



IK GUJRAL PUNJAB TECHNICAL UNIVERSITY

Scheme & Syllabus

B. Tech. (Part-time) Industrial Engineering & Management (Specialisation in TQM)

Scheme
B.Tech. (Part-time)-Industrial Engineering & Management (Spl. in TQM)

1 st Semester		L	T	P	Marks		Total Marks	Credits
					Int.	Ext.		
IEM 101	Introduction to TQM	3	0	0	60	40	100	3
IEM 102	Communication Skills	3	0	0	60	40	100	3
IEM 103	Applied Physics	3	2	0	60	40	100	5
IEM 104	Applied Mathematics	3	2	0	60	40	100	5
IEM 105	Communication Skills Lab	0	0	2	35	15	50	1
Total		12	4	2	275	175	450	17

2 nd Semester		L	T	P	Marks		Total Marks	Credits
					Int.	Ext.		
IEM 201	Essentials of Management	3	1	0	60	40	100	4
IEM 202	Manufacturing Processes & Materials	3	0	0	60	40	100	3
IEM 203	Fundamentals of Statistics	3	2	0	60	40	100	5
IEM 204	Management Systems & Standards	3	1	0	60	40	100	4
IEM 205	Seminar in IT	0	0	2	35	15	50	1
Total		12	4	2	275	175	450	17

3 rd Semester		L	T	P	Marks		Total Marks	Credits
					Int.	Ext.		
IEM 301	Operations Management	3	1	0	60	40	100	4
IEM 302	Marketing Management	3	1	0	60	40	100	4
IEM 303	Measurements & Metrology	3	1	0	60	40	100	4
IEM 304	Quality Improvement Tools	3	1	0	60	40	100	4
IEM 305	Metrology Lab	0	0	2	35	15	50	1
Total		12	4	2	275	175	450	17

4 th Semester		L	T	P	Marks		Total Marks	Credits
					Int.	Ext.		
IEM 401	Work Study & Ergonomics	3	1	0	60	40	100	4
IEM 402	Managerial Accounting & Industrial Economics	3	1	0	60	40	100	4
IEM 403	Statistical Quality Control	3	1	0	60	40	100	4
IEM 404	Work Study & Ergonomics Lab	0	0	2	35	15	50	1
IEM 405	Minor Project	0	0	4	70	30	100	2
Total		9	3	6	285	165	450	15

Scheme
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5 th Semester		L	T	P	Marks		Total Marks	Credits
					Int.	Ext.		
IEM 501	Industrial Automation & Robotics	3	0	0	60	40	100	3
IEM 502	Operations Research	3	1	0	60	40	100	4
IEM 503	Maintenance & Project Management	3	0	0	60	40	100	3
IEM 504	HRM & Organisational Behaviour	3	1	0	60	40	100	4
IEM 505	Computer Aided Design	0	0	3	50	25	75	2
Total		12	2	3	290	185	475	16

6 th Semester		L	T	P	Marks		Total Marks	Credits
					Int.	Ext.		
IEM 601	Product Planning, Design & Development	3	1	0	60	40	100	4
IEM 602	Lean Management	3	1	0	60	40	100	4
IEM 603	Management Information Systems	3	0	0	60	40	100	3
IEM 604	Supply Chain Management	3	0	0	60	40	100	3
IEM 605	Industrial Safety, Health & Environment	3	0	0	60	40	100	3
Total		15	2	0	300	200	500	17

7 th Semester		L	T	P	Marks		Total Marks	Credits
					Int.	Ext.		
IEM 701	Six Sigma	3	1	0	60	40	100	4
IEM 702	Management Practices for Business Excellence	3	0	0	60	40	100	3
IEM 703	Independent Study Seminar	0	0	2	35	15	50	1

Elective-I (Choose one)

IEM 751	Advanced Quality Tools	3	0	0	60	40	100	3
IEM 752	Advanced Manufacturing Processes	3	0	0	60	40	100	3
IEM 753	Customer Relationship Management	3	0	0	60	40	100	3

Elective-II (Choose one)

IEM 754	Value Engineering	3	0	0	60	40	100	3
IEM 755	Energy Management	3	0	0	60	40	100	3
IEM 756	Service Marketing & Quality	3	0	0	60	40	100	3

Elective-III (Choose one)

IEM 757	Reliability Engineering	3	0	0	60	40	100	3
IEM 758	Computer Integrated Manufacturing	3	0	0	60	40	100	3
IEM 759	Creativity, Innovation & Entrepreneurship	3	0	0	60	40	100	3

Total		15	1	2	335	215	550	17
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8 th Semester		L	T	P	Marks		Total Marks	Credits
					Int.	Ext.		
IEM 801	Major Project	0	0	16	140	60	200	8

Grand Total		87	20	33	2175	1350	3525	124
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Syllabus

B.Tech. (Part-time) – Industrial Engineering & Management (Spl. in TQM)

IEM 101 INTRODUCTION TO TQM

Internal Marks	: 60	L	T	P
External Marks	: 40	3	0	0
Total Marks	: 100			

UNIT 1 : Historical perspective and definitions

- Brief history of global quality movement: Industrial revolution – Taylor system – World war II scene
- Post war scenario of quality: Japanese revolution – American response – Quality in Europe – Asian tigers – Emergence of China
- Globalisation and quality – India's late awakening
- Various definitions of quality: Two meanings of quality
- Competition: Main driver of quality
- Emerging concept of Total Quality – Definition of TQM – Four pillars of TQM – Benefits of TQM

UNIT 2 : Principal quality philosophies

- Deming: Journey and contribution to quality – The fourteen points – The deadly diseases – Obstacles – PDCA cycle
- Juran: Journey and contribution to quality – Juran Trilogy
- Crosby: Contribution to quality – Four absolutes of Quality Management – 14 Steps to Quality Improvement
- Comparison of philosophies of the three Quality Gurus – Areas of unanimity – Differences in approach

UNIT 3 : Other contributions and initiatives

- Contributions of Shewhart, Feigenbaum, Conway, Ishikawa, Taguchi, Ohno, Shingo, Ouchi
- Overview of other initiatives: Quality circles – Suggestion schemes – Six sigma – Kaizen
- Overview of Management System Standards: ISO 9000 Quality Management System – ISO 14000 Environment Management System – Key elements of certification
- Other Standards and Ratings: Emission standards – Homologation standards – CMM – FDA approvals

UNIT 4 : Delivering customer expectations

- Changing business scenario
- Managing for quality: Juran Quality Trilogy
- Quality planning: Why quality planning – Quality gaps – Steps in quality planning – Roadmap for quality planning
- Quality control: Definition – Quality control steps – Concept of controllability – Provision for audit – Relationship with quality audit & quality assurance – Improving effectiveness of quality control
- Quality improvement: Types of improvement – Quality improvement steps – Rate of improvement
- Quality and other disciplines

UNIT 5 : Business view of quality: Connecting quality to the bottom line

- Economic effects of quality: Effect of quality on costs and income
- Quality perceptions of customers and suppliers
- Relationship between quality, price and market share: Translation of superiority into profit
- Variation in quality requirements of customers

UNIT 6 : Cost of poor quality (COPQ)

- Quality gurus on cost of poor quality
- Hidden losses and quality iceberg
- Categories of cost of poor quality : Internal failure – External failure – Appraisal – Prevention – Loss of opportunity
- Controversial costs: Is it operation costs – Controversy on categorization – Adding all quality losses
- Reducing COPQ – Improvement journey according to Juran

UNIT 7 : Calculation and analysis of COPQ

- Objectives of calculating COPQ: Relating total quality cost to business measures
- Analysis of quality costs: The right costs – Optimum quality costs – Strategy for reducing quality costs
- Quality-accounting interface: Procedural steps for computing COPQ – Initial studies for awakening management – Data for initial study – Paramount issues
- Potential misapplications & pitfalls

UNIT 8 : India and quality

- Post independence developments on quality
- Institutions focused on quality: Bureau of Indian Standards – Standardisation – Testing and Quality Certification Directorate – National Productivity Council
- Centres of excellence: Indian Institute of Science – Indian Statistical Institute – Indian Institutes of Technology – Indian Institutes of Management – All India Institute of Medical Science
- Institutions of advance research and application: DRDO – CSIR – NPL – ICAR – ISRO – BARC
- Current scenario of quality in India: Awakening to quality – Some seminal contributors
- Quality awards in India, Deming prize winners from India
- Quality roadmap in the 11th five year plan (2007-2012)

Recommended books:

1. Juran, J.M. and Gryna, F.M.; *Quality Planning and Analysis for Enterprise Quality*, 5th Edition; Tata McGraw-Hill.
2. Juran, J.M. (2000); *Quality Control Handbook*; Tata McGraw-Hill; 5th Edition
3. Mitra, Amitava; *Fundamentals of Quality Control and Improvement*; Pearson Education; 2nd Edition
4. Campanella, Jack; *Principles of Quality Costs: Principles Implementation and Use*; American Society for Quality (ASQ), Quality Costs Committee

IEM 102 COMMUNICATION SKILLS

Internal Marks	: 60	L	T	P
External Marks	: 40	3	0	0
Total Marks	: 100			

UNIT 1 : Communication in today's world

- Basic principles of communication: Introduction & definition of communication – Importance of communication
- Nature of communication: Communication is perception – Communication is expectation – Communication makes demands – Communication differs from information
- Types of communication: Verbal communication – Non verbal communication
- Communication barriers: Problems in sending and transmission – Problems in reception and comprehension – Dealing with communication barriers
- Distortions in communication – Methods of reducing distortion
- Communication in the modern technology era: Telephone – Tele conferencing and Video conferencing – Fax communication – E-mail – Blogs – Social network services

UNIT 2 : Verbal & non-verbal communication

- Defining verbal and non-verbal communication
- Para language: Tone – Pitch – Volume – Speed – Emphasis – Pronunciation – Vocal segregates – Voice control and appeal
- Kinesics or body language – Eye contact – Facial gestures – Gestures with arms and hands – Hand movements – Touch – Handshakes – Posture – Styles of walking – Other movements
- Effective listening: Barriers to effective listening – Guidelines for better listening
- Interpersonal skills: Building positive relationships – Giving praise – Dealing with criticism

UNIT 3 : Presentations: Introduction, planning and contents

- What is a presentation – Need for presentation – Types of presentations (Informative, Persuasive, Goodwill presentations)
- Classification of presentations – Making a good presentation – Ingredients of a good presentation (Content – Preparation – Delivery)
- Planning a presentation – Understanding the audience – Research – Closing/conclusion – Opening/introduction – Sequencing ideas and actions
- Content creation: Creating effective content – Collecting matter for presentation – Condensing – Keep it simple – Use of Examples – Selecting a title – Use of mini-summaries – Things to avoid

UNIT 4 : Structuring a presentation

- Parts of a presentation – Introduction/opening – Body of the presentation – Concluding the presentation
- Visuals: Approach to visuals – Content – Clarity – Layout
- Fonts and colour: Suggested font sizes – Styles – Spacing – Things to avoid – Selection of colours – Background and foreground combinations
- Illustrations and tables: Do's and Don'ts

UNIT 5 : Delivery of presentations

- Proxemics: Definition – Understanding Proxemics – The four zones
- Location and equipment: Location and lighting – Room layout – Equipment and their right use

- Involving the audience: Use of questions – Answering questions – Dealing with awkward questions – Suggestions – Stories – Case studies – Using humour – Using notes – Reading a script
- Dealing with nervousness: Causes of nervousness – Remedies or strategies to control nervousness
- Practice tips: 5 essential tips for practicing before a presentation

UNIT 6 : Written communication - I

- Writing skills
- Systematic approach: Planning – Drafting – Organising & formatting – Revising – Checking for correctness – Proof reading
- Letter writing
- Writing effective memos – Characteristics of good memos – Types of memos
- Use of gender neutral language

UNIT 7 : Written communication - II

- Types of Reports: Routine – Informational – Justification – Situational – Feasibility – Research – Business – Project reports
- Project Report: Formats – Guidelines for project report writing – Common mistakes in project reports
- Précis writing – Techniques of writing a précis – Guidelines for writing a précis
- Job application letter: Opening section – Middle section – Closing section
- Résumé writing for employment: Self analysis – Career analysis – Job analysis – Structure of Résumé – Contents of Résumé – Résumé writing guidelines
- Other business documents: Enquiry – Quotation – Purchase order – Delivery note – Invoice – Credit note

UNIT 8 : Communication within organisations

- Communication in organization: Downward communication – Upward communication – Horizontal communication – Cross-channel communication – Informal communication
- Effective meetings: Planning & Preparation – Conducting the meeting – Keeping the meeting on track
- Minutes of meeting (MOM): What is MOM? – Recording of MOM – Points to remember when recording MOM
- Interviews: Description – Types of interview – Planning an interview – Conducting an interview – Commonly asked questions in employment interviews

Recommended books:

1. Wright, Chrissie; *Handbook of Practical Communication Skills*; 4th Edition 2003; Jaico Publishing House, Mumbai.
2. Kaul, Asha; *Business Communication*; 9th Print 2003; Prentice-Hall of India Pvt. Ltd., New Delhi.
3. Mitra, Barun K., *Effective Technical Communication*; Oxford University Press.
4. Kaul, Asha; *The Effective Presentation*; 1st Edition 2005; Response Books, New Delhi.

Reference books:

1. Cole, Kris; *Crystal Clear Communication*; 2nd Edition; East West Books (Madras) Pvt. Ltd.
2. Dobson, Ann; *Communicate at Work*; 1st Impression 2005; Jaico Publishing House, Mumbai.
3. Sen, Leena, *Communication Skills*; Prentice-Hall of India Pvt. Ltd., New Delhi.
4. Kozicki, Stephen and Peacock, Gary; *The Persuasive Presenter*, Tata McGraw-Hill, New Delhi.

IEM 103 APPLIED PHYSICS

Internal Marks	: 60	L	T	P
External Marks	: 40	3	2	0
Total Marks	: 100			

UNIT 1 : Scientific thinking and units of basic measurements

- Introduction
- Scientific method: Steps in scientific method – Scientific method in everyday problem solving
- Philosophy of science: Discovering Relationships – Objectives of improvement – Commonly used principles of science
- Quantities, units and measurements: Definitions
- Systems of measurement: The English system – The Metric system – Metre convention and BIPM – International system of units
- SI system of units: Overview – Base quantities and base units – Derived quantities and derived units – Decimal multiples and sub-multiples of SI units – Units outside the SI – Dimensions of quantities – NPL – Standards organizations
- Need for universal adoption of SI system

UNIT 2 : Principles of mechanics

- Elementary definitions: Speed – Velocity – Acceleration – Momentum – Force – Units – Equations of motion
- Concept of force: Newton's first law – Newton's second law – Newton's third law – Frames of reference – Centripetal force – Projectiles – Satellite motion
- Turning effects of force: Moments of force – Equilibrium – Couple and torque

UNIT 3 : Work, power and energy

- Introduction to work, energy and power: Scalar product of vectors
- Notions of work and kinetic energy: Work energy theorem
- Concept of Work
- Concept of Kinetic energy
- Work done by variable force: Work energy theorem for a variable force
- Concept of Potential energy
- Principle of conservation of energy: Conservation of mechanical energy – Potential energy of a spring – Conservation of heat energy – Chemical energy – Electrical energy – Nuclear energy
- Concept of power: Elastic and inelastic collisions

UNIT 4 : Properties of matter and fluid flow

- Concept of Elasticity: Stress and strain – Relationship between Stress and Strain
- Hook's law and Moduli of Elasticity: Young's Modulus – Bulk Modulus – Modulus of Rigidity
- More illustrations of elasticity: Elongation of wire – Thermal stress in wire – Twisting of a cylinder
- Pressure: Formula for pressure – Atmospheric pressure – Variation of pressure with depth – Archimedes principle – Floatation
- Surface Tension: Surface energy – Excess pressure – Capillarity – Molecular theory of surface tension
- Streamline flow and velocity

- Pressure and velocity: Bernoulli's Principle – Applications of Bernoulli's Principle – Aerodynamics
- Measurement of fluid velocity: Pitot – Static tube
- Viscosity: Stokes law and terminal velocity – Critical velocity and Reynold's number

UNIT 5 : Rate processes

- Introduction
- Nature of rate processes: Laws of conservation of mass and energy
- Electric analogy
- Concept of driving potential: Driving potential in heat transfer – Driving potential in mass transfer
- Mechanisms of heat transfer: Conduction – Convection – Radiation – Illustrations
- Fluid flow as a rate process

UNIT 6 : Electricity and magnetism

- Electric charge: Positive and negative charge – Unit of charge – Coulomb's law – Induction of charge – Electric field – Line of force – Electric potential
- Magnetism: Force on a charge moving through a magnetic field – Unit of magnetic field – Applications – Magnetic force on a current carrying wire – Electric motors
- Magnetic effect of current: Ampere law – Electromagnetism and electromagnets
- Electromagnetic induction: Faraday's experiments – Lenz's law – Interaction of magnetism & electric charges
- Electromagnetic radiation: Electromagnetic spectrum and its applications
- Sources of electrical energy: Electric generator – Electro-chemical batteries – Fuel cells

UNIT 7 : Waves: Sound and light

- Waves: Concept – Longitudinal and transverse waves – Properties and definitions – Speed of waves – Reflection of waves
- Sound: Frequency – Pitch – Musical intervals – Sound power – Sound power level and intensity – Loudness – Speed – Echo – Interference – Beats – Tuning musical instruments – Doppler effect – Natural frequency – Resonance – Standing wave patterns – Applications of ultrasound waves
- Light: Colour – Light absorption, reflection and transmission – Law of reflection – Plane and spherical mirrors – Refraction – Apparent depth of submerged objects – Dispersion – Laser

UNIT 8 : Solids and Semiconductors

- Structure of solids: The crystal lattice – The unit cell – Mono crystal or single crystal – Polycrystals – Liquid crystals
- Energy bands in solids
- Metals, insulators and semiconductors: Intrinsic and extrinsic semiconductors
- Semiconductor devices: P-N junction diode – Forward and reverse bias diode – P-N junction diode as a rectifier
- Applications of semiconductors: Transistors – Integrated circuits –VLSI – Microprocessor – Solar cells

Recommended Books:

1. Nelkon, Michael; *Advanced level Physics*; CBS Publishers and distributors, New Delhi.
2. Tipler, Paul A.; 2nd Edition 2003; *Physics*; Volume 1 and 2; CBS Publishers and distributors, New Delhi.
3. Beiser, Arthur; 4th Edition 2004; *Theory and problems of Applied Physics*; Publisher: Tata Mcgraw Hill.
4. Gupta, Satish K.; *ABC of Physics*; Volume I and II, 2006; Modern Publishers.

