Sarodaya, Preamble of Indian Constitution, Fundamental Rights-Directive Principles-Fundamental Duties

UNIT-II

Human Rights Enforcement Mechanism: Human Rights Act, 1993, Judicial organs-Supreme Court (Art 32) and High Court (Art 226), Human Rights Commission, National and State Commission of Women/Children/Minority/SC/ST

UNIT-III

A Right to Development: Socio-Economic and Cultural Effects of Globalization, Right to Education, Transparency in Governance and Right to Information, Consumer Protection act.

UNIT-IV

Environment Rights Such as Right to Clean Environment and Public Safety: Issues of Industrial Pollution, Prevention, and Rehabilitation, Safety aspects of New Technologies such as Chemical and Nuclear Technologies, Issues of Waste Disposal, Protection of Environment.

UNIT-V

Role of Advocacy Groups: (a) Professional bodies: Press, media role of Lawyers – Legal Aid., (b) Educational Institutions (c) Role of Corporate Sector (d) N.G.Os

Text Books:

1. Mr. Ishay, "The history of Human rights", Orient Longman, New Delhi, 2004.
2. S.N. Chaudhary, "Human Rights and Poverty in India: Theoretical Issues", Delhi: Concepts, 2005.
3. Anuradha Kumar, "Encyclopedia of Human Rights Development of under Privilege", New Delhi: Sarup, 2002.
4. P.M. Katare and B.C. Barik, "Development, Deprivation and Human Rights, Violation", New Delhi: Rawat, 2002.

Suggested Readings:

1. Venket Iyer, (ed.), Democracy, "Human Rights and the Rule of Law: Essays in Honour of Nani Palkhivala", New Delhi: Butterworth's, 2000.
2. R.J. Cook and C.G. Ngwena (ed.), "Health and Human Rights", OUP, Clarendon, 2007.
3. UNESCO, "Ethics of Science and Technology: Explorations of the Frontiers of Science and Ethics", OUP, Clarendon, 2006.
4. K.P. Saksena, (ed.), "Human Rights and the Constitution: Vision and the Reality", New Delhi: Gyan Pub., 2003.

16ME O04

INTELLECTUAL PROPERTY RIGHTS (Open Elective)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will learn

1. Fundamental aspects of IP
2. Aspects of IPR acts.
3. Awareness of multi disciplinary audience
4. Awareness for innovation and its importance
5. The changes in IPR culture and techno-business aspects of IPR

Outcomes: At the end of the course, a student

1. Will respect intellectual property of others
2. Learn the art of understanding IPR
3. Develop the capability of searching the stage of innovations.
4. Will be capable of filing a patent document independently.
5. Completely understand the techno-legal business angle of IPR and converting creativity into IPR and effectively protect it.

UNIT-I

Overview of Intellectual Property: Introduction and the need for intellectual property right (IPR), IPR in India – Genesis and Development, IPR abroad, Some important examples of IPR. Importance of WTO, TRIPS agreement, International Conventions and PCT

Patents: Macro economic impact of the patent system, Patent and kind of inventions protected by a patent, Patent document, How to protect your inventions. Granting of patent, Rights of a patent, how extensive is patent protection. Why protect inventions by patents. Searching a patent, Drafting of a patent, Filing of a patent, the different layers of the international patent system, (national, regional and international options), compulsory licensing and licensers of right & revocation, Utility models, Differences between a utility model and a patent. Trade secrets and know-how agreements

UNIT-II

Industrial Designs: What is an industrial design. How can industrial designs be protected? What kind of protection is provided by industrial designs? How long does the protection last? Why protect industrial designs?

UNIT-III

Trademarks: What is a trademark, Rights of trademark? What kind of signs can be used as trademarks. Types of trademark, function does a trademark perform, How is a trademark protected? How is a trademark registered. How long is a registered trademark protected for? How extensive is trademark protection. What are well-known marks and how are they protected? Domain name and how does it relate to trademarks? Trademark infringement and passing off.

UNIT-IV

Copyright: What is copyright. What is covered by copyright. How long does copyright last? Why protect copyright? Related Rights: what are related rights. Distinction between related rights and copyright. Rights covered by copyright? Copy rights in computer programming.

UNIT-V

Enforcement of Intellectual Property Rights: Infringement of intellectual property rights Enforcement Measures Emerging issues in Intellectual property protection. Case studies of patents and IP Protection.

Unfair Competition: What is unfair competition. Relationship between unfair competition and intellectual property laws.

