

**VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM**  
**CHOICE BASED CREDIT SYSTEM (CBCS)**  
**SCHEME OF TEACHING AND EXAMINATION 2015-2016**  
**B.E. INDUSTRIAL & PRODUCTION ENGINEERING**

**V SEMESTER**

Sl. No.	Subject Code	Title	Teaching Hours/ Week		Examination				Credits
			Theory	Practical/ Drawing	Duration	Theory/ Practical Marks	I.A. Marks	Total Marks	
1	15XX51	Management & Entrepreneurship (Excluding CS, IS and EV Branches)	04		03	80	20	100	4
2	15IP52	Work Study and Ergonomics	04		03	80	20	100	4
3	15IP53	Design of Machines Elements	04		03	80	20	100	4
4	15IP54	Hydraulics & Pneumatics	04		03	80	20	100	4
5	15IP55X		03		03	80	20	100	3
6	15IP56X		03		03	80	20	100	3
7	15IPL57	Mechanical and Fluid Power Lab	02	1I+2P	03	80	20	100	2
8	15IPL58	Work study and ergonomics Lab	02	1I+2P	03	80	20	100	2
<b>TOTAL</b>			<b>22</b>	<b>06</b>	<b>24</b>	<b>640</b>	<b>160</b>	<b>800</b>	<b>26</b>

Professional Elective		Open Elective	
15IP551	Engineering Economy	15IP561	Professional communication & report writing
15IP552	Theory of Metal Forming	15IP562	Concurrent Engineering
15IP553	Finite Elements Method	15IP563	Technology Management
15IP554	Composite Materials	15IP564	Human Resource Management

1. **Core Subject:** This is the course, which is to be compulsorily studied by a student as a core requirement to complete the requirement of a program in a said discipline of study.
2. **Professional Elective:** Elective relevant to chosen specialization/branch.
3. **Open Elective:** Electives from other technical and/or emerging subject area.

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**B.E. INDUSTRIAL & PRODUCTION ENGINEERING**

**VI SEMESTER**

Sl. No.	Subject Code	Title	Teaching Hours/ Week		Examination				Credits
			Theory	Practical/ Drawing	Duration	Theory/ Practical Marks	I.A. Marks	Total Marks	
1	15XX61	Computer Integrated Manufacturing	04		03	80	20	100	4
2	15IP62	Operations Research	04		03	80	20	100	4
3	15IP63	Tool Engineering & Design	04		03	80	20	100	4
4	15IP64	Materials Management	04		03	80	20	100	4
5	15IP65X		03		03	80	20	100	3
6	15IP66X		03		03	80	20	100	3
7	15IM/IPL67	CAD/CAM lab		1I+2P	03	80	20	100	2
8	15IPL68	Machine Tool Lab		1I+2P	03	80	20	100	2
<b>TOTAL</b>			<b>22</b>	<b>06</b>	<b>24</b>	<b>640</b>	<b>160</b>	<b>800</b>	<b>26</b>

Professional Elective		Open Elective	
15IP651	Quality and Assurance & Reliability	15IP661	Management Information Systems
15IP652	Analysis of Manufacturing Processes	15IP662	Advance Machining Process
15IP653	Total Quality Management	15IP663	Value Engineering
15IP654	Product Design & Manufacturing	15IP664	Development of Enterprises

- 1. Core Subject:** This is the course, which is to be compulsorily studied by a student as a core requirement to complete the requirement of a program in a said discipline of study.
- 2. Professional Elective:** Elective relevant to chosen specialization/branch.
- 3. Open Elective:** Electives from other technical and/or emerging subject area

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<b>MANAGEMENT AND ENTREPRENEURSHIP</b>			
<b>SEMESTER – V</b>			
Subject Code	<b>15IM/IP51</b>	IA Marks	20
Number of Lecture Hours/Week	04	Exam Hours	03
Total Number of Lecture Hours	50	Exam Marks	80
<b>CREDITS – 04</b>			
<b>Course Objectives:</b>			
This course will enable students to			
<ol style="list-style-type: none"> <li>1. Understand the basic concepts of management, planning, organizing and staffing.</li> <li>2. Acquire the knowledge to become entrepreneur.</li> <li>3. Comprehend the requirements towards the small-scale industries and project preparation.</li> </ol>			
<b>Modules</b>		<b>Teaching Hours</b>	<b>Revised Bloom's Taxonomy (RBT) Level</b>
<b>Module -1</b> <b>MANAGEMENT:</b> Introduction - Meaning - nature and characteristics of Management, Scope and Functional areas of management - Management as a science, art of profession - Management & Administration - Roles of Management, Levels of Management, Development of Management Thought - early management approaches - Modern management approaches. <b>PLANNING:</b> Nature, importance and purpose of planning process Objectives - Types of plans (Meaning Only) - Decision making Importance of planning - steps in planning & planning premises - Hierarchy of plans		<b>10 Hours</b>	<b>L1, L2, L3</b>
<b>Module -2</b> <b>ORGANIZING AND STAFFING:</b> Nature and purpose of organization Principles of organization - Types of organization - Departmentation Committees- Centralization Vs Decentralization of authority. and responsibility - Span of control - MBO and MBE (Meaning Only) Nature and importance of staffing— :Process of Selection & Recruitment.		<b>10 Hours</b>	<b>L1, L2,L3</b>

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<p><b>DIRECTING &amp; CONTROLLING:</b> Meaning and nature of directing Leadership styles, Motivation Theories, Communication - Meaning and importance - coordination, meaning and importance and Techniques of Co Ordination. Meaning and steps in controlling - Essentials of a sound control system - Methods of establishing control.</p>		
<p><b>Module -3</b>  <b>ENTREPRENEUR:</b> Meaning of Entrepreneur; Evolution of .the Concept; Functions of an Entrepreneur, Types of Entrepreneur, Entrepreneur - an emerging. Class. Concept of Entrepreneurship - Evolution of Entrepreneurship, Development of Entrepreneurship; Stages in entrepreneurial process; Role of entrepreneurs in Economic Development t; En trepre neur ship in India; Entrepreneurship - its Barriers.</p>	<b>10 Hours</b>	<b>L2, L3, L4</b>
<p><b>Module -4</b>  <b>SMALL SCALE INDUSTRIES:</b> Definition; Characteristics; Need and rationale; Objectives; Scope; role of SSI in Economic Development. Advantages of SSI Steps to start and SSI - Government policy towards SSI; Different Policies of SSI; Government Support for SSI during 5 year plans. Impact of Liberalization, Privatization, Globalization on SSI Effect of WTO/GA TT Supporting Agencies of Government for SSI, Meaning, Nature of support; Objectives; Functions; Types of Help; Ancillary Industry and Tiny Industry.</p>	<b>10 Hours</b>	<b>L3,L4,L5</b>
<p><b>Module -5</b>  <b>INSTITUTIONAL SUPPORT:</b> Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single Window Agency; SISI; NSIC; SIDBI; KSFC.  <b>PREPARATION OF PROJECT:</b> Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; Formulation; Guidelines by Planning Commission for Project report; Network Analysis; Errors of Project Report; Project Appraisal. Identification of business opportunities: Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study &amp; Social Feasibility Study.</p>	<b>10 Hours</b>	<b>L2, L3</b>
<p><b>Course Outcomes :</b>           After studying this course, students will be able to:</p>		

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1. Explain about the management and planning.
2. Apply the knowledge on planning, organizing, staffing, directing and controlling.
3. Describe the requirements towards the small-scale industries and project preparation.

**Graduate Attributes :**

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions
- Modern Tool Usage and Interpretation of data

**Question paper pattern:**

- The question paper will have ten questions.
- Each full question consists of 16 marks.
- There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books:**

1. Principles of Management – P. C. Tripathi, P.N. Reddy – Tata McGraw Hill,
2. Dynamics of Entrepreneurial Development & Management Vasant Desai - Himalaya Publishing House
3. Entrepreneurship Development – Poornima. M. Charantimath Small Business Enterprises - Pearson Education - 2006 (2 & 4).

**Reference Books:**

1. Management Fundamentals - Concepts, Application, Skill Development - Robers Lusier - Thomson
2. Entrepreneurship Development - S.S.Khanka - S.Chand & Co.
3. Management - Stephen Robbins - Pearson Education/PHI - 17<sup>th</sup> Edition, 2003.

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<b>Subject Code</b>	<b>: 15IM/IP52</b>	<b>No. of Credits</b>	<b>: 4 - 0 - 0</b>
<b>No. of Lecture Hours / Week</b>	<b>: 04</b>	<b>Exam Hours</b>	<b>: 3</b>
<b>Total No. of Lecture Hours</b>	<b>: 50</b>	<b>Exam Marks</b>	<b>: 80</b>

**COURSE OBJECTIVES**

1. To develop concepts related to principles of productivity & work study as a tool for increasing the efficiency and effectiveness in organizational systems.
2. To study the existing method, compare and propose a new method.
3. To provide the usage of the various tools and techniques used in work measurement.
4. To develop basic ideas of ergonomics and its design.
5. To develop concepts related Man-Machine Interfaces and Design of Displays and controls.

**COURSE CONTENT**

**UNIT – 1 Productivity and Work Study:** Definition of productivity, task of management, productivity of materials, land, building, machine and power, factors affecting the productivity, work content, basic work content, excess work content, how manufacturing job is made up, work content due to excess product and process, ineffective time due to short comings on part of the management.

**Definition, Objective and scope of Work Study:** Work study and management, work study and worker

**08 Hours**

**UNIT – 2.**

**Method Study:** Definition, objective and scope of method study, activity recording and tools, **Recording tools:** Out Line Process Chart, Flow Process Chart, Flow

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diagram, String Diagram, Travel Chart, Multiple Activity Chart, Two- Handed process chart.

**Principles of Motion Economy:** Introduction, Classification of movements. Two- hand process chart, Micromotion study, Therbligs, SIMO Chart. Special Charts: Cyclegraph and Chronocycle graph - development, definition and installation of the improved method.

**Work Measurement:** Definition, objectives, work measurement techniques.

**Work sampling** – Need, confidence levels, and sample size determination, conducting study with problems

**12 Hours**

**UNIT – 3 Time study** - Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information.

**Rating:** Systems of rating, standard rating, standard performance, scales of rating.

**Allowances:** Standard time determination, predetermined motion time study (PMTS), factors affecting rate of working, problems on allowances.

**08Hrs**

**UNIT – 4 Introduction to Ergonomics:** Human factors and ergonomics, psychology, engineering, bio mechanics, industrial design, graphics design, statistics, operation research and anthropometry Morphology of design and its relationship with cognitive abilities of human being.

**Physical Ergonomics** : human anatomy, and some of the anthropometric, physiological and bio mechanical characteristics as they relate to physical activity. Cognitive: mental processes, such as perception, memory, reasoning, and motor response, mental workload, and decision-making. Organizational ergonomics: optimization of socio-technical systems, including their organizational structures, policies, processes. Communication, work design, design of working times, teamwork, cooperative work, and new work programs. Environmental ergonomics: human interaction with the environment- characterized by climate, temperature, pressure, vibration, light.

**12 Hours**

**UNIT – 5 Man-Machine Interaction;** Man-Machine interaction cycle, Man-machine interfaces, Displays : factors that control choice of display, visual displays-qualitative displays; moving pointer displays, moving scale displays, digital displays Indicators, auditory displays, tactile displays. Factors affecting effectiveness of displays. Quantitative displays, check- reading displays, representational displays. Types of controls and their integration with displays.