IEM 104 APPLIED MATHEMATICS

Internal Marks	: 60	L	T	P
External Marks	: 40	3	2	0
Total Marks	: 100			

UNIT 1 : Algebra

- Linear equations, quadratic equations: Introduction to equations – Linear equations – Quadratic equations – Conic sections and quadratics
- Exponential and logarithmic functions: Defining exponential functions – Properties of exponents – Negative integer exponents – Graph of an exponential function – Graph of logarithmic function
- Binomial theorem for positive integral index
- Binomial approximation with application to basic engineering problems

UNIT 2 : Trigonometry

- Trigonometric Functions: Angles – Radian – Triangles – Tangents
- Graphs of trigonometric functions
- Trigonometric ratios – Formulae – Equations
- Trigonometric functions of sum and difference of two angles
- Product formulae
- T-ratios of multiple angles – Sub-multiple angles

UNIT 3 : Coordinate geometry

- Cartesian and Polar coordinates (two dimensional), conversion from Cartesian to polar coordinates and vice versa: Position of a point in a plane
- Distance between two points (cartesian co-ordinates): Straight line – Ratio formula – Slope of a line – Equation of the line cutting intercepts from the axes – Angle between the two intersecting lines whose slopes are given
- Area of triangle when its vertices are given
- Circle and conics: Equations of Circle – Ellipse – Parabola – Hyperbola
- Three dimensional co-ordinate geometry – Co-ordinates of a point in space – Distance between two points in space – Angle between two planes

UNIT 4 : Matrices and determinants

- Types of matrices: Square – Diagonal – Unit and scalar
- Basic operations: Addition – Subtraction – Multiplication – Transposition
- Determinants – Properties of determinants
- Applications of determinants and matrices in solving linear equations

UNIT 5 : Vector algebra

- Base vectors
- Vector components – Rectangular components in two dimensions
- Direction cosines
- Vectors connecting two points
- Dot and cross product
- Rectangular co-ordinates
- Triple vector product
- Application of vectors – Work done and moment

UNIT 6 : Differential calculus

- Introduction to calculus
- Limit
- Rate of change and derivatives – Derivatives of some common functions – Derivatives of power of x – Derivatives of polynomials – Derivatives of products of functions – Derivatives of quotients of functions – Derivatives of exponential and logarithmic functions
- Gradient of a curve

UNIT 7 : Integral calculus

- Indefinite integrals: Introduction – Indefinite integrals as antiderivatives – Integration by substitution – Integration by partial fractions – Integration by parts – Some special types of integrals
- Definite integrals: Introduction – Definite integral as the limit of a sum – Fundamental theorem of calculus – Evaluation of definite integrals by substitution – Some properties of definite integrals

UNIT 8 : Applications of differential and integral calculus

- Determining maximum and minimum values of functions: Steps for solving maxima/minima problems – Points of inflexion
- Definite integral: Areas under a curve – Terminology and notation – Properties of definite integrals – Fundamental theorem of calculus – Illustrations of integration – Strategy for modeling with integrals – Area between curves – Area enclosed by intersecting curve – Volumes and surfaces of revolution of curves
- Other applications of integral calculus: Center of mass – Moment of inertia
- Differential equations: Introduction – Order of differential equation and its solution – Linear differential equation – Mathematical modeling – Initial value problem – Illustrations

Recommended books:

1. Grewal, B.S.; *Higher Engineering Mathematics*, Khanna Publishers
2. Moyer, Robert. E. and Aryes, Frank; *Schaum's Outline of Trigonometry*; Tata McGraw-Hill.
3. Thomas, B. George, Jr. and Finney, L Ross; *Calculus and Analytic Geometry, 9th Edition*; Pearson Education.
4. Ahsan, Akhtar and Ahsan Sabiha; *Textbook of Differential Calculus*; Prentice-Hall India

Reference book:

1. Loney, S.L.; *Trigonometry and Co-ordinate Geometry*, 2008 – GK Publishers

IEM 105 COMMUNICATION SKILLS LAB

Internal Marks : 35

L T P

External Marks : 15

0 0 2

Total Marks : 50

1. English pronunciation: Practice

- Features of spoken English
 - Pronunciation
 - Word stress
 - Sentence stress
 - Intonation
- Basic differences in British & American English

2. Spoken English: Practice

- Oral communication skills
 - Starting a conversation
 - Introducing oneself and others
 - Greeting & taking leave
 - Wishing well
 - Expressing thanks
 - Talking about oneself
 - Expressing likes & dislikes

3. Written English: Practice

- Common mistakes in subject-verb agreement
- Common mistakes in similar words
- Articles – Use of a, an & the
- Effective paragraph writing

4. Presentation: Practice

- Presentation on topics of common interest:
 - Greeting the audience – Introduction of self – Building a rapport
 - Emphasis on catchy opening: Use of questions, Use of anecdotes and quotations, Answering awkward questions
 - Practice on forceful closing techniques: Use of suggestions, Answering questions, Asking for feedback
 - Handling questions from audience

IEM 201 ESSENTIALS OF MANAGEMENT

Internal Marks	: 60	L	T	P
External Marks	: 40	3	1	0
Total Marks	: 100			

UNIT 1 : Introduction to management

- Overview of management: Definition – Functions – Levels of management
- Theories of management: Classical – Neoclassical – Quantitative approach – System approach
- Social responsibility of management: Defining social responsibility – Arguments for and against social responsibility of business – Social Audit
- Ethics in management: Institutionalizing ethics – Raising ethical standards
- Introduction to management functions: Planning – Organizing – Staffing – Leading – Control

UNIT 2 : Planning

- Mission, objectives and plans: Multiplicity of objectives – Approaches for establishing objectives
- Types of plans: Plans based on breadth – Plans based on frequency of use
- Steps in planning: Recognise opportunity – Set objectives – Determine planning premises – Search alternative courses – Evaluate alternatives – Choose alternatives – Implement plan – Review & revise
- Decision making: Rationality and intuition in decision making – Role of intuition – Steps in decision making – Decision making under certainty vs. uncertainty
- Pitfalls and limitations of planning
- Management by objectives (MBO): Evolving concepts in MBO – Early impetus to MBO – The systems approach to MBO – Steps in the MBO process – Benefits of MBO – Limitations of MBO

UNIT 3 : Organising

- Concept of organization and organizing: What is organizing? – Benefits of organising
- Organization Structure: Elements of organizational design
- Types of organization: Merits and demerits of various organization structure
- Departmentation: Methods of departmentation
- Centralization and decentralization: Advantages of decentralization – Disadvantages of decentralization
- Authority and responsibility: Chain of command – Span of control and organisational levels – Delegation of authority
- Factors in organizational change: External and internal factors

UNIT 4 : Staffing

- Concept of staffing: Definition of Staffing – Systems approach to Staffing
- Manpower planning process: Current assessment – Meeting future human resource needs
- Job analysis and job description: Definitions
- Recruitment and selection: Sources of recruitment – Separation – Selection process
- Training and development: Orientation – Types of training – Training methods
- Performance appraisal: Objectives of appraisal – Performance appraisal methods

UNIT 5 : Leadership

- What is leadership: Leader versus Manager
- Basic styles of leadership: Exploitive authoritative – Benevolent authoritative – Consultative – Participative
- Essential characteristics of a leader: Obsession with the mission – Takes tough decisions when needed – Loyalty to the cause etc.
- Other leadership traits: Drive – Communication skills – Intelligence etc.
- Communication: Purpose of communication – Communication model

- Leading organizational change: The source of culture – Strong versus weak culture – Creating the desired culture
- Leadership style in Indian organizations: Family managed organizations – Professionally managed organizations – Public sector or Government undertakings

UNIT 6 : Motivation

- Concept of motivation: What is motivation?
- Motivation and behaviour: Motivational techniques used by organizations
- Motivation theories: Maslow's need hierarchy theory – McGregor's Theory X and Theory Y – Herzberg's two-factor theory – McClelland's Three-needs theory – Vroom's expectancy theory
- Job enrichment: Techniques of job enrichment
- Quality of work life: Concept and methods of QWL

UNIT 7 : Controlling

- Introduction: Nature of controls
- Basic control process: Steps in control process
- Types of control: Classification on the basis of levels – Classification on the basis of stage
- Effective control systems: Characteristics of effective control systems
- Control systems and techniques: Budgetary control – Financial control etc
- Integration of planning, organising and control
- Recent issues in control: Workplace privacy – Employee theft – Workplace violence
- MIS and information technology: Use of computer networks and internet

UNIT 8 : International management

- Management in an International Environment: Impact of the changing global business environment on management
- Managerial attitudes towards the globalization of business: Issues related to planning and managing in the international environment
- Laws and regulations: International labour relations and host government interaction
- Socio-cultural environment of International business: Impact of socio-cultural factors on management – Management of international personnel
- Methods of international involvement: Joint-venture – Exports etc.
- Cross border coordination in global companies: International contract development and enforcement.

Recommended books:

1. Wehrich, Henz & Koontz, Harold; *Management: A Global Perspective*, 11th Edition; Tata McGraw-Hill, New Delhi.
2. Koontz, Harold & Wehrich, Henz; *Essentials of Management*, 6th Edition; Tata McGraw-Hill, New Delhi.
3. Robbins, Stephen P and Coulter, Mary; *Management*, 8th Edition; Prentice-Hall of India, New Delhi.
4. Prasad, L.M.; *Principles and Practice of Management*, 2006; Sultan Chand & Sons

IEM 202 MANUFACTURING PROCESSES & MATERIALS

Internal Marks	: 60	L	T	P
External Marks	: 40	3	0	0
Total Marks	: 100			

UNIT 1 : Introduction to manufacturing processes & materials

- Manufacturing processes: Definition – Classification – Selection
- Materials: Characteristics & application – Iron & steel – Alloy steels – Non-ferrous metals – Aluminum and aluminum alloys – Copper & copper alloys – Nickel alloys – Other important metals – Refractory metals and alloys

UNIT 2 : Polymers, rubbers, ceramics & composites

- Polymers
 - Thermoplastics: Moulding of thermoplastics – Plastic sheet forming process – Machining of thermoplastics
 - Thermosetting plastics: Properties – Moulding processes and machining
 - Extrusion of plastics
- Rubber: Manufacturing process – Manufacturing techniques – Materials design – Sizing – Components – Building – Moulding and vulcanising of tyres – Belting – Manufacture of hose
- Ceramic materials: Processing of ceramic products
- Composite materials: Fibre – Particulate – Whisker reinforced ceramics – Properties of reinforcements and matrix – Manufacturing Techniques and applications of different Composites, namely PMC, MMC and CMC

UNIT 3 : Casting

- Casting of metals
 - Methods of melting
 - Methods of casting: Sand casting – Machine casting – Centrifugal casting – Die casting – Investment casting – Vacuum casting
 - Core baking – Elements of gating system – Runners and Risers
 - Metallurgical considerations in casting: Casting defects & remedies – Testing & Inspection
- Casting of plastics: Transfer moulding – Injection moulding

UNIT 4 : Metal forming

- Introduction to metal forming process
- Forging: Elements of forging – Smith forging – Drop forging – Upset forging – Press forging – Roll forging
- Extrusion Processes: Extruding metals – Types of extrusion – Forward, Backward and Impact extrusion – Extrusion equipment
- Basic Forming processes: Blanking – Shearing – Bending – Forming – Drawing – Cupping – Roll forming – Coining – Embossing

UNIT 5 : Machining processes

- Importance of machining: Types of cutting operations and machinability
- Turning: Reaming – Boring – Drilling – Reaming – Threading – Knurling – Grinding – Honing – Lapping.
- Milling – Shaping & Planning – Sawing – Broaching
- Machining of plastics

UNIT 6 : Welding and assembly

- Method of joining of components: Type of welding joints
- Types of welding: Arc welding – Submerged arc welding – Oxyacetylene – Gas welding – Pressure gas welding – Gas welding & cutting – Resistance welding – Spot welding – Seam welding – Other welding methods
- Brazing & soldering
- Riveting & bolting: Screws and bolts – Riveting and staking – Stapling – Stacking – Stitching – Seaming and curling – Shrink fit – Adhesives for joining

UNIT 7 : Heat treatment

- Iron carbon diagram
- Annealing: Hardening and tempering of steel – Thermo-mechanical treatment of steel – Surface hardening – Heat-treatment defects
- Chemical heat-treatment processes and their general features: Carburizing – Nitriding – Cyaniding

UNIT 8 : Protective coating

- Purpose of coating
- Methods of cleaning: Tumbling – Sandblasting – Shot blasting – Abrasive cleaning– Ultrasonic and chemical cleaning
- Organic coatings: Types – Applications and advantages
- Metallic coatings: Types – Metallic paints – Zinc coatings – Tin coating – Hot dipping – Electroplating – Oxide coatings – Anodizing – Cladding – Spraying
- Plastic and miscellaneous coating
 - Plastic coating – Types and methods of application
 - Miscellaneous coatings – Natural oxides – Paper and fabric

Recommended books:

1. Kohser Ronald A., Degarmo E. Paul, Black, J.T.; *Materials and Processes in Manufacturing*; 8th Edition
2. Hazra Choudhury; *Elements of Workshop Technology Volume – I & II*; Indian Book Distributing Co. Calcutta
3. Gupta, J.K. and Khurmi, R.S.; *A Textbook of Workshop Technology: Manufacturing Processes*
4. NIIT; *An Introduction to Engineering Materials and Manufacturing Processes*
5. Campbell, J.S; *Principles of Manufacturing Materials & Processes*; Tata McGraw-Hill Publishing Co.
6. Amstead, B.H., Philip, F. Ostwald and Myron, L. Begeman, *Manufacturing Processes*, John Wiley & Sons, 8th Edition.

IEM 203 FUNDAMENTALS OF STATISTICS

Internal Marks	: 60	L	T	P
External Marks	: 40	3	2	0
Total Marks	: 100			

UNIT 1 : Descriptive statistics - 1

- Introduction to statistics
- Universe – Population – Sample – Parameter and statistic
- Sub divisions of statistics: Descriptive statistics – Inferential statistics
- Theories of probability – Decision theory
- Data and data collection: Attribute data – Variable data – Data arrays
- Frequency distribution: Frequency distribution table – Histogram – Frequency graphs – Frequency polygon – Cumulative frequency distribution

UNIT 2 : Descriptive statistics – 2

- Introduction
- Measures of central tendency: Arithmetic mean – Weighted mean – Geometric mean – Median – Mode
- Measures of dispersion: Range – Standard deviation – Coefficient of variation – Skewness and its measures

UNIT 3 : Correlation and regression

- Introduction
- Correlation analysis: Scatter diagrams – Karl Pearson's correlation co-efficient
- Regression analysis: Origin of the term '*Regression*' – Equation of a straight line – Slope of a line – Examining the linear relationships – Fitting a regression line mathematically – Line of best fit – Method of Least squares – Checking the estimating line – Measuring reliability of the regression line – Standard error of estimate

UNIT 4 : Introduction to probability

- Introduction: History – Relevance of probability theory
- Basic concepts: Definition – Events and experiments
- Types of probability: Classical approach – Relative frequency approach or empirical probability – Subjective approach to probability
- Probability rules: Addition theorem – Multiplication theorem – Conditional probability

UNIT 5 : Probability distributions

- Introduction: Difference between frequency and probability distributions – Types of probability distributions – Expected value and its calculation – Random variables
- The Binomial distribution: Bernoulli process – Parameters of binomial probability distribution – Calculation of binomial probability – Graphic illustration
- The Poisson distribution: Parameters of Poisson distribution – Characteristics – Calculation of Poisson probability
- The Normal distribution: Characteristics of normal probability distribution – Areas under the normal curve – Probability distribution
- The Exponential distribution: Introduction – Calculation of exponential probability
- Choosing the correct probability distribution

UNIT 6 : Sampling and sampling distribution

- Introduction to sampling
- Random sampling: Independent – Stratified
- Sampling distribution: Introduction – Sampling distribution of mean – Concept of standard error – Sample size and standard error – Central limit theorem

UNIT 7 : Estimation

- Estimator: Definition – Criteria of good estimator – Finding best estimator
- Point estimate: Estimate of population mean – Estimate of population standard deviation – Estimate of population proportion
- Interval estimate: Confidence interval and confidence level – Level of significance – Confidence interval for population mean – Interval estimate of mean for standard deviation known/unknown – Interval estimate using t distribution – Confidence interval for population proportion (p)

UNIT 8 : Hypotheses Testing

- Basic concept to the hypothesis: Steps involved in testing of hypothesis
- Hypothesis testing: Interpreting significance level – Type 1 & type 2 error – One tailed & two tailed tests – Standard deviation known – Standard deviation not known – Hypothesis testing of large proportions

Recommended books:

1. Levin, I. Richard; & Rubin, S. David; *Statistics for Management*, 7th Edition, 2006; Pearson Education.
2. Newbold, Paul; Carlson, William L.; Thorne, Betty; *Statistics for Business and Economics*; 6th Edition; Pearson Education.

Reference books:

1. Gupta, S.P.; *Statistical Methods*; Sultan Chand & Sons.
2. Hooda, R.P.; *Introduction to Statistics*, 2002; Macmillian India Ltd, New Delhi.

IEM 204 MANAGEMENT SYSTEMS AND STANDARDS

Internal Marks	: 60	L	T	P
External Marks	: 40	3	1	0
Total Marks	: 100			

UNIT 1 : Overview of standards and certification

- Introduction to standardization: History of standardisation – Definition of standardisation
- Types of standards: ISO classification – Classification by intended user group – Classification by requirements – Classification by obligation of use – Other types of standards
- Aims, principles and benefits of standardization
- International standardization: Evolution of international standardization – International trade agreements
- Certification: First party – Second party – Third party
- Introduction to management systems standards: Introduction to ISO 9000 series – Introduction to ISO 14000 series – OHSAS 18001 family
- Introduction to sector specific QMS standards: ISO/TS 16949 – AS 9100 – TL 9000 – ISO 22000:2005

UNIT 2 : National and international standards

- International Standards Organization (ISO): Introduction to ISO – Range of ISO standards – Structure of ISO – Development of international standards
- International Electro-technical Commission (IEC): Introduction – Structure – Development of standards – IEC publications
- International Telecommunication Union (ITU): Introduction – Purpose and role – Structure – Members – Standards status – Telecommunication standardization sector
- Bureau of Indian Standards (BIS): Structure – Standardisation – Procedure for formulation of standards by BIS – Product certification scheme of BIS
- Management systems certifications by BIS – Other certification schemes – BIS laboratories

UNIT 3 : ISO 9001:2008 QMS – Requirements (Clause 1 to 5)

- History of ISO 9000
- ISO 9000:2008 quality management principles
- Introduction: Scope – General – Application – Normative reference – Terms and definitions
- Quality management system: General requirements – Documentation requirements
- Documentation of quality management system
- Management responsibility: Management commitment – Customer focus – Quality Policy – Planning – Responsibility, authority and communication – Management review

UNIT 4 : ISO 9001:2008 QMS – Requirements (Clause 6 to 8)

- Resource management: Provision of resources – Human resources – Infrastructure – Work environment
- Product realization: Planning of product realization – Customer related processes – Design and development – Purchasing – Production and service provision – Control of monitoring and measuring devices
- Measurement, analysis and improvement: General – Monitoring and measurement – Control of nonconforming product – Analysis of data – Improvement

UNIT 5 : Implementation, certification and audit of QMS

- Process approach: Types of processes – Benefits of process approach
- Steps for implementing ISO 9001:2008: Check list
- Importance of conformity assessment: Customer requirements – Government regulation – Marketing advantage – A tool for improvement
- Certification of quality management system – Steps involved
- Audit of quality management system: Purpose – Types of quality audits
- ISO 9004:2000 model for quality improvement
- International Accreditation Forum

UNIT 6 : ISO 14000 series of environmental management system (EMS)

- Importance of EMS: World heading for a disaster – Health problems due to pollution – Avoiding this catastrophe
- Sustainable development – Guidelines for industry
- Benefits from EMS
- Overview of ISO 14000 series: Scope – Normative reference – Terms and definitions
- Requirements of ISO 14001: General requirements – Environmental policy – Planning – Implementation and operation – Checking – Management review
- Relationship between ISO 9001 & ISO 14001

UNIT 7 : Other management system standards

- TS-16949: Introduction – Scope – Normative reference – Terms and definitions – Quality management system – Management responsibility – Resource management – Product realization – Measurement, analysis and improvement
- ISO 22000 : 2005
 - Introduction: Food safety management systems – Aims of food safety management system – ISO 22000 family – Legal compliance – International framework – Continual improvement
 - Requirements: Scope – Normative reference – Terms and definitions – Food safety management system – Management responsibility – Resource management – Validation, verification & improvement of food safety management system

UNIT 8 : Standards and accreditation for laboratories

- Quality management in laboratories
- Types of laboratories: Test laboratories – R&D Labs – Calibration laboratories
- Laboratory accreditation
- ISO/IEC 17025:2005: Management requirements – Technical requirements
- Proficiency testing
- Mutual recognition mechanism for laboratory accreditation: ISO/IEC 17011:2004
- Quality Council of India and NABL
- National Accreditation Board for Test and calibration Labs: Procedure for NABL accreditation

Recommended books:

1. Pranab K.R. Nag; *The Management Systems, Quality, Environment, Health & Safety ISO 9001:2000, ISO 14000, OHSAS 18001*; Quest Publications, Mumbai (Part V and VII).
2. Dale H. Besterfield, Carol Besterfield-Michna, Glen H. Besterfield and Mary Besterfield-Sacre; *Total Quality Management*, 3rd Edition; Pearson Education.
3. Arora, K.C.; *ISO 9000 to OHAS 18001*, 2003-2004 Edition; SK Kataria & Sons, Delhi.