Text Books:

1. Ajit Parulekar and Sarita D' Souza, "Indian Patents Law – Legal & Business Implications", Macmillan India ltd , 2006
2. B. L.Wadehra; "Law Relating to Patents, Trade Marks, Copyright, Designs & Geographical Indications", Universal law Publishing Pvt. Ltd., India 2000
3. P. Narayanan, "Law of Copyright and Industrial Designs", Eastern law House, Delhi 2010

Suggested Reading:

1. W.R1 Cronish, "Intellectual Property; Patents, copyright, Trad and Allied rights", Sweet & Maxwell, 1993.
2. P. Narayanan, "Intellectual Property Law", Eastern Law Edn., 1997.
3. Robin Jacob and Daniel Alexander, "A Guide Book to Intellectual Property Patents, Trademarks, Copy rights and designs", 4/e, Sweet, Maxwell,.

16ME O05

NANO MATERIALS AND TECHNOLOGY (Open Elective)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Student will learn

1. Nanotechnology approach and challenges
2. Materials and characterization procedures
3. Zero and One dimensional Nano structures
4. Various Fabrication Techniques
5. Special nano materials and Nano biomaterials

Outcomes: At the end of the course, students will

1. Understand the developments and challenges in nano technology
2. Understand magnetic and electronic properties and its microstructure
3. Learn synthesis and characterization techniques of Zero and One dimensional Nano structures and their applications
4. Study various Nano Material Fabrication Techniques
5. Understand the applications of special nano materials and nano bio materials

UNIT - I

Introduction: Nanoscale, Properties at Nanoscale, advantages and disadvantages, importance of Nanotechnology, Bottom-up and Top-down approaches, challenges in nanotechnology

UNIT - II

Materials of Nanotechnology: Introduction, Si-based materials, Ge-based materials, Ferroelectric materials, Polymer materials, GaAs& InP (HI-V) group materials, Nanotribology and materials, characterization using Scanning Probe Microscope, AFM

UNIT - III

Nano Structures: Zero dimensional Nanostructure, synthesis procedure by heterogeneous method, characterization techniques, properties and applications of Nano particles

One dimensional Nanostructures: Synthesis procedure, characterization procedure and principles involved, properties and applications of Nano Wires

UNIT - IV

Nano Fabrication: Introduction, Basic fabrication techniques by Lithography and doping, MEMS fabrication techniques, Nano fabrication techniques by E-beam, Nano-imprint fabrication, Epitaxy and strain engineering

UNIT - V

Special Nano Materials: Introduction, Synthesis procedure by metal-polymer, Characterization procedures, applications

Nano Biomaterials: Introduction, Biocompatibility, anti-bacterial activity, applications

Text Books:

1. Dieter Vollath, “Nanomaterials: An introduction to Synthesis, properties and applications”, Wiley, 2013
2. Guozhong Cao, “Nanostructures and Nano Materials, Synthesis properties and applications”, Imperial College Press
3. Carl C Koch, “Nano materials Synthesis , Properties and applications”, Jaico Publishing House

Suggested Reading:

1. Willia Tllsey Atkinson, “Nano Technology”, Jaico Publishing House
2. George W. Hanson, “Fundamentals of Nanoelectronics”, Pearson Education, 2009
3. T. Pradeep, “Nano: Essentials-understanding Nano Science and Technology”, TMH, 2007

16ME O06

RESEARCH METHODOLOGIES (Open Elective)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. To make the students to formulate the research problem
2. To identify various sources for literature review and data collection.
3. To prepare the research design
4. To equip the students with good methods to analyze the collected data
5. To explain how to interpret the results and report writing

Outcomes: At the end of the course, the students are able to

1. Define research problem
2. Review and asses the quality of literature from various sources.
3. Understand and develop various research designs.
4. Analyze problem by statistical techniques: ANOVA, F-test, Chi-square
5. Improve the style and format of writing a report for technical paper/ Journal report

UNIT – I:

Research Methodology: Objectives and Motivation of Research, Types of Research- Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, Research Approaches, Significance of Research, Research Methods verses Methodology, Research process, Criteria of Good Research, Problems Encountered by Researchers in India, Technique involved in defining a problem.

UNIT–II

Literature Survey: Importance of Literature Survey, Sources of Information-primary, secondary, tertiary, Assessment of Quality of Journals and Articles, Information through Internet.