**Design guidelines for displays and controls:** viewing distance, Illumination, angle of view, reach etc., general design checklist for displays and controls. Standards for ergonomics in engineering and design, displays and controls.

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**08 Hours**

**COURSE OUTCOMES:**

Upon completion of this course, students should be able to:

1. Recollect the basic concepts of productivity, work content and work study and define the objective and scope of Work Study.
2. Define the various charts and to construct the charts on the basis of present method and develop a new / proposed method and identify the unnecessary movements.
3. Explain the basic work measurement techniques and to gain knowledge of measurement of work, rating and imbibe the concept of allowance in estimating Standard Time
4. Determine the basic concepts of Ergonomics and demonstrate a sound knowledge of Ergonomics in engineering applications.
5. Demonstrate a sound knowledge of Man-Machine Interfaces and design of displays and controls in engineering systems

**TEXT BOOKS**

1. **Introduction to Work Study** – ILO, 4<sup>th</sup> edition 1992
2. **Mark. S. Sanders and Ernest. J McCornick.** “Human Factor in Engineering and Design”, McGraw-Hill Book Co., Inc., New York, 1993

**REFERENCE BOOKS**

1. S. Dalela and Sourabh, “**Work Study and Ergonomics**”. Standard publishers 2013
2. **Wesley Woodson, Peggy Tillman and Barry Tillman**, “Human Factors Design Handbook”, McGraw-Hill; 2<sup>nd</sup> edition, 1992
3. Ralph M. Barnes, “Motion and Time Study”, Wiley International, 7<sup>th</sup> Edition.
4. Mark S. Sanders and Ernest J. McCormick , “Human Factors in Engineering Design” 4<sup>th</sup> edition, 2013.
5. B. Niebel and Freivalds, Niebel’s Methods Standards and Work Design, McGraw-Hill, 12<sup>th</sup> Edition, 2009,



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<b>DESIGN OF MACHINE ELEMENTS</b>				
<b>Semester - V</b>				
Subject Code: <b>15IM/IP53</b>			IA Marks	20
Number of Lecture Hours/Week	04		Exam Marks	80
Total Number of Lecture Hours:	50		Exam Hours	03
<b>CRIDITS – 04</b>				

**Module 1**

**DESIGN FOR STATIC STRENGTH:** Design considerations; Codes and Standards, static loads and factor of safety. Theories of failure: Maximum Normal Stress Theory, Maximum Shear Stress Theory, Distortion energy theory. Failure of Brittle and Ductile materials. Stress concentration. Determination of stress concentration factor.

**8 Hours**

**Module 2**

**DESIGN FOR FATIGUE STRENGTH:** S – N Diagram, low cycle and High cycle fatigue. Endurance limit. Modifying factors: Load, Size and Surface finish effects. Fatigue stress concentration factor. Fluctuating stresses. Goodman and Soderberg Relationship. Stresses due combined loading, Cumulative fatigue damage.

**8 Hours**

**Module 3**

**DESIGN OF SHAFTS:** Design of shafts subjected to torsion, bending moment and combined torsion moment and axial loading. ASME and BIS Codes for design of transmission shafting. Design for strength and rigidity. Shafts under fluctuating loads and combined loads.

**12 Hours**

**Module 4**

**DESIGN OF GEARS:** Introduction to Spur, Helical and Bevel Gears. Design of Spur gear, Lewis equation, form factor, stresses in gear tooth, Dynamic load and wear load.

**12 Hours**

**Module 5**

**RIVETED JOINTS AND WELDED JOINTS:** Types of riveted joints, failures of riveted joints, Boiler joint, Efficiency. Types of welded joints, Strength of butt and fillet welds, eccentrically loaded welds.

**5 Hours**

**DESIGN OF SPRINGS:** Types of springs, Stresses in Coil springs of circular and non-circular cross-sections. Tension and compression springs. Stresses in Leaf springs.

**5 Hours**

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**TEXT BOOKS:**

1. **Mechanical Engineering Design** - Joseph Edward Shigley – Tata McGraw Hill, New Delhi - 1986.
2. **Machine Design** - VL. Maleev and Hartman – CBS Publishers and Distributors, Delhi - 1983.
3. **Design of Machine Elements** - V. B. Bahandari – Tata McGraw Hill, New Delhi - 2000.

**REFERENCE BOOKS:**

1. Machine Design - Robert. L. Norton – Pearson Education Asia, New Delhi - 2001.
2. Theory and Problems of Machine Design - Hall, Holowinko, Laughlin Schaums - Outline Series - 2002.
3. Elements of Machine Design - N. C. Pandey and C. S. Shah – Chorotar Publishing house – 2002.

**Question paper pattern:** The question paper will have TEN questions. There will be TWO questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer FIVE full questions, selecting ONE full question from each module.

**HYDRAULICS and PNEUMATICS**

<b>Subject Code</b>	<b>: 15IP54</b>	<b>No. of Credits</b>	<b>: 4 - 0 - 0</b>
<b>No. of Lecture Hours / Week</b>	<b>: 04</b>	<b>Exam Hours</b>	<b>: 3</b>
<b>Total No. of Lecture Hours</b>	<b>: 50</b>	<b>Exam Marks</b>	<b>: 80</b>

**COURSE OBJECTIVES**

1. To Study the fundamentals of Hydraulic Power Pumps, Actuators and Motors.

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2. To develop a sound knowledge of control components in Hydraulic Systems.
3. To have basic skills to design Hydraulic Circuits and analyze them.
4. To acquire the fundamental knowledge on pneumatic control.
5. To develop skill sets to handle Pneumatic Actuators , Valves, Pneumatic circuits and logic circuits

**COURSE CONTENT**

**MODULE 1**

**Introduction to Hydraulic Power and Pumps:** review of fluid mechanics, Pascal's Law, structure of hydraulic control system. pumps: pumping theory, pump classification, gear pumps- external and internal type, vane pumps- simple, balanced, pressure compensated types, piston pumps- radial and axial (both swash plate and bent axis type), pump performance.

**Hydraulic Actuators and Motors:** Linear hydraulic actuators - single acting, double acting, tandem cylinder, telescopic rod cylinder, mechanics of hydraulic cylinder loading, cylinder cushioning, hydraulic rotary actuators, hydrostatic transmission – open and close circuit, performance of hydraulic motor.

**12Hrs**

**MODULE 2**

**Control Components in Hydraulic Systems:** directional control valves (DCV), constructional features, 2/2,3/2,4/2,4/3 DCV, center configuration in 4/3 DCV- open, closed, tandem, regenerative, floating centre configuration, actuation of DCVs- manual, mechanical, solenoid, and indirect actuation, relays for the solenoid operation, check valve, pilot check valve, pressure control valves – direct and pilot operated types, pressure reducing valve, flow control valves- fixed throttle, and variable throttle, throttle check valve, pressure compensated flow control valve- relief and reducing type.

**12Hrs**

**MODULE 3**

**Hydraulic Circuit Design and Analysis:** control of single and double acting hydraulic cylinder, regenerative circuit, counter balance valve application, cylinder sequencing circuits, cylinder synchronizing circuits, speed control of hydraulic cylinder – meter in and meter out, speed control of hydraulic motors, relay circuit

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design for the operation of solenoid directional control valve- single and double solenoid relay circuit

**08Hrs**

**MODULE 4**

**Introduction To Pneumatic Control:** choice of working medium, characteristics of compressed air, structure of pneumatic control system , supply, signal generators, signal processor, final control elements , actuators, production of compressed air – compressors - reciprocating and rotary type, preparation of compressed air – driers, filters, regulators, lubricators, distribution of compressed air – piping layout.

**08Hrs.**

**MODULE 5**

**Pneumatic Actuators , Valves:** linear cylinder – types, conventional type of cylinder – working, directional control valve, shuttle valve, quick exhaust valve, twin pressure valve, direct and indirect actuation of pneumatic cylinder, memory valve, time delay valve.

**Pneumatic circuits and logic circuits:** supply air and exhaust air throttling, will dependent circuits, travel dependent controls – types – construction – practical applications, cylinder sequencing circuits, travel step diagrams, practical examples involving two or three cylinders, use of logic functions – OR, AND, NOR, NAND, YES, NOT functions in pneumatic applications, practical examples involving the use of logic functions.

**10Hrs**

**COURSE OUTCOMES:**

**Upon successful completion of this course, the students will be able to**

1. Recall the basic concept of fluid mechanics; identify different components of hydraulic system.
2. Analyze the requirement of control components and their selection.

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**MECHANICAL AND FLUID POWER LAB**

Subject Code	: 15IPL	IA Marks	: 20
	57		
No. of Lab Hours./ Week	: 03	Exam Hours	: 03
Total No. of Lab Hours.	: 42	Exam Marks	: 80

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**PART – A**

**FLUID POWER LAB**

1. a) Study of components of Hydraulic circuit.  
b) Study of symbols for components in hydraulic circuits.
2. Testing of Pump.
3. Testing of Flow Control Valve.
4. Speed control of Piston in Forward and Return stroke with Meter in Meter out circuit.
5. Study of Regenerative circuit and study of Bleed of circuit.
6. Study of Variation of Flow with pressure and with throttle.
7. Building of Circuits using different kinds of Valves.

**PART - B**

**MECHANICAL ENGINEERING LAB**

(At least Four experiments)

1. Determination of viscosity of lubricating oil using Redwoods and Saybolts – Viscometers.
2. Flash and Fire point of given oil
3. Performance Tests on Four stroke Petrol and Diesel Engines, Calculations of IP, BP, thermal efficiencies, SFC, FP and heat balance sheet.
4. Multi cylinder petrol / diesel engine (Morse test).
5. Performance test on Centrifugal or Reciprocating pumps.
6. Study of flow through pipes for fluid transport.

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Note: A minimum of 12 exercisers are to be conducted

**WORK STUDY AND ERGONOMICS LAB**

Subject Code	: 15IML/IPL58	IA Marks	: 20
No. of Practical Hrs./ Week	: 03	Exam Hours	: 03
Total No. of Lecture Hrs.	: 42	Exam Marks	: 80

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**PART - A**

**METHOD STUDY**

Recording Techniques: Preparing the following charts and diagrams (Minimum 3 Charts)

Outline process chart

Multiple Activity Chart

Flow process chart and Flow diagram

String diagram,

Experiments on the Application of principle of motion economy, Two handed process chart. Exercises on conducting method study for assembling simple components and office work. Development of Layout plans using SLP technique. Experiments on Line balancing.

**PART - B**

**WORK MEASUREMENT**

1. Rating practice using: walking simulator, pin board assembly, dealing a deck of cards and marble collection activity
2. Determining the standard time for simple operations using stopwatch time study
3. Exercises on estimating standard time using PMTS.
4. Determination of standard time using PDA device and time study software
5. Measurement of parameters (heart beat rate, calorie consumption) using walking simulator
6. Measurement of parameters (heart beat rate, calorie consumption, revolutions per minute) using ergometer

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7. Effect of Noise, Light, Heat on human efficiency in work environments.