Reference book:

1. ISO 9001:2008, ISO 14001:2004, ISO 22000:2005, ISO/ TS 16949: 2009 – Requirements; Published by ISO, Geneva

IEM 205 SEMINAR IN IT

Internal Marks	:	35	L	T	P
External Marks	:	15	0	0	2
Total Marks	:	50			

1. Computing Fundamentals

- Computer basics: Basic structure of computer and its working – Block diagram of computer associated peripherals
- Identifying computer hardware components and their functions: CPU – Memory (RAM, ROM) – Modems – Input/output devices – Secondary storage devices
- Identifying types of software and its interaction with hardware: Classification of Programming languages – Data processing – Data communication
- Identifying operating system functions: OS definition – Role of OS in computer system – Multi programming – Time sharing – Multi tasking – Multi processing – Cluster system – Real time system – Client server computing – Distributed OS

2. Windows based productivity improvement software

- Introduction of MS Excel: Introduction to Spreadsheets – Entering formulas and formatting a worksheet – Using functions and formulas – Creating charts
- Making PowerPoint presentations: Selecting templates – Spacing & layout – Alignment of visuals with text – Font style, font size and use of punctuation marks – Numbering of slides – Choice of colors

3. Introduction to Networks

- Fundamentals of networks: Networking terminology – Communication models – Transmission media – Connection topologies – LAN – WAN – MAN
- Internet and its applications: Internet – ISP – Email – URL – Web – Browsers – Websites – Intranet – Extranet – Understanding e-mail – Information sources on the internet – Intranet

4. Programming development tools

- Introduction to programme development tools and implementing simple programmes
- Concepts of Object Oriented programming, structures, classes and objects

Recommended books:

1. Jain, V.K.; *Fundamentals of computer Programming and Information Technology*; S.K Kataria & Sons
2. Peter, Norton; *Introduction to Computers*; Tata McGraw Hill.

IEM 301 OPERATIONS MANAGEMENT

Internal Marks	: 60	L	T	P
External Marks	: 40	3	1	0
Total Marks	: 100			

UNIT 1 : Introduction to operations management

- System's concepts: Elements of system – Classification of systems –Organizations as systems
- Definition, objectives, functions and scope of operations management
- Industrial management – relationship of operations management with the areas of industrial management
- Types of productive systems and their characteristic features – Continuous and intermittent systems
- Decision making in production systems: Scientific process – Characteristics of decisions – Framework for decision making
- Challenges and priorities in operations management

UNIT 2 : Location analysis

- Globalization of operations: Regulatory issues – Factor advantages – Expanding markets in developing countries
- Location decision process and location decision variables: Steps involved in location decision process – Factors affecting location decision
- Influence of decision: Goods vs. Services
- Facilities location models: Location factor rating – Centre of gravity method etc.
- Other issues in location planning: Transportation infrastructure – Supply chain management practice

UNIT 3 : Facilities layout

- Implication of layout planning: Volume-variety – Flow relationship
- Types of layouts: Process layout – Product layout – Group technology layout – Fixed position layout
- Layout design for services: Office layouts – Proximity and privacy –Types of office layouts
- Performance measures for layout design: Performance metrics for measuring layout effectiveness
- Systematic layout planning (SLP) – Steps in SLP
- Computer packages for layout design: Construction method – Modelling techniques – Improvement method

UNIT 4 : Material handling

- Introduction to material handling: Concept of material movement and material handling – Scope – Characteristics – Objectives – Principles of material handling and cost reduction
- Assessment of movement by various charting techniques: tools and methods for systematic recording and assessment of movements –Charts – Diagrams
- Selection of material handling system and equipment: Classification of material handling systems (Fixed path, Flexible path, Auxiliary)
- Production storage and methods of storage: Closed storage system – Open storage system – Types of Stores – Identification systems for materials – Storage equipment
- Computers in layout design and material handling : Automated storage and retrieval systems – Automated material handling equipment

UNIT 5 : Forecasting & aggregate planning

- Requirement of forecasting in organisations
- Forecasting time horizons: Short, Medium and Long term horizons
- Models of forecasting: Extrapolative models – Causal models
- Using the forecasting system: Designing forecasting logic and model – control mechanism
- Aggregate production planning (APP): Alternatives for managing demand and supply – Basic strategies for APP – APP methods

UNIT 6 : Capacity planning

- Measures and time horizons of capacity planning
- Capacity planning framework: Estimating total requirement – Estimating labour and machine requirements – Computing capacity availability – Comparison of capacity availability and capacity requirement – Process mapping and capacity analysis
- Alternatives for capacity augmentation: Waste elimination – Multi skilling – Subcontracting
- Decision tree for capacity planning: Terminology and use of decision tree
- Capacity issues in a service industry: Variability of demand and no inventory

UNIT 7 : Resource planning

- Master Production Scheduling (MPS) and developing an MPS
- Material requirement planning (MRP): MRP planning framework – Using the MRP systems
- Manufacturing resource planning (MRP-II): MRP Logic – Closed loop MRP
- Enterprise resource planning (ERP): Modules of ERP
- Resource planning in services: Nature of resource planning in services

UNIT 8 : Production control

- Objectives of production control : Desirable data for production control system – Basic procedures of control systems
- Functions of production control : Routing – Scheduling – Despatching – Reporting & status control – Corrective activities
- Need and basis of scheduling: Inputs for scheduling
- Scheduling rules: First come first serve (FCFS) – Earliest Due Date (EDD) – Critical Ratio (CR) etc.
- Scheduling for flow shops: Johnson's rule – Gantt chart for schedule
- Modern developments in manufacturing systems : JIT, FMS, CIM, CAM and WCM

Recommended books:

1. B. Mahadevan: *Operations management: Theory and Practice*, Pearson Education
2. Buffa, Elwood. S and Sarin, Rakesh K.; *Modern Production and Operations Management*, 8th Edition, Wiley, India
3. Agarwal, G.K.; *Plant Layout and Material handling*; Jain Brothers New Delhi.

Reference books:

1. Krajewski, Lee J. and Ritzman, Larry. P.; *Operations Management – Strategy and Analysis*; 5th Edition; Addison – Wesley Longman (Singapore).
2. Monks, G. Joseph; *Operations Management*; McGraw-Hill, Inc., Singapore.

IEM 302 MARKETING MANAGEMENT

Internal Marks	: 60	L	T	P
External Marks	: 40	3	1	0
Total Marks	: 100			

UNIT 1 : Introduction to marketing: Identifying customer

- Introduction to marketing: Marketing management concepts – Marketing vs. Selling – Market – Marketing mix
- Quality and competitive advantage: What is competitive advantage? – Impact of quality on competitive advantage
- Identifying customers: Who is a customer – Types of customers – Suppliers as customers, Types of Goods
- Vital few customers: Estimation of Customer profitability
- Concepts of Marketing: Product – Production – Consumer – Societal

UNIT 2 : Understanding customer needs

- Concept of needs, wants and demands
- Categorisation of customer needs: Stated and real needs – Perceived needs – Cultural needs etc.
- Sources of needs: Available product/service is inadequate – Relief from routine tasks – Changes in customer habits/ tastes
- Translating needs into product/service specifications

UNIT 3 : Connecting with customer

- Segmentation and Targeting : Demerits of mass marketing – Bases of segmenting consumer markets & business markets – Evaluating and selecting target markets
- Consumer behaviour: Factors influencing consumer buying behaviour – Steps involved in buying process
- Building a strong brand: Creating brand equity – Methods of brand positioning

UNIT 4 : Customer satisfaction and loyalty

- Customer value and satisfaction: Evolution of customer satisfaction
- Customer care and Customer delight : Importance of customer care – Methods of delighting customer
- Kano's model of customer satisfaction: Basic, Performance and Excitement features – Uses of Kano Model
- Customer loyalty and retention: Significance of customer loyalty –Market share vs. Customer share – Life-time value of a customer
- Customer feedback management: Understanding voice of the customer – Translating voice of the customer into measurable yardsticks
- Handling customer complaints: Complaint redressal mechanism

UNIT 5 : Marketing research and market environment

- Introduction to marketing research: What is Marketing Research? –Need of marketing research
- Market research process: Steps involved in marketing research process
- Types of marketing research: Qualitative and quantitative market research
- Tools and techniques of marketing research: Tools for Primary research and Secondary research
- Business micro environment: Suppliers – Intermediaries – Customers – Competitors – Society
- Business macro environment: Demographics – Economic – Technological – Political

UNIT 6 : New product development & pricing

- New product development process: Idea generation – Idea screening – Concept development and testing – Business analysis – Market testing and commercialization
- Product life cycle strategies: Strategies at various stage of PLC
- Pricing: Setting the price – Pricing objectives – General pricing approaches (discounts, discriminatory pricing) – Adapting the price – Initiating and responding to price changes

UNIT 7 : Delivering value

- Nature and importance of marketing channels: Role of marketing channels – Channel levels
- Channel design and management decisions: Selection – Training – Motivation and evaluation of channel members
- Retailing: Types of retailers
- Private labels: House brands – Private label threat
- Wholesaling: Growth and types of wholesaling

UNIT 8 : Communicating value

- Role of marketing communication: communication process models
- Mass communication: Advertising – Sales promotion – Public relations – Personal communication
- Managing personal communication: Benefits of Direct marketing – Catalogue marketing – Telemarketing,
- Designing and managing sales force: Sales force objectives and strategies – Sales force structure – Evaluation of sales representative

Recommended books:

1. Kotler, Philip and Keller, Kevin Lane (12th Edition, 2006); *Marketing Management*; Prentice-Hall of India, New Delhi
2. Juran, J. M. and Gryna, F. M.; *Quality Planning and Analysis for Enterprise Quality*; Fifth Edition; Tata McGraw Hill.

Reference books:

1. Allen, Derek R. (2005); *Customer Satisfaction Research Management*; American Society for Quality
2. Thompson, Harvey (2004); *Who Stole My Customer?*; Pearson Education Inc.

IEM 303 MEASUREMENTS AND METROLOGY

Internal Marks	: 60	L	T	P
External Marks	: 40	3	1	0
Total Marks	: 100			

UNIT 1 : Basic concepts of measuring instruments & metrology

- The measurement process: Introduction – Historical background – Fundamental methods – Significance
- Metrology: Objectives – Classification – Terminology
- Basic elements of a measurement system
- Key features of a measuring instrument: Least count – Accuracy – Precision – Resolution – Sensitivity – Zero error – Magnification & its types
- Accuracy of measurements: Bias/systematic errors – Random/ Precision errors – Combined effect of errors
- Selection of instruments
- Principles of high precision measurement

UNIT 2 : Dimensional measuring instruments

- Dimensional measurements: Classification by resolution
- Line graduated rules, tapes and bars: Steel rules and tapes – Inspection bars
- Vernier Caliper: Working principles – Reading-precautions and errors – Digital vernier – Care of verniers – Vernier depth gauge – Vernier & digital height gauge
- Micrometer: Working principles and reading – Precautions – Care – Test of micrometers – types
- Gauges: Master and limit gauges – Gauge design – Advantages – Types
- Slip gauges: Introduction – Grades – Wringing – Sets of slip gauges
- Comparators: Types (Mechanical, Electrical, Optical & Pneumatic) – Advantages

UNIT 3 : Geometrical measurements

- Inspection accessories: Surface plate – Angle plate – Straight Edge – Engineer parallel – V blocks – Bench centre
- Angular, taper and level measurement: Bevel protractors – Sine bar – Spirit level – Clinometer
- Taper, straightness and leveling: Taper gauges – Sine tables – Spirit levels
- Straightness, flatness, Squareness, and parallelism: Definition – Methods of measurements – Instruments used – Types of parallelism – Squareness of machine tools table
- Roundness and circularity: Types of irregularities – Devices used – Polar graph
- True rotation and alignment: Machine tool testing – Lathe and drill machines
- Measurement of threads : Introduction – Classification of threads – Elements of threads – Three and two wire methods – Screw thread gauge
- Coordinating measuring machine (CMM): Types – Main components – Uses – Special features

UNIT 4 : Material testing and measurement of surface finish

- Optical measurement: Principle – Advantages – Devices (Microscope, Telescope, Autocollimator)
- Testing of material: Tensile testing – Stress & strain testing – Chemical composition testing – Laboratory equipment
- Hardness testing of metals and plastics: Principles – Scales – Types of equipments
- Measurement of surface finish: Introduction – Surface roughness – Methods – Direction of lay – Texture
- Roughness testers : Types – Comparisons

UNIT 5 : Measurement of mechanical parameters

- Measurement of motion : Displacement – Velocity & acceleration – Vibration
- Measurement of force and weight: Basic approach – Load cells
- Measurement of mechanical power: Basic concept – Dynamometer – Measurement of torque
- Measurement of pressure: Bourdon tube gauge – Manometers – Diaphragm gauge – Piezoelectric gauges
- Measurement of air and fluid flow: Meters – Positive displacement – Venturi – Orifice – Variable area – Propeller –Magnetic flow – Pressure probe – Flow visualization
- Measurement of liquid level: Direct and indirect method –Ultrasonic measurement
- Measurement of temperature: Classification of measuring instruments – Types of Instruments

UNIT 6 : Measuring Instruments: Electrical & Electronic

- Elements of electrical/electronic measurement system: Electrical instruments – Electronics instruments
- Sensors: Types of sensors – Types of transducers – Choice of transducers
- Instruments for measuring electrical parameters: Measurement of dc & ac current & voltage – Measurement of resistance – Types of multimeters
- Instruments for measuring basic process parameters: Measurement of Torque – Film thickness – Air/smoke density – Humidity – pH value – Light absorption/transmission
- Global positioning system (GPS)
- Impact of microelectronics and automation: Automatic test equipments (ATE) – Virtual instruments

UNIT 7 : Limits, fits, tolerances and gauging

- Definition of tolerances – Concept of interchangeability
- Terms and definitions: Shaft – Hole – Size – Limit – Deviation – Size tolerance – Clearance – Interference
- Fit: Clearance fit – Interference fit – Transition fit
- Grading in international standards: Finer grades add to costs
- ISO system of fits & tolerances: Hole based system – Shaft based systems
- Taylor's Principle
- Engineering tolerances: International standards – Tolerance grades – Tolerance tables – Tolerance zones – Using of tables
- Spatial tolerances

UNIT 8 : Management & calibration of measuring instruments, and Legal metrology

- Purchase, receipt and issue of instruments
- Monitoring and servicing of instruments: Preventive – Breakdown – Service record
- Calibration: Methodology – Needs – System requirement
- Types of calibration laboratories: In house – Third party – Mobile – Fully automated
- Inter-laboratory comparison (ILC)
- Traceability: International mutual recognition – Role of BIPM
- Legal metrology: International organisation of legal metrology (OIML)

Recommended books:

1. Beckwith, Thomas G., Marangoni, R.D., and Lienhard, John H.; *Mechanical Measurements*, 5th Edition; Pearson Publications.
2. John P. Bentley; *Principles of Measurement Systems*; Pearson Publishing House.
3. Helfrick D. Albert and Cooper D. William; *Modern Electronic Instrumentation and Measurement Techniques*; Prentice-Hall of India Pvt. Ltd.
4. Jain R.K.; *Engineering Metrology*, 9th Edition; Khanna Publication
5. R.K. Rajput; *Mechanical Measurements and Instrumentation*

IEM 304 QUALITY IMPROVEMENT TOOLS

Internal Marks : 60
External Marks : 40
Total Marks : 100

L	T	P
3	1	0

UNIT 1 : Analytical and creative thinking

- Creativity vs. innovation
- Relevance of creativity to quality improvement
- Creative thinking
- Basic principles in creative thinking: Attention – Escape – Movement
- Process of directed creativity
- Searching for relationships
- Six thinking hats – Edward de Bono

UNIT 2 : Problem solving

- Elements of effective problem solving – Problem statement
- Project-by-project approach: Identify project – Organize project team
- Charter and mission statement
- Problem solving steps: Problem definition – Diagnostic journey – Remedial journey – Holding the gains
- Quality improvement tools application

UNIT 3 : Flow diagram

- Use of flow diagrams in problem solving
- Standard symbols
- High level flow diagrams
- Interpreting flow diagrams : Potential pitfalls
- When to use flow diagrams
- Guidelines for constructing a flow diagram

UNIT 4 : Brainstorming and Cause & Effect diagram

- Brainstorming – Empathy – Analogy – Fantasy
- Elements of creativity – Technique of brainstorming – Potential pitfalls
- When to use brainstorming?
- How to brainstorm?
- Cause & effect diagram: Concept – How to interpret – When to use – How to construct
- 5Ws & 1H Technique

UNIT 5 : Data collection, Graphs & Charts

- Concept: Type of data – Attribute data, Variable data
- Planning for data collection
- Data collection forms: Check sheet – Data sheet – Checklist
- Interpretation of collected data: Validating results – Pitfalls
- How to collect data
- Rounding – Representativeness – Missing or erroneous data
- Graphs & charts: Concept – How to interpret – When to use – How to construct

UNIT 6 : Stratification & Scatter diagram

- Stratification: Concept – How to interpret – When to stratify – How to stratify
- Scatter diagram: Concept – How to interpret – When to use – How to construct

UNIT 7 : Histogram and Box plot

- Histogram: Concept – How to interpret – When to use – How to construct
- Box plot: Concept – How to interpret – When to use – How to construct

UNIT 8 : Pareto diagram

- Concept
- How to interpret
- When to use
- How to construct

Recommended books:

1. Juran, J.M.; Godfrey, Blanton A; *Juran's Quality Handbook* (5th Edition); McGraw-Hill (Appendix V : Quality Improvement Tools).
2. Plsek, E. Paul; *Creativity Innovation and Quality*; Prentice-Hall of India Pvt. Ltd., New Delhi.
3. Harrington, H.J (Dr.); *Business Process Improvement*; Tata McGraw-Hill, New Delhi. (*Chapter 4 : Flow charting, drawing a flow picture*).
4. Tague, Nancy R; *The Quality Toolbox*, Second Edition; Pearson Education (Published by arrangement with American Society for Quality).
5. Ramasamy, Subburaj,; *Total Quality Management*, Tata McGraw-Hill. (Chapter 11: The Seven Quality Control Tools and Introduction to Statistics).