UNIT – III

Research Design: Meaning of Research Design, Need of Research Design, Feature of a Good Design Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Steps in sample design

UNIT – IV

Data Collection: Collection of primary data, Secondary data, Measures of central tendency-mean, mode, median, Measures of dispersion- Range, Mean deviation, Standard deviation, Measures of asymmetry (skewness), Important parametric tests -z, t, F, Chi-Square, ANOVA significance

UNIT – V

Research Report Writing: Format of the Research report, Synopsis, Dissertation, Thesis its Differentiation, References/Bibliography/Webliography, Technical paper writing/Journal report writing, making presentation, Use of visual aids. Research Proposal Preparation- Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

Text Books:

1. C.R Kothari, “Research Methodology, Methods & Technique”, New Age International Publishers, 2004.
2. R. Ganesan, “Research Methodology for Engineers”, MJP Publishers, 2011

Suggested Reading:

1. Vijay Upagade and Aravind Shende, “Research Methodology”, S. Chand & Company Ltd., New Delhi, 2009
2. G. Nageswara Rao, “Research Methodology and Quantitative methods”, BS Publications, Hyderabad, 2012.
3. Naval Bajjai, “Business Research Methods”, Pearson 2011.
4. Ratan Khananabis and Suvasis Saha, “Research Methodology”, Universities Press, Hyderabad, 2015

16ME O07

INTRODUCTION TO OPERATIONS RESEARCH (Open Elective)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

1. Students will come to know the formulation of LPP models
2. Students will understand the Algorithms of Graphical and Simplex Methods
3. Students will understand the Transportation and Assignment techniques
4. Students will come to know the procedure of Project Management along with CPM and PERT techniques
5. Students will understand the concepts of sequencing

Outcomes: At the end of the course, the students were able to

1. Formulate a managerial decision problem into a mathematical model;
2. Apply transportation problems in manufacturing industries;
3. Build and solve sssignment models
4. Apply project management techniques like CPM and PERT to plan and execute project successfully
5. Apply sequencing concepts in industry applications

UNIT-I

Introduction: Definition and Scope of Operations Research.

Linear Programming: Introduction, Formulation of linear programming problems, graphical method of solving LP problem, simplex method

UNIT-II

Transportation Models: Finding an initial feasible solution - North West Corner Method, Least Cost Method, Vogel's Approximation Method, Finding the optimal solution, Unbalanced Transportation problem, Degeneracy in Transportation

UNIT-III

Assignment Techniques: Introduction, Hungarian technique of Assignment techniques, unbalanced problems, problems with restrictions, Maximization in Assignment problems

UNIT-IV

Project Management: Definition, Procedure and Objectives of Project Management, Differences between PERT and CPM, Rules for drawing Network diagram, Scheduling the activities, Fulkerson's rule, Earliest and Latest times, Determination of critical path, duration of the project

UNIT-V

Sequencing Models: Introduction, General assumptions, processing 'n' jobs through two machines, processing 'n' jobs through three machines.

Text Books:

1. Hamdy, A. Taha, "Operations Research-An Introduction", Prentice Hall of India Pvt. Ltd., 6/e, 1997.
2. S.D. Sharma, "Operations Research", Kedarnath, Ramnath & Co., Meerut, 2009.
3. V.K. Kapoor, "Operations Research", S. Chand Publishers, New Delhi, 2004.

Suggested Reading:

1. Harvey M. Wagner, "Principles of Operations Research", Second Edition, Prentice Hall of India Ltd., 1980.
2. R. Paneer Selvam, "Operations Research", Second Edition, PHI Learning Pvt. Ltd., New Delhi, 2008
3. Nita H. Shah, Ravi M. Gor, Hardik Soni, "Operations Research", PHI Learning Private Limited, 2013

16ME O08

INDUSTRIAL ADMINISTRATION AND FINANCIAL MANAGEMENT (Open Elective)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Students able to learn

1. Various types of business organizations and organization structures and importance of plant location and plant layout
2. Importance of industrial engineering techniques like method study and work measurement.
3. The significance of quality control and production planning and control
4. The importance of project management techniques
5. The total cost of a product based on elements of cost

Outcomes: At the end of the course, the students will be able to

1. Understand the role of different types of business organizations along with the need and importance of various types of layouts used in manufacturing industries
2. Apply the techniques of method study and work measurement in industry to enhance productivity
3. Understand the importance of quality control and plot the control charts
4. Apply the techniques of project management in industry
5. Calculate the total cost of the product based on its elements.

UNIT-I

Industrial Organization: Definition of an organization, types of various business organizations, organization structures and their relative merits and demerits, functions of management.

Plant location and layouts: Factors affecting the location of plant and layout, types of layouts and their merits and demerits.

