DR. A.P.J. ABDUL KALAM TECHNICAL UNIVERSITY
LUCKNOW

STUDY & EVALUATION SCHEME WITH SYLLABUS

FOR

B. TECH 4th YEAR
PRODUCTION ENGINEERING/INDUSTRIAL PRODUCTION ENGINEERING

ON

CHOICE BASED CREDIT SYSTEM

(EFFECTIVE FROM THE SESSION: 2019-20)

SEVENTH SEMESTER									
Sl.No.	**Subject Code**	**Subject Name**	**Department**	**L-T-P**	**Th/Lab Marks**	**Sessional**		**Total**	**Credit**
					ESE	**CT**	**TA**		
1		OPEN ELECTIVE COURSE-1	Other Deptt.	3-0-0	70	20	10	100	3
2		DEPTT ELECTIVE COURSE-3	Core Deptt.	3-0-0	70	20	10	100	3
3		DEPTT ELECTIVE COURSE-4	Core Deptt.	3-1-0	70	20	10	100	4
4	RPI701	Automation & Robotics	Core Deptt.	3-1-0	70	20	10	100	4
5	RME701	CAD/CAM	Core Deptt.	3-0-0	70	20	10	100	3
6	RME751	CAD/CAM Lab	Core Deptt.	0-0-2	50		50	100	1
7	RPI751	Automation & Robotics Lab	Core Deptt.	0-0-2	50		50	100	1
8	RPI753	INDUSTRIAL TRAINING	Core Deptt.	0-0-3			100	100	2
9	RPI754	PROJECT-1	Core Deptt.	0-0-6			200	200	3
	TOTAL				**450**	**100**	**450**	**1000**	**24**

DEPARTMENTAL ELECTIVE-3	
S.Code	**Subject Name**
RME070	Composite Materials
RPI070	Advanced Material Technology
RPI071	Quality Engg. in Manufacturing
RME073	Additive Manufacturing

DEPARTMENTAL ELECTIVE-4	
S.Code	**Subject Name**
RME075	Operation Research
RPI075	Reverse Engineering
RPI076	Decision Support & Intelligent System
RPI077	Process Planning & Cost Estimation

- **Students who was not-place in any company, it is mandatory to select any one subject from DE-5 & 6.**
- **Students who was place in any company, it is mandatory to select MOOC subject in both DE-5 & 6.**

EIGHT SEMESTER									
Sl.No.	**Subject Code**	**Subject Name**	**Department**	**L-T-P**	**Th/Lab Marks**	**Sessional**		**Total**	**Credit**
					ESE	**CT**	**TA**		
1		OPEN ELECTIVE COURSE-2	Other Deptt.	3-0-0	70	20	10	100	3
2		DEPTT ELECTIVE COURSE-5	Core Deptt.	3-1-0	70	20	10	100	4
3		DEPTT ELECTIVE COURSE-6	Core Deptt.	3-0-0	70	20	10	100	3
4	RPI851	SEMINAR	Core Deptt.	0-0-3			100	100	2
5	RPI852	PROJECT-2	Core Deptt.	0-0-12	350		250	600	12
	TOTAL				**560**	**60**	**380**	**1000**	**24**

DEPARTMENTAL ELECTIVE-5	
S.Code	**Subject Name**
RPI080	Design of Experiment
RPI081	Lean Manufacturing
RPI082	Project Management
RPI083	Supply Chain Management

OR

S.Code	**MOOC Subject Name**
RME084	Industrial Safety Engineering.

DEPARTMENTAL ELECTIVE-6	
S.Code	**Subject Name**
RME085	Total Quality Management
RPI085	Flexible Manufacturing System
RPI086	Reliability Engineering
RPI087	Innovation & Entrepreneurship

OR

S.Code	**MOOC Subject Name**
RPI088	Principles of Metal Forming Technology.

SEMESTER-VII

AUTOMATION & ROBOTICS

L-T-P
3-1-0

UNIT- I

Automation:

Definition, Advantages, goals, types, need, laws and principles of Automation. Elements of Automation.
Fluid power and its elements, application of fluid power, Pneumatics vs. Hydraulics, benefit and limitations of pneumatics and hydraulics systems, Role of Robotics in Industrial Automation.

UNIT- II

Manufacturing Automation:

Classification and type of automatic transfer machines; Automation in part handling and feeding, Analysis of automated flow lines, design of single model, multi model and mixed model production lines.
Programmable Manufacturing Automation CNC machine tools, Machining centres, Programmable robots, Robot time estimation in manufacturing operations.

UNIT- III

Robotics:

Definition, Classification of Robots - Geometric classification and Control classification, Laws of Robotics, Robot Components, Coordinate Systems, Power Source.
Robot anatomy, configuration of robots, joint notation schemes, work volume, manipulator kinematics, position representation, forward and reverse transformations, homogeneous transformations in robot kinematics, D-H notations, kinematics equations, introduction to robot arm dynamics.

UNIT -IV

Robot Drives and Power Transmission Systems:

Robot drive mechanisms: Hydraulic / Electric / Pneumatics, servo & stepper motor drives.
Mechanical transmission method: Gear transmission, Belt drives, Rollers, chains, Links, Linear to Rotary motion conversion, Rotary-to-Linear motion conversion, Rack and Pinion drives, Lead screws, Ball Bearings.

Robot end Effectors:

Classification of End effectors – active and passive grippers, Tools as end effectors, Drive system for grippers. Mechanical, vacuum and magnetic grippers. Gripper force analysis and gripper design.

UNIT- V

Robot Simulation:

Methods of robot programming, Simulation concept, Off-line programming, advantages of offline programming.

Robot Applications:

Robot applications in manufacturing-Material transfer and machine loading/unloading, Processing operations like Welding & painting, Assembly operations, Inspection automation.
Limitation of usage of robots in processing operation. Robot cell design and control, Robot cell layouts-Multiple robots & Machine interference.

Books and References:

1. An Introduction to Robot Technology, by CoifetChirroza, Kogan Page.
2. Robotics for Engineers, by Y. Koren, McGraw Hill.
3. Robotic: Control, Sensing, Vision and Intelligence, by Fu, McGraw Hill.
4. Introduction to Industrial Robotics, by Nagrajan, Pearson India.
5. Robotics, by J.J. Craig, Addison-Wesley.
6. Industrial Robots, by Groover, McGraw Hill.
7. Robotic Engineering - An Integrated Approach : Richard D. Klafter Thomas A.
8. Robots & Manufacturing Automation, by Asfahl, Wiley.