IEM 305 METROLOGY LABORATORY

Internal Marks : 35
External Marks : 15
Total Marks : 50

L	T	P
0	0	2

1. Mechanical measurements (Dimensional)

- Measurement using micrometer & vernier
- Measurement of diameters of hole and shaft using air gauge
- Use of spirit level, water level, plumb and try square.
- Inspection of surface plate with straight edge and dial indicator
- Measurement of thread by three and two wire method

2. Geometrical & optical measurements

- Measurements of angle using sine center/sine bar/bevel protractor
- Measurements using optical projector or toolmaker microscope/pocket comparator
- Measurement of flatness using optical flat

3. Electrical measurements

- Measurements of resistance using a Megger
- Measurements of voltage/current/resistance using digital multimeter
- Measurements of voltage/current/resistance using analog multimeter
- Use of Clamp-on meter.

4. Calibration of measuring Instruments

- Calibration of micrometer & vernier
- Calibration of pressure gauge
- Calibration of thermometer

IEM 401 WORK STUDY & ERGONOMICS

Internal Marks	: 60	L	T	P
External Marks	: 40	3	1	0
Total Marks	: 100			

UNIT 1 : Productivity

- Introduction: Definition – Importance of productivity – Comprehensive approach to productivity – Efficiency & effectiveness
- Measurement of productivity: Objectives – Need – Productivity measures of input resources – Productivity standards – Productivity index
- Productivity improvement: Improving productivity of input resources, namely, Land & Building, Materials, Machines & technology, Men
- Productivity & Quality: Impact of productivity improvement – Factors affecting productivity – Internal factors – External factors
- Improving productivity by reducing work content: Reducing excess work content – Reducing ineffective time

UNIT 2 : Work study

- Introduction & history: Definition – Objectives
- Work-study as a direct means of improving productivity: Importance – Basic procedure
- Factors influencing work study:
 - Human factors: Work study and management – Work study and supervisor – Work study and worker
 - External factors
 - Other important factors

UNIT 3 : Method study

- Introduction and history: Definition – Objectives – Scope
- Basic steps of method study: Select – Record – Examine – Develop – Define – Install – Maintain – Work method design
- Principles of motion economy: Rules concerning human body – Equipment design and workplace layout – Application of motion economy principles in workplace design

UNIT 4 : Recording techniques: Charts & Diagrams

- Use of various charts & diagrams (shop operations): Operation process chart and diagram – Flow process chart and diagram – Multiple activity chart – Travel chart – String diagram
- Use of various charts & diagrams (workplace operations): Left-hand right-hand chart – Simo chart – Therbligs – Micro motion study – Memo motion study – Other recording techniques – Cyclograph – Chronocyclograph

UNIT 5 : Work measurement

- Introduction: Important terms – Objective – Application & use
- Work measurement techniques
- Stop-watch time study: Definition – Equipment – Selection of job – Worker – Time study sheet – Procedure – Rating – Approach – Methods – Training – Types of allowances – Calculating standard time
- Work Sampling: Application – Procedures – Design of sampling plans – Group timing technique (GTT)
- Predetermined Time Systems (PTS): Types – Uses
- Application of work measurement: Line balancing – Costing – Incentives (Objectives of an incentive plan, Various types of incentive plans, Latest trends)
- Learning curve and learning curve effect

UNIT 6 : Introduction to ergonomics

- Introduction: Brief history – Definition – Focus – Objectives – Basic principles
- Areas of application: Man-machine Interface – Designing consumer goods & services – Factors affecting design
- Man Machine Systems
 - Human information processing
 - Types of Man-Machine Systems: Closed loop – Open loop – Manual – Semi-automatic – Automatic
- Anatomy, posture and body mechanics: Types of posture – Types of body movement – Anthropometric principles in workspace and equipment design
- Modern ergonomics and future directions

UNIT 7 : Human Anthropometrics and System Design

- Introduction: Classification – Principles – Anthropometric measurements
- Work capacity, stress and fatigue: Sources of occupational stress
- Workplace design: User centered design – Design for seated and standing workers – Design for repetitive tasks – Design for manual handling tasks – Design of displays and controls
- Product design considerations: Shape – Visual appearance – Colour – Feel

UNIT 8 : Design of physical environment

- Temperature (Heat & cold): Human adaptability – Human heat balance – Factors affecting heat exchange – Heat & Cold stresses and their effect on performance – Reducing stresses – Ventilation & humidity
- Light and illumination: Light sources – Effect of lighting on performance – Guidelines for choosing lighting – Characteristics of good lighting
- Sound and noise: Characteristics of noises – Noise and hearing loss – Other effects of noise on performance – Noise control
- Vibration: Health effects of vibrations – Influencing factors – Physical factors – Biodynamic factors and individual factors – Measuring vibrations – Controlling exposure to vibrations
- Human senses and displays: Senses of light – Hearing – Touch – Taste and smell

Recommended books:

1. International Labour Office, Geneva; *Introduction to Work Study*; First Indian edition Reprinted 2005; Oxford & IBH publishing company, New Delhi.
2. Barnes, Ralph M.; *Motion and Time Study: Design and Measurement of Work*; 7th Edition; John Wiley & Sons
3. Bridger, R.S.; *Introduction to Ergonomics*; McGraw-Hill International editions, New York.
4. McCormick, E.J. and Sanders, M.S.; *Human Factors in Engineering and Design*; 6th Edition; McGraw-Hill Book Company, New York.

Reference book:

1. Zandin, K.B.; *Maynard's Industrial Engineering Handbook*; 5th Edition; McGraw-Hill.

IEM 402 MANAGERIAL ACCOUNTING & INDUSTRIAL ECONOMICS

Internal Marks	: 60	L	T	P
External Marks	: 40	3	1	0
Total Marks	: 100			

UNIT 1 : Financial accounting concepts

- Financial accounting – Definition, scope & standards
- Basic financial accounting concepts: Double entry system – Basic terms used in accounting – Types of accounts – Debit & Credit concept
- Accounting cycle: Transaction – Journal – Ledger – Trial balance
- Financial statements: Trading Account – Profit & Loss account – Balance sheet
- Working capital funds: Fixed assets – Current assets

UNIT 2 : Basic economic concepts

- Fundamental concepts of microeconomics
- Fundamental concepts of macroeconomics
- National income concepts: Gross Domestic Products (GDP), Gross National Product (GNP) – Savings and capital formation – Balance of payments and related concepts
- Economic analysis and managerial decisions

UNIT 3 : Demand and supply

- Meaning and types of demand – Demand function
- Law of demand: Demand schedule – Market demand – Substitution effect
- Elasticity of demand: Price elasticity of demand – Income elasticity of demand – Cross elasticity of demand
- Marginal utility analysis: Cardinal measurement of utility – Law of diminishing marginal utility – Consumer equilibrium
- Law of supply: Supply function – Supply schedule
- Elasticity of supply: Types of elasticity of demand

UNIT 4 : Cost and management accounting

- Cost and management accounting – Definition & scope
- Cost terminology: Cost – Cost object – Cost centre – Cost unit – Elements of cost – Costing system
- Management uses of costing
- Classification of costs: Direct/Indirect – Fixed/Variable/Mixed – Capital/Revenue
- Methods of costing: Job costing – Process costing
- Techniques of costing: Absorption – Marginal – Standard – Differential
- Specific cost systems
- Cost-volume-profit (CVP) analysis – Break even analysis
- Depreciation and replacement analysis: Techniques of depreciation and replacement analysis

UNIT 5 : Price and output determination

- Market structure and economics of price determination: What is market? – Classification of market – Mechanism of price determination – Shifts in demand and supply – Role of time element
- Perfect competition, monopoly and oligopoly: Price and output determination under perfect competition – Price and output determination under perfect monopoly – Price and output determination under perfect oligopoly

- Interdependence, collusion and price leadership: Price leadership models, – Cartelization and formal collusion
- Basic price, product line pricing and discounting: Pricing practices – Cost plus pricing – Penetration pricing – Price skimming
- Transfer pricing: Concept of transfer pricing

UNIT 6 : Investment analysis

- Elements of investment decision: Concept of capital budget – Purpose of capital budgeting – Basic quantities to be estimated
- Stages in capital budgeting
- Capital budgeting methods
 - Non discounted cash flow methods: Payback period method – Average rate of return method
 - Discounted cash flow methods: Net present value (NPV) method – Internal rate of return (IRR) method
- Steps for increasing capital productivity

UNIT 7 : Cost analysis

- Conventional approach – Analysing costs as percentage of sales
- Costs as percentage of gross contribution: Advantages of analysing costs as percentage of G.C – Comparison of British & Japanese industry
- Balance sheet analysis of some companies: Analysis of input material costs, Analysis of operating costs, Analysis of finance related costs,
- Two ways to improve performance: Reduction of wastes – Increase gross contribution
- Illustrations

UNIT 8 : Government and business

- Need for government's intervention in the market: Impossibility of perfect competition – Externalities – Public goods – Other goals
- Price controls, support prices and administered prices: Effective price controls – Meaning and rationale of administered prices – Principles and techniques of administered prices – Policy approaches in administered prices
- Prevention and control of monopoly and restrictive trade practices: Types of monopoly – Objectives of monopoly – Regulation of monopoly
- Protection of consumer interests: Need for consumer protection – Grievances of consumers – Consumer protection in India – Consumer Protection Act
- Economic liberalization policies
- Planning as a guide to overall business development

Recommended books:

1. Dhingra, I.C.; *Business Economics*; S Chand & Sons
2. Dewett, K.K.; *Modern Economic Theory*; S Chand & Sons
3. Mithani, D.M.; *Managerial Economics*; Himalaya Publishing House
4. Ahuja, H.L.; *Macro Economics-Theory*; S Chand & Sons

IEM 403 STATISTICAL QUALITY CONTROL

Internal Marks	: 60	L	T	P
External Marks	: 40	3	1	0
Total Marks	: 100			

UNIT 1 : Introduction to SQC

- History of quality control: Definition of quality control – Objectives of Quality Control – Misconceptions about Quality Control – Japanese contribution in evolution of quality control
- Planning for quality control – Feedback control loop
- Self-control and self-inspection by operators
- Inspection, testing and measurement: Objectives of inspection – Need for inspection and testing – Inspection by variable – Inspection by attribute – In-situ inspection – Centralised inspection – Categories of inspection by size of sample
- Planning of inspection: Decide characteristics to be inspected – Inspection and test equipment – Other requirements for Quality Planning
- Classification of defects on basis of seriousness: Critical – Major –Minor
- Automated inspection: Automation of inspection –Automatic Vs visual inspection
- Product audit: Definition – Stages of evaluation – Scope of audit – Audit plans

Unit 2 : Acceptance sampling – 1

- Introduction: Definition of sampling – Advantages and disadvantages of sampling – Sampling and process control
- Sampling risks and indices: Producer's risk – AQL – Consumer's risk – LQL
- Operating Characteristic Curve (OCC): Ideal OCC – Construction of OCC – Effect of lot size, sample size and acceptance number
- Average Outgoing Quality Limit (AOQL): AOQ graph – Calculation of AOQL
- Types of sampling plans: Attribute – Variable – Single sampling – Double sampling – Multiple sampling – Sequential sampling – Skip lot sampling

UNIT 3 : Acceptance sampling – 2

- Implementing an acceptance sampling procedure: Assumptions – Selection of samples – Choosing between attribute and variable plans
- Procedure for inspection by attributes: Symbols & abbreviations – Terms & definitions – Normal, tightened, reduced inspection – Switching scores – Initial preparation – Steps for inspection by attributes
- Procedure for sampling inspection by variables: Lot formation – Variability known plans – Variability unknown plans

Unit 4 : Other sampling procedures and acceptance control

- Introduction
- Dodge-Romig sampling procedure: Plans based on LQL – Plans based on AOQL – Single sampling Lot Tolerance Tables (SL) – Single sampling AOQL Tables (SA)
- Sampling procedure for continuous production: Continuous sampling inspection – Continuous sampling plans – Procedure for continuous sampling – Automation of inspection in continuous production
- Chain Sampling Plan (Ch SP): Application of Ch SP– Probability of lot acceptance
- Bulk sampling: Objectives of bulk sampling – Models and their use
- Value of sampling inspection
- Moving from acceptance sampling to acceptance control: Acceptance techniques – Control techniques

UNIT 5 : Variability

- Concept of variability
- Distribution of measured data: Central tendency– Dispersion & shape – Accuracy – Precision – Use of normal probability distribution
- Sources of variability: Machine – Material – Operator – Environment – Methods – Common cause – Assignable cause
- The loss function: Traditional loss function – Taguchi quadratic loss function

UNIT 6 : Process capability

- Purpose of process capability analysis – Application of process capability study – Selecting quality characteristics for analysis – Procedure for study – Action resulting from a process capability study – Stages in process capability studies
- Specification limits and control limits: Definition – Specifications vs process capability
- Measuring process performance: Process Capability – Process performance indices – C_p , C_{pk} , P_p , P_{pk} , Taguchi capability index C_{pm}
- Estimating process yields: Defect per million opportunity – First time yield – Rolled throughput yield – Defects per unit (DPU) and yield

UNIT 7 : Statistical Process Control - 1

- Introduction: Definition – Importance – Objectives – Advantages
- SPC using control charts: Introduction – Significance – Application – When to use control chart – Control charts and quality improvement
- Steps in setting up a control chart: Choosing the characteristic to be charted – Choosing type of control chart – Deciding centre-line and basis of limits – Choosing rational sub-group – Providing a system for data collection – Providing a system for measurement – Drawing chart – Interpreting chart

UNIT 8 : Statistical Process Control - 2

- Introduction to control charts – Benefits of control charts
- Control charts for variables
 - Average and Range chart – Average and standard deviation charts – Multivariate control charts
 - Data collection – Scale for control charts – Calculation of Grand average and Control limits
 - Plotting – Grand average and Control limits – Interpreting control charts
- Control charts for attributes
 - p chart – np chart – c chart – u chart
 - Data collection – Calculation of process average – Control limits
 - Plotting of process average and control limits – Interpreting control charts
- Measurement System Analysis (Gage R&R): Part-to-part variation – Equipment variation – Appraisal variation – Total variation

Recommended books:

1. Grant, Eugene. L and Leavenworth, Richard. S.; *Statistical Quality Control*, 7th Edition (1996), McGraw Hills International.
2. Ishikawa, Kaoru (Dr.); *Introduction to Quality Control*, 1st Edition; Productivity Press India Pvt. Ltd, Chennai.
3. Frank, M. Gryna, Richard, C.H. Chua Joseph A. Defeo; *Juran's Quality Planning and Analysis for Enterprise Quality*, 5th Edition; Tata McGraw-Hill, New Delhi.
4. Mitra, Amitava; *Fundamentals of Quality Control and Improvement*, 2nd Edition; Prentice-Hall of India Pvt. Ltd, New Delhi.

IEM 404 WORK STUDY & ERGONOMICS LAB

Internal Marks : 35
External Marks : 15
Total Marks : 50

L	T	P
0	0	2

1. Method study - 1

- Preparation of two handed charts
- Principles of motion economy

2. Method study - 2

- Work place layout design
- Working out improved method

3. Work measurement

- Conducting stop watch studies to assemble objects
- Rating experiments using playing cards distribution and walking
- Work sampling to know occupancy

4. Ergonomics

- Experiments covering controls, lights, visual displays
- Ergonomic design of workplace

IEM 405 MINOR PROJECT

Internal Marks : 70

L T P

External Marks : 30

0 0 4

Total Marks : 100

▪ **Project from own company/organization**

- **Objective:** Application of the quality improvement tools and problem solving concepts learnt
- **Methodology**
 - Project selection and approval by Project Guide
 - Periodic review and presentation
 - Submission of final report as per specified guidelines
 - Project presentation and evaluation by team of examiners

IEM 501 INDUSTRIAL AUTOMATION & ROBOTICS

Internal Marks	: 60	L	T	P
External Marks	: 40	3	0	0
Total Marks	: 100			

UNIT 1 : Introduction to automation

- Concept and scope of industrial automation – Impact of automation – Advantages & disadvantages – Automation strategies – Low cost automation – Devices, drives and control circuits in automation – Human machine interface (HMI)

UNIT 2 : Principles of pneumatic & hydraulic automation systems

- Basic laws & principles of pneumatic & hydraulic systems – Control loops – Components of pneumatic and hydraulic systems
- Pneumatic and Hydraulic circuits – Classification

UNIT 3 : Pumps, compressors & accessories

- Pumps – Compressors – Characteristics – Properties – Industrial usage and application
- Pneumatic and hydraulic actuators & valves – Construction and working of cylinders and motors – Construction and working of pneumatic and hydraulics valves – Servo valves and simple servo control systems
- Pneumatic and hydraulic accessories like filters, lubricators, air dryers, FRLs, pipelines, connectors etc

UNIT 4 : Transfer devices and feeders

- Classification – Construction details and applications of transfer devices and feeders used for job orienting and pick up operation

UNIT 5 : Electric & Electronic controls in automation

- Introduction to principles of electric & electronic control systems – Block diagram of feedback control system
- Introduction to sensors - Micro controller – Micro-processors – Programmable logic controllers (PLCs)

UNIT 6 : NC & CNC Machines

- Concepts, features, fundamentals, advantages and classification of NC systems: Input media – Design consideration of NC machine tools – Machining centre – MCU functions
- Controls and System devices: Control loops of NC system – CNC concepts – Reference pulse and sampled data techniques – Microprocessor and CNC adaptive control

UNIT 7 : Introduction to Robotics

- Fundamentals of robotics: Wrists design – End effectors – Actuators – Modular robots
- Types of robots – Definition of parameters in robotics – Robot manufacturers – Features of industrial robots – Robot cell design and control – Motion controls

UNIT 8 : Application of robots in industries

- Applications: Welding – Painting – Assembly – Pick & place – Packaging
- Product inspection: CMM
- Material handling systems: Conveyors – AGVs – AS/RS

Recommended books:

1. Groover, Mikell P.; *Automation, Production Systems and Computer-Integrated Manufacturing*; 3rd Edition; Prentice-Hall of India Pvt. Ltd.
2. Rajput, R.K.; *Robotics and Industrial Automation*; S. Chand & Sons
3. Majumdar, S.R; *Pneumatic Control*; Tata McGraw-Hill Publishing Co. Ltd.
4. Deb, S.R; *Robotics and Flexible Automation*; Tata McGraw-Hill Publishing Co. Ltd.

IEM 502 OPERATIONS RESEARCH

Internal Marks	: 60	L	T	P
External Marks	: 40	3	1	0
Total Marks	: 100			

UNIT 1 : Introduction

- History and development of Operations Research (OR)
- Introduction to quantitative modeling
- Definition of OR – Application to engineering – Managerial problems – Models of OR – Features of OR models – Limitations
- Conditional, joint and marginal probabilities – Multiplication Law – Bayes Theorem
- Overview of decision theory approach
- Types of decision making situations: Decision making under risk – Decision making under uncertainty
- Decision trees

UNIT 2 : Linear programming - 1

- Linear programming: Definition – Mathematical formulation – Standard form – Solution space – Solution feasibility – Basic feasible – Optimal – Infeasible – Multiple – Redundancy – Degeneracy – Graphical method
- Formulation of Linear programming problem – Graphical solution – Sensitivity analysis through graphical solution

UNIT 3 : Linear programming - 2

- Simplex method: Variants of simplex algorithm – Artificial basis techniques – Computational procedure in simplex – Duality – Economic interpretation of duality – Solution of LPP using duality concept – Dual simplex method
- LP model for product mix and production scheduling problems.