UNIT-II

Work study: Definitions, objectives of method study and time study, steps in conducting method study, symbols and charts used in method study, principles of motion economy, calculation of standard time by time study and work sampling, performance rating factor, types of ratings, jobs evaluation and performance appraisal, wages, incentives, bonus, wage payment plans

UNIT-III

Inspection and quality control: Types and objectives of inspection, S.Q.C., its principles. Quality control chart and sampling plans, quality circles, introduction to ISO.

Production planning and control: Types of manufacture, types of production, principles of PPC and its function, production control charts.

UNIT-IV

Optimization: Introduction to linear programming and graphical solutions, assignment problems.

Project Management: Introduction to CPM and PERT, determination of critical path.

Material Management: Classification of materials, materials planning, duties of purchase manager, determination of economic ordering quantities, types of materials purchase.

UNIT-V

Cost accounting: Elements of cost, various costs, types of overheads, break even analysis and its applications, depreciation, methods of calculating depreciation fund, nature of financial management, time value of money, techniques of capital budgeting and methods, cost of capital, financial leverage.

Text Books:

1. Pandey I.M. , "Elements of Financial Management", Vikas Publ. House, New Delhi, 1994.
2. James C Van Horne, John M Wachowicz, Jr., "Fundamentals of Financial Management", 13/e, Prentice Hall Financial Times.
3. Khanna O.P., "Industrial Engineering and Management", Dhanapat Rai & Sons.

Suggested Reading:

1. S.N. Chary, “Production and Operations Management”, 3/e, Tata McGraw Hill, 2006.
2. Paneer Selvam, “Production and Operations Management”, Pearson Education, 2007.
3. Joseph Monk, “Operations Management”, TMH Publishers, New Delhi, 2004.
4. Buffa Elwood S, “Modern Production /Operations Management”, John Wiley Publishers, Singapore, 2002.
5. Everrete E. Adama & Ronald J. Ebert, “Production & Operations Management”, 5/e, Prentice Hall of India, 2005.
6. S.D. Sharma, “Operations Research” ,Kedarnath, Ramnath & Co., Meerut,2009.

16ME O09

ORGANIZATIONAL BEHAVIOUR (Open Elective)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: The objectives of the course are to:

1. Define basic organizational behavior principles and analyze how these influence behavior in the workplace.
2. Analyze the influence of perceptions and personality on individual human behavior in the workplace.
3. Discuss the theories of Motivation and Leadership.
4. Provide knowledge on different organizational structures; and concepts of culture, climate and organizational development and make the students familiarize with individual behaviour.
5. Describe the interpersonal and their intrapersonal reactions within the context of the group and also demonstrate effective communication and decision making skills in small group settings.

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

1. Enable the students to practically implement the Organizational Behavior principles and practice in real time situations.
2. Analyze the behavior, perception and personality of individuals and groups in organizations in terms of the key factors that influence organizational behavior.
3. Acquire knowledge in applying motivational theories to resolve problems of employees and identify various leadership styles and the role of leaders in decision making process.
4. To examine various organizational designs and explain concepts of organizational culture, climate and organizational development.
5. To explain group dynamics and skills required for working in groups and identify the processes used in developing communication and resolving conflicts, power conflicts in organization.

UNIT – I

Introduction: Organizational behavior – Nature and levels of organizational behavior – Individuals in organization – Individual differences – Personality and Ability – The Big 5 Model of personality – Organizationally relevant personality traits. The nature of perception – characteristics of the perceiver, target and situation – perceptual problems.

UNIT – II

Organization Structure: Organizational Designs and Structures – Traditional and Contemporary organizational designs. Organizational culture and ethical behavior – factors shaping organizational culture– creating an ethical culture. Concepts - Organizational Climate, Organization Conflict, and Organization Development.

UNIT – III

Motivation and Leadership: Motivation–early and contemporary theories of motivation. Leadership – early and contemporary approaches to leadership.

UNIT – IV

Group Dynamics: Groups and group development – turning groups into effective teams. Managing change – process, types and challenges. Communicating effectively in organizations – communication process–barriers to communication–overcoming barriers to communication–persuasive communication–communication in crisis situations.

UNIT – V

Power, Politics, Conflict and Negotiations: Power, Politics, Conflict and Negotiations–Sources of individual, functional and divisional Power. Organizational politics. Conflict – causes and consequences – Pondy's model of organizational conflict–conflict resolution strategies.