CAD/CAM

L-T-P
3-0-0

UNIT-I:

Principles of Computer Graphics:

Point plotting, drawing of lines, Bresenham's circle algorithm.

Transformation in Graphics:

Co-ordinate system used in Graphics and windowing, view port, views.

2D transformations – rotation, scaling, translation, mirror, reflection, shear - homogeneous transformations – concatenation.

3D Transformation – Perspective Projection – Technique (Description of techniques only).

Geometric Modelling:

Classification of Geometric Modelling – Wire frame, Surface and Solid Modelling, applications – representation of curves and surfaces – Parametric form.

Design of curved shapes- Cubic spline – Bezier curve – B-spline – Design of Surfaces - features of Surface Modelling Package – Solid Primitives, CSG.

B-rep and description of other modelling techniques like Pure primitive instancing, cell decomposition, spatial occupancy enumeration, Boolean Operations (join, cut, intersection), Creating 3D objects from 2D profiles (extrusion, revolving etc).

UNIT-II:

Graphics standard & Data storage:

Standards for computer graphics GKS, PHIGS. Data exchangestandards – IGES, STEP - Manipulation of the model - Model storage.

Finite Element Modelling:

Introduction, Mesh Generation – mesh requirements.

Semi-AutomaticMethods- Node-based approach, Region based approach, Solid-modelling-based methods.

FullyAutomatic Methods- Element-based approach, Application, Mesh Refinements using Isoperimetric Finite Elements, Meshing in high gradient areas, Transition Regions. Sub modelling Concept.

An overview of modelling software's like PRO-E, CATIA, IDEAS, SOLID EDGE etc.

UNIT-III:

CAM:

Scope and applications – NC in CAM – Principal types of CNC machine tools and there construction features – tooling for CNC – ISO designation for tooling – CNC operating system – FANUC, SINUMERIK – LINUMERIK.

Programming for CNC machining – coordinate systems – manual part programming – computer assisted part programming – CNC part programming with CAD system.

Material handling in CAM environment:

Types – AGVS – AS/RS – Swarf handling and disposal of wastes – single and mixed mode assembly lines – quantitative analysis of assembly systems.

UNIT-IV:

Robotics:

Classification and specification – drive and controls – sensors - end effectors - grippers- tool handling and work handling – machine vision – robot programming concepts – case studies in assembly.

Quality Function Deployment:

Process Planning – CAPP – Variant and Generative systems- Concurrent Engineering and Design for Manufacturing.

Advanced manufacturing Planning Computer Aided Production Planning and Control – Aggregate production planning and master production schedule – MRP – MRP II – ERP - Capacity planning.

UNIT-V:

Rapid prototyping:

Need for rapid prototyping, Basic principles and advantages of RP, General features and classifications of different RP techniques with examples.
Introduction to three representative RP techniques: Fusion Deposition Modelling, Laminated Object Manufacturing and Stereo-lithography.

Flexible manufacturing cells:

Systems – characteristics – economics and technological justification – planning, installation, operation and evaluation issues – role of group technology and JIT in FMS – typical case studies future prospects.

Books and References:

1. Chris Mcmahon and - CAD/CAM – Principle Practice and Manufacturing Management,Jimmie Browne Addision Wesley England , Second Edition,2000.
2. Dr.Sadhu Singh - Computer Aided Design and Manufacturing, Khanna Publishers, NewDelhi, Second Edition,2000.
3. P.Radhakrishnan, - CAD/CAM/CIM, New Age International (P) Ltd., New Delhi.S.Subramanayanand V.Raju.
4. Groover M.P. and - CAD/CAM; Computer Aided Design and Manufacturing, Prentice HallZimmers EW. International, New Delhi, 1992.
5. Ibrahim Zeid - CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd.,Company Ltd., New Delhi, 1992.
6. Mikell P.Groover - Automation , Production Systems and Computer IntegratedManufacturing, Second edition, Prentice Hall of India, 2002.
7. S.Kant Vajpayee - Principles of Computer Integrated Manufacturing, Prentice Hall ofIndia, 1999.
8. David Bed worth - Computer Integrated Design and Manufacturing, TMH, 1998.

CAD/CAM LAB

L-T-P
0-0-2

List of Experiments: (Total EIGHT Experiments are to carried out. FOUR Experiments each from CAD and CAM.)

A. CAD Experiments:

1. Line Drawing or Circle Drawing experiment: Writing and validation of computer program.
2. Geometric Transformation algorithm experiment for translation/rotation/scaling: Writing and validation of computer program.
3. Design of machine component or other system experiment: Writing and validation of computer program.
4. Understanding and use of any 3-D Modelling Software commands.
5. Pro/E/Idea etc. Experiment: Solid modelling of a machine component.
6. Writing a small program for FEM for 2 spring system and validation of program or using a FEM Package.
7. Root findings or curve fitting experiment: Writing and validation of computer program.
8. Numerical differentiation or numerical integration experiment: Writing and validation of computer program.

B. CAM Experiments:

1. To study the characteristic features of CNC machine.
2. Part Programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC machine.
3. Part Programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine.
4. Part Programming (in word address format or ATP) experiment for milling operation (contouring) and running on CNC machine.
5. Experiment on Robot and programs.
6. Experiment on Transfer line/Material handling.
7. Experiment on difference between ordinary and NC machine, study or retrofitting.
8. Experiment on study of system devices such as motors and feedback devices.
9. Experiment on Mechatronics and controls.

AUTOMATION & ROBOTICS LAB

L-T-P
0-0-2

List of Experiments: The practical can include the following topics:

UNIT-I:
Artificial Muscles:
After a general overview of artificial muscle technologies used in robotics, the students fabricate dielectric elastomer actuators (DEAs) by hand and test the mechanical and electrical properties of their devices, comparing their results with theoretical predictions.

UNIT-II:
Outdoor Flying Robots:
This is a practical exercise on the design of a combined altitude and speed controller for a miniature autonomous airplane.
Mobile robot position estimation and navigation:
The goal of this practical is to implement position estimation and navigation on a real mobile robot.

UNIT-III:
Teaching Robots to Accomplish a Manipulation Task:
In this robotic practical, the student will be teaching a robot to build a tower by stacking several objects on top of each other.
Industrial Robot Control:
The goal is to control a robot specifically designed for tasks such as assembly, manipulation or packaging where there is need of fast and precise actions.

UNIT-IV:
Haptics:
After a brief overview of the state of the art of haptic devices, the students need to generate useful sensations in respect to a give problem, study the type of sensations that can be produced, as well as how they can be programmed.
Assembly, programming and characterization of a modular fish robot:
This practical is aimed at realizing a swimming fish robot using the same modules used for the Salamandra robotica II and AmphiBot III robots.