UNIT 4 : Transportation problem

- Formulation of transportation model: Basic feasible solution using different methods (North-West corner, Least Cost, Vogel's approximation method)
- Optimality methods – Unbalanced transportation problem – Degeneracy in transportation problems – Variants in transportation problems
- Applications of transportation problems

UNIT 5 : Assignment problem

- Definition and concept – Solution of an assignment problem for optimum solution – Hungarian method – Traveling salesman problem
- Sequencing: Job-Sequencing problems for
 - Processing N jobs on 2 Machines
 - Processing N jobs on 3 Machines
 - Processing N jobs on M Machines
 - Processing 2 jobs on M Machines (Graphic Method)

UNIT 6 : Queuing theory

- Introduction – Queuing systems and their characteristics – Queuing Problem
- M/M/I Queuing system – Steady state performance analysis of M/M/I Queuing Model
- M/M/K Queuing Model
- Traffic Intensity – Distribution of queuing systems (birth and death process)
- Queuing Models (I, II and III Model)

UNIT 7 : Deterministic inventory models

- Inventory models: Inventory decisions – Costs involved in inventory problems – Controlled and uncontrolled variables – Deterministic inventory models
- Selective approaches to different inventory control systems – Concept of average inventories – Concept of Economic Order Quantity (EOQ)
- EOQ with no shortages: Manufacturing model with no shortage – EOQ with shortage – Manufacturing model with shortages – Model with price breaks

UNIT 8 : Probabilistic inventory models and Replacement analysis

- Probabilistic inventory model: Reorder point model – Multi product model – Selective inventory control
- Replacement analysis: Reasons for replacement – Individual replacement of machinery or equipment with/without value of money – Group replacement policies

Recommended books:

1. Taha, *Operations Research: An Introduction*; 8th Edition; Prentice-Hall, 2006
2. Hira and Gupta; *Introduction to Operations Research*; Sultan Chand and Co., 2002
3. Sharma, J.K.; *Operations Research Theory and Application*; 2nd Edition; Pearson Education Pvt. Ltd.

Reference books:

1. Sharma, S.D., Kedarnath; *Operations Research*; Ramnath & Co., 1996
2. Kanthi, Swarup & Others; *Operations Research*; Sultan Chand and Sons, 1992.

IEM 503 MAINTENANCE AND PROJECT MANAGEMENT

Internal Marks	: 60	L	T	P
External Marks	: 40	3	0	0
Total Marks	: 100			

UNIT 1 : Introduction

- Concept of maintenance: Importance of maintenance management – Evolution of maintenance – Maintenance objectives
- Maintenance functions: Basic function – Managerial functions
- Types of maintenance: Breakdown maintenance – Planned maintenance
 - Types of planned maintenance: Routine – Scheduled – Preventive – Corrective – Predictive – Design out maintenance
- Maintenance management: Organization of maintenance – Interface between operations and maintenance – Maintenance controls – Indices used in maintenance control (Reliability, Maintainability and Availability)

UNIT 2 : Planning of maintenance

- Factors governing design of maintenance systems
- Documents for maintenance planning: Facility register – Equipment record sheet/card – Equipment history card – Job manuals
- Maintenance strategies: Selection of maintenance strategy – Comparison of maintenance strategies
- Types of maintenance planning: Short range – Long range – Rolling plans
- Steps in maintenance planning
- Maintenance scheduling: Types of schedules – Allocation of priorities – Techniques used

UNIT 3 : Maintenance evaluation and control

- Introduction: Establishing standards for maintenance tasks – Techniques for setting maintenance time standards
- Evaluation of maintenance: Evaluation through reports – Subjective evaluation – Objective evaluation
- Maintenance control system: Purpose – Work orders – Job cards – Control reports – Periodic maintenance summaries – Benefits of maintenance control system
- Maintenance inventory control – Maintenance cost control
- Maintenance budget and budgetary control: Types of maintenance budgets – Preparation of budget – Budgetary control

UNIT 4 : Maintenance organisation and improvement

- Typical problems in maintenance: Lack of business culture – Isolation from other departments – Lack of management skills – Low levels of planned maintenance – Emphasis on “advanced” practices neglecting “basic” ones
- Organisational framework for maintenance: Factors affecting the maintenance organization – Objectives of organization design – Organizational structures
- Training for maintenance: Planning for training – Levels of training – Methodology
- Motivation for maintenance: Incentives in maintenance – Basis of incentives
- Benchmarking in maintenance management: Advantages of benchmarking – Procedure – Cost of benchmarking
- Computers in maintenance management

UNIT 5 : Reliability centered maintenance

- Introduction to reliability centered maintenance
- Vibration Analysis: Theory of vibration – Machine vibration – Alignment – Balancing – Monitoring techniques – Shock pulse method – Vibration severity measurement
- Oil analysis: Introduction – Physical properties of oil – Analysis of metal ppm in oil – Coolant analysis
- Fatigue and friction: Introduction – Cyclic load – Shock load – Abrasion and weakening – Crack detection of materials
- Corrosion and its effects: Types of corrosion – Corrosion prevention – Corrosion failures – Aging
- Performance evaluation: Overloading – Operator abuse

UNIT 6 : Project management: Planning and scheduling

- Project management : Introduction – Definition – Importance of project management – Four constraints
- Classification of projects: Types of projects – Phases of project management
- Project initiation / conceptualization: Project identification – Objectives – Project teams
- Preparation of cost estimates: Components of cost – Project financing – Evaluation criteria
- Planning and scheduling: Common mistakes – Key points – Preparation of basic schedule – Categories of project schedule – Gantt charts
- Organization and delegation of authority
- Project implementation plan: Set priorities – Communicate across interface – Productivity check list – Conflict management

UNIT 7 : Network techniques

- Network analysis techniques : PERT and CPM – Activity based & event based
- Construction of network: Network components – Symbols – Rules – Time estimation
- Critical path method: Historical development – Forward & backward passes method – Difference between PERT and CPM
- Earliest and latest activity times – Float and Slack
- Crashing of network: Time-cost trade-offs – Incremental cost – Crashing of activities – Crashing the project

UNIT 8 : Project implementation and controls

- Project performance control: Reporting system – Process evaluation – Auditing
- Deviation and alternatives: Deviation guidelines – Project overview – Existing condition – Deviation description – Alternative description – Justification
- Project commissioning: Installed testing – Guarantee information – System check – Dry and wet running – Reliability – Traceability – Performance review
- System building (SOPs) and handing over: Statement of purpose – Policy – Operating procedures – Interactive training – Safety practices– Govt. certification and licensing – Handing over
- Computerized project management system : Software packages – Microsoft Project 2000 – Enterprise-wide project management

Recommended books:

1. Gopalakrishnan, P and Banerji, A.K.; *Maintenance and Spare Parts Management*; Prentice-Hall of India Pvt. Ltd., New Delhi.
2. Hartmann, Edward; *Maintenance Management*; 1st Indian Edition 1995; Productivity & Quality Publishing Pvt. Ltd., Madras.
3. Srivastava, Sushil Kumar; *Maintenance Engineering and Management*; Revised Edition 2006; S. Chand & Company Ltd., New Delhi.
4. Choudhury, S.; *Project Management*; 1st Edition 2004; Tata McGraw-Hill Publishing Co., New Delhi.

IEM 504 HRM & ORGANISATIONAL BEHAVIOUR

Internal Marks	: 60	L	T	P
External Marks	: 40	3	1	0
Total Marks	: 100			

UNIT 1 : Introduction to HRM and Organizational Behaviour (OB)

- Human resource management (HRM) at work: Definition – HR Challenge – Management process
- Changing environment of Human Resource Management: Work force diversity – Technological trends – Globalization
- Strategic planning and HR today: Nature of strategic planning – Building competitive advantage – Human resource as a source of competitive advantage
- Definition of organizational behaviour (OB) and historical development: Definition – Goals of OB – Challenges and opportunities
- OB in a global context: The global economy – Facing the international challenge – Behaviour across cultures

UNIT 2 : Understanding and managing individual behaviour

- Foundation of individual behaviour: Biographical characteristics – Ability – Learning – Implication for performance and satisfaction
- Values and attitudes: Importance of values – Types of values – Types of attitude – Attitude and consistency
- Perception: Defining perception and its importance – Factors influencing perception
- Personality & emotions: Personality determinants – Personality traits – Major personality attributes influencing OB
- Emotional intelligence: Defining emotions – The six universal emotions – Emotions and national culture – OB applications
- Individual decision making: The rational decision-making process – Improving creativity in decision making – Identifying problems – Ethics in decision making

UNIT 3 : Understanding and managing group behaviour

- Defining & classifying groups: Formal group – Informal group – Command group – Task group – Interest group
- Basic group concepts: Roles – Norms – Cohesiveness – Size – Composition – Status
- Group decision making: Individual vs. group – Group decision making techniques
- Understanding work teams: Team versus groups – Types of teams – Cross-functional teams – Creating effective teams
- Conflict and inter-group behaviour: Definition of conflict – Transitions in conflict thought – The conflict process – Intergroup relations

UNIT 4 : Recruitment and placement

- Nature of job analysis: Definition – Uses of job analysis information
- Steps in job analysis
- Methods of collecting job analysis information: Interview – Questionnaires – Observation – Quantitative job analysis techniques
- Job description and specification: Job identification – Responsibilities and duties – Specification for trained versus untrained personnel
- Recruitment and selection process: Introduction – Advertising – Employment agencies – Selection process – Basic testing concepts
- Human resource planning and forecasting: Employment planning and forecasting – Factors in forecasting personnel needs – Forecasting supply of inside candidates – Recruiting job candidates

UNIT 5 : Training and development

- Building employee commitment – Orientation and socialization
- Training needs analysis: Task analysis – Performance analysis – Setting training objectives

- Training techniques: On-the-job training – Job instruction training – Audiovisual techniques – Programmed learning
- Information technology and HR – Training via the internet
- Nature and purpose of management development: Definition – Succession planning
- Job rotation and management: Coaching – Action learning – Advantage
- Performance management & appraisal: Appraisal process – Appraisal methods – Problems and solutions – Role of appraisals in managing performance
- Using HR to build a responsive learning organization: HR and systematic problem solving – Learning from experience – Transferring knowledge

UNIT 6 : Compensation and retention

- Basic aspects of compensation: Compensation at work – Legal considerations in compensation
- Pricing managerial and professional jobs: Basic compensation elements – Compensating professional employees
- Current trends and issues in compensation: Skill-based pay – Broad banding Comparable worth – Pay secrecy – Inflation and salary compression
- Financial incentives: Use of financial incentives – Types of incentive plans
- Retirement benefits: Social security – Pension plans – Other retirement benefits
- Employee service benefits: Job-related service benefits – Executive perquisites – Law for working women
- Retention of employees: Definition – Strategy – Benefits

UNIT 7 : Labour relations & legislation

- The labour movement, unions and the law: Introduction – Why do workers organize – Background – Labour law today
- Guaranteed fair treatment and employee discipline: GFTP at work – Fairness in disciplining – Discipline guidelines – Discipline without punishment
- Managing dismissals: Definition – Grounds for dismissal – Dismissal procedure
- Salient provisions under Indian Factories Act: Labour issues – Factory Act 1948
- Industrial Disputes Act: Objective – Applicability
- Employees State Insurance Act: Definition – Commencement and application
- Workmen's Compensation Act: Definition – Employer's liability for compensation
- Payment of Bonus Act: Applicability – Eligibility – Benefits

UNIT 8 : Global HRM & Organizational development (OD)

- Nature of global HRM: Strategic overview – HR and the international business – HR challenges of international business
- Multinational and global corporations: Market imperfections – International power – Criticisms of multinationals
- The expatriate manager in multinational corporations: Introduction – Selecting the expatriate manager – Training
- OD values and outcomes: Respect for people – Trust and support – Power equalization – Confrontation
- Implementation issues in OD and difference in organizational cultures: Improved organizational effectiveness – Greater commitment and involvement – Increased personal and organizational awareness

Recommended books:

1. Stephen, P. Robbins; *Organizational behavior*; 7th Edition; Prentice-Hall of India, New Delhi
2. Gary, Dessler; *Human Resource Management*; Pearson Education
3. Cynthia, D. Fisher, Schoenfeldt & Shaw; *Human Resource Management*; 5th Edition; Biztantra, New Delhi.

IEM 505 COMPUTER AIDED DESIGN (CAD)

Internal Marks	: 50	L	T	P
External Marks	: 25	0	0	3
Total Marks	: 75			

1) CADD exercises using 2D CAD software

- Drawing limits, Cartesian & polar co-ordinate system.
- Point, line, construction line, polygon, rectangle, curve, circle, spline, eclipse, eclipse curve, polyline
- Dimensioning & tolerance: Quick dimensioning, linear, aligned, radial, jogged, baseline, continuous – Tolerance styles – Text styles
- Precision drawing: Snap, grid, ortho, polar, osnap, otrack
- Editing & modification: Selection, delete, trim, extend, copy, mirror, offset, array, move, rotate, break, join, hatching

2) Geometric modeling practice

- Part modeling with some of the modeling techniques
- Commercial solid modeling packages & their salient features - Parametric feature (Parent-Child relationship)
- Constraints
- Understanding the modeling concept, planes, datum planes, sketch, alignment, regeneration, editing & dimensioning
- Changing 2D to 3D model, wire frame modeling, surface modeling, solid modeling
- Three dimensional graphics, curves and surfaces – Hidden surface elimination – Sweep & blends – Protrusions

3) Assembly

- Assembly techniques and guidelines
- Assembly of Screw Jack, Safety Valve, Tail Stock, Eccentric, IC Engine Parts, Plumber blocks etc.

4) Animation

- Slider crank mechanism, four bar mechanism and other simple mechanism.

IEM 601 PRODUCT PLANNING, DESIGN & DEVELOPMENT

Internal Marks	: 60	L	T	P
External Marks	: 40	3	1	0
Total Marks	: 100			

UNIT 1 : Planning for new product development

- Product design and development process – Phases of product development – Designing for basic functional requirements – Designing of complex products
- Quality planning – Planned quality problems – Quality planning by amateurs – Quality gap
- Quality planning roadmap: Establish projects – Identify customers – Discover customer needs – Develop products – Develop process – Develop process control
- Quality Function Deployment (QFD): What-how matrix relationships – House of Quality
- Screening ideas for new products

UNIT 2 : Basic design considerations

- Convenience of use
- Appearance and role of aesthetics
- Concept of standardization and simplification
- Concept of slim design
- Operational considerations: Strength – Rigidity – Stability (buckling) – Vibration – Thermal resistance
- Functional requirements: Concept of synthesis and assembly – Role of Fits, Tolerance and Process capability
- Material selection: Spectrum of material properties – Performance characteristics of materials – Cost Vs Performance relations

UNIT 3 : Design for excellence

- Introduction to design for excellence (DFX) – Application of DFX
- Design for manufacturability
- Design for assembly – Design guidelines for manual and automated assembly
- Design for serviceability/maintainability
- Design for reliability – Mean time between failure, noise factors
- Design for people and safety
- Design for environment
- Role of aesthetics in product design

UNIT 4 : Other design considerations

- Failure Mode & Effects Analysis (FMEA): Definition – Terminology – Limitations and abuses – Purpose and deliverables of FMEA – Procedure for performing FMEA – Evaluation of risk (calculating RPN) – Severity ranking – Occurrence ranking – Detection evaluation
- Benchmarking: Definition – Need – Types – Process – Pitfalls
- Establishing engineering specifications
- Optimizing specifications

UNIT 5 : Concurrent engineering & Reverse engineering

- Concurrent engineering: Contrast of sequential and concurrent engineering – Key ingredients – Role of technology – Benefits – Concurrent design in real time – Roadblocks
- Reverse engineering: Concept – legality – Methodologies – Process – Forward and reverse engineering

UNIT 6 : Product development

- Design review: Conceptual design review – Design standard check points – Interaction behaviours – Creative design review
- Minimum material wastage
- Recycleability: History – Process – Cost benefits – Common items
- Remanufacturing ability: Factors driving remanufacturing – Current remanufacturing trends and guidelines – Improving design to remanufacture
- High impact material reduction
- Energy efficiency: Design to emit less carbon and nitrogen oxides – Design to emit less noise – Integrate advanced materials – Increase fuel economy – More energy efficient product

UNIT 7 : Prototyping and robust design

- Difference between prototype and production design – Basic prototype categories
- Physical prototypes & models – Limitations
- Types of prototypes
- Rapid prototyping
- Design for robustness – Using Taguchi methods

UNIT 8 : Other important issues

- Intellectual property: Overview – Concept – Origin – IPR (Patents, Copyrights, Industrial designs, Trademarks) – Indian patent law – International patent law
- Product liability: Legal terms – Product liability claims – Negligence – Breach of warranty – Strict liability – Concept of defect
- Product development economics: Data and economics tools – Development costs – Testing costs – Unit production costs – Unit revenue
- Managing design projects: Project management approaches – Traditional approach – Critical chain project management – Extreme project management and process based management.