**REFERENCE BOOKS:**

1. **ILO, Introduction to work study** - III Revised Edition, 1981
2. **Motion and Time study** - Ralph M Barnes; John Wiley, 8<sup>th</sup> Edition, 1985.
3. **Engineered work Measurement** - Wledon, ELBS , 1991
4. **Motion and Time study** - Marvin E. Mundel-, PHI, 1<sup>st</sup> edition

**ENGINEERING ECONOMY**

<b>Subject Code</b>	<b>: 15IM/IP551</b>	<b>No. of Credits</b>	<b>: 4 - 0 - 0</b>
<b>No. of Lecture Hours / Week</b>	<b>: 04</b>	<b>Exam Hours</b>	<b>: 3</b>
<b>Total No. of Lecture Hours</b>	<b>: 50</b>	<b>Exam Marks</b>	<b>: 100</b>

**COURSE OBJECTIVES**

1. To acquire a clear understanding of the fundamentals of engineering economics.
2. To learn the concepts of decision making, problem solving, and comparison of the alternatives and elements of cost.
3. To inculcate an understanding of concept of money and its importance in the evaluation of projects.
4. To illustrate concept of money and its importance in evaluating the projects.
5. To evaluate the alternatives based on the present annual worth and equivalent annual worth methods.

**COURSE CONTENT**

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**MODULE 1**

**Introduction:** engineering decision – makers, engineering and economics, problem solving, intuition and analysis, tactics and strategy with an example.

**Interest and Interest Factors:** Interest rate, simple interest compound interest, interest formulae, time value equivalence exercises, problems and discussion.

**10Hrs.**

**MODULE 2**

**Present Worth Comparison:** Conditions for present worth comparisons, rule 72, basic present worth comparisons, present worth equivalence, net present worth, assets with equal and unequal lives, comparison of assets assume to have infinite lives, exercises and problems.

**10 Hrs**

**MODULE 3**

**Equivalent Annual Worth Comparisons:** Situations for equivalent annual worth comparison, net annual worth of a single project, comparison of net annual worth's, definitions of asset life, comparison of assets with equal and unequal lives, exercises and problems.

**10 Hrs**

**MODULE 4**

**Depreciation:** Introduction, methods of depreciation, problems.

**Replacement Analysis:** Reasons- Deterioration, obsolescence, inadequacy, replacement criteria problems

**08 Hrs**

**MODULE 5**

**Estimating and Costing:** components of costs such as direct material cost, direct labour cost, Fixed, over – heads, factory costs, administrative – over heads, first cost, selling price, calculation of the total cost of various components, mensuration, estimation of simple components.

**10 Hrs.**



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**COURSE OUTCOMES:**

Upon completion of this course, students should be able to:

1. Recall the basic concepts of decision making, problem solving, tactics and strategy.
2. Defining the time value of money concept, interest formulae.
3. Explain the comparison by present worth method for different lives of the asset. Compare the asset on the basis of EAW comparison.
4. Explain the concepts of depreciation and replacement criteria.
5. Calculate the total cost of a component and explain the process for estimating simple components.

**TEXT BOOKS**

1. **Engineering economy** – Riggs J.L., McGraw Hill, 2002.
2. **Engineering economy** – Paul Degarmo, Macmillan Pub, Co., 2001

**REFERENCE BOOKS**

1. **Engineering Economy** – NVR. Naidu, KM Babu and G.Rajendra, New Age International Pvt. Ltd., 2006.
2. **Industrial Engineering and Management** - O.P Khanna, DhanpatRai and Sons, 2000.
3. **Financial Management** – I M Pandey, Vikas Publishing House, 2002.
4. **Engineering Economy** – Theusen. G. PHI, 2002.

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**THEORY OF METAL FORMING Common to (IM & IP)**

Subject code	15IM/IP552		IA Marks	20
Number of Lecture Hrs / Week	Lectures	3	Exam Marks	80
Total Number of Lecture Hrs	40		Exam Hours	03
CREDITS - 04				

**MODULE: 1**

**Basics of plastic deformation & Introduction to metal forming process**

Concept of true stress and true strain. Flow stress and strain hardening. Tresca's and Von-Mise's yield criteria and yield surface. Factors affecting yield strength of materials. Forming properties of materials. Ductility and formability. Classification of forming processes. Importance of temperature in metal forming. Hot and cold working. Effect of strain rate. Friction and its role in metal forming. Different methods of analysis of metal forming.

9 Hrs

**MODULE: 2**

**Forging & Rolling Processes**

Open-die and close-die forging processes. Brief description of the forging machines, equipments and heating furnaces. Slab analysis of upset forging of rectangular slab under plane strain condition. Forging load calculation. Common forging defects. Different types of rolling mills. Geometrical considerations in rolling. Role of friction in rolling and neutral point location. Simplified methods for calculating rolling load, torque and power required for rolling. Effect of back and front tension on rolling force. Residual stresses in rolling and common rolling defects.

8 Hrs

**MODULE: 3**

**Extrusion & drawing of rods, wires and tubes**

Types of extrusion processes. Metal flow pattern in extrusion. Extrusion equipments and dies. Extrusion of hollow sections. Slab analysis of extrusion of strips and circular sections and calculation of force and power required for extrusion. Common extrusion defects. Drawing equipments and dies. Analysis of rod or wire drawing and calculation of draw force and power required. Maximum possible reduction in drawing. Tube drawing using different types of mandrels, residual stresses and defect in drawn products.

8 Hrs

**MODULE: 4**

**Sheet metal working, sheet metal drawing**

Classification of sheet metal working and equipments used, Blanking and Piercing operation – Die design, cutting force required, slitting, trimming and shaving operations. Bending operation – Types of bending. Bend angle, bend radius, bend allowance and force required for bending. Spring back effect in bending. Roll bending process. Brief description of spinning and stretch forming processes. Die design, Number of draws required, Blank size calculation, and drawing force necessary. Drawability and defects in drawn products.

8 Hrs

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**MODULE: 5**

**High Energy Rate Forming (HERF)**

Introduction, advantages, limitations and applications of HERF: Process description, parameters of Explosive forming, Electro discharge forming, Electromagnetic forming and Electro Hydraulic Forming. Newer forming processes: laser beam and plasma arc. Die less forming of sheet metal

7 Hrs

**TEXT BOOKS:**

1. Mechanical Metallurgy - Dieter G.E – McGraw Hill publication.
2. Fundamentals of Metal Forming Processes – Juneja B.L - New age International
3. Principle of Industrial Metal Working Processes – Rowe Edward - CBS Publication

**REFERENCE BOOKS:**

1. Materials and Processes in Manufacturing – E.Paul, DeGarmo etal - PHI publication.
2. Fundamentals of Working of Metals – Sach G. - Pergamon press.
3. Mechanics of sheet metal forming - Z.Marciniak, J.L.Duncanand S.J. Hu – Elsevier-Butterworth-Heinemann-2006

**FINITE ELEMENT METHODS**

**Subject Code : 15IM/IP553**

**Hours/Week : 03**

**Total Hours : 40**

**IA Marks : 20**

**Exam Hours : 03**

**Exam Marks : 80**

**Course Objectives**

*The course objectives of Finite Element Methods are to teach the students and gain knowledge of:*

*CO1: Basic fundamentals of continuum and structural mechanics and numerical Technique.*

*CO2: Finite Element Method (FEM) as a Numerical Technique for engineering analysis of continuum and structures using variational and weighted residual approaches*

*CO3: Finite element formulation for one, two and three dimensional continuum and structural mechanics problems subjected to static, thermal and dynamic loads*

*CO4: Solving continuum and structural mechanics problems using finite element method.*

*CO5: Formulating, analyzing, error detecting, solution and interpretation of results for practical Problems using commercial software.*

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**MODULE-1**

**Introduction.** General description of Finite Element Method, application and limitations. Types of elements based on geometry. Node numbering, Half band width. Gauss-Elimination technique for solving linear algebraic equations. Numerical integration : 1, 2 and 3 gaussian point for 1D and 2D cases.

**08 hrs**

**MODULE-2**

Principle of virtual work, principle of minimum potential energy, Raleigh's Ritz method. Direct approach for stiffness matrix formulation of bar element. Galerkin's method.

**Interpolation Models:** Interpolation polynomials- Linear, quadratic and cubic. Shape functions Iso-parametric, Sub parametric and Super parametric elements and Jacobian matrix. **08 Hours**

**MODULE-3**

**Formulation of 1-D element:** Bars, tapered and stepped bars. 2D and 3D Truss element subjected to concentrated, distributed, body forces and thermal loading. Problems of 1D members for displacements, reactions and stresses by using penalty approach and elimination approach.

**Beams:** Hermite shape functions for beam element, Derivation of stiffness matrix. Numerical problems of beams carrying concentrated, UDL and linearly varying loads. **08 Hours**

**MODULE-4**

**Formulation of 2D and 3D elements:** Triangular, quadrilateral, tetrahedron and hexahedron elements, shape function formulation.

**Dynamics:** Determination of natural frequency and mode shape for 1D bar and beams only. **08 Hours**

**MODULE-5**

**Heat Transfer:** Steady state heat transfer, 1D heat conduction governing equations. Functional approach for heat conduction. Galerkin's approach for heat conduction. 1D heat transfer in thin fins.

**08 Hours**

**TEXT BOOKS:**

1. **Finite Elements in Engineering**, T.R.Chandrupatla, A.D Belegunde, 3rd Ed PHI.
2. **Finite Element Method in Engineering**, S.S. Rao, 4th Edition, Elsevier, 2006.

**REFERENCE BOOKS:**

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1. **“Finite Element Methods for Engineers”** U.S. Dixit, Cengage Learning, 2009
2. **Concepts and applications of Finite Element Analysis,** R.D. Cook D.S Maltus, M.E Plesha, R.J.Witt, Wiley 4th Ed, 2009
3. **Finite Element Methods,** Daryl. L. Logon, Thomson Learning 3<sup>rd</sup> edition, 2001.
4. **Finite Element Method,** J.N.Reddy, McGraw -Hill International Edition.

**Course Outcome:**

*On completion of the course the student will be*

*CO1: Knowledgeable about the FEM as a numerical method.*

*CO2: Able to formulate any solid mechanics, structural mechanics and thermal problems*

*CO3: Able to solve and interpret the results of solid, structural and thermal problems*

*CO4: Developing skills required to use commercial FEA software*

**COMPOSITE MATERIALS Common to (IM & IP)**

Subject code	15IP554		IA Marks	20
Number of Lecture Hrs / Week	Lectures	3	Exam Marks	80
Total Number of Lecture Hrs	40		Exam Hours	03
CREDITS - 04				

**MODULE: 1**

**Introduction to composite materials**

Definition, classification and characteristics of composite materials: Fibrous, laminate, particulate, flake composites. Properties and types of reinforcement and matrix materials. Fibre reinforced plastic processing: basic steps in manufacturing of a composite, impregnation, lay-up, consolidation and solidification. Open and closed mould process, hand lay-up techniques, structural laminate vacuum bag and autoclave processing, filament winding, pultrusion, pulforming, thermo-forming, injection molding, resin transfer molding.

9 Hrs

**MODULE: 2**

**Fabrication of composites**

Cutting: machining, drilling, mechanical fasteners and adhesive bonding: design guidelines for adhesive bonding. mechanical joining: design parameters for bolted joints, waterjet and laserjet cuttings. Challenge during machining of composites, failure mode during machining. Cutting tools and fabrication equipment. Ceramic matrix composites and their fabrication technologies.

7 Hrs

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**MODULE: 3**

**Structural application of composites**

Aerospace, air craft and military, medical, sporting goods and recreation, automotive. Marine, infrastructure. Micro analysis of a uni-directional lamina: definition of volume and mass fractions, density and void content. Derivation for longitudinal, transverse and shear modulus. Major and minor Poission's ratio's. Numerical problems.