DEPARTMENTAL ELECTIVE-III

COMPOSITE MATERIALS

L-T-P
3-0-0

UNIT-I

Overview of Composite material:

Classifications of Engineering Materials, Concept of composite materials.

Matrix materials, Functions of a Matrix, Desired Properties of a Matrix, Polymer Matrix (Thermosets and Thermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc.

UNIT-II

Types of Reinforcements/Fibers:

Role and Selection of reinforcement materials.

Types of fibres: Glass fibers, Carbon fibers, Aramid fibers, Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers, Quartz and Silica fibers, Multiphase fibers, Whiskers, Flakes etc.

Mechanical properties of fibres:

Material properties that can be improved by forming a composite material and its engineering potential.

UNIT-III

Various types of composites:

Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC), Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramic matrix composites (CMC).

Classification based on reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites.

UNIT-IV

Fabrication methods:

Processing of Composite Materials: Overall considerations, Autoclave curing, Other Manufacturing Processes like filament welding, compression moulding, resin transplant method, pultrusion, pre-peg layer, Fiber-only performs, Combined Fiber-Matrix performs.

Manufacturing Techniques: Tooling and Specialty materials, Release agents, Peel plies, release films and fabrics, Bleeder and breather plies, bagging films, maximum stress and strain criteria, Von Mises Yield criterion for isotropic materials.

UNIT-V

Testing of Composites and Analysis:

Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc.

Analysis of laminated plates: equilibrium equations of motion, energy formulation, static bending analysis, buckling analysis, free vibrations, natural frequencies.

Books and References:

1. Materials characterization, Vol. 10, ASM hand book.
2. Mechanical Metallurgy, by G. Dieter, McGraw Hill.
3. Analysis and Performance of Fiber Composites, by Agarwal, McGraw Hill.
4. Thermal Analysis of Materials, by R.F. Speyer, Marcel Decker.
5. Engineering Mechanics and Composite Materials, by Daniels, Oxford University Press.
6. Material Science and Engineering (SIE) with CD, by Smith, McGraw Hill.
7. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.
8. Engineering Materials: Polymers, Ceramics and Composites, by A.K Bhargava Prentice Hall India.

ADVANCED MATERIAL TECHNOLOGY

L-T-P
3-0-0

UNIT-I:

Overview:

Intelligent / Smart materials – Functional materials – Polyfunctional materials – Structural materials, Electrical materials, bio-compatible materials. – Intelligent biological materials – Biomimetics – Wolff's Law – Biocompatibility.

Material response: swelling and leaching, corrosion and dissolution, deformation and failure, friction and wear – host response: the inflammatory process – coagulation and hemolysis – in vitro and in vivo evaluation of biomaterials.

UNIT-II

Electro-Rheological & piezoelectric materials:

The principal ingredients of smart materials –microsensors- hybrid smart materials - an algorithm for synthesizing smart materials – active, passive reactive actuator based smart structures-suspensions and electro-rheological fluids.

Bingham body model – principal characteristics of electro-rheological fluids – charge migration mechanism for the dispersed phase – electro- rheological fluid domain – fluid actuators- design parameter – application of Electo-rheological fluids.

Basics, Principles and instrumentation and application of Magnetorheological fluids – Piezoelectric materials: polymers and ceramics, mechanism, properties and application. Introduction to electro-restrictive and magneto-restrictive materials.

UNIT-III:

Shape memory materials:

Nickel – Titanium alloy (Nitinol) – Materials characteristics of Nitinol – martensitic transformations – austenitic transformations – thermoelastic martensitic transformations.

Classification of SMA alloys- mechanism of magnetic SMA – applications of SMA – continuum applications of SMA fasteners – SMA fibers – reaction vessels, nuclear reactors, chemical plant, etc. – micro robot actuated by SMA.

SMA memorization process (Satellite Antenna Applications) SMA blood clot filter – Impediments to applications of SMA – Shape memory polymers– mechanism of shape memory-Primary moulding – secondary moulding– types and applications.

UNIT-IV:

Orthopaedic and dental materials:

Bone and teeth composition, formation and properties – bioresorbable, bioinert, bioactive materials - temporary fixation devices – joint replacement.

Biomaterials used in bone and joint replacement metals and alloys- Fillings and restoration materials – Materials for oral and maxillofacial surgery – dental cements and dental amalgams – dental adhesives- bone tissue engineering.

UNIT-V:

Applications of materials:

Blood clotting – blood theology– approaches to thrombo resistance materials development– blood vessels – The heart – aorta and valves – geometry of blood circulation – cardiac pacemakers – blood substitutes – extracorporeal blood circulation devices.

The lungs – vascular implants: vascular graft, cardiac valve prostheses, card– Biomaterials in

opthalmology –skin grafts -connective tissue grafts – tissue adhesives – drug delivery methods and materials.

Books and References:

1. Sujata V., Bhat., "Biomaterials", Narosa Publication House, New Delhi, 2002.
2. M. V. Gandhi and B. S. Thompson, "Smart Materials and Structures", Chapman and Hall, London, First Edition, 1992.
3. Duerig,T. W., Melton, K. N, Stockel, D. and Wayman, C.M., "Engineering aspects of Shapememory Alloys", Butterworth – Heinemann, 1990.
4. Rogers, C. A., Smart Materials, "Structures and Mathematical issues", Technomic Publishing Co., U.S.A, 1989.
5. Mohsen Shahinpoor and Hans-Jo¨rg Schneider "Intelligent Materials", RSC Publishing,2008.
6. Mel Schwartz (Ed), Encyclopaedia of Smart Materials" Volume –I and II, John Wiley & Sons, Inc.2002.
7. Buddy D. Ratner (Editor), Allan S. Hoffman (Editor), Frederick J. Schoen (Editor), Jack E. Lemons, "Biomaterials Science: An Introduction to Materials in Medicine", Academic Press,2nd edition, 2004.

QUALITY ENGINEERING IN MANUFACTURING

L-T-P
3-0-0

UNIT-I:

Overview:

Different Definitions and Dimensions of Quality, Historical Perspective (From Evolution of Quality Control, Assurance and Management to Quality as Business Winning Strategy), Contribution of Renowned Quality Gurus (Their Philosophies and Impact on Quality).