Recommended books:

1. Chitale, A.K. and Gupta, R.C.; *Product Design and Manufacturing*, 4th Edition, Prentice-Hall of India
2. Dieter, George; *Engineering Design*, Tata McGraw-Hill
3. Dhillon, Balbir Singh; *Engineering Design*, Tata McGraw-Hill

IEM 602 LEAN MANAGEMENT

Internal Marks	: 60	L	T	P
External Marks	: 40	3	1	0
Total Marks	: 100			

UNIT 1 : Introduction to lean management

- Historical perspective: Origin of Toyota Production System – Toyota’s engineering innovation
- Overview of lean management: Definition – Objectives – Difference between mass and lean manufacturing – Benefits of Lean
- Key concepts of lean management: Just-in-time – Jidoka
- Overview of various Lean tools & supportive strategies
- Lean system & lean tools interlink: The “TPS House” diagram
- 14 Principles of Toyota Way

UNIT 2 : Waste elimination

- Value added and Non-value added activities: Value-added activities – Non-value activities – Required non-value-added activities – Test for value added activities
- Three M’s: MUDA – MURI – MURA
- Seven wastes: Overproduction – Waiting – Transportation and conveyance – Unnecessary inventory – Over processing or incorrect processing – Unnecessary/excess movement – Product defects

UNIT 3 : Preparing enterprise for lean

- 5S: S1 Seiri – S2 Seiton – S3 Seiso – S4 Seiketsu – S4 Shitsuke – Keys to successful implementation of 5S – Benefits of 5S
- Visual Management: Use of indicators, signals and controls – Takt board
- Team building: Definition – Types of teams– Ingredients of effective teams
- Problem solving, the Toyota Way: Every problem is an improvement opportunity – Toyota’s tactics for maximizing performance

UNIT 4 : Creating Lean processes across the enterprise

- Continuous improvement cycle – Smaller and smaller batch sizes
- Creating initial process stability
- Continuous flow & pull system: Batch & queue system vs. Pull system – Creating one piece flow – Difficulties in shifting to continuous flow
- Kanban: Rules – Size – Techniques – Squares – Containers – Cards
- Establishing standard processes & procedures: Standardization as a basis for continuous improvement and Quality – Difference between standardized work and work-standards – Pre-requisites of standardized work – Standardization as an enabler
- Takt time (Pace of manufacturing): Benefits of Takt time – Limitation of Takt time
- Heijunka (Leveling work load): Leveling by volume – Leveling by product

UNIT 5 : Cellular manufacturing and value stream mapping

- Manufacturing cells: Work cell layouts – Linear work cells – U turn work cell – Benefits of cellular manufacturing
- Value stream mapping – Five steps to value stream mapping – Constructing a Value Stream Map
- Future state value map: Objective whilst mapping future state – Implementing the future state
- Difference between Value Stream Mapping and Process Mapping

UNIT 6 : Other lean techniques

- Kaizen: The Kaizen Blitz – When to use Kaizen Blitz – Benefits of Kaizen Blitz – Mini Kaizen – Key characteristics of Mini Kaizen – Sequence of events for Mini Kaizen – Benefits of Mini Kaizen
- SMED: Doing SMED – Reduction of external setup tasks – Reduction of internal setup tasks – Working together – Suppressing adjustments and trials
- Poka Yoke: Achieving zero defect through Poka yoke – Judgment inspection – Informative inspection – Source inspection – Poka yoke devices
- Cycle time reduction
- PDCA: Plan stage – Do stage – Check stage – Act stage

UNIT 7 : Total Productive Maintenance (TPM)

- Historical background: Productive maintenance – Evolution of TPM – Autonomous maintenance
- Definition of TPM – Comparison of TPM with TQM – Lean Manufacturing and JIT
- Overall equipment effectiveness and six big losses: Downtime losses – Speed losses – Defect losses
- Pillars of TPM: Autonomous maintenance (Jishu Hozen) – Focused improvement (Kaizen) – Planned maintenance – Quality Maintenance (QM) – Maintenance prevention – Education & Training – Safety, health and environment – Office TPM
- Increase in productivity with TPM: Intangibles of TPM – Broad concepts of improvement
- Implementation of TPM: Top management commitment – 5S implementation – Dedicated people – Flexible, cross-trainable workers – Preparatory stage – Introduction stage – Implementation – Institutionalizing stage
- TPM in India – Awards for TPM achievement

UNIT 8 : Applying lean philosophy across organization

- Jidoka (Stopping the line to build in quality) – Autonomation
- Building a culture of “line stop” to fix problem: Organization structure at Toyota – Andon (Line Stop Alarm Light) – Changing the culture – The problem-resolution cycle – Minimizing line stop time
- Making technology fit with people and lean processes
- Developing exceptional people & partners
- Lean implementation strategy & tactics: Process improvement approach – Value stream mapping approach – Hot projects approach – Plant wide lean tools approach – Enterprise wide lean tools approach – Applying lean to the extended enterprise
- Leading the change: Role of top management – Role of middle management – Role of bottom management – Environments for change – Time frame for Lean

Recommended books:

1. Liker, Jeffrey K. and Meier, David P. (2007); *The Toyota Way Fieldbook*; Tata McGraw-Hill
2. Liker, Jeffrey K. (2004); *The Toyota Way*; Tata McGraw-Hill.
3. Womack, James P. and Roos, Daniel T. (2003); *Lean Thinking*; Simon and Schuster, New York.

Reference books:

1. Womack, James P. and Roos, Daniel T. (2005); *Lean Solutions*; Simon and Schuster, New York.
2. Liker, Jeffrey K. (1997); *Becoming Lean: Inside Stories of U.S. Manufacturers*; Productivity Inc., Portland, U.S.

IEM 603 MANAGEMENT INFORMATION SYSTEMS

Internal Marks	: 60	L	T	P
External Marks	: 40	3	0	0
Total Marks	: 100			

UNIT 1 : Introduction to information systems

- Information as key resource: Role of information in business – Types of information – Characteristics of information
- People as key resource: People involvement – People engagement
- Information technology as key resource: Role of IT in business – IT as a productivity improvement tool
- Defining information systems: Function of information systems – Structure of a good management information system
- Role of information system in gaining competitive advantage: Information system for decision making – Organization's strategy and information system – Information system as an enabler

UNIT 2 : Classification of information systems

- Levels of information systems: Strategic – Tactical – Operational
- Major types of information systems: Transaction Processing Systems – Management Information Systems – Decision Support Systems (DSS) – Executive Support Systems (ESS)
- Functional information systems: Finance – Marketing – Manufacturing – HR
- Artificial intelligence technologies in business

UNIT 3 : Database Management

- Introduction: Database hierarchy – File management – Traditional approach – Data duplication – Data inconsistency – Lack of data integration
- Modern approach: Database management – Objectives – Advantages – Disadvantages – Database structure – Database management system (DBMS)
- Types of database structure: Hierarchical models – Network models – Relational model
- Advances in data base technology: Object oriented database – Distributed database – Client server database

UNIT 4 : Development of Management Information Systems

- Phases of system development life cycle: System development – System investigation – System analysis – System design
- System Development: Alternatives for system development (external acquisition, outsourcing, end user development, prototyping)
- System Analysis: Introduction – Requirement determination – Understanding the process – Identifying data used and information generated – Strategies for requirement determination – Structured analysis tools
- System design: Objectives – Conceptual design – Problem definition – Setting of objectives – Identifying constraints – Determining information needs – Information sources – Developing alternatives – Report generation – Output/input design – Feedback from user – Procedure design – Design documentation

UNIT 5 : Implementation & Evaluation of MIS

- Implementation process: Planning the implementation – Procedure development – User training – Creation of forms and database
- Hardware and software selection: Requirement analysis – Preparation of specification – Detailed evaluation of vendors – Installation – Post installation review
- Evaluation of MIS: Evaluation approaches – Evaluation classes
- System maintenance : Corrective maintenance – Adaptive maintenance –Preventive maintenance

UNIT 6 : Enterprise-wide information systems

- Enterprise wide information systems: Description – Operational advantages of enterprise wide information systems
- Types of enterprise wide information systems: Internally focused – Externally focused
- Integration of enterprise wide information systems

UNIT 7 : E-Commerce

- Role of telecommunications, networks and internet in organisations
- Architectural framework for E-commerce: Application services and transaction
- Models: B2C transactions – B2B transactions – Intra-organizational transactions
- Key factors to successful web-based electronic commerce

UNIT 8 : Issues in managing Information Technology

- Issues in managing information: Resources – Technologies – Globalization – Global information technology
- Managing, planning and implementing change
- Computer crime and methods of computer security: Ethical challenges in managing IT – Privacy, property and accessibility – Social challenges of information technology

Recommended books:

1. Brien. A.O.; *Management Information Systems: Managing Information Technology in the Internet Worked Enterprise*; Tata McGraw-Hill Publishing Company Ltd., 2002
2. Laaudan & Laudon; *Management Information System*; Prentice-Hall of India Pvt. Ltd., New Delhi.

IEM 604 SUPPLY CHAIN MANAGEMENT

Internal Marks	: 60	L	T	P
External Marks	: 40	3	0	0
Total Marks	: 100			

UNIT 1 : Introduction to supply chain management

- Historical perspective – Definition of Supply Chain Management (SCM)
- Flows in supply chain – Flow of Value, Information and Cash
- Customer service dimension : Eight “R” Principles
- Process view of a supply chain: Cyclic view – Push pull view
- Responsiveness and efficiency of supply chain – The responsiveness spectrum
- Supply chain macro processes in a firm: CRM – ISCM – SRM
- Supply chain drivers and metrics: Facilities – Inventory – Transportation – Information – Sourcing – Pricing
- Obstacles to achieving strategic fit – Competitive advantage through SCM

UNIT 2 : Designing the supply chain network

- Designing distribution networks: Role of distribution in supply chain – Factors influencing distribution network design – Design options for a distribution network
- e-Business and the distribution networks
- Distribution networks in practice
- Network design in supply chain: Role of network design in supply chain – Factors influencing network design decisions – Framework for network design decisions – Models for facility location and capacity allocation – Role of IT in network design – Making network design decisions in practice

UNIT 3 : Purchase and stores management

- Purchase management: Scope – Importance – Objectives – Functions
- Purchase systems & procedures: Methods of purchasing – Negotiation – Purchase price analysis
- Stores and store keeping: Types of stores – Codification and standardization – Purpose of store-keeping – Store location and layout
- Store systems and procedures: Receipt – Physical storage & location – Issue
- Stocking policies: Costs of inventory – Selective controls – ABC analysis – VED analysis – Stores accounting and stock verification – Obsolete, surplus and scrap management

Unit 4 : Planning demand and supply in a supply chain

- Demand forecasting in a supply chain
- Aggregate planning in a supply chain
- Managing predictable variability in supply & demand: Alternative for managing demand – Alternative for managing supply
- Managing economies of scale in a supply chain: Cycle inventory
- Managing uncertainty in a supply chain: Safety inventory – Service level
- Determining the optimal level of product availability: Cost and profitability – Managerial lever to improve profitability

UNIT 5 : Sourcing decisions in a supply chain

- Supplier selection and capability assessment: Evaluation criteria and steps – ISO guidelines
- Contract management: When to outsource – Outsourcing activities
- Supplier certification and quality audit: ASQ criteria – Certification practice
- Performance assessment and rating: Key areas – Visits – Key suppliers – Product & process assessment – Delivery adherence – Rating system

- Supplier communication and feedback
- Self-certification by supplier: Conformity assessment – Types of assessment
- Supplier information system
- Product Quality planning: Advanced Product Quality Planning (APQP) – Product part approval process (PPAP)

Unit 6 : Designing and planning transportation networks

- Role of transportation in supply chain
- Modes of transportation and Key performance indicators - Inbound and outbound transportation – Transportation infrastructure & policies
- Transportation network: Scheduling and routing decision – Network suitability & design options
- Trade-offs in transportation design: Choices of transport mode – Inventory aggregation – Cost & response trade-off
- Tailored transportation: Customer density – Customer size – Distance – Product demand and value
- Risk management in transportation: Types of delays and disruption – Challenges
- Transport economics: Distance – Volume – Density – Stowability – Handling – Liability – Market factors – Routing and scheduling cost
- Concept of warehousing: Location consideration – Design – Delivery frequency
- 3rd & 4th party logistics providers: Types of services – 3PL in India – 4PL

UNIT 7 : Global supply chains

- Globalization: Trends – Driving forces – Implications – Commonality and differences
- Centralization of inventories: Postponement and localization
- Global logistics challenges: Extended lead time of supply – Extended and unreliable transit times – Consolidation & break bulk – Multiple freight mode & cost option
- Import-export processes: Types of risks – Reducing risks – Fundamental processes – Incoterms
- Organizing global logistics: Structure and control – Customer service – Outsourcing and partnership – Logistics information

UNIT 8 : Modern trends and other aspects

- Sharing risks in inter-organizational relationships: Confidentiality – Research and development – Increased service expectation
- Environment friendly supply chain practices
- Benchmarking and performance measurement in supply chain
- Outsourcing and partnerships: Role of sourcing-related process – Sourcing planning and decision – 3rd parties supplier-risk management
- Supply chain and e-commerce: Pricing and revenue – Role of IT and revenue management
- Supply chain for lean manufacture: Reduce the supply base – Develop strategic long term partners – Manage supplies with commodity teams

Recommended books:

1. Chopra, Sunil; Meindl, Peter and Kalra, D. V.; *Supply Chain Management*, 5th Impression, 2009; Pearson Education (Singapore) Pvt. Ltd., Delhi.
2. Handfield, Robert B. and Nichols, Ernest L. Jr.; *Introduction to Supply Chain Management*; Pearson Education.
3. Christopher, Martin; *Logistics and Supply Chain Management*, 2nd Edition; Pearson Education.
4. Arnold, J. R. Tony and Chapman, Stephen N.; *Introduction to Materials Management*, 5th Edition; Pearson Education.
5. Gopalakrishnan, P.; *Handbook of Materials Management*; Reprint 2006; Prentice-Hall of India Pvt. Ltd., New Delhi.

IEM 605 INDUSTRIAL SAFETY, HEALTH & ENVIRONMENT

Internal Marks	: 60	L	T	P
External Marks	: 40	3	0	0
Total Marks	: 100			

UNIT 1 : Introduction

- Growing concern for safety and health – Safety terminology
- Health and safety regulations: International and National scenario – National policy – Product and system liability
- Safety cost and losses – Cost of accidents and hidden costs
- Growing awakening and concern for environment: Environment protection Act 1986 (amended 1991) – Global warming
- Principles of total safety and environment management: Goal, synergy and differences between safety and environment
- Synergy of quality with safety, health and environment

UNIT 2 : Safety

- Safety and health hazards – Types of hazards
- Measuring performance of safety and health systems – Indices, and their computation
- Safety hazards: Safety in construction – Machine guards & machine tools safety – Safety in material handling – Flammable, Reactive and Explosive chemicals
- Safety against physical injury: Safety standards
- Training for safety and health
- Accident investigation: Reporting – Finding causes – Preserving evidences – Preparing investigation reports
- Risk assessment: System safety – Hazard analysis – Fault tree analysis
- Risk control: Nature of risk control – Methods of risk control

UNIT 3 : Fire safety and industrial security

- Principles of fire safety – Occupational injuries and precaution
- Characteristics and nature of fire – Fire hazards
- Types of fires and ways of extinguishing: Automatic sprinklers – Portable extinguisher – Extinguishing agents
- Fire prevention techniques: Building codes & regulation – Building materials and internal finishes
- Electrical fire safety: Problems and facts – Electrical distribution and earthing – FRLS wiring – Portable genset and appliances – Electrical processes like welding & cutting
- Fire regulations: Standards – Occupancy & egress – Escape plans & displays – Protective clothing – Protective strategies – Emergency preparedness
- Fire losses and assessment: After effect & plan of action
- Emerging threats to industrial security: Awareness – Training and manuals – Facilities data base – Security clearance

UNIT 4 : Health

- Industrial hygiene: Loss control and productivity – Application of occupational hygiene
- Health hazard agents: Chemical agents like toxic compounds and materials – Physical agents like noise, vibration & radiation – Biological hazards
- Exposure risk assessment: Routes of exposure – Measurement of exposure – Exposure factors
- Pulmonary diseases due to environment pollution
- Respiratory and personal protective equipment
- Development and administering medical surveillance system

UNIT 5 : Environmental management

- Sustainable development planning – National policy
- Environmental damage and costs – Deteriorating impact on environment
- Environmental factors and safety
- Environmental design of work place: Location – Work direction walkways – Area allocation and sitting/working plan
- Illumination: Types of lighting (natural vs artificial) – Luminous level – Glare
- Ventilation: Types (natural and mechanical) – Heat calculation – Measurements
- Noise: Types – Protection – Effects & productivity
- Drinking water: Contamination – Causes – Precaution – Preventive maintenance

UNIT 6 : Industrial pollution hazards

- Air pollution: Types – Causes – Prevention and control
- Water pollution: Categories – Causes – Prevention and control
- Soil and ground pollution: Categories – Causes – Prevention and control
- Noise pollution: Causes – Prevention – Acoustic design – Monitor and controls
- Industrial waste: Types – Control – Reuse
- Environmental impact assessment: Objective – Environment impact in India – Other efforts in conserving nature
- Compliance of environmental laws: Guidelines for location of industries – Compliance of water & air pollution acts, and other environmental laws

UNIT 7 : Imperative for sustainable development

- Green house gases: Composition – Effect
- Carbon emission: Kyoto protocol – Carbon credits – Emission trading – Carbon credit scenario in India – Corporate social responsibility
- Carbon foot print: Measures to reduce – Initial investment
- Ozone layer depletion
- Mutual agreements: Member states – Scope – Responsibilities
- Rain water harvesting: India's tradition in water harvesting – Rainfall data – Catch water practice and policy – Basic design – Making a mass movement
- Wasteland reclamation and reforestation: Restoration of ecology – Restoration of water logged soil – Mine rehabilitation – Managed reforestation – Tree plantation – Climatic change mitigation

UNIT 8 : EHS regulations and disaster management

- Introduction to disaster management
- Disaster management practices: Risk assessment – Disaster mitigation – Preparedness – Response (rescue and relief operation) – Recovery – Disaster management frame work in India
- Common types of disasters and their management: Earthquakes – Volcanoes & tsunamis – Cyclones – Hurricanes – Tornados –Typhoons
- Environment regulatory agencies in India: At National level – State level
- OHSAS policy: OHSAS 18001 – Structure and features – Scope and certification
- Health and safety: Standards – Scope and criteria

Recommended books:

1. Hamsagar, S. Ram (Dr.) *Manual of EHS Management*; Galgotia Publications Pvt. Ltd. (2004).
2. Chary, S.N and Vinod, V.; *Environmental Management: An Indian perspective*; Macmillan India (2001).
3. Pani, Balram; *Environmental Science and Engineering*; Galgotia (2007).
4. Asthana, D.K and Asthana, Meera; *A Textbook of Environmental Studies*; S. Chand & Company Ltd. (2006).

Reference book:

1. Pascal, Dennis; *Quality, Safety and environment Synergy in the 21st Century*; ASQ Quality press.

IEM 701 SIX SIGMA

Internal Marks	:	60	L	T	P
External Marks	:	40	3	1	0
Total Marks	:	100			

UNIT 1 : Overview of Six Sigma

- Evolution of Six Sigma
- Basic concepts: Variation and customer requirements – Definition of Sigma – Defects and Sigma levels – Tracking the Xs and Ys
- Concept of Six Sigma: Six Sigma as a metric – Six Sigma as a methodology – Six Sigma as a management system
- Six themes of Six Sigma: Genuine focus on customer – Data and fact driven management – Process focus – Proactive management – Boundaryless collaboration – Drive for perfection; Tolerance for failure
- DMAIC improvement model
- 6-Sigma organization: Apex Council – Project champion – Process owner – Master Black Belt – Black Belt – Green Belt – Team member

UNIT 2 : Define phase

- Project selection essentials – Selecting winning six sigma projects
- Identify what is important to customer: Six steps to defining customer requirements – Analyzing and prioritizing customer requirements – CTQ tree – Getting measures for priority requirements
- Develop problem statement and project charter: Business case – Problem statement – Goal statement – Project scope, constraints & assumptions – Team selection & roles – Team guidelines – implementation plan
- Map high level processes: Build a SIPOC diagram
- Select Critical to Quality (CTQ) characteristics

UNIT 3 : Measure phase

- Develop detailed “As Is” process maps: Set the baseline – See the process
- Determine What to measure (Y) and opportunities for the defect to occur
- Plan for data collection: Operational definition – Data source – Data type – Defect type – Stratification – Sampling strategy – Sampling frequency – Sample size
- Select measurement methods – Validate measurement system (MSA)
- Measure process capabilities: Output performance measures – Calculate baseline sigma levels for process as a whole – Calculate baseline sigma – Calculate final and first pass yield – Capability indices
- Finishing the measure work: Create a plan for analyze – Update project storyboard – Tollgate review

UNIT 4 : Analyze phase

- Identify patterns through data analysis
- Analyze root causes (X's) : Cause & Effect diagram – Relations diagram – CE matrix – FMEA
- Test hypothesis and screen potential causes
- Identify root causes (Key X's) – Validate Cause & Effect relationships through pilot testing/experimentation
- Implement appropriate corrective actions
- Finishing the Analyze work: Finalize project charter – Document verified causes – Update your project storyboard – Create a plan for improve

UNIT 5 : Improvement phase

- Generate and rank solutions: Out-of-the-box thinking – Structured design of experiments
- Refine solutions: Refine brainstormed list – Identify which problem-segment would each idea address – Document “full solution” ideas
- Justify and select a solution: Minimum requirement test – Assessment of impact and effort – Formal analysis
- Prove effectiveness in pilot runs: Pilot test – Problem prevention – Counter measure matrix
- Provide statistical evidence of improvement
- Prepare “should be” process map
- Implement solution
- Finishing improve work: Getting ready for control – Finalize process documentation – Update your project storyboard – Create plan for control phase

UNIT 6 : Control phase

- Overview of Control phase – Understanding process control system
- Steps in Control Phase: Development of risk mitigation plans – New process documentation & training – Installation of process audit system – Quantification of gains – Side sharing of learning
- Verify results of changes and improvements
- Monitor improvement
- Institutionalize change into quality system
- Ending the project: Completing your storyboard – Preparing for the tollgate review – The final celebration
- Tollgate review: Assess adequacy of risk mitigation plans – Assess adequacy of process documentation – Check resources for process audits

UNIT 7 : Design for Six Sigma (DFSS)

- Overview of DFSS
- DFSS phases: Define – Measure – Analyse – Design – Verify
- TRIZ: Contradiction – Resources – Ideality – Patterns of Evolution – Innovative Principles

UNIT 8 : Other aspects of Six Sigma

- Six Sigma and other techniques: Six Sigma & ISO 9000 series – Six Sigma & TQM
- Integrating Six Sigma and Lean
- Sustaining Six Sigma
- Best practices in Six Sigma
- Pitfalls to be avoided

Recommended books:

1. Pande, Peters; Neuman, Robert P. and Cavanagh, Roland R.; *The Six Sigma Way*; Tata McGraw-Hill, New Delhi.
2. Gupta, Praveen and Sri, Arvin; *Stat Free Six Sigma*; 1st Edition 2008; S Chand & Company Ltd., New Delhi.
3. Keller, Paul; *Six Sigma DeMystified, A Self-teaching Guide* (2005); Tata McGraw-Hill, New Delhi.
4. Benbow, Donald W. and Kubiak, T.M.; *The Certified Six Sigma Black Belt* (2008); Pearson Education, South Asia.