8 Hrs

**MODULE: 4**

**Study properties of MMC's**

Physical Mechanical, wear, machinability and other properties. Effect of size, shape and distribution of particulate on properties. Advanced composites such as Polymer based Sandwich structures. Introduction to shape memory alloys.

8 Hrs

**MODULE: 5**

**Study of composite materials from natural resources**

**Introduction to natural composites:** classification of natural fibers: plant, animal, mineral fibers and their sources; silk, human, feather, jute, sisal, flax, cotton, bamboo fibres. Advantages and disadvantages of natural fibres. Characteristics of natural fibres. Extraction of plant fibres. Recent developments in natural fibre composites, feature potential of natural fibre composites.

8 Hrs

**TEXT BOOKS:**

1. Composite Science and Engineering - K.K.Chawla - Springer Verlag - 1998.
2. Introduction to composite materials - Hull and Clyne - Cambridge University Press - 2<sup>nd</sup> Edition, 1990.
3. Composites Manufacturing: materials, product and process engineering - Sanjay K. Mazumdar CRC press - First edition 2010.

**REFERENCE BOOKS:**

1. Composite Materials hand book - Meing Schwaitz - McGraw Hill Book Company - 1984.
2. Forming Metal hand book - 9th edition, ASM handbook, V15, 1988, P327-338.
3. Mechanics of composites - Autar K kaw - CRC Press - 2002.
4. Fiber-Reinforced Composites – P.K. Mallick – Third Edition.

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**OPEN ELECTIVES**

**PROFESSIONAL COMMUNICATION AND REPORT WRITING**

<b>Subject Code</b>	<b>: 15IM/IP561</b>	<b>No. of Credits</b>	<b>: 4 - 0 - 0</b>
<b>No. of Lecture Hours / Week</b>	<b>: 03</b>	<b>Exam Hours</b>	<b>: 3</b>
<b>Total No. of Lecture Hours</b>	<b>: 40</b>	<b>Exam Marks</b>	<b>: 80</b>

**COURSE OBJECTIVES**

1. **To know the nuances and importance of professional communication.**
2. **To demonstrate the capability of explaining and making others understand.**
3. **To plan and prepare Technical Reports for documentation and analysis.**
4. **To appreciate the use of appropriate channel to maximize the reach of any Communication channel.**
5. **To manage the organizational communication in very effective manner.**

**COURSE CONTENT**

**UNIT – 1      Communication:** Importance of communication, oral and written communication, role of oral and written communication in effectiveness, communication process with basic model, formal and informal communication in management , barriers to communication, feedback and its effectiveness, conflict communication.

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**08 Hours**

**UNIT – 2 Oral communication: factors:** factors influencing effective oral communication, role of trust self confidence motivational factors, styles of oral communication, importance of listening, grapevine and its role, role of visual aids, advantages and disadvantages over written communication , informative and persuasive communication.

**08 Hours**

**UNIT – 3 Written communication:** Writing style, importance of writing skills, books review and its importance. **Letter writing:** Personal correspondence, formal and informal letters, official and Demi-official letters, business and commercial letter and other technical correspondence , choice of stationary. **Technical report writing:** Synopsis writing, formats for reports, report types- introductory report, progress report, incident report, feasibility report, marketing report, field report laboratory test report. **Project report:** Reference work, synopsis, general objective, specific objective, introduction, body, tabular and graphical representation, use of visual aids, conclusion, bibliography.

**08 Hours**

**UNIT – 4 Effective Meetings:** Meeting as a decision making body, psychology of member, chairmanship-outside meeting, , chairmanship control of progress, chairmanship control of the member, behavior in meeting, effective secretary and his role, Types of meetings, symposia, conference, convections.

**Effective interviews:** Interviewing, types of interview, selection interview, grievance interview, employee appraisal interview, informational interview, interrogational interview, organizing interview, types of question, effective questioning in the interview, responsibilities of an interviewer and an interviewee, interview assessment form and its importance.

**08 Hours**

**UNIT – 5 Problem Solving In Communication:** periodic training, role of conflicts, evaluation through possible solutions.

**Individual Tasks:** business correspondence, restructuring/reforming of some business correspondence, preparation of synopsis, role play, case studies, seminar on selected topics, other oral and written communication exercise. **Group Tasks:** preparation of project report, meeting, interviews, seminars, role play.

**08MODULE Hours**

**COURSE OUTCOMES:**



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Upon completion of this course, students should be able to:

1. Make effective presentations.
2. Demonstrate good skills in handling oral communication.
3. Comfortably draft letters and reports for various agencies and stakeholders.
4. Handle meetings and interviews from both the sides.
5. Comfortably handle conflict situations and resolve the same through effective communication.

**TEXT BOOKS**

1. **Effective Communication-** Made Simple Series, Rupa and co., 1985.
2. **Urmila raj and S.M Rai**, Business Communication, Himalaya publishing house, 1989.
3. **S. Krishnamurthy Ithal**, Expository English.

**REFERENCE BOOKS**

1. **Cheryl Hamilton and parker**, Communication for Results, Macmillan publication, 1986.
  2. **Bill scoot**, The Skill of Communicating for Professional Engineers, Thomas Telford Ltd., London.
  3. **Gartside Pitman**, Modern Business Correspondence, 4th edition, 1986.
  4. **EM Mc Grathh**, Basic Managerial Skill for All, 3rd Edition, Prentice- hall of India, 1986.
  5. **Houp and pearsall**, Reporting Technical Information, 5th edition, MacMillan, 1986.
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<b>CONCURRENT ENGINEERING</b>				
<b>Semester - V</b>				
Subject Code: <b>15IM/IP562</b>			IA Marks	20
Number of Lecture Hours/Week	03		Exam Marks	80
Total Number of Lecture Hours:	40		Exam Hours	03
<b>CREDITS – 03</b>				

**MODULE 1**

**MANUFACTURING COMPETITIVENESS:** Review, Product and Services, Process and Methodologies, performance, the need for change, Sequential versus concurrent Engg.

**4 Hours**

**PROCESS REENGINEERING:** Managing change, Reengineering approaches, Enterprise models, concurrent process reengineering.  
**4 Hours**

**MODULE 2**

**CONCURRENT ENGINEERING:** Introduction, Basic principles, components of CE models.  
**8 Hours**

**MODULE 3**

**CONCURRENT ENGINEERING ORGANIZATIONS:** Benefits, cooperative concurrent teams, Types of CE organisations.  
**4 Hours**

**SYSTEM ENGINEERING:** Introduction, System thinking, System complexity, System Integration, Angle virtual company.  
**4 Hours**

**MODULE 4**

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**INFORMATION MODELLING:** Methodology, foundation of information modelling.

**4 Hours**

**C. E. PROCESS:** Concurrent engineering process invariant enterprise model class, product mode class, cognitive models.

**4 Hours**

**MODULE 5**

**CE METRICS FOR IT:** Based manufacturing – process efficiency metrics, Process effectiveness metrics.

**8 Hours**

**TEXT BOOKS:**

1. **Concurrent Engineering Fundamentals** - Prasad. B – Integrated Product and process organization Vol. 1 & 2, Prentice Hall Englewood, Cliffs, New Jersey -1996.
2. **Concurrent Engineering** - Hartely R John– Shortening lead times, raising quality & Lowering costs, Productivity press, Portland, Oregon -1992.

**REFERENCE BOOK:**

**Concurrent Engineering** - Carter DE & Baker BS, - The product development environment for the 1990's. Addison – Wesley Publishing company, Reading MA -1992.

**Question paper pattern:** The question paper will have TEN questions. There will be TWO questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer FIVE full questions, selecting ONE full question from each module.

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**TECHNOLOGY MANAGEMENT**

Sub Code	<b>15IM/IP563</b>	IA Marks	20
No. of Lecture Hrs/week	03	Exam Hours	03
Total Lecture Hrs	40	Exam Marks	80

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**COURSE OBJECTIVES:**

1. To understand the fundamentals Concepts of Technology
2. To apply the economics of technology to real world problems
3. To Analyze & adopt the Technology for Service and Manufacturing sectors.

**MODULE 1**

THE CONCEPT OF TECHNOLOGY: Introduction, The nature of knowledge, Aspects of classification, Concept and Meaning of technology, the character of a specific technology, Scope of technology, Examples of classification of technology, Scale of technology information, Levels of technology, Technology portfolios, Technology as an environment. **8 Hours**

**MODULE 2**

THE NATURE OF TECHNOLOGICAL CHANGE: Introduction, Meaning of technological change, Concept of invention, Nature of innovation, Emergence of new technologies, Life cycle of a technology, Motivation for technological change, Nature of technological progress, Nature of mature technology, Nature of diffusion, Technological convergence. **8 Hours**

**MODULE 3**

THE ECONOMICS OF TECHNOLOGY & CORPORATE TECHNOLOGY STRATEGY: Introduction, Meaning of technological economics, Examples of technological economics, Scope of technological economics, Engineering economics, Production economics, Concept of economy of scale, Concept of optimum size, Technology as a commodity, The Business Mission, Concept Of Business Strategy, Capability For Strategic Planning, Corporate Technology Strategy, Competitive Technology, Technological Alliances, , Technology Crisis.

**8 Hours**

**MODULE 4**

ANALYSIS FOR TECHNOLOGY STRATEGY & THE REALIZATION OF NEW TECHNOLOGY: Introduction, Technology assessment, Technology forecasting, Main techniques of technology forecasting, Technology forecasting system, Yield of technology forecasting, Concept of R&D policy, Stimuli

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for innovation, Sources of innovation, Intelligence function of R&D, Management of R&D, R&D team, Effectiveness of R&D, Marketing aspects of R&D, Finance for Design, Development, Manufacture and Marketing, Patterns for new technology development.  
**8 Hours**

**MODULE 5**

THE ADOPTION OF NEW MANUFACTURING TECHNOLOGY & TECHNOLOGICAL COMPETITION ANALYSIS: Introduction, manufacturing strategy, Introduction of new technology, Challenges of factory automation, Stages of factory automation, Manufacturing FMS, CIM, CAD/CAM, Intelligent manufacturing systems, operation of new technology, Change management, People and technology at work, Work structures, securing competitive advantage, Technological competition analysis, Technological leadership, Adoption of new technology, marketing a new technology product, Retention of competitive advantages.