UNIT-II:

Quality Engineering and Management Tools, Techniques & Standards:

7 QC tools, 7 New Quality Management Tools, 5S Technique, Kaizen, Poka-Yoke, Quality Circle, Cost of Quality Technique.

Introduction to Quality Management Standards – ISO: 9000, ISO:14000, QS:9000 (Concept, Scope, Implementation Requirements & Barriers, and Benefits), Introduction to National and International Quality Awards (Malcolm Baldrige National Quality Award – MBNQA, The Deming Prize Rajiv Gandhi National Quality Award).

UNIT-III:

Total Quality Management:

Basic Philosophy, Approach, Implementation Requirements & Barriers.

Designing for Quality:

Introduction to Concurrent Engineering, Quality Function Deployment (QFD) and Failure Mode and Effect Analysis (FMEA) – Concept, Methodology and Application (with case studies).

UNIT-IV:

Introduction to Design of Experiments:

Introduction, Methods, Taguchi approach, Achieving robust design, Steps in experimental design.

UNIT-V:

Contemporary Trends in Quality Engineering & Management:

Just in time (JIT) Concept, Lean Manufacturing, Agile Manufacturing, World Class Manufacturing, Total Productive Maintenance (TPM), Bench Marking, Business Process Re-engineering (BPR).

Six Sigma - Basic Concept, Principle, Methodology, Implementation, Scope, Advantages and Limitation of all as applicable.

Quality in Service Sectors:

Characteristics of Service Sectors, Quality Dimensions in Service Sectors, Measuring Quality in Different Service Sectors.

Books and References:

1. Quality Assurance and Total Quality Management (ISO 9000, QS 9000 ISO 14000) by K C Jain and A K Chitale, Khanna Publishers.
2. Quality Control & Application by B. L. Hanson & P. M. Ghare, Prentice Hall of India.
3. Total Quality Management by Dale H. Besterfield, Carol Besterfield-Michna, Glen H. Besterfield and Mary Besterfield-Sacre, Pearson Educaiton.
4. Quality Management by Kanishka Bedi.
5. Total Quality Management – Dr. S. Kumar, Laxmi Publication Pvt. Ltd.
6. Total Quality Management by K C Arora, S K Kataria& Sons.
7. Statistical Quality Control by M. Mahajan, Dhanpat Rai & Co. (P) Ltd.

ADDITIVE MANUFACTURING

L-T-P
3-0-0

UNIT-I

Overview of AM:

History and Advantages of Additive Manufacturing, Distinction Between Additive Manufacturing and CNC Machining, Types of Additive Manufacturing Technologies, Nomenclature of AM Machines.

Direct and Indirect Processes:

Prototyping, Manufacturing and Tooling.

Layer Manufacturing Processes:

Polymerization, Sintering and Melting, Extrusion, Powder-Binder Bonding, Layer Laminate Manufacturing, Other Processes; Aerosol printing and Bio plotter.

UNIT-II

Development of Additive Manufacturing Technology:

Computer Aided Design Technology, Other Associated Technology, Metal and Hybrid Systems.
Generalized Additive Manufacturing Process Chain;The Eight Steps in Additive Manufacturing, Variation from one AM Machine to Another, Metal System, Maintenance of Equipment, Material Handling Issue, Design of AM.

UNIT-III

Additive Manufacturing Processes:

Vat Photopolymerization, Materials, Reaction Rates, Photopolymerization Process Modelling, Scan Patterns.

Powder Bed Fusion Processes:

Material, Powder Fusion Mechanism, Process Parameters and Modelling, powder Handling. Extrusion Based System: Basic principles, plotting and Path Control, Bio extrusion, Other Systems.

Material Jetting:

Materials, Material Processing Fundamentals, Material Jetting Machines. Binder Jetting:Materials, Process Variations, BJ Machines. Sheet lamination Processes:Materials, Ultrasonic Additive Manufacturing.

Directed Energy Deposition Processes:

General DED Process Description, Material Delivery, DED systems, Process Parameters, Processing-Structure-Properties Relationships.

Direct Write Technologies:

Ink-Based DW, laser Transfer DW, Thermal Spray DW, Beam Deposition DW, Liquid Phase Direct Deposition, Hybrid Technologies.

UNIT-IV

Design & Software Issues:

Additive Manufacturing Design and Strategies; Potentials and Resulting Perspectives, AM based New Strategies, Material Design and Quality Aspects for Additive Manufacturing; Material for AM, Engineering Design Rules for AM.

Software Issue for Additive Manufacturing:

Introduction, Preparation of CAD Models: The STL file, Problem with STL file, STL file Manipulation, Beyond the STL file, Additional Software to Assist AM.

UNIT-V

Material Design & Quality Aspects:

Machines for Additive Manufacturing, Printers, Secondary Rapid Prototyping processes, Intellectual Property, Product Development, Commercialization, Trends and Future Directions in Additive Manufacturing, Business Opportunities

Applications:

Aerospace, Automotive, Manufacturing, Architectural Engineering, Art, Jewellery, Toys, Medical, Biomedical, Dental, Bio-printing, Tissue & Organ Engineering and many others.

Books and References:

1. Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, by- Ian Gibson, D Savid W. Rosen, Brent Stucker, Springer.
2. Additive Manufacturing, by- Amit Bandyopadhyay, Susmita Bose, CRC Press.
3. Rapid Prototyping: Principles and Applications, by - Chee Kai Chua, Kah Fai Leong, Chu Sing Lim.
4. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing by Ian Gibson and David Rosen.
5. Additive Manufacturing of Metals: From Fundamental Technology to Rocket Nozzles, Medical Implants, and Custom Jewelry (Springer Series in Materials Science) by John O Milewski.
6. Additive Manufacturing: Advanced Manufacturing Technology in 3d Print Deposit by SabrieSoloman.
7. Advances in 3D Printing and Additive Manufacturing Technologies by David Ian Wimpenny and Pulak M Pandey.
8. Understanding Additive Manufacturing, by- Andreas Gebhardt, Hanser.

DEPARTMENTAL ELECTIVE-IV

OPERATIONS RESEARCH

L-T-P
3-1-0

UNIT-I

Overview of OR:

Basic of Operation Research, Origin & development of Operation Research, Applications.

Linear Programming:

Introduction & Scope, Problem formulation, Graphical Method, Simplex methods, primal and dual problem sensitivity analysis.

UNIT-II

Transportation Problem:

Methods of obtaining initial and optimum solution, degeneracy in transportation problems, unbalanced Transportation Problem.

Assignment Problem:

Methods of obtaining optimum solution, Maximization problem, travelling salesman problem.

UNIT-III

Game Theory:

Two-person Zero sum game, Solution with/without saddle point, dominance rule, Different methods like Algebraic, Graphical and game problem as a special case of Linear Programming.