IEM 702 MANAGEMENT PRACTICES FOR BUSINESS EXCELLENCE

Internal Marks	: 60	L	T	P
External Marks	: 40	3	0	0
Total Marks	: 100			

UNIT 1 : Leadership for business excellence

- Role of leadership in business excellence
- Creating an effective organization – Creating a customer focus
- Value based management
- Change management
- Focus on business results
- Leadership styles of effective leaders

UNIT 2 : Strategic management and policy deployment

- Elements of strategic planning
- Gaining competitive edge through strategic plans
- Integrating Quality into business strategy: Maintenance – Improvement – Breakthrough
- Mission, vision and values
- Quality goals and policy – Quality council – Training for quality
- Selection of projects – Assignment to teams – Monitoring of progress

UNIT 3 : Creating a culture for excellence

- Steps for creating a culture of excellence
 - Provide quality goals & measurement at all levels
 - Create and maintain quality awareness
 - Provide evidence of management leadership
 - Employee participation and empowerment
 - Recognition and rewards

UNIT 4 : Building high performance teams

- Team Work: Definition of team – Importance of team work
- Types of teams: Corrective action team – Continuous improvement team – Cross functional team – Departmental team – Self managing team
- Ingredients of effective teams
- Team formation: Selection of members – Size
- Team member roles & responsibilities – Stages of team development
- Problem areas, conflicts and behaviours not conducive to teamwork
- Measurement of team performance: Rewards & recognition

UNIT 5 : Quality circles and suggestion schemes

- Introduction to quality circles: Definition – Concept – Impact of quality circles – Quality circles in India
- Structure of quality circles: Organization structure – Role of top management
- Training for Quality Circles: Objectives – Levels of training
- Implementation & evaluation of quality circles
- Experiences with Quality Circles: Japan – Asian countries – India
- Problems and pitfalls in implementation – Institutionalization quality circles
- Suggestion schemes: Objectives – Scope – Experience with suggestion schemes – Rewards and recognitions

UNIT 6 : Balanced score card

- Introduction: The Balanced card – Beyond the financial perspective
- Balanced score card perspectives: The learning & growth perspective – The business focus perspective – The customer perspective – The financial perspective
- Assessment of business performance: Objectives – Measures – Targets - Initiative
- Business performance management strategy: Strategy mapping – Balanced scorecard software
- How to establish performance measures

UNIT 7 : Benchmarking

- Introduction: Definition – Objectives – Need for benchmarking
- Types of benchmarking: Internal benchmarking – Competitive benchmarking – Process benchmarking
- Benchmarking process: Deciding what to benchmark – Understanding current performance – Planning learning from the data – Using the findings – Analysis – Integration – Action – Maturity
- Success factors and management considerations
- Pitfalls and criticisms of benchmarking

UNIT 8 : Business excellence frameworks

- Malcolm Baldrige National Quality Award (MBNQA): Origin – Award eligibility criteria and categories – Criteria for evaluation – Organisational profile – Programme impact – Recipients of Baldrige awards – Framework for assessment – Review procedure – Profiles of winners
- The European Excellence Model and Quality Award (EFQM): Criteria for evaluation – Framework for assessment
- Deming Prize: Introduction – Award eligibility criteria and categories – Evaluation process for Deming application prize – Deming application prize award criteria – Impact of Deming prize – Framework for assessment – Profiles of winners

Recommended books:

1. Summers, Donna C.S.; *Quality Management, Creating and Sustaining Organizational Effectiveness* (2005); Prentice-Hall of India, New Delhi
2. Gryna, F.M.; Chua RCH and Defeo J.A.; *Quality Planning and Analysis for Enterprise Quality*, 5th Edition; Tata McGraw-Hill.
3. Besterfield, Dale H, Carol Besterfield-Michna, Glen H. Besterfield and Mary Besterfield-Sacre. (2003); *Total Quality Management*, 3rd Edition; Pearson Education
4. Robert, S. Kaplan, David, P. Norton; *The Balanced Scorecard: Translating Strategy into Action*

IEM 703 INDEPENDENT STUDY SEMINAR

Internal Marks : 35
External Marks : 15
Total Marks : 50

L	T	P
0	0	2

- **Focus on one area of Operations/R&D in own company/organization**
 - **Objective:** To sharpen analytical ability through in depth study of an area/operation in own organization
 - **Methodology**
 - Area/operation selection and approval by Seminar Guide
 - Periodic review and presentation
 - Submission of final report as per specified guidelines
 - Presentation and evaluation by team of examiners

ITEM 751 ADVANCED QUALITY TOOLS

Internal Marks	: 60	L	T	P
External Marks	: 40	3	0	0
Total Marks	: 100			

UNIT 1 : Seven Advanced Tools – 1

- Introduction to Advanced Quality Tools (AQT): Generating information – Benefits of AQT
- Relations diagram: Concept – When to use – Advantages – How to construct?
- Affinity diagram: Concept – When to use – How to construct?
- Systematic diagram: Concept – Advantages – When to use – How to construct?
- Matrix diagram: Concept – Common uses – Classification of matrix diagram (L-shaped, T-shaped, Y-shaped, C-shaped, X-shaped, Roof shaped) – How to construct?

UNIT 2 : Seven Advanced Tools – 2

- Matrix data analysis diagram: Concept – When to use – How to construct?
- Process decision program chart: Concept – When to use – How to construct?
- Arrow diagram: Concept – When to use – How to construct?
- Summary of Advanced Quality Tools

UNIT 3 : Methods of analysis for experimental results

- Introduction
- Statistical terms
- Steps in tests of significance
- Chi-square test
- F-test
- ANOVA: Choosing ANOVA instead of t-test – ANOVA for detecting sources of variation – Statistical procedure for one-way ANOVA – Procedure for two-way ANOVA

UNIT 4 : Design of experiments: Factorial experimentation

- Introduction to experiments
- Conventional method: One factor experiment – Several factors, one at a time – Several factors, all at the same time
- Concept of design of experiments – Common terms – Designed experiment
- Three phases of DOE process: Planning phase – Conducting phase – Analysis and interpretation
- Full factorial experiments: Orthogonality – 2^3 factorial runs and results
- Fractional factorial experiments: Design – Seven factors at two levels

UNIT 5 : Design of experiments: Taguchi methods

- Introduction to Taguchi methods
- Counting degrees of freedom
- Selection and use of standard orthogonal array
- Linear graphs and interaction assignment

UNIT 6 : Steps in robust design

- Evaluation of sensitivity
- Signal to noise ratio
- Noise factors and testing conditions
- Interaction of controllable with uncontrollable factors

UNIT 7 : MINITAB (Part I)

- Introduction to MINITAB for Windows: Working with data – Working with MINITAB windows – Working with MINITAB projects
- Session commands
- Worksheet operations
- Summaries and graphs: Exploring graphs – Creating single and multiple variable graphs – Generating statistics – Summarising categorical and ordinal data – Control charts – Box plots & Histogram – Pareto Analysis

UNIT 8 : MINITAB (Part II)

- Create factorial design
- Analyse factorial design
- ANOVA
- One way ANOVA
- Two way ANOVA
- Main effects plots
- Interaction plots

Recommended books:

1. Mitra, Amitava; *Fundamentals of Quality Control and Improvement*, 2nd Edition; Pearson Education
2. Tague, Nancy R; *The Quality Tool Box*; Pearson Education
3. Phillip, J. Ross; *Taguchi Techniques for Quality Engineering*; Tata McGraw-Hill.
4. Phadke, Madhav. S; *Design of Experiments*; Prentice-Hall of India Ltd.

IEM 752 ADVANCED MANUFACTURING PROCESSES

Internal Marks	: 60	L	T	P
External Marks	: 40	3	0	0
Total Marks	: 100			

UNIT 1 : Advancements in casting

- Melting & solidification: Mechanism – Grain growth and structure – Shrinkage defects
- Advanced casting techniques: Precision investment casting – Lost wax casting for carbon steel
- Casting of alloys and nonferrous material: Casting of alloy steel – Stainless steel and super alloy steel – Casting aluminum

UNIT 2 : Advancements in heat treatment

- Advancements in heat treatment: Diffusion coating – Heat treatment of non-ferrous alloys, Aluminum and its alloys, Copper and its alloys
- Hardening – Aging – Annealing

UNIT 3 : Fundamentals of fusion welding and cutting

- Fundamentals of fusion welding processes: Analysis of heat source – Weld pool characteristics – Solidification mechanisms in fusion zone – Heat affected zone characteristics
- Weld defects: Distortion and residual stresses
- Destructive and non-destructive testing of welds
- Under water plasma cutting, Plasma arc welding, Laser welding & cutting

UNIT 4 : Non-conventional machining processes - 1

- Introduction: Need – Principle – Theory of material removal
- Non conventional methods: Electro discharge machining – Laser beam machining – Electrochemical machining – Ultrasonic machining
- Advantages, limitations and applications of non-conventional methods

UNIT 5 : Non-conventional machining processes - 2

- Special processes: Micro machining – Nano-technology – Molecular dynamic analysis – Dry electro discharge machining – Electro discharge chemical machining – Vacuum coating – Ballistic machining – Unit head machining – Hot machining

UNIT 6 : Sheet metal forming

- Sheet Metal forming: Bending theory – Cold Rolling theory – Hill's anisotropic plasticity theory – Hill's general yield theory – CAD/CAM applications in extrusion – Forging and sheet metal forming – Localized necking in biaxial stretching
- Redrawing: Ironing – Complex stamping – Metal spinning – Stretch forming – Fine blanking – High speed blanking

UNIT 7 : Advances in material forming

- Basics of metal forming: Mohr's circle – Isotropic elasticity – Yield theories – Plastic stress strain relationship – Plastic work – The principle of normality – Incremental plastic strain
- Constitutive relationships: Mechanical properties – Work hardening – Compression test – Bulge test – Plane strain compression test – Plastic instability in tension tests
- Strain rate: Super plasticity – Slab analysis for sheet drawing – Extrusion and forging – Upper bound solution for extrusion – Indentation and plane strain forging
- Slip line field theory and its solution: Formability and its testing

UNIT 8 : Unconventional forming processes

- Powder metallurgy: Basic powder process – Method of producing metal powders – Methods of manufacture – Blending – Sintering and hot pressing – Tolerances and precision – Advantages and limitations – Applications
- High energy rate forming: Electromagnetic forming – Explosive forming – Peen forming - High speed hot forging - High velocity extrusion

Recommended books:

1. Rao, P.N.; *Manufacturing Technology*, Tata McGraw-Hill.
2. Steve, Krar and Art, Gill; *Exploring Advanced Manufacturing Technology*; Industrial Press
3. Pandey, P.C; *Modern Machining Processes*; Tata McGraw-Hill.
4. Groover, Mikell P; *Fundamentals of Modern Manufacturing*; Prentice Hall

IEM 753 CUSTOMER RELATIONSHIP MANAGEMENT

Internal Marks	: 60	L	T	P
External Marks	: 40	3	0	0
Total Marks	: 100			

UNIT 1 : Introduction to CRM

- Evolution of CRM – Factors responsible for shift in orientation
- Defining CRM – Various perspectives of CRM (Technology perspective, Strategy perspective etc.)
- Benefits of CRM: Marketing benefits of CRM – Service benefits of CRM
- Types of CRM: Operational CRM – Analytical CRM – Collaborative CRM
- Strategic imperatives of CRM: Enablers for growth of CRM – Criticality of customer relationships

UNIT 2 : Building customer relationship and economics of CRM

- Relationship building as a process: Key steps – Ladder of loyalty – Bonding for customer relationship
- Zero customer defections: Price defectors – Product defectors – Service defectors
- CRM framework – Steps involved
- Market share vs. Share of customer – Profitability and customer share
- Lifetime value of customers – Components of lifetime value (Acquisition cost, Base profit etc.)

UNIT 3 : CRM in consumer (B2C) markets

- Characteristics of B2C markets – Service recovery
- Campaign management
- Cross-selling and up-selling
- Customer retention: Customer attraction vs. customer retention – Importance of customer retention – Methods of customer retention
- Behaviour prediction and Personalization – Nature of personalized marketing
- Event based marketing – Applications of event based marketing
- CRM in services: Hospitality – Telecom – Banking – Airlines
- CRM in product markets: Consumer durables – Automobiles

UNIT 4 : CRM in business (B2B) markets

- Characteristics of business markets: Market structure and demand – Nature of buying unit – Type of decision and decision process
- Key account management – Concept and application
- Customer value management: Understanding value – Creating value – Delivering value
- CRM in e-business : Expectations of online customers – Benefits of e-CRM

UNIT 5 : Sales force automation (SFA)

- Introduction to SFA: Evolution of SFA – Components of SFA – Benefits of SFA to business
- Territory management: Sales Territory – Steps for designing sales territories – Reasons for establishing sales territories – Territory Management component of CRM
- Contact management: Main features – Market for contact management
- Lead management: Lead management architecture – Analytics for lead management – Enhancing effectiveness of lead management of business partners
- Mobile CRM: Growth of mobile technology – Application in sales and marketing
- Field force automation: Goals and challenges of FFA

UNIT 6 : Customer service and support

- Contact center and customer care: Role of contact centre in building relationship – Components of contact centre – Economies of contact centre
- Automation of contact center: Implementation of automation of contact centre – Challenges of automation of contact centre – Overcoming contact centre automation challenges
- Web based services
- Customer satisfaction measurement: Customer satisfaction measurement tools – Improving customer satisfaction through CSM

UNIT 7 : Organising for CRM

- Choice of strategy – Factors influencing strategy decision
- CRM development team – Role of team members
- Planning the programme: Defining success factors – Preparing business plan – Understanding business processes
- Choice of CRM tool and technology selection: Bottom-up approach – Requirements-driven approach
- CRM success factors and road blocks
- Integration of CRM into business: CRM and cultural change – Integration of CRM with ERP – Integration of CRM with other systems

UNIT 8 : Operational issues in implementing CRM

- Process view of CRM: Formation – Management & governance – Performance evaluation and evolution
- Budgeting for attraction and retention: Issues in allocating resources
- Learning from customer defections: Analyzing customer defections and identifying root cause
- Customer retention plans: Customer portfolio analysis – Reorganization for customer retention – Customer retaining marketing mix
- Evaluating retention programmes: Targeting the right customers – Providing value – Measuring increase in loyalty

Recommended books:

1. Dyche, Jill; *The CRM Handbook, A Business Guide to Customer Relationship Management*; Pearson Education.
2. Shainesh, G., and Sheth, Jagdish N.; *Customer Relationship Management, A Strategic Perspective*; Mcmillan India Ltd.

IEM 754 VALUE ENGINEERING

Internal Marks	: 60	L	T	P
External Marks	: 40	3	0	0
Total Marks	: 100			

UNIT 1 : Introduction to Value Engineering

- Value engineering/Value analysis: Origin and history of value engineering – Definition of Value, Value engineering and Value analysis – Difference between Value analysis and Value engineering
- VE/VA as management tool: Value analysis versus traditional cost reduction techniques – Applications – Advantages and limitations – Symptoms for application

UNIT 2 : Concept of value

- Meaning of value: Types of value & their effect in cost reduction – Concept of Cost, Price and Value
- Value analysis procedure: Reasons for unnecessary cost of product – Value Analysis Zone – Simulation
- Attractive features of value analysis – Detailed case studies of simple products

UNIT 3 : 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
- Other techniques: Matrix technique – Numerical evaluation of functional relationships – Case studies

UNIT 4 : Problem setting & solving system

- Basic principles to achieve effectiveness in a VE study
- Areas of employing human relations in VE
- Steps in problem setting system: Identification, Separation and Grouping of functions
- Various steps in problem solving
- Case studies

UNIT 5 : 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 – Judgment phase – Development planning phase
- Cost reduction programs: Criteria for cost reduction program
- Value analysis change proposal

UNIT 6 : Value engineering techniques

- Result accelerators: Creative and analytical techniques – Role of techniques and role of creativity in value engineering
- Essential qualification and training required for a Value analyst and Value engineer
- Case examples

UNIT 7 : Advanced value analysis techniques

- Functional analysis system technique (FAST)
- Value analysis of management practice (VAMP)
- Steps involved in VAMP
- Application of VAMP: Government University – College – Hospital – School etc. (service type problems)

UNIT 8 : Application of value analysis

- Application of Value analysis in various fields: Accounting – Appearance Design – Engineering – Manufacturing – Purchasing – Quality Control – Sales & Marketing – Material Management.
- Comparison of approach of Value analysis & other management techniques

Recommended books:

1. Lawrence D. Miles; *Techniques of Value Analysis and Engineering*; McGraw-Hill.
2. Mudge, Arthur E.; *Value Engineering - A systematic approach*, McGraw Hill, New York, 2000.
3. Anil Kumar, Mukhopadhyaya; *Value Engineering Mastermind: From Concept to Value Engineering Certification*; Response Books; 2009
4. Zimmerman & Hart; *Value Engineering – A Practical Approach*; CBS Publishers & Distributors, New Delhi.
5. Jagannathan, G.; *Getting More at Less Cost (The Value Engineering Way)*; Comp. Edition 1995; Tata McGraw-Hill.