**8 Hours**

**TEXT BOOK:**

1. The Management of Technology Perceptions & Opportunities - Paul Lowe -Chapman & Hall, London - 1995.

**REFERENCE BOOKS:**

1. Strategic Management of Technology -Frederick Betz - McGraw- Hill Inc -1993.
2. Management of Technology & Innovation competing Through Technological Excellence - Rastogi P.N - Sage Publications – 1995.
3. Mastering the dynamics of innovation – J Utterback

**HUMAN RESOURCE MANAGEMENT**

Subject Code : 15IM/IP564

No. of Lecture Hrs./ Week : 03

Total No. of Lecture Hrs. : 40

IA Marks : 20

Exam Hours : 03

Exam Marks :80

Module	Course content	Hours
1	<b>INTRODUCTION:</b> Evolution of HRM, Objectives, Functions and Policies. <b>HUMAN RESOURCE PLANNING:</b> Uses and benefits, Man Power Inventory, Man Power Forecasting, Methods of Man Power Forecasting, job	09

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	Description, Job Specification	
2	<p><b>RECRUITMENT:</b> Sources of Man power, Advertisement, Short Listing of Candidates calling Candidates for selection Process.</p> <p><b>SELECTION:</b> Selection procedure – Written Test, Group Discussion. Interview – Different methods, advantages and limitations, Psychological testing – Advantages and limitations, Induction procedure, transfers, promotion, exit interview, (Tutorial on written test, Group Discussion, Interviews)</p>	09
3	<p><b>TRAINING AND DEVELOPMENT:</b> Identification of Training needs, Training Evaluation, Training Budget, Executive Development – Different Approaches, Non-executive development – Different methods.</p> <p><b>PERFORMANCE APPRAISAL:</b> Components (all round performance appraisal), Methods. Advantages and limitations of different methods, Personal Counselling based on Annual Confidential Reports.</p>	10
4	<p><b>COUNSELLING AND HUMAN RESOURCE ACCOUNTING:</b> Characteristics, Need, Function, Types, Suggestions for personnel development, communication function, communication process, effective communication. Human resource records, Advantages of HR accounting, Various methods of accounting.</p>	6
5	<p><b>INDUSTRIAL RELATIONS:</b> Indian trade union act, standing orders act, Indian factories act</p> <p><b>INDUSTRIAL DISPUTES AND SETTLEMENT:</b> Indian Industrial Disputes act, Industrial disputes settlement machinery. Works committee, Board of Conciliation, Voluntary Arbitration, Compulsory arbitration, Court of inquiry, Industrial tribunal, Adjudication.</p>	6

**TEXT BOOKS**

1. **Human Resources Management** – Dr. K Ashwathappa – Tata McGraw Hill - Edition 1999.
2. **Management of Human Resources** – CB Mamoria – Himalaya Publication House – 2003.

**REFERENCES BOOKS:**

1. **Personnel / Human resource Management** – Decenoz and robbins- PHI - 2002

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2. **Industrial Relations** – Arun Monappa – TMH - ISBN – 0-07-451710-8.
3. **Human Resources Management** – VSP Rao
4. **Human Resources Management** – Ravi Dharma Rao

**VI SEMESTER**  
**COMPUTER INTEGRATED MANUFACTURING**

<b>Subject Code</b>	<b>: 15IP61</b>	<b>No. of Credits</b>	<b>: 4 - 0 - 0</b>
<b>No. of Lecture Hours / Week</b>	<b>: 04</b>	<b>Exam Hours</b>	<b>: 3</b>
<b>Total No. of Lecture Hours</b>	<b>: 50</b>	<b>Exam Marks</b>	<b>: 80</b>

**COURSE OBJECTIVES**

1. To learn the basic concepts of Computer Integrated Manufacturing and the benefits that can be achieved by integrating technology with manufacturing systems.
2. To have a fundamental knowledge of CNC Machine Tools.
3. To imbibe the basic knowledge of Robotics and their application to production
4. To develop the fundamental skill sets in CNC Programming
5. To inculcate the fundamental knowledge CIM, Group Technology and Flexible Manufacturing.

**COURSE CONTENT**

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**Unit 1**

**Introduction:** Role of computers in design and manufacturing, influence of computers in manufacturing environment, product cycle in conventional and computerized manufacturing environment, introduction to CAD/CAM/CIM,

**NC Technology:** NC, CNC, DNC modes, NC elements, advantages and limitations of NC and CNC.

**10Hrs**

**Unit 2**

**CNC Machine Tools:** Turning tool geometry, milling tooling systems, tool presetting, ATC, work holding, CNC machine tools, overview of different CNC machining centers, CNC turning centers.

**10Hrs**

**Unit 3**

**Introduction to Robotics:** Introduction, robot configuration, robot motions, programming the robots, robot programming languages, end effectors, work cell, control and interlock, robot sensor.

**08Hrs**

**Unit 4**

**CNC Programming:** Steps involved in development of a part program, manual part programming-milling and turning, ISO programming in drilling, milling and turning with numerical problems.

**12Hrs**

**Unit 5**

**CIM:** Computer aided process planning, computer integrated production planning system, material requirements planning, capacity planning, shop floor control.

**Group Technology and Flexible Manufacturing:** Part families, part classification and coding, machine cell design and benefits of group technology, FMS work stations, planning the FMS, FMS layout configuration.

**14 Hrs.**



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**COURSE OUTCOMES:**

Upon completion of this course, students should be able to:

1. Outline the use of computers and NC technology in CIM systems.
2. Understand the concepts of CNC machine tool technology.
3. Comprehend the applications of robots in CIM.
4. Develop CNC programs for turning and milling operations.
5. Plan and control the CIM systems effectively. Apply the GT and FMS in actual manufacturing practice.

**Text Books:**

1. **CAD/CAM Principles and Applications** – P.N. Rao, TMH, New Delhi, 2002.
2. **CAD/CAM** – Mikell P-groover, Emory W.ZimrnersJr Pearson Education inc, 2003.

**Reference Books:**

1. **CAD/CAM/CIMP**.Radhakrishnan, S.Subramanyan, U.Raju, New Age International Publication Revised Third Edition 2007
2. **NC Machine programming and software Design**, Chno-Hwachang, Michel.A.Melkanoff, Prentice Hall, 1989.
3. **CAD/CAM**-Ibrahim Zeid, Tata McGraw Hill, 1999.
4. **Computer Aided Manufacturing**, P.N.Rao, N.K.Tewri and T.K.Kundra Tata McGraw Hill 1999.
5. **An Introduction to NC/CNC machines**, S. Vishal, 2<sup>nd</sup> edition, S.K. Kataria and Sons, 2010.

**OPERATION RESEARCH**

Course Title: <b>Operations</b>	Total Contact Hours: 50	Lecture hours/week: 04	Credits: 04
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<b>Research</b>			
<i>Course Code: 15IM/IP62</i>	<i>Total I.A. Marks: 20</i>	<i>SEE Duration:03 hours</i>	<i>SEE Marks: 80</i>

<b>Module</b>	<b>Contents</b>	<b>Hours</b>
<b>1</b>	<p><b>Introduction:</b> Evolution of OR, definition of OR, scope of OR, application areas of OR, steps (phases) in OR study, characteristics and limitations of OR, models used in OR, linear programming (LP) problem-formulation and solution by graphical method.</p> <p><b>Solution of Linear Programming Problems:</b> The simplex method, canonical and standard form of an LP problem, slack, surplus and artificial variables, big M method and concept of duality, dual simplex method.</p>	<b>10</b>
<b>2</b>	<p><b>Transportation Problem:</b> Formulation of transportation problem, types, initial basic feasible solution using different methods, optimal solution by MODI method, degeneracy in transportation problems, application of transportation problem concept for maximization cases.</p> <p><b>Assignment Problem:</b> Formulation, types, application to maximization cases and travelling salesman problem, flight scheduling problem.</p>	<b>10</b>
<b>3</b>	<p><b>Project Management using Network Techniques:</b> Introduction, network construction - rules, Fulkerson's rule for numbering the events, AON and AOA diagrams; Critical path method to find the expected completion time of a project, floats; PERT for finding expected duration of an activity and project, determining the probability of completing a project, predicting the completion time of project; crashing of simple projects (network construction by AOA approach can be used for all the cases).</p>	<b>10</b>
<b>4</b>	<p><b>Queuing Theory:</b> Queuing systems and their characteristics, Pure-birth and Pure-death models (only equations), empirical queuing models – M/M/1 and M/M/C models (no derivations) and their steady state performance analysis.</p> <p><b>Game Theory:</b> Formulation of games, types, solution of games with saddle point, graphical method of solving mixed strategy games, dominance rule for solving mixed strategy games.</p>	<b>10</b>
<b>5</b>	<p><b>Sequencing:</b> Basic assumptions, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule-'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing 2 jobs on 'm' machines</p>	<b>10</b>

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	using graphical method. <b>Introduction to Integer Programming:</b> Pure and mixed integer programming problems, solution of simple Integer programming problems using Gomory's all integer cutting plane method and mixed integer method.	
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**Texts:**

1. **Operations Research - Theory and Applications** - J K Sharma, Pearson Education Pvt Ltd., Recent edition.
2. **Operations Research** - P K Gupta and D S Hira, S Chand Publications, New Delhi, Recent edition.

**References:**

1. **Introduction to Operation Research** -Taha H A – PHI / Pearson Publications, Recent edition.
2. **Operations Research** - Paneerselvan, PHI
3. **Operations Research** -S.D. Sharma – Kedarnath, Ramnath & Co – Recent edition.

**TOOL ENGINEERING & DESIGN**

Sub Code	<b>15IP63</b>	IA Marks	20
No. of Lecture Hrs/week	04	Exam Hours	03
Total Lecture Hrs	50	Exam Marks	80

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**MODULE-1**

**Introduction:** Concept, meaning and definitions of tool, tool design and tool engineering.  
 Tools-types, classification, features & applications.

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**Design of Single Point Tool:** Tool Signature, Selection of Tool Angles, Design of shank section for single point tool to account for strength and rigidity. Design of Multi Point Tools – Drill, Reamers **10 Hours**

**MODULE –2**

**DESIGN** of peripheral Milling cutters, Design of Broach.

**Location and Clamping:** General principles of location, 3-2-1 Principle of Location, Principle of Radial location, General study of locating devices. General principles of clamping, Study of various Clamping devices. **10 Hours**

**MODULE – 3**

**Design of Fixtures:** Difference between a Jig and a Fixture, Design of Milling fixture, Study of other fixtures like Lathe fixture, Inspection fixture. Study of different types of Drill jigs.

**Design of Gauges:** Types of gauges. Factors to be considered in the design of gauges, Design of Plug gauge, Design of Snap gauge. **10 Hours**

**MODULE–4**

**Design of Press Tools:** A General study of Press operations. Elements of a Die, Strip layout, calculation of center of pressure. Design of Blanking Die, Design of Piercing Die, Design of Progressive Die. **10 Hours**

**MODULE – 5**

**Design of Forming Dies:** Study of Drawing and Bending process, Design of Drawing Die, Design of Bending Die

**Tool Layout and Cam Design of Single Spindle Automats:** Classification of Automats and their applications. Tool layout and Cam design for automatic screw cutting machine. **10 Hours**

**TEXT BOOKS:**

1. Text book of Production Engineering – P. C. Sharma – Chorotar Publishing house.
2. Tool Design – Donaldson and Golding – Tata McGraw Hill, New Delhi.

**REFERENCE BOOKS:**

1. Fundamentals of Tool Design -ASTME

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**MATERIALS MANAGEMENT**

Subject Code	: 15IM/IP64	IA Marks	:	20
No. of Lecture Hrs./ Week	: 04	Exam Hours	:	03
Total No. of Lecture Hrs.	: 50	Exam Marks	:	80

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**MODULE - 1**

Introduction: Dynamics of Materials Management - Materials Management at Micro-level, Materials Management at Macro-level. Definition of Material Management

Systems Approach to Materials Management: Systems Approach - The Process of Management and the Materials Function, The Materials Function, Interfaces. Benefits of the Integrated Systems Approach.

**8 Hours**

**MODULE - 2**

Forecasting, Objectives and the Materials Organization: Systems Design, Integral Control of the Flow of Materials, Forecasting and Planning, Forecasting Methods, Objectives of Materials Management - Organization of Materials Management, Functional Organization Model for Materials Management. Materials Planning: Making the Materials Plan Work, The Materials Cycle and Flow Control System.