Sequencing:

Basic assumptions, n Jobs through 2-3 machines, 2 Jobs on m machines.

UNIT-IV

Stochastic inventory models:

Single & multi period models with continuous & discrete demands, Service level & reorder policy.

Simulation:

Use, advantages & limitations, Monte-Carlo simulation, Application to queuing, inventory & other problems.

UNIT-V

Queuing models:

Characteristics of Queuing Model, M/M/1 and M/M/S system, cost consideration.

Project management:

Basic Concept of network Scheduling, Rules for drawing network diagram, Applications of CPM and PERT techniques in Project planning and control; crashing of operations; resource allocation.

Books and References:

1. Operations Research: Principles and Practice, by- Ravindran, Phillips, Solberg, John Wiley & Sons.
2. Principal of Operation Research, by- Harvey M. Wagner, Prentice Hall.
3. Introduction to Operation Research, by- Gillett, McGraw Hill.
4. Operations Research - An Introduction, by- Hamdy A. Taha, Pearson India.
5. Operation Research, by- Wayne L. Winston, Thomsan Learning.
6. Problems in Operations Research by- Prem Kumar Gupta & D.S. Hira, S. Chand.
7. Operation Research Application and Algorithms, by- Wayne L Winston, Duxbury Press.
8. Operations Research, by Jha, McGraw Hill.
9. Operation Research, by Yadav & Malik Oxford University Press.

REVERSE ENGINEERING

L-T-P
3-1-0

UNIT-I:
Introduction to New Product Development.
Tasks of detailed design, new frontiers of Computer-Aided Design tools.

UNIT-II:
Reverse Engineering:
Objectives and common application fields.
Existing technologies.
Contact systems.
Non-contact systems.
Manipulation of acquired data.
Practical experiences.

UNIT-III:
Introduction to the Basic Principles of Additive Manufacturing.
Design for Additive Manufacturing.

UNIT-IV:
Rapid Prototyping technologies:
For polymers with a particular focus on Stereolithography (SLA) and Fused Deposition Modelling (FDM).
For metals.
For other materials.
Practical experiences.

UNIT-V:
Employment of Reverse Engineering and Rapid Prototyping technologies in different industrial fields with an outlook on the South Tyrolean industrial fabric.

Books and References:
1. Eldad Eilam's Reversing: Secrets of reverse engineering.
2. Hacking the Xbox: An Introduction to Reverse Engineering.
3. The IDA Pro Book: The Unofficial Guide to the World's Most Popular Disassembler.
4. The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux, and Mac Memory.
5. Practical Malware Analysis: The Hands-On Guide to Dissecting Malicious Software.
6. The Rootkit Arsenal: Escape and Evasion in the Dark Corners of the System 2nd Edition.
7. Practical Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and obfuscation.

DECISION SUPPORT & INTELLIGENT SYSTEM

L-T-P
3-1-0

UNIT-I:

Management Support Systems: An Overview:

Managers and Decision-Making; Managerial Decision-Making and Information Systems; Managers and Computer Support; Computerized Decision Support and the Supporting Technologies.

A Framework for Decision Support; The Concept of Decision Support Systems; Group Support Systems; Enterprise Information Systems; Knowledge Management Systems; Expert Systems; Artificial Neural Networks; Advanced Intelligent Decision Support Systems; Hybrid Support Systems.

Decision-Making Systems, Modelling, and Support:

Decision-Making: Introduction and Definitions; Systems; Models; Phases of the Decision-Making Process.

Decision-Making: The Intelligence Phase; Decision-Making: The Design Phase; Decision-Making: The Choice Phase.

Decision-Making: The Implementation Phase; How Decisions Are Supported; Personality Types, Gender, Human Cognition, and Decision Styles; The Decision-Makers.

UNIT-II:

Decision Support Systems:

DSS Configurations; What Is a DSS? Characteristics and Capabilities of DSS; Components of DSS; The Data Management Subsystem.

The Model Management Subsystem; The User Interface (Dialog) Subsystem; The Knowledge-Based Management Subsystem; The User; DSS Hardware; DSS Classifications.

Modelling and Analysis:

Modelling; Static and Dynamic Models; Certainty, Uncertainty, and Risk; Influence Diagrams; MSS Modelling with Spreadsheets; Decision Analysis of a Few Alternatives.

The Structure of MSS Mathematical Models; Mathematical Programming Optimization; Multiple Goals, Sensitivity Analysis, What-If, and Goal Seeking.

Problem-Solving Search Methods; Heuristic Programming; Simulation; Visual Interactive Modelling and Visual Interactive Simulation; Quantitative Software Packages; Model Base Management.

Decision Support System Development:

Introduction to DSS Development; The Traditional System Development Life cycle; Alternative Development Methodologies.

Prototyping: The DSS Development Methodology; Change Management; DSS Technology Levels and Tools; DSS Development Platforms; DSS Development Tool Selection; Team-Developed DSS; End User Developed DSS; Putting the DSS together.

UNIT-III:

Knowledge Management:

Introduction to Knowledge Management; Organizational Learning and Transformation; Knowledge Management Initiatives; Approaches to Knowledge Management; Information Technology in Knowledge Management.

Knowledge Management Systems Implementation; Roles of People in Knowledge Management; Ensuring Success of Knowledge Management.

UNIT-IV:

Artificial Intelligence and Expert Systems: Knowledge-Based Systems:

Concepts and Definitions of Artificial Intelligence; Evolution of Artificial Intelligence; The Artificial Intelligence Field; Basic Concepts of Expert Systems; Applications of Expert Systems.

Structure of Expert Systems; How Expert Systems Work; Problem Areas Suitable for Expert Systems; Benefits and Capabilities of Expert Systems.

Problems and Limitations of Expert Systems; Expert System Success Factors; Types of Expert Systems; Expert Systems on the Web.

Knowledge Acquisition, Representation, and Reasoning:

Concepts of Knowledge Engineering; Scope and Types of Knowledge; Methods of Knowledge Acquisition from Experts; Knowledge Acquisition from Multiple Experts; Automated Knowledge Acquisition from Data and Documents.
Knowledge Verification and Validation; Representation of Knowledge; Reasoning in Rule-Based Systems; Explanation and Metaknowledge; Inferencing with Uncertainty; Expert Systems Development; Knowledge Acquisition and the Internet.

UNIT-V:

Advanced Intelligent Systems:

Machine-Learning Techniques; Case-Based Reasoning; Basic Concept of Neural Computing; Learning in Artificial Neural Networks; Developing Neural Network-Based Systems.
Genetic Algorithms Fundamentals; Developing Genetic Algorithm Applications; Fuzzy Logic Fundamentals; Developing Integrated Advanced Systems.