Text Books:

1. Jennifer George and Gareth Jones, "Understanding and Managing Organizational Behavior", Pearson Education Inc., 2012.
2. Jon L Pierce and Donald G. Gardner, "Management and Organizational behavior", Cengage Learning India (P) Limited, 2001.
3. Richard Pettinger, "Organizational Behaviour", Routledge, 2010.

Suggested Readings:

1. Stephen P. Robbins, Jennifer George and Gareth Jones, "Management and Organizational Behaviour", Pearson Education Inc., 2009.
2. K. Aswathappa, "Organizational behavior", Himalaya Publishing House, 2013.
3 John Schermerhorn, Jr., James G. Hunt and Richard N. Osborn, "Organizational Behaviour", 10/e, Wiley India Edition, 2009.

16ME O10

3D PRINTING (Open Elective)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives: Students able to learn

1. To make students understand the basic concept of digital manufacturing.
2. To teach different processes involved in digital fabrication of products.
3. To demonstrate the STL file generation and manipulations.
4. To demonstrate various post processing techniques
5. To demonstrate the applications of RP in different fields of engineering

Outcomes: At the end of the course, the students will be able to

1. Understand the concept of 3D printing processes, its advantages and limitations
2. Understand different fabrication processes in regard to different materials
3. Resolve the various STL file issues during preprocessing stage
4. Apply different post processing techniques to obtain a finished component and understand rapid tooling concept
5. Understand the applications of RP in various fields of engineering

UNIT-I

Design considerations: Materials, Size, Resolution, mass customization. Additive *vs* subtractive manufacturing, its advantages and limitations

UNIT-II

Processes and Principles: Photo Polymerization, StereolithoGraphy, Fused Deposition Modeling (FDM), laser in Additive Manufacturing

UNIT-III

Pre Processing in AM: Modeling and viewing - 3D scanning; Model preparation – STL conversion, STL error diagnostics, STL file Repairs: Generic Solution; Slicing; Newly Proposed File formats

UNIT-IV

Post Processing in AM: Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, Property enhancements using non–thermal and thermal techniques

UNIT-V

Applications of AM: Application in Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry. Medical and Bioengineering Applications: Planning and simulation of complex surgery, Forensic Science.

Text Books:

1. Gibson, DW. Rosen and B.Stucker; "Additive manufacturing methodologies : Rapid prototyping to direct digital manufacturing ", Springer, 2010.
2. Chee Kai Chua, Kah Fai Leong, "3D printing and Additive Manufacturing : principles and application" , 4/e of rapid prototyping.
3. PK. Venuvinod, "Rapid prototyping – Laser based and other technologies", Kluwer, 2004.

Suggested Reading:

1. Jacob, Paul, "Rapid tooling : Technologies and industrial applications"
2. Andreas Gebhanrdt, "Understanding Additive anufacturing", Hanses, 2012.
3. Alain Brnard, Georges Talliander, "Additive Manufacturing", Wiley, 2014.

16ME O11

ESSENTIALS OF MANAGEMENT (Open Elective)

Instruction	3 Hours per week
Duration of Semester End Examination	3 Hours
SEE	70 Marks
CIE	30 Marks
Credits	3

Objectives:

To make the students to

1. Understand basic fundamentals and insights of management
2. Understand the nature and purpose of planning
3. Gain the knowledge about the frame work of organizing
4. Understand the essence and significance of directing
5. Recognize the importance of controlling and its outcomes

.

Outcomes:

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

1. Identify and evaluate the principles of management
2. Demonstrate the ability to have an effective and realistic planning
3. Identify the nature and the type of organization
4. Apply the tools and techniques of directing
5. Explain and evaluate the necessity for controlling and further refinement of an organization.

UNIT - I

Management: Definition of management**,** science or art, manager vs entrepreneur; managerial roles and skills;. Evolution of management, Basic management theories by FW Taylor, Henry Fayol, Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises;

UNIT - II

Planning: Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes.

UNIT - III

Organizing: Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning, Recruitment selection, Training & Development,

UNIT - IV

Directing: Individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication.

UNIT - V

Controlling: system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, control and performance, direct and preventive control, reporting.

Text Books:

1. S.P. Robins and M. Couiter, “Management”, 10/e., Prentice Hall India, 2009.
2. JAF Stoner, RE Freeman and DR Gilbert, “Management”, 6/e., Pearson Education, 2004.

Suggested Reading:

1. P.C. Tripathy & P.N. Reddy, “Principles of Management”, Tata McGraw Hill, 1999
2. Harold Koontz and Cyril O’Donnell “Principles of Management’’, Tata McGraw Hill, 2017