Purchasing: Purchasing Principles, Procedures and Practices, Fundamental Objectives of Purchasing - Scope, Responsibility and Limitations, Sources of Supply and Supplier Selection, Purchasing Policy and Procedures.

**12 Hours**

**MODULE -3**

Purchasing in Materials Management System Concept: Price Determination, Price Forecasting, Price-Cost Analysis, Negotiation, Reciprocity, Cost-Plus Contracts, Hedging, Forward Buying, Buying Ethics, Principles and Standards of Purchasing, Make-or-Buy, Information, Documentation and Purchasing Library, Legal Aspects of Purchasing, Law of Agency, Law of Contract, Legal Status of the Buyer, Warranties and Conditions, Right of Inspection, Right of Rejection, Vendor-Vendee Relations, Vendor Development, Vendor Rating.

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Purchasing and Procurement Activities under Materials Management: Supplier Quality Assurance Programme, Buyer-Supplier Relationship.

Incoming Material Quality Control: Significance of Inspection, Metrology or Engineering Measurement, Purchase Inspection, Sampling Inspection, Sampling Technique, Different Types of Population, Different Types of Sampling.

**10 Hours**

**MODULE - 4**

Purchasing Capital Equipment, Plant and Machinery: Responsibility and Decision, Purchasing v/s Leasing,

International Buying, Import Purchasing, and Governmental Purchasing: Industrial Needs, Import Procedure and Documents, Basis of Licensing, Import Purchasing Procedures, Letter of Credit, Income-Tax Clearance, Customs Tariff-Registration of Licenses at Port. Governmental Purchasing: Policy and Procedures, Tenders.

Registration of Firms, Procedure for Registration, Terms of Registration, Removal of the Firms from the List, Blacklisting of Firms, Banning of Firms, Suspension of Firms.

Inventory Management and Control Systems: Definition of Inventories, The Need for Inventory Audits Control, Types of Inventories, Inventory Control, Max-Min System, Inventories and Demand Uncertainty, Determining Safety Stock.

**10 Hours**

**MODULE-5**

Q-system or Quantity Control System or Re-order Point System-Effect of Quantity Discounts, P-system or Periodic Review or Periodic Count System or Replenishment System, Optional Replenishment System or "S, s" Policy. Discussion on ABC Analysis, advantages and disadvantages. MRP system and MPS system

Stores Management and Operation: Storage System, Stores Location and Layout,

Materials Management Information System and Computer: MIS - Management and MM, Computer System for MIS and MM, In-process Materials and Management Control.

**10 Hours**

**Text Book:**

A.K. Datta., **Materials Management**, PHI Pvt. Ltd, New Delhi, 2001.

**Reference Book:**

P. Gopalakrishnan, **Handbook of Materials Management**, PHI Pvt. Ltd, New Delhi, 2002.

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**CAD/CAM LAB**

Subject Code	: 15IML /IPL 67	IA Marks	: 20
No. of Lecture Hrs./ Week	: 03	Exam Hours	: 03
Total No. of Lab Hrs.	: 42	Exam Marks	: 80

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**PART - A**

Modelling of simple machine parts using Graphics Package.

Study of Finite Element Analysis Package - 1D, 2D, Structural problems, Evaluation of displacement (Strain) and Stress. Problems involving Beams and Trusses.

**PART - B**

Modelling and Simulation of Machining process of simple machine parts using CAM packages.

Suggested Software Packages: Solid Works/ Uni Graphics/Catia and MASTER CAM or any other similar packages.

Note: A minimum of 12 exercises are to be conducted.

**MACHINE TOOLS LAB**

Subject Code	: 15IPL 68	IA Marks	: 20
No. of Lecture Hours./ Week	: 03	Exam Hours	: 03
Total No. of Lab Hours.	: 42	Exam Marks	: 80

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**PART - A**

1. Machining of T - slot or L- slot on milling machine and Checking
  - a. Parallelism between the surfaces.
  - b. Perpendicularity between surfaces.
2. Exercise on Spur Gear cutting and Measurement of all the parameters of the gear.
3. Machining of Spiral slots on milling machine.
4. Measurement of Cutting forces, Determination of Shear angle, Chip

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Thickness Ratio and Verification of Merchant's Angle Relationship in Turning Operation.

5. Study the variation of Axial force and Torque in Drilling with respect to cutting speed and feed.

**PART – B**

1. A General study of Acceptance test of commonly used machine tool (Theory).
2. Test for True running of the main spindle of Lathe
3. Test for True running of the main spindle of Drill.
4. Alignment of centers in Vertical plane in Lathe.
5. Testing for true running of Headstock center of a Lathe.
6. Disassembly of  
b) Tool Head of a Shaper and measurement of component dimension.

a) Lathe Tail Stock ,

Note: A minimum of 12 exercises are to be conducted.



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**QUALITY ASSURANCE & RELIABILITY**

Sub Code	<b>15IP651</b>	IA Marks	20
No. of Lecture Hrs/week	04	Exam Hours	03
Total Lecture Hrs	50	Exam Marks	80

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**COURSE OBJECTIVES:**

1. To understand the fundamentals of Quality tools and techniques
2. To apply the quality and reliability tools and techniques to real world problems
3. To Interpret the results of quality and reliability study for decision making

**MODULE 1:**

**Introduction:** Definition of Quality, Quality function, Dimensions of Quality, Quality Engineering terminology, Brief history of quality methodology, Statistical methods for quality improvement, Quality costs – four categories costs and hidden costs. Brief discussion on sporadic and chronic quality problems.

**Quality Assurance:** Definition and concept of quality assurance, departmental assurance activities. Quality audit concept, audit approach etc. structuring the audit program, planning and performing audit activities, audit reporting, ingredients of a quality program. **12 Hours**

**MODULE 2**

**Statistical Process Control:** Introduction to statistical process control – chance and assignable causes variation. Basic principles of control charts, choice of control limits, sample size and sampling frequency, rational subgroups. Analysis of patterns of control charts. Case Studies on application of SPC. Process capability – Basic definition, standardized formula. **08 Hours**

**MODULE 3**

**Control Charts for Variables:** Controls charts for X bar and Range  $\bar{R}$ , statistical basis of the charts, development and use of X bar and R charts, interpretation of charts. Control charts for X bar and standard deviation (S), development and use of X bar and S chart. Brief discussion on – Pre control X bar and S control charts with variable sample size, control charts for individual measurements, cusum chart, moving-range charts

**Control Charts for Attributes:** Controls chart for fraction non-conforming (defectives) development and operation of control chart. **10 Hours**

**MODULE 4**

**Sampling Inspection:** Concept of accepting sampling, economics of inspection, Acceptance plans – single, double and multiple sampling. Operating characteristic curves – construction and use. Determinations of average outgoing quality, average outgoing quality level, average total inspection, producer risk and consumer risk, published sampling plans. **10 Hours**

**MODULE 5**

**Statistical Theory of Tolerances:** Application of statistical theory of tolerances to design of tolerances in random assemblies and application in other areas.

**Reliability and Life Testing:** Failure models of components, definition of reliability, MTBF, Failure rate, common failure rate curve, types of failure, reliability evaluation in simple cases of exponential failures in series, paralleled and series-parallel device configurations. **10 Hours**

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**TEXT BOOKS**

1. **Introduction to statistical Quality Control** - D C Montgomery 3rd Edition, John Wiley and Sons.
2. **Quality Planning & Analysis** - J M Juran, Frank M Gryna; Tata McGraw Hill, 3rd edition,
3. **Total Quality Management** – NVR Naidu, KM Babu and G. Rajendra – New Age International Pvt. Ltd - 2006

**REFERENCE BOOKS.**

1. **Statistical Quality Control** - Grant and Leavenworth, McGraw Hill, 6th Edition
2. **The QS9000 Documentation Toolkit** - Janet L Novak and Kathleen C Bosheers,” Prentice Hall PTR, 2nd Edition
3. **ISO 9000 a Manual for Total Quality Management** - Suresh Dalela and Saurabh, S Chand and Co. 1st Edition
4. **Total Quality Management** - Kesavan R, I.K. International, New Delhi – 2007.

<b>Analysis of Manufacturing Processes</b> [As per Choice Based Credit System (CBCS) scheme] SEMESTER – VI			
Subject Code	<b>15IP652</b>	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
<b>Course Objective:</b> The student will learn to			
<ol style="list-style-type: none"> <li>1. Understand basic manufacturing processes like casting and welding</li> <li>2. Learn various aspects of different manufacturing techniques such as various casting methods, welding methods and advanced manufacturing methods.</li> </ol>			
Modules			Teaching Hours
Module- 1			

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<p><b>ANALYSIS OF CASTING PROCESS:</b> Gating design for simple vertical gating and Bottom gating. Aspiration effect and Sprue design. Cooling and solidification of casting, rate of solidification. Riser design and placement. (Numerical Treatment).</p> <p><b>ANALYSIS OF MACHINING PROCESS:</b> Estimation of torque and thrust force in drilling operation. Estimation of cutting force and thrust force and power consumption in milling operation. Estimation of tooth spacing and load estimation in Broaching. (Numerical Treatment).</p>	08 Hours
Module- 2	
<p><b>ANALYSIS OF FINISH MACHINING PROCESS:</b> Components of grinding force. Estimation of uncut thickness, force per single grit and power consumption in grinding. Grinding wheel characteristics, wheel specification and selection, wheel life. (Numerical Treatment).</p> <p><b>ECONOMICS OF MACHINING:</b> Optimization of cutting parameter for minimum cost. Optimizing cutting parameters for maximum production. Optimum cutting speed for maximum efficiency. (Numerical Treatment).</p>	08 Hours
Module- 3	

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<p><b>ANALYSIS OF WELDING PROCESS:</b> Structure and characteristics of arc, Arc efficiency, electrical characteristics of an arc. Requirements for an arc. Welding power source. Volt-ampere characteristics of a welding power source. Process variables in submerged Arc welding, Gas Metal Arc welding (GMAW), Shielded Arc welding (SAW). Economics of welding. (Numerical Treatment).</p>	08 Hours
Module- 4	
<p><b>ANALYSIS OF ROLLING AND FORGING:</b> Assumptions in analysis of rolling. Determination of rolling pressure, roll separating forces, pressure distribution in rolling, torque and power required to drive the rolls, power loss in bearing. (Numerical Treatment).</p> <p>Assumptions made in open die forging of a flat strip. Determination of maximum force required for forging a strip and a disc between two parallel dies, forging of disc. (Numerical Treatment).</p>	08 Hours
Module- 5	
<p><b>ANALYSIS OF ULTRASONIC MACHINING:</b> Assumptions made in analysis of material removal rate in ultrasonic machining. Calculating material removal rate in USM. Study of process parameters. (Numerical Treatment).</p> <p><b>ANALYSIS OF ELECTRO-CHEMICAL MACHINING:</b> Electrochemistry of ECM process, Calculation of material removal rate. Kinematics and dynamics of the process, effect of heat and H<sub>2</sub> Bubble generation. Study of factors affecting the surface finish. Tool design ECM. (Numerical Treatment).</p>	08 Hours
<p><b>Course Outcomes:</b>  On completion of the course the student will be able to :</p> <ol style="list-style-type: none"> <li>1. Understand basic manufacturing processes like casting and welding</li> </ol>	

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2. Compute stresses and strains, both in-process and residual, for mechanical, thermal and thermo-mechanical processes
3. Compute temperatures and cooling trends in thermal processes
4. Effect on performance and application
5. Select the best suitable advanced manufacturing process for processing of unconventional materials employed in modern manufacturing industries

**Question paper pattern:**

1. The question paper will have ten questions.
2. Each full question consists of 16 marks.
3. There will be 2 full questions (with a maximum of four sub questions) from each module.
4. The students will have to answer 5 full questions, selecting one full question from each module.