Intelligent Systems over the Internet:

Web-Based Intelligent Systems; Intelligent Agents: An Overview; Characteristics of Agents; Why Intelligent Agents?
Classification and Types of Agents; Internet-Based Software Agents; DSS Agents and Multi-Agents; Semantic Web: Representing Knowledge for Intelligent Agents; Web-Based Recommendation Systems; Managerial Issues of Intelligent Agents.

Books and References:

1. Decision Support Systems and Intelligent Systems, Seventh Edition, Efraim Turban, Jay E. Aronson, Richard V. McCarthy, Prentice-Hall of India, 2007.
2. Decision Support Systems, A Knowledge-Based Approach, Clyde W. Holsapple and Andrew B. Whinston.
3. Business Intelligence and Analytics: Systems for Decision Support" by Ramesh Sharda and DursunDelen.
4. Decision Support and Business Intelligence Systems" by Efraim Turban and Ramesh E Sharda.
5. Decision Making and Knowledge Decision Support Systems" by Anna Maria Gil-Lafuente and Constantin Zopounidis.
6. Decision Support, Analytics, and Business Intelligence (Information Systems Collection)" by Daniel J Power.
7. Fuzzy Sets, Decision Making, and Expert Systems (International Series in Management Science Operations Research)" by Hans-Jürgen Zimmermann.
8. Decision Support Systems for Business Intelligence by Vicki L. Sauter.

PROCESS PLANNING AND COST ESTIMATION

L-T-P
3-1-0

UNIT-I:
Overview of process planning:
Introduction- methods of process planning-Drawing Interpretation-Material evaluation – steps in process selection-. Production equipment and tooling selection.

UNIT-II:
Process planning activities:
Process parameters calculation for various production processes-Selection jigs and fixtures electionof quality assurance methods - Set of documents for process planning-Economics of process planning- case studies.

UNIT-III:
Introduction to cost estimation:
Importance of costing and estimation –methods of costing-elements of cost estimation.
Types of estimates – Estimating procedure- Estimationlabour cost, material cost- allocation of overhead charges- Calculation of depreciation cost.

UNIT-IV:
Production cost estimation:
Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop.

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

Books and References:
1. Peter scalon, “Process planning, Design/Manufacture Interface”, Elsevier science technologyBooks, Dec 2002.
2. Ostwalal P.F. and Munez J., “Manufacturing Processes and systems”, 9th Edition, John Wiley,1998.
3. Russell R.S and Tailor B.W, “Operations Management”, 4th Edition, PHI, 2003.
Chitale A.V. and Gupta R.C., “Product Design and Manufacturing”, 2nd Edition, PHI, 2002.
4. Process planning and cost estimation by M. Adithan.
5. Process planning and cost estimation by B. Vijayaramanath.

SEMESTER-VIII

DEPARTMENTAL ELECTIVE-V

DESIGN OF EXPERIMENT

L-T-P
3-1-0

UNIT-I:
Strategy of Experimentation, Typical applications of Experimental design, Basic Principles, Guidelines for Designing Experiments.
Concepts of random variable, probability, density function cumulative distribution function. Sample and population, Measure of Central tendency; Mean median and mode, Measures of Variability, Concept of confidence level. Statistical Distributions: Normal, Log Normal & Weibull distributions. Hypothesis testing, Probability plots, choice of sample size. Illustration through Numerical examples.

UNIT-II:
Classical Experiments: Factorial Experiments: Terminology: factors, levels, interactions, treatment combination, randomization, Two-level experimental designs for two factors and three factors. Three-level experimental designs for two factors and three factors, Factor effects, Factor interactions, Fractional factorial design, Saturated Designs, Central composite designs. Illustration through Numerical examples.
Measures of variability, Ranking method, Column effect method & Plotting method, Analysis of variance (ANOVA) in Factorial Experiments: YATE's algorithm for ANOVA, Regression analysis, Mathematical models from experimental data. Illustration through Numerical examples.

UNIT-III:
Quality, Western and Taguchi's quality philosophy, elements of cost, Noise factors causes of variation. Quadratic loss function & variations of quadratic loss function. Robust Design: Steps in Robust Design: Parameter design and Tolerance Design. Reliability Improvement through experiments, Illustration through Numerical examples.

UNIT-IV:
Types of Orthogonal Arrays, selection of standard orthogonal arrays, Linear graphs and Interaction assignment, Dummy level Technique, Compound factor method, Modification of linear graphs. Illustration through Numerical examples.

UNIT-V:
Evaluation of sensitivity to noise. Signal to Noise ratios for static problems: Smaller-the-better type, Nominal-the –better-type, Larger-the-better type. Signal to Noise ratios for Dynamic problems. Illustration through Numerical examples.
Parameter and tolerance design concepts, Taguchi's inner and outer arrays, parameter design strategy, tolerance design strategy. Illustration through Numerical examples.

Books and References:

1. Statistics for Experimenters: Design, Innovation, and Discovery, 2nd Edition[Hardcover] George E. P. Box (Author) J. Stuart Hunter (Author), William G. Hunter (Author).
2. Design and Analysis of Experiments [Hardcover] Douglas C. Montgomery (Author).
3. Design of Experiments: An Introduction Based on Linear Models (Chapman & Hall/CRC Texts in Statistical Science) [Hardcover] Max Morris (Author).
4. Design and Analysis of Experiments (Springer Texts in Statistics) [Hardcover] Angela M. Dean (Author), Daniel Voss (Author).
5. Experiments: Planning, Analysis, and Optimization (Wiley Series in Probability and Statistics) [Hardcover] C. F. Jeff Wu (Author), Michael S. Hamada (Author).
6. Statistical Design and Analysis of Experiments, with Applications to Engineering and Science [Hardcover] Robert L. Mason (Author), Richard F. Gunst (Author), James L. Hess (Author).

7. Statistical Design and Analysis of Experiments (Classics in Applied Mathematics No 22.) [Paperback] Peter W. M. John (Author).

LEAN MANUFACTURING

L-T-P
3-1-0

UNIT-I:
Overview:
SEVEN forms of waste and their description; Historicalevolution of lean manufacturing;Global competition, Customerrequirements, Requirements of other stake holders.
Meaning of LeanManufacturing System (LMS), Meaning of Value and waste, Need forLMS, Symptoms of underperforming organizations, Meeting thecustomer requirement, Elements of LMS.