IEM 755 ENERGY MANAGEMENT

Internal Marks	: 60	L	T	P
External Marks	: 40	3	0	0
Total Marks	: 100			

UNIT 1 : Energy and environment

- Introduction: Energy and development – World energy consumption – Impact of energy use on environment – Global warming
- Commercial or conventional sources of energy: Fossil fuel – Water – Power – Energy of nuclear fission – Gas
- Non conventional sources of energy: Sources of renewable energy – Advantages of renewal energy – Limitation of renewal energy systems
- Clean development mechanism – World energy futures

UNIT 2 : Solar energy

- Solar radiation and its measurement: Solar constant – Solar radiation at earth surface – Pyrheliometer – Pyranometer
- Solar energy collectors: Conversion of solar energy into heat – Flat plate collectors – Heat transport system – Concentrating collectors
- Direct conversion of solar energy to electricity and its various uses, materials, limitations and costs:
- Applications of solar energy: Solar – Photovoltaic – Solar cell principle – Photovoltaic system for power generation – Battery storage – Application of solar photovoltaic system – Advantage and disadvantage of photovoltaic solar energy conversion

UNIT 3 : Other forms of non-conventional energy

- Energy from wind: Conversion systems – Storage – Application of wind energy – Site selection – Environmental aspects
- Energy from ocean: Ocean thermal electrical conversion – Energy from ocean waves – Energy from tides – Environment aspects – Limitations
- Energy from biomass: Generation of biogas – Classification of biogas plants – Biogas plants – Problems related to biogas plants – Selection of site for biogas plant
- Energy from geothermal sources: Geothermal sources – Conversion systems – Potentiality and limitations – Geothermal energy in India
- Energy from chemical and hydrogen: Fuel cells – Batteries – Hydrogen production – Storage – Safety and management – Technology development in India

UNIT 4 : Energy storage, distribution and management

- Energy storage: Energy storage systems – Mechanical storage – Electrical storage – Chemical storage – Thermal energy storage – Electromagnetic energy storage
- Distribution of energy: Gas pipelines – Electricity transmission – Heat transmission
- Energy management: Concept of energy management – Energy demand and supply – Economic analysis – Duties and responsibilities of energy managers

UNIT 5 : Management of Heating, Ventilation and Air-conditioning (HVAC)

- Categories of HVAC system: All air systems – air-water systems – all water systems
- Description of HVAC systems : Single duct systems - Dual duct – Constant volume - Multi zone variable air volume system (VAV) – Multi zone with reheat system
- Energy management opportunities in HVAC systems

UNIT 6 : Electrical load and lighting management

- Lighting systems : Basic principles -Typical illumination system – Lighting equipment
- Motors and electrical heat : Load distribution management
- Energy management opportunities: Electrical load analysis and their parameters – Demand management strategies - Peak demand control - Power factor

UNIT 7 : Management of process energy

- Fuels and consumption – Boilers - Furnaces
- Energy saving in condensate return - Steam generation & distribution - Hot water and water pumping
- Heat exchangers – Waste heat recovery systems - Insulation
- Other process energy forms – Compressed air

UNIT 8 : Planning for energy management and energy audit

- Energy management programme: Initiation phase - Audit and analysis phase - Implementation phase
- Understanding energy costs – Benchmarking – Matching energy use to requirement – Maximizing system efficiencies
- Economics of efficient energy use: General considerations - Life cycle costing – Cost/benefit analysis – Pay Back Period Analysis
- Energy audit: Definition – Need and type of energy audit – General methodology for building and site energy audit - Basic energy audit instrumentation

Recommended books:

1. Rai, G.D.; *Non-conventional Energy Sources*; 4th Edition; Khanna Publishers, Delhi.
2. Paul, W; O Callaghan; *Energy Management*; McGraw-Hill.
3. *Handbook on Energy Audit and Environment Management*; TERI
4. Sasi Bushan Rao; *Energy Management*; Regal Publications
5. Craig B. Smith; *Energy management Principles*; Pergamon Press.

IEM 756 SERVICES MARKETING & QUALITY

Internal Marks	: 60	L	T	P
External Marks	: 40	3	0	0
Total Marks	: 100			

UNIT 1 : Introduction to service industry

- Concept of service
- Difference between products and services – Differences in processes of manufacturing industry and service Industry
- Worldwide growth of service sector – Factors responsible for growth of service sector
- Service revolution in India: Service sector scenario in India – Opportunities and challenges
- Changing attitudes towards service quality: Attitudes of customers, service providers, regulatory bodies, and investors
- Classification of services: Labour vis-à-vis capital intensive – High contact vis-a-vis low contact – Single vis-a-vis multiple location – Profit vis-a-vis non-profit

UNIT 2 : Characteristics of services and service quality

- Nature of service offering: Core product and supplementary services
- Characteristics of services: Intangibility – Inseparability – Heterogeneity – Perishability – Absence of ownership
- Consumer behaviour in service encounters : Types of service encounters – Customer involvement in service encounters – Steps in purchase process for services
- Service quality characteristics: Human factors – Behavioural characteristics – Timeliness – Nonconformity

UNIT 3 : 7 Ps of service marketing

- Product or package: Planning and creating service products – Branding service products
- Pricing: Objectives and foundations for setting price – Types of pricing approaches – Revenue management
- Place: Distribution in service context
- Promotion: Marketing communication mix
- People: Importance of service staff (people)
- Physical evidence: Role of service environment
- Process management: Nature of service processes

UNIT 4 : Managing the service delivery process

- Service delivery process: Process approach to service delivery – Categorization of service processes
- Designing and managing service processes: Blueprinting services to create valued experiences – Service process redesign
- Balancing demand and capacity: Fluctuations in service demand – Patterns of demands – Management of demand levels
- Planning the service environment : Customer responses to service environments – Dimensions of service environment
- Managing people for service advantage: Human resource management in services – Service leadership and culture

UNIT 5 : Managing relationships, Customer feedback and Service recovery

- Targeting the right customers: Understanding the customer – Selecting appropriate customer portfolio
- Building customer loyalty: Foundations of customer loyalty – Creating bonds with customers – Loyalty programs
- Understanding customer responses to service failure: Reasons for customer complaints – Customer expectations about complaints
- Customer responses to effective service recovery: Impact of service recovery on loyalty – Service recovery paradox
- Principles of effective service recovery – Dealing with complaining customers
- Service guarantees: Power of service guarantees – Design of service guarantees
- Learning from customer feedback: Objectives of customer feedback systems – Analysis – Reporting & dissemination of customer feedback

UNIT 6 : Measuring and evaluating service quality

- Defining and measuring service quality: Technical quality – Functional quality
- Techniques for evaluating service quality : SERVQUAL model – Gap model of service quality – Flow charting method
- Improving service quality & productivity: Generic productivity improvement strategies – How productivity improvement impacts quality and value
- Quality standards for services : Defining service standards

UNIT 7 : Implementing TQM in service sector – 1

- IT Industry: Software development – Quality in IT industry and its management – CMMI – Levels of CMMI – CMMI processes – Benefits of CMMI
- IT-Enabled Services (ITES): ITSM (Information Tech. Service Management) – COPC (Customer Operations Performance Center) – Information Security Management System (ISMS) – ISO 20000 – Challenges in ITES
- Banking & Financial Services – Delivering service quality in financial sector – Methods of improving quality in banks
- Insurance sector: Growth of private sector in insurance – Assessment of service quality in insurance sector – Methods of improving quality

UNIT 8 : Implementing TQM in service sector – 2

- Government and public utilities: Classification of Government and Public organizations – Problem areas in government systems
- Healthcare: Importance of TQM in healthcare – Undesirable issues in healthcare systems – Unique features of healthcare systems – Service delivery and performance measures – Accreditation of hospitals
- Hospitality and travel sector: Measures of quality performance – Challenges in implementing TQM in the hospitality and travel industry

Recommended books:

1. Lovelock, Christopher and Wirtz, Jochen (2004); *Services Marketing (People, Technology, Strategy)*, 5th Edition; Pearson Education.
2. Chowdhary, Nimit and Chowdhary, Monika (2005); *Textbook of Marketing of Services (The Indian Experience)*; Macmillan India Ltd.
3. Kano, Noriaki; *Guide to TQM in Service Industries*; Asian Productivity Organization.

Reference book:

1. Drewes, W.F.; *Quality Dynamics for the Service Industry*; ASQC Quality Press, Milwaukee, Wisconsin.

IEM 757 RELIABILITY ENGINEERING

Internal Marks	: 60	L	T	P
External Marks	: 40	3	0	0
Total Marks	: 100			

UNIT 1 : Introduction to reliability engineering

- Concepts, terms and definitions: Reliability – Maintainability – Availability – Relationship between reliability, maintainability and availability
- Dependability: Four dimensions of dependability – Renewal theory
- Applications of reliability engineering: Applications – Benefits – Examples
- Product reliability: Reliability of simple products – Reliability of complex products
- Optimization of reliability: Manufacturer's viewpoint – Customer viewpoint
- Reliability and quality control compared

UNIT 2 : Analyzing product reliability

- Causes of failure: Deficiencies in design – Deficiencies in material – Deficiencies in processing – Errors in assembly – Improper service conditions
- Failure distribution: Reliability function – Mean time to failure – Hazard rate function – Bathtub curve – Conditional reliability
- Life data analysis: Analysis of time-to-failure data – Selecting analysis method – Requirements of life data analysis
- Constant failure rate models: Exponential reliability function – Failure modes – Two-parameter exponential distribution – Redundancy and the CFR model
- Time dependent failure models: Weibull distribution – Normal distribution – Lognormal distribution

UNIT 3 : Reliability of systems

- System reliability: Basics of redundancy – Standby redundancy systems
- Use of reliability block diagrams: Graphical depiction of the system – RBD for different systems – Assumptions when making RBD
- System with components in series: Two components in series – n components in series
- System with components in parallel: Two components in parallel – n components in parallel
- System with mixed configuration: Combined series-parallel systems – High level vs. low level redundancy – k -out-of- n redundancy
- Software reliability: Embedded software – Definition of software reliability – Software failure mechanisms – Bathtub curve for software reliability – Software reliability models – Software reliability metrics – Software reliability improvement techniques

UNIT 4 : Design for reliability (DFR)

- Basics of design for reliability: Six principles for reliability improvement – Steps to build in reliability
- DFR programme: Basic parameters – Key activities – Reliability goals – System measurement
- Reliability allocation: Establishment of reliability objectives – Sub-system breakdown – Component level breakdown
- Reliability prediction: Five stages of reliability prediction – Measurement
- Design methods: Material selection – Derating – Stress-strength – Implementing design methods – Analysis – Reducing complexity – Redundancy
- Failure analysis: Eight steps in conducting FMECA
- Implementing DFR: DFR spans product life cycle – Improving reliability of new products

UNIT 5 : Product testing for reliability

- Objective of reliability life testing – Factors to address before testing
- Life and test data analysis – Performance testing of a system
- Types of reliability tests: Design and product evaluation tests – Design and product verification/validation tests
- Accelerated life testing: Design of accelerated life testing plans – Stress loading – Accelerated life testing models
- Highly accelerated life testing: When to do HALT – Implementing HALT
- Reliability enhancement testing: When to conduct RET – RET methodology
- Environmental stress screening (ESS): What is ESS? – Underlying principles of ESS – Nature of environmental stresses – Four types of ESS tests –Implementing ESS
- Burn-in testing: Objective – Determining length of burn-in period – Lot formation & Sampling
- Life testing plans for reliability: Failure terminated test plan – Time terminated test plan – Sequential reliability test plan

UNIT 6 : Fault Tree Analysis (FTA)

- Fault tree model: Primary events – Intermediate events – Gates – Failure mechanism – Failure mode – Failure effect – Failure vs. Success models – Advantages of Failure models
- Fault tree construction fundamentals: Faults vs. Failures – Fault occurrence vs. Fault existence – Passive vs. Active components – Component fault categories (Primary, Secondary, Command)
- Fault tree construction and analysis: Basic rules for fault tree construction fault tree construction process – Analysing a fault tree

UNIT 7 : Reliability centered maintenance (RCM)

- Historical evolution of RCM – Philosophy of RCM – RCM goals
- Nine RCM principles – Maintenance analysis process – Types of maintenance tasks
- Failure mode: System and system boundary – Function and functional failure – Failure modes – Failure characteristics – Preventing failure
- RCM programme benefits: Safety – Cost – Reliability – Scheduling – Efficiency and productivity

UNIT 8 : Applications and case studies

- Reliability application in different organizations
- Case studies
 - Redundancy
 - Burn-in testing
 - Repairable system analysis
 - Reliability allocation

Recommended books:

1. Ebing, Charles E.; *Introduction to Reliability and Maintainability Engineering*, Tata McGraw-Hill, New Delhi, 2000.
2. Srinath, L.S.; *Reliability Engineering*, East-West Press, New Delhi, 2005.
3. Lewis, E.E.; *Introduction to Reliability Engineering*, John Wiley, New York, 1994.
4. Balagurusamy, E.; *Reliability Engineering*, Tata McGraw-Hill, New Delhi, 1984.

IEM 758 COMPUTER INTEGRATED MANUFACTURING

Internal Marks : 60
External Marks : 40
Total Marks : 100

L T P
3 0 0

UNIT 1 : Introduction

- Manufacturing Systems: Types – Current trends – Role of computers in manufacturing
- Special manufacturing systems – Machine tools and equipment – Material handling systems
- Computer Integrated Manufacturing: Evolution – Principles – Hardware and software of CIM

UNIT 2 : Computer aided manufacturing (CAM)

- Historical Background – Problems with conventional NC
- Computer aided manufacturing: Relation with CAD – Programming and interface hardware – Computer aided process monitoring – Online search strategies.
- Computer Numerical Control (CNC), Direct Numerical Control (DNC) and combined CNC/DNC systems
- Adaptive control machining system

UNIT 3 : Computer aided process planning (CAPP)

- Problem with traditional process planning
- Retrieval process planning system – Generative Process Planning system – Machinability data system
- Computer generated time standards

UNIT 4 : Group Technology (GT)

- Introduction to Group Technology: Part families – Coding – Classification – Production Flow Analysis
- Machine cell design: Clustering method – Modern algorithm – Benefits of GT
- System planning: Objectives – Guidelines – System definition and sizing – Human resources

UNIT 5 : Flexible Manufacturing Systems (FMS)

- Introduction : Evolution – Definition – Need for FMS – Need for flexibility – Economic justification of FMS application
- Flexible manufacturing cells: Introduction – Cell description and classification – Unattended machining – Cellular v/s FMS system – Lean manufacturing and agile manufacturing
- FMS software : Introduction – General structure and requirement

UNIT 6 : Computer aided production planning and control systems

- Problem with conventional production planning control – Application of computers – Shop floor monitoring – Introduction to Computer aided production planning and control
- Introduction to computer aided inventory management, Materials requirement planning (MRP-I)
- Manufacturing resource planning (MRP-II) – ERP packages – JIT

UNIT 7 : Computer aided quality control

- Computer aided inspection and quality control – Computer aided testing
- Sensor technologies: Coordinate measuring machines – Non contact inspection methods – Optical computer aided testing – Non optical computer aided testing
- Computer aided data capturing and analysis

UNIT 8 : Computer aided material handling and store management

- Automated material handling systems (conveyor, automated guided vehicle, pallets etc.) – Automated storage and retrieval systems – Automated warehouse control
- Computerized material handling for automated inspection and assembly.
- Bar coding – Other computer applications in supply chain management

Recommended books:

1. Groover & Zimmers; *CAD/CAM: Computer-Aided Design and Manufacturing*; Prentice Hall
2. Groover, Mikell; *Automation Production Systems and CIMS*; Prentice Hall
3. Beasanat & Lui, EWP; *CAD/ CAM*; Tata-McGraw Hill
4. *Material Handling Hand Book*, Tata-McGraw Hill
5. Groover, Mikell & Mitchell Weiss; *Industrial Robotics*; Tata-McGraw Hill

IEM 759 CREATIVITY, INNOVATION & ENTREPRENEURSHIP

Internal Marks	: 60	L	T	P
External Marks	: 40	3	0	0
Total Marks	: 100			

UNIT 1 : Introduction to entrepreneurship

- Evolution of the concept of entrepreneur and entrepreneurship
- Characteristics of an entrepreneur – Functions of an entrepreneur
- Benefits of entrepreneurship – Potential drawbacks of entrepreneurship
- Types of entrepreneurs – Intrapreneurs
- Growth of entrepreneurship in India – Role of entrepreneurs in economic development
- Opportunities for entrepreneurs in India and abroad

UNIT 2 : Generating Ideas

- Sources of new ideas
- Creative thinking and innovation – Attitudes, approaches and actions that support creativity
- Barriers to creativity
- The creative process
- Techniques for generating creative ideas in individuals
- Techniques for generating creative ideas in groups
- Process of technological innovation

UNIT 3 : Fostering creativity & innovation in organizations

- Creativity & innovation as competitive resources
- Role of managerial leadership
- Building an organization culture for creativity & innovation
- Managerial style & practices supportive of creativity & innovation
- Strategic issues & company culture
- Managing creativity & innovation

UNIT 4 : Project identification, formulation and appraisal

- Project identification and selection
- Project formulation: Significance and benefits of business plan / project report
- Elements of a business plan / project report
- Project appraisal / business plan presentation
- Project report / business plan format

UNIT 5 : Financing the new venture

- Source of financing – Equity capital vs. debt
- Sources of equity financing: Personal savings – Friends & family – Partners – Angel investors – Venture capital – Public offering
- Sources of debt financing: Commercial banks and financial institutions (Long term loans, Short term loans) – Non banking sources – Lease financing – Hire purchase – Government sponsored lending programmes

UNIT 6 : Forms of business ownership and new venture expansion

- Different forms of ownership structure open to an enterprise: Main features of each form of ownership – Advantages and disadvantages
 - Sole proprietorship
 - Partnership
 - Private limited company
 - Public limited company
- Franchising – Joint venture – Mergers and acquisitions
- Rights issues, Bonus issues, Stocks splits

UNIT 7 : Institutional support to entrepreneurs and Tax benefits to SSI

- Need for institutional support
- Supporting institutions: Directorate of Industries – District Industries Centres (DICs) – Industrial Development Corporations (IDCs) – State Financial Corporations (SFCs) – Small Scale Industries Development Corporations (SSIDCs) – Khadi and Village Industries Commission (KVIC) – Technical Consultancy Organisation (TCO) – Small Industries Service Institute (SISI) – National Small Industries Corporation (NSIC) – Small Industries Development Bank of India (SIDBI)
- Tax benefits to Small Scale Industries: Need for tax benefits – Tax holiday – Depreciation – Rehabilitation allowance – Investment allowance – Expenditure on scientific research

UNIT 8 : Building a competitive edge

- Leadership in the new economy
- Choosing the right location and layout – Criteria for choosing region & factors – Build, buy or lease
- Hiring the right employees – Avoid hiring mistakes
- Building the right organization culture and structure – Managing growth & changing culture
- Challenge of motivating employees
- Management succession – Development of management succession plan

Recommended books:

1. Khanka, S.S.; *Entrepreneurial Development*; S Chand & Company Ltd. New Delhi
2. Zimmerer, W. Thomas & Scarborough, M. Norman; *Essentials of Entrepreneurship and Small Business Management*; 4th Edition; Prentice-Hall of India, New Delhi
3. Dollinger J. Marc; *Entrepreneurship Strategies and Resources*; 3rd Edition; Pearson Education Pte. Ltd. New Delhi
4. Rastogi, P.N.; *Managing Creativity for Corporate Excellence*; Macmillian India Ltd. New Delhi

IEM-801 MAJOR PROJECT

Internal Marks : 140

L T P

External Marks : 60

0 0 16

Total Marks : 200

- **Each participant will work on a problem which is significant to his/her organization**
 - **Purpose:** To apply the principles, tools and techniques learnt during the programme to solving work related problems
 - **Methodology**
 - Project selection and approval by Project Guide
 - Periodic review and presentation
 - Submission of final report as per specified guidelines
 - Project presentation and evaluation by team of examiners