**Text Books**

1. **Manufacturing Science** - Amitabh Ghosh and Ashok KumarMallik – Affiliated East-West Press Private Ltd.
2. **Welding Processes and Technology** - Dr.R S. Parmar – KhannaPublishers.

**Reference Books:**

1. **Principles of Machine tools** - Sen and Bhattacharya – Oxford IBM Publishing - 2000.

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**SCHEME OF TEACHING AND EXAMINATION 2015-2016**  
**VALUE ENGINEERING**

Subject Code	: IP653	IA Marks	: 20
No. of Lecture Hrs./ Week	: 03	Exam Hours	: 03
Total No. of Lecture Hrs.	: 40	Exam Marks	: 80

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### **MODULE – 1**

**INTRODUCTION TO VALUE ANALYSIS:** Definition of Value, Value Analysis, Value Engineering, Value management, Value Analysis versus Value Engineering, Value Analysis versus Traditional cost reduction techniques, uses, Applications, advantages and limitations of Value analysis. Symptoms to apply value analysis, Coaching of Champion concept.

**TYPE OF VALUES:** Reasons for unnecessary cost of product, Peeling cost Onion concept, unsuspected areas responsible for higher cost, Value Analysis Zone, attractive features of value analysis. Meaning of Value, types of value & their effect in cost reduction. Value analysis procedure by simulation. Detailed case studies of simple products.

**9 Hours**

### **MODULE – 2**

**FUNCTIONAL COST AND ITS EVALUATION:** Meaning of Function and Functional cost, Rules for functional definition, Types of functions, primary and secondary functions using verb and Noun, Function evaluation process, Methods of function evaluation. Evaluation of function by comparison, Evaluation of Interacting functions, Evaluation of function from available data, matrix technique, MISS technique, Numerical evaluation of functional relationships and case studies.

**PROBLEM SETTING & SOLVING SYSTEM:** A problem solvable stated is half solved, Steps in problem setting system, Identification, Separation and Grouping of functions. Case studies.

**PROBLEM SETTING & SOLVING SYSTEM:** Goods system contains everything the task requires. Various steps in problem solving, case studies.

**10 Hours**

### **MODULE - 3**

**VALUE ENGINEERING JOB PLAN:** Meaning and Importance of Value Engineering Job plan. Phases of job plan proposed by different value engineering experts, Information phase, Analysis phase, Creative phase, Judgement phase, Development planning phase, and case studies. Cost reduction programs, criteria for cost reduction program, Value analysis change proposal.

**7 Hours**

### **MODULE- 4**

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**VALUE ENGINEERING TECHNIQUES:** Result Accelerators or New Value Engineering Techniques, Listing, Role of techniques in Value Engineering, Details with Case examples for each of the Techniques.

**ADVANCED VALUE ANALYSIS TECHNIQUES:** Functional analysis system technique and case studies, Value analysis of Management practice (VAMP), steps involved in VAMP, application of VAMP to Government, University, College, Hospitals, School Problems etc., (service type problems).

**TOTAL VALUE ENGINEERING:** Concepts, need, Methodology and benefits.

**8 Hours**

**MODULE- 5**

**APPLICATION OF VALUE ANALYSIS:** Application of Value analysis in the field of Accounting, Appearance Design, Cost reduction, Engineering, manufacturing, Management, Purchasing, Quality Control, Sales, marketing, Material Management Etc., Comparison of approach of Value analysis & other management techniques.

**6 Hours**

**TEXT BOOKS:**

**Techniques of Value Analysis and Engineering**– Lawrence D. Miles, McGraw – Hill Book Company, 2<sup>nd</sup> Edn.

**Value engineering for Cost Reduction and Product Improvement** – M.S. Vittal, Systems Consultancy Services Edn 1993

**Value Management, Value Engineering and Cost Reduction** – Edward D Heller Addison Wesley Publishing Company 1971

**REFERENCE BOOKS:**

**Value Analysis for Better Management** – Warren J Ridge American Management Association Edn 1969

**Getting More at Less Cost (The Value Engineering Way)** – G.Jagannathan Tata Mcgraw Hill Pub. Comp. Edn 1995

**Value Engineering** – Arther E Mudge McGraw Hill Book Comp. Edn 1981

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<b>Product Design &amp; Manufacturing</b> [As per Choice Based Credit System (CBCS) scheme] SEMESTER – VI			
Subject Code	<b>15IP654</b>	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40	Exam Hours	03
<p><b>Course Objective:</b> The student will learn to</p> <ol style="list-style-type: none"> <li>1. Inculcate specialized knowledge and skill in production process optimization using the principles and methods of engineering analysis and design..</li> <li>2. Cultivate the ability to build and implement new improved methods resulting in creation and distribution of value in operations</li> <li>3. Cultivate work space design capability.</li> </ol>			
Modules			Teaching Hours
Module- 1			
<p><b>Introduction To product Design:</b> Asimow’s Model : Definition of product Design, Design by Evaluation, Design by Innovation, Essential Factors of Product Design, Production-Consumption Cycle, Flow and Value Addition in the Production-Consumption Cycle, The Morphology of Design ( The seven Phase), Primary Design phase and flowcharting , Role of Allowance</p> <p><b>Product Design Practice And Industry:</b> Introduction, Product Strategies, Time to Market, Analysis of the Product, The three S’s, Standardization, Renard Series ( Preferred Numbers), Simplification, The designer and His Role, The Designer: Myth and Reality, The Industrial Design Organization, Basic Design Consideration, Problems faced by Industrial! Designer, Procedure adopted by Industrial Designers, Types of Models designed by Industrial Designers.</p>			08 Hours
Module- 2			



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<p><b>Review of Strength Stiffness And Rigidity Consideration In Product Design:</b> Principal stress Trajectories (Force – Flow Lines), Balanced Design, Criteria and Objective of design, Material Toughness: Resilience, Designing for Uniform Strength, Tension vis-à-vis Compression.</p> <p><b>Designing With Plastic, Rubber, Ceramics and Wood:</b> Approach to Design with Plastic, Plastic Bush Bearings, Gears in plastic, Fasteners in plastic, Rubber parts, Design Recommendation for Rubber parts, Distortion in Rubber, Dimensional Effects Tolerances, Ceramics and Glass parts, production Design Factors for Ceramics parts, Special Considerations for Design of Glass parts, Dimensional Factors and Tolerances, Wood.</p>	08 Hours
Module- 3	
<p><b>Design of production – Metal Parts:</b> Producibility Requirements in the Design of Machine Components, Forging Design, Pressed Components Design, Casting Design for Machining Ease, The Role of process Engineer, Ease of Location and Clamping, Die Casting and Special Casting, Design for Powder Metallurgical Parts.</p> <p><b>Optimization In Design:</b> Introduction, Siddal’s Classification of Design Approaches, Optimization by Differential Calculus, Lagrange Multiplies, Linear Programming (Simplex Method), Geometric Programming, Johnson’s Method of optimum Design.</p>	08 Hours
Module- 4	
<p><b>Economic Factors Influencing Design:</b> Product value, Design for Safety, Reliability and Environmental Considerations, Manufacturing operations in relation to Design, Economic Analysis, Profit and Competitiveness, Breakeven Analysis, Economics of a New product Design (Samuel Eilon Model).</p> <p><b>Human Engineering Considerations In Product Design:</b> Introduction, Human being as Applicator of Forces, Anthropometry: Man as occupant of Space, the Design of Controls, The Design of Displays, Man/Machine Information Exchange.</p>	08 Hours

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Module- 5	
<p><b>Modern Approaches To Product Design:</b> Concurrent Design, Quality Function Deployment (QFD).</p> <p><b>Value Engineering and product Design:</b> Introduction, Historical perspective, What is value? Nature and Measurement of value, Maximum value, normal Degree of value, Importance of value, The value Analysis job plan, Creative, Steps to problem – solving and value Analysis, value Analysis Test.</p>	08 Hours
<p><b>Course Outcomes:</b></p> <p><b>On completion of the course the student will be able to :</b></p> <ol style="list-style-type: none"> <li>6. Understand the objectives of product design and the requirements of a good product design.</li> <li>7. Use a systematic design process being fully aware of its benefits</li> <li>8. Translate the concepts of economics in design, optimization of design and human factors approach to product design.</li> <li>9. Understand and explain the methods employed in composite fabrication</li> <li>10. Appreciate the theoretical basis of the experimental techniques utilized for failure mode of composites</li> </ol>	
<p><b>Question paper pattern:</b></p> <ol style="list-style-type: none"> <li>1. The question paper will have ten questions.</li> <li>2. Each full question consists of 16 marks.</li> <li>3. There will be 2 full questions (with a maximum of four sub questions) from each module.</li> </ol> <p style="text-align: center;">The students will have to answer 5 full questions, selecting one full question from each module.</p>	
Text Books	

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| 1. <b>Product Design and Manufacturing</b> - A.C. Chitale and R.C. Gupta –       |
| 2. <b>Product Design &amp; Development</b> – Karl T. Ulrich & Steven D., Epinger |

**Reference Books:**

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|--|
| 1. <b>Product Design</b> - Kevin otto and Kristini - wood Pearson Education - 2004.  |
| 2. <b>New product Development</b> - Tim Jones, Butterworth Heinmam, Oxford - UIC -1997.  |
| 3. <b>New product Development: Design &amp; Analysis</b> - Roland Engene Kinetovicz - John Wiley and Sons Inc., N.Y. – 1990.   |
| 4. <b>Successful Product Design</b> - Bill Hollins, Stwout Pugh, Butterworth - London 1990.                                    |
| 5. <b>Design for Assembly, a Designer,s Hand book</b> - Boothroyod & Dewhurst P. – University of Massachusets, Amherst - 1983. |

## **OPEN ELECTIVES**

### **MANAGEMENT INFORMATION SYSTEMS**

Sub Code	<b>15IM/IP661</b>	IA Marks	20
No. of Lecture Hrs/week	03	Exam Hours	03
Total Lecture Hrs	40	Exam Marks	80

**Course objectives:**

1. To elevate students' awareness of information Technology and develop an in-depth and systematic understanding of key aspects of IT management.
2. To help students gain a strategic perspective on business.
3. To evaluate the value of emerging technologies and their competitive advantage.

**Course content:**

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**MODULE– 1**

**Fundamentals of Information Systems:** Information systems in business, fundamentals of information systems solving business problems with information systems. **7 Hours**

**MODULE– 2**

**Information Systems for Business Operations:** Business information systems, Transaction processing systems, management, information systems and decision support systems. Artificial intelligence technologies in business, information system for strategic applications and issues in information technology. **9 Hours**

**MODULE–3**

**Issues in Managing Information Technology:** Managing information resources and technologies global information technology, management, planning and implementing change, integrating business change with IT, security and ethical challenges in managing IT, social challenges of information technology. **8 Hours**

**MODULE-4**

**E-Business Model:** E-commerce frame work, Architectural frame work for e-commerce, Application services and transaction, Models – B2C Transactions, B2B Transactions, Intra-Organizational Transactions, WWW Architecture: Client server structure of the web, e-Commerce architecture, Technology behind the web. **8 Hours**

**MODULE-5**

**Consumer Oriented E-Commerce:** Consumer oriented Application: Finance and Home Banking, Home shopping, Home Entertainment, Mercantile Process Models, Consumers perspective, Merchants perspective.