UNIT-II:
Primary tools used in LMS:
Meaning and Purpose of 5S Work placeorganization, 5S process – Sort, set in order, Shine, Standardize,Sustain, implementing 5S.
Meaning and purpose of TPM, Pillars ofTPM, Conditions for TPM success, TPM implementation process,Overall Equipment Effectiveness and problems on computation ofOEE.

UNIT-III:
Process Mapping and Value StreamMapping (VSM) – Need for process maps, advantages, types and itsconstruction, steps in preparing VSM.
Concept of work Cell and itsdesign, Line balancing algorithms and problems.

UNIT-IV:
Secondary tools used in LMS:
Cause and effect diagram, Pareto chart,Radar chart, Poke Yoke, Kanban, Automation, SMED, Standardizedfixture, DFMA, JIT.
Visual workplace, problems on Pareto analysis andcomputation of number of kanbans.

UNIT-V:
LMS Rules:
Stability, Management, Standardized work, Pull system,Continuous improvement. Lean Implementation: Training, selectingthe projects, preparing project charter, project implementation, Projectreview.
Implementing LMS for higher productivity: Operator, process,machinery and equipment, workplace organization, Inventory, LMSDesign Process.

Books and References:
1. N. Goplakrishnan, Simplifed Lean Manufacture, PHI, 2010.
2. Pascal Dennis, Lean Production Simplified, Productivity Press, 2007.
3. Creating a Kaizen Culture (2013) by Jon Miller, Mike Wroblewski and Jaime Villafuerte.
4. The Lean Turnaround (2012) by Art Byrne.
5. The Toyota Production System: Beyond Large-Scale Production (1988) by Taiichi Ohno.
6. Out of the Crisis (1986) by W. Edwards Deming.
7. Jeffrey Liker, The Toyota Way, Tata McGraw-Hill, 2004

PROJECT MANAGEMENT

L-T-P
3-1-0

UNIT-I:
Project Management Concepts:
Introduction, project characteristics, taxonomy of projects, project identification and formulation. Establishing the project and goals.
Nature & context of project management; phases of PM, A framework for PM issues, PM as a conversion process, project environment & complexity.
Organizing human resources, organizing systems & procedures for implementation. Project direction.

UNIT-II:
Project Organization & Project Contracts:
Introduction, functional organization, project organization, matrix organization, modified matrix organization.
Pure project organization, selection of project organization structure, project breakdown structures, project contracts, types of contracts, types of payments to contractors.

UNIT-III:
Project Appraisal & Cost Estimation:
Introduction, technical appraisal, commercial appraisal, economic appraisal, financial appraisal, management appraisal, social cost/benefit analysis, project risk analysis.
Cost analysis of the project, components of capital cost of a project, modern approach to project performance analysis.

UNIT-IV:
Project Planning & Scheduling:
Introduction to PERT & CPM, planning and scheduling networks, time estimation, determination of critical path, CPM model, event slacks & floats, PERT model.
Expected time for activities, expected length of critical path, calculating the project length and variance, PERT & CPM cost accounting systems, lowest cost schedule, crashing of networks, linear programming formulation of event-oriented networks, updating of networks, LOB technique.

UNIT-V:
Modification & Extensions of Network Models:
Complexity of project scheduling with limited resources, resource levelling of project schedules, resource allocation in project scheduling - heuristic solution.
Precedence networking- examples with algorithm, decision networks, probabilistic networks, computer aided project management essential requirements of PM software, software packages for CPM. Enterprise- wide PM, using spread sheets for financial projections.

Books and References:

1. Project Management by Harvey Maylor, Pearson India.
2. Project Management by Choudhury, McGraw Hill.
3. Project Management by K. Nagarajan.
4. Project Management: A Systems Approach to Planning, Scheduling and Controlling, by Kerzner, Willey.
5. Project Management: A Life Cycle Approach by Kanda, PHI, India.
6. Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education, 2004.
7. Tripathy PC & Reddy PN, Principles of Management, Tata McGraw Hill, 1999.
8. Project Management and Appraisal, by Khatua, Oxford University Press.

SUPPLY CHAIN MANAGEMENT

L-T-P
3-1-0

UNIT-I:
Introduction to Supply Chain Management, Understanding the Supply Chain.
Supply Chain Performance: Competitive and Supply Chain Strategies, achieving Strategic Fit and Scope of Strategic Fit.

UNIT-II:
Supply Chain Drivers and Metrics: Drivers of Supply Chain Performance, Framework for structuring Drivers, Facilities, Inventory, Transportation, Information, Sourcing and Pricing, Case Study: Seven-Eleven Japan Company.

UNIT-III:
Planning Demand and Supply in a Supply Chain: Demand Forecasting in a Supply Chain, Aggregate Planning in a Supply Chain.
Designing Distribution Networks and Application to E-Business- Role of distribution, factors influencing distribution network design, design options for a distribution network, E-Business and the distribution network.

UNIT-IV:
Network Design in the Supply Chain- Role of network design in the supply chain, factors influencing network design decisions, framework for network design decisions.
Role of Information Technology in supply chain, coordination in a supply chain, Bullwhip Effect, Effect on performance due to lack of coordination, obstacles to coordination in a supply chain.

UNIT-V:
Factors influencing logistics and decisions.
Benchmarking and performance measurement.

Books and References:
1. Supply Chain Management: Strategy, Planning & Operation- Sunil Chopra & Peter Meindle- Pearson Prentice Hall Publication.
2. Logistical Management: The integrated Supply Chain Process- Donald J. Bowersox & David J. Closs- TMH Publication.
3. Supply Chain Management – Maretin Christopher.
4. World Class Supply Management: The key to Supply Chain Management- Burt, Dobler and Straling – TMH Publication.
5. Logistics and Supply Management – D K Agarwal – MacMillan Publication
6. Supply Chain Management in the 21st Century- B. S. Sahay- MacMillan Publication.
7. Supply Chain Management: Theories & Practices – R P Mohanty and S. G. Deshmukh- Biztantra Publication.
8. e-Procurement: From Strategy to Implementation- Dale Neef- Prentice Hall Publication.

DEPARTMENTAL ELECTIVE-VI

TOTAL QUALITY MANAGEMENT (TQM)

L-T-P
3-0-0

UNIT -I:

Quality Concepts:

Evolution of Quality control, concept change, TQM Modern concept, Quality concept in design.

Control on Purchased Product:

Procurement of various products, evaluation of supplies, capacity verification, Development of sources, procurement procedure.

Manufacturing Quality:

Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims.

UNIT -II:

Quality Management:

Organization structure and design, Quality function, decentralization, Designing and fitting organization for different types products and company, Economics of quality value and contribution, Quality cost, optimizing quality cost, seduction programme.