**Electronics Data Interchange (EDI):** EDI Concepts, Applications in business – components of international trade, Customs Financial EDI, Electronic fund transfer, Manufacturing using EDI, Digital Signatures and EDI. **8 Hours**

**TEXT BOOKS:**

1. Management Information systems – managing information technology in the internet worked enterprise – jams. A O'Brien – Tata McGraw Hill publishing company limited – 2002.
2. Management Information Systems – Laudon & Laudon – PHI – ISBN 81-203-1282-1.1998.

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**REFERENCE BOOKS:**

1. Management Information systems – S. Sadogopan. – PHI – 1998Edn. ISBN 81-203-1180-9.
2. Information systems for modern management – G.R. Murdick – PHI – 2nd Edition.

**ADVANCED MACHINING PROCESSES**

<b>Subject Code</b>	<b>: 15IM/IP662</b>	<b>No. of Credits</b>	<b>: 4 - 0 - 0</b>
<b>No. of Lecture Hours / Week</b>	<b>: 03</b>	<b>Exam Hours</b>	<b>: 3</b>
<b>Total No. of Lecture Hours</b>	<b>: 40</b>	<b>Exam Marks</b>	<b>: 80</b>

**COURSE OBJECTIVES**

1. To learn the fundamental concepts of Non-Traditional Machining and their Mechanical Processes
2. To have a good knowledge of Abrasive Jet Machining and its application
3. To learn the fundamental principles of Electrochemical Machining Process (ECM)
4. To have basic exposure to Chemical Machining (CHM) and Chemical Milling
5. To imbibe a the basic principles of Thermal Metal Removal Processes, Plasma Arc Machining (PAM)and Laser Beam Machining (LBM)

**COURSE CONTENT**

**Unit 1**

**Introduction:** History, need for non-traditional machining processes, classification, process selection.

**Mechanical Process:** Ultrasonic Machining (USM): Introduction, equipment, tool material and tool size, abrasive slurry, magnetostriction assembly, tool cone (concentrator), exponential concentrator of circular cross section and rectangular cross sections, effect of parameters, amplitude, frequency, grain diameter, applied

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static load and slurry, tool and work material. USM process characteristics: material removal rate, tool wear, accuracy, surface finish, applications, advantages and disadvantages of USM.

**08Hrs**

**Unit 2**

**Abrasive Jet Machining (AJM):** Introduction, equipment, variables in AJM: carrier gas, size of abrasive grain, velocity of the abrasive jet, mean no. abrasive particles per unit volume of the carrier gas, work material, stand-off distance (SOD), process characteristics-material removal rate, nozzle wear, Accuracy and surface finish, Applications, advantages and disadvantages of AJM.

**08Hrs**

**Unit 3**

**Electrochemical Machining Process (ECM):** Introduction, elements of ECM process: Cathode tool, anode work piece, source of DC power, electrolyte, chemistry of the process, ECM process characteristics - material removal rate, accuracy, surface finish, tool and insulation materials, tool size, electrolyte flow arrangement, applications, simple problems.

**08Hrs**

**Unit 4**

**Chemical Machining (CHM):** Introduction, elements of the process, chemical blanking process: preparation of work piece, preparation of masters, masking with photo resists, etching for blanking, accuracy of chemical blanking.

**Chemical Milling (Contour machining):-** Process steps-masking, etching, etc. process characteristics of CHM: - material removal rate, accuracy, surface finish, application of CHM.

**08Hrs**

**Unit 5**

**Thermal Metal Removal Processes:** Electrical Discharge Machining (EDM) - Introduction, mechanism of metal removal, dielectric fluid, spark generator, EDM tool (electrode), electrode material selection, machining time, flushing: suction flushing, side flushing, pulsed flushing synchronized with electrode movement, EDM process characteristics: metal removal rate, accuracy, surface finish, heat affected zone, machine tool selection, applications, electric discharge grinding, traveling wire EDM.

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**Plasma Arc Machining (PAM):** Principle of generation of plasma, equipment, non-thermal generation of plasma, selection of gas, mechanism of metal removal, PAM parameters, process characteristics.

**Laser Beam Machining (LBM):** Principle of generation of lasers, equipment and machining procedure, types of lasers, process characteristics, applications.

**08 Hrs**

**COURSE OUTCOMES:**

Upon completion of this course, students should be able to:

1. Understand the need for advanced manufacturing process and explain the principle of operation of ultrasonic machining process.
2. Explain the characteristic features of Abrasive Jet Machining (AJM)
3. Define the process parameters influence the material removal rate with the help of characteristics curves.
4. Explain the principle of chemical machining and chemical milling process.
5. Summarize the various aspects of Electric discharge machining (EDM). Explain the principle of generation plasma and laser and their application in machining

**Text Books:**

1. **Modern Machining Process** by P C Pandey and H S Shan, Tata McGraw Hill, 2008
2. **New Technology** by Bhattacharaya, Institution of Engineering Publication.

**References:**

1. **Production Technology**, by HMT Tata McGraw Hill.
2. **Modern Machining Methods** by Dr. M. Adithan, Khanna Publishers, 2008.
3. **Non-conventional Machining** by P K Mishra, Reprint 2006, Narosa publishing House, New – Delhi.

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**VALUE ENGINEERING**

Subject Code	: IP653	IA Marks	: 20
No. of Lecture Hrs./ Week	: 03	Exam Hours	: 03
Total No. of Lecture Hrs.	: 40	Exam Marks	: 80

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### **MODULE – 1**

**INTRODUCTION TO VALUE ANALYSIS:** Definition of Value, Value Analysis, Value Engineering, Value management, Value Analysis versus Value Engineering, Value Analysis versus Traditional cost reduction techniques, uses, Applications, advantages and limitations of Value analysis. Symptoms to apply value analysis, Coaching of Champion concept.

**TYPE OF VALUES:** Reasons for unnecessary cost of product, Peeling cost Onion concept, unsuspected areas responsible for higher cost, Value Analysis Zone, attractive features of value analysis. Meaning of Value, types of value & their effect in cost reduction. Value analysis procedure by simulation. Detailed case studies of simple products.

**9 Hours**

### **MODULE – 2**

**FUNCTIONAL COST AND ITS EVALUATION:** Meaning of Function and Functional cost, Rules for functional definition, Types of functions, primary and secondary functions using verb and Noun, Function evaluation process, Methods of function evaluation. Evaluation of function by comparison, Evaluation of Interacting functions, Evaluation of function from available data, matrix technique, MISS technique, Numerical evaluation of functional relationships and case studies.

**PROBLEM SETTING & SOLVING SYSTEM:** A problem solvable stated is half solved, Steps in problem setting system, Identification, Separation and Grouping of functions. Case studies.

**PROBLEM SETTING & SOLVING SYSTEM:** Goods system contains everything the task requires. Various steps in problem solving, case studies.

**10 Hours**

### **MODULE - 3**

**VALUE ENGINEERING JOB PLAN:** Meaning and Importance of Value Engineering Job plan. Phases of job plan proposed by different value engineering experts, Information phase, Analysis phase, Creative phase, Judgement phase, Development planning phase, and case studies. Cost reduction programs, criteria for cost reduction program, Value analysis change proposal.

**7 Hours**

### **MODULE- 4**



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**VALUE ENGINEERING TECHNIQUES:** Result Accelerators or New Value Engineering Techniques, Listing, Role of techniques in Value Engineering, Details with Case examples for each of the Techniques.

**ADVANCED VALUE ANALYSIS TECHNIQUES:** Functional analysis system technique and case studies, Value analysis of Management practice (VAMP), steps involved in VAMP, application of VAMP to Government, University, College, Hospitals, School Problems etc., (service type problems).

**TOTAL VALUE ENGINEERING:** Concepts, need, Methodology and benefits.

**8 Hours**

**MODULE- 5**

**APPLICATION OF VALUE ANALYSIS:** Application of Value analysis in the field of Accounting, Appearance Design, Cost reduction, Engineering, manufacturing, Management, Purchasing, Quality Control, Sales, marketing, Material Management Etc., Comparison of approach of Value analysis & other management techniques.

**6 Hours**

**TEXT BOOKS:**

**Techniques of Value Analysis and Engineering**– Lawrence D. Miles, McGraw – Hill Book Company, 2<sup>nd</sup> Edn.

**Value engineering for Cost Reduction and Product Improvement** – M.S. Vittal, Systems Consultancy Services Edn 1993

**Value Management, Value Engineering and Cost Reduction** – Edward D Heller Addison Wesley Publishing Company 1971

**REFERENCE BOOKS:**

**Value Analysis for Better Management** – Warren J Ridge American Management Association Edn 1969

**Getting More at Less Cost (The Value Engineering Way)** – G.Jagannathan Tata Mcgraw Hill Pub. Comp. Edn 1995

**Value Engineering** – Arther E Mudge McGraw Hill Book Comp. Edn 1981

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<b>DEVELOPMENT OF ENTERPRISES</b>				
<b>Semester - V</b>				
Subject Code: <b>15IM/IP664</b>			IA Marks	20
Number of Lecture Hours/Week	03		Exam Marks	80
Total Number of Lecture Hours:	40		Exam Hours	03
<b>CREDITS – 03</b>				

**MODULE 1**

**DEFINITION AND CONCEPT OF ENTERPRISE:** Profile of an entrepreneur-need scope and characteristics of entrepreneurs. Attitude development, creativity–stress management-positive reinforcement. **8 Hours**

**MODULE 2**

**METHODOLOGY OF PROJECT IDENTIFICATION:** Short listing and zeroing on to product/service-project in outline project planning- technical and feasibility analysis-evaluation of project report. Project appraisal technical, commercial and financial appraisal - problems in project equation - legal, financial and environmental aspects. **8 Hours**

**MODULE 3**

**MARKETING:** Market share-distribution-sale strategies-certification agencies-term finance-source and management working capital-coating and cost control (basic principles only) need analysis-product design (basic principles only)- developing operational expertise- innovation and change. **8 Hours**

**MODULE 4**

**SMALL INDUSTRIES DEVELOPMENT:** Small Industries development in India and its concepts- ancillary industries-starting a small scale industry steps involved-role of financing and other institutions providing assistance to small industries- preparation of project (case study). **8Hours**

**MODULE 5**

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**ACCOUNTING PRINCIPLES:** Conventions and concepts-balance sheet, profit and loss account. Accounting rate of return, pay back period, SSI duty practice. **8 Hours**

**TEXT BOOK:**

1. **Developing Entrepreneurship** -Udai Pareek and T.V. Venkateswara Rao, – A Hand Book Learning systems - ND. 1978.

**REFERENCE BOOKS:**

1. **EDI - 1 Faculty and External Experts**, A handbook for new entrepreneurs, Entrepreneurship development institute of India -1986.

2. **Entrepreneurship Development** - P. Saravanavel - Ess Pee Kay publishing house -1st Edition.

3. **Entrepreneurship and Small Business** - Anil Kumar - I K International Publishing house Pvt. Ltd - 1st Edition.

**Question paper pattern:** The question paper will have TEN questions. There will be TWO questions from each module. Each question will have questions covering all the topics under a module. The students will have to answer FIVE full questions, selecting ONE full question from each module.