TQM Principles:

Leadership, strategic quality planning; Quality councils - employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal.

Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

UNIT -III:

Tools and Techniques:

Seven QC tools (Histogram, Check sheet, Ishikawa diagram, Pareto, Scatter diagram, Control chart, flow chart).

Control Charts:

Theory of control charts, measurement range, construction and analysis of R charts, process capability study, use of control charts, P-charts and C-charts.

UNIT -IV:

Defects Diagnosis and Prevention:

Defect study, identification and analysis of defects, corrective measure, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle.

UNIT -V:

IS0 and its concept of Quality Management:

Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation, Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits.

TQM implementation in manufacturing and service sectors, Auditing, Taguchi method, JIT in some details.

Books and References:

1. Total Quality Management, by Dale H. Besterfield, Pearson India.
2. Beyond Total Quality Management, Greg Bounds, McGraw Hill.
3. Besterfield D.H. et al., Total qualityManagement, 3rd ed., Pearson Education Asia, 2006.

4. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.
5. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
6. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.
7. Total Quality Management by Mukherjee, P.N.
8. TQM in New Product manufacturing, H. G. Menon, McGraw Hill.

FLEXIBLE MANUFACTURING SYSTEM

L-T-P
3-0-0

UNIT-I:
Planning, scheduling and control of flexible manufacturing systems:
Introduction To FMS– Development of Manufacturing Systems – Benefits – Major Elements – Types of Flexibility – FMS Application and Flexibility –Single Product, Single Batch, N – Batch Scheduling Problem – Knowledge Based Scheduling System.

UNIT-II:
Computer control and software for flexible manufacturing systems:
Introduction – Composition of FMS– Hierarchy of Computer Control –Computer Control of Work Centreand Assembly Lines – FMS Supervisory Computer Control – Types of Software Specification and Selection – Trends.

UNIT-III:
FMS simulation and data base:
Application of Simulation – Model of FMS– Simulation Software – Limitation – Manufacturing Data Systems – Data Flow – FMS Database Systems – Planning For FMS Database.

UNIT-IV:
Group technology and justification of FMS:
Introduction – Matrix Formulation – Mathematical Programming Formulation –Graph Formulation – Knowledge Based System for Group Technology – Economic Justification Of FMS- Application of Possibility Distributions in FMS Systems Justification.

UNIT-V:
Applications of FMS and factory of the future:
FMS Application in Machining, Sheet Metal Fabrication, Prismatic Component Production – Aerospace Application – FMS Development Towards Factories of The Future – Artificial Intelligence and Expert Systems in FMS – Design Philosophy and Characteristics for Future.

Books and References:

1. Jha, N.K. “Handbook of Flexible Manufacturing Systems”, Academic Press Inc., 1991.

2. Radhakrishnan P. And Subramanyan S., “CAD/CAM/CIM”, Wiley Eastern Ltd., New AgeInternational Ltd., 1994.

3. Raouf, A. And Ben-Daya, M., Editors, “Flexible Manufacturing Systems: RecentDevelopment”, Elsevier Science, 1995.

4. Groover M.P., “Automation, Production Systems And Computer Integrated Manufacturing”, Prentice Hall Of India Pvt., New Delhi, 1996.

5. Kalpakjian, “Manufacturing Engineering And Technology”, Addison-Wesley PublishsingCo., 1995.

6. Taiichi Ohno, “Toyota Production System: Beyond Large-Scale Production”, Productivity Press (India) Pvt. Ltd. 1992.

RELIABILITY ENGINEERING

L-T-P
3-0-0

UNIT-I:
Overview of reliability engineering:
Definition of reliability, Failures & failures modes, Failure rates, MTTF, MTBF, Bath tub curve, Definition and factors influencing system effectiveness, various parameters of system effectiveness.

UNIT-II:
Reliability analysis:
Reliability Mathematics, Definition of probability, laws of probability, conditional probability.
Bay's theorem, Various probability distributions, Data collection, Recovery of data, Data analysis Procedures, Empirical reliability calculations.

UNIT-III:
Types of reliability:
Reliability types, System of series, parallel, series parallel, stand by and complex systems.
Development of logic diagram, Methods of reliability evaluation; Cut set and tie set methods, Matrix methods, Event trees and fault trees methods, Reliability evaluation using probability distributions.
The Weibull distribution and its application in reliability, Markov method, Frequency and duration method.

UNIT-IV:
Improvement in reliability:
Reliability Improvements: Methods of reliability improvement, component redundancy, system redundancy, types of redundancies-series, parallel, series - parallel, stand by and hybrid, effect of maintenance.

UNIT-V:
Testing methods:
Reliability Testing, Life testing, requirements, methods, test planning, data reporting system, data reduction and analysis, reliability test standards.

Books &References:
1. R.Billintan& R.N. Allan,"Reliability Evaluation of Engineering and Systems", Plenum Press.
2. K.C. Kapoor& L.R. Lamberson,"Reliability in Engineering and Design", John Wiely and Sons.
3. S.K. Sinha& B.K. Kale,"Life Testing and Reliability Estimation", Wiely Eastern Ltd.
4. A Birolini. Reliability Engineering-Theory & Practice, Springer.
5. G.H.Sandler,"System Reliability Engineering", Prentice Hall.
6. Inspection quality Control and Reliability by S. C. Sharma.
7. Creating Quality Concepts, Systems & Tools by W.J. Kolarik.
8. D J Smith, Reliability, Maintainability & Risk, Butterworth-Heinemann.

INNOVATION & ENTREPRENEURSHIP

L-T-P
3-0-0

UNIT-I:
Should You Become an Entrepreneur?
What Skills Do Entrepreneurs Need?
Identify and Meet A Market Need.
Entrepreneurs in A Market Economy.
Select A Type of Ownership.

UNIT-II:
Develop A Business Plan.

UNIT-III:
Choose Your Location and Set Up for Business.
Market Your Business.
Hire and Manage A Staff.

UNIT-IV:
Finance, Protect and Insure Your Business.
Record Keeping and Accounting.
Financial Management.

UNIT-V:
Meet Your Legal, Ethical, Social Obligations.
Growth in Today's Marketplace.

Books &References:

1. Entrepreneurship Ideas in Action—South-Western, 2000.

2. Innovation and Entrepreneurship by Peter Drucker.

3. Running Lean: Iterate from Plan A to a Plan That Works by Ash Maurya.

4. The Ten Faces of Innovation by Tom Kelley and Jonathan Littman.

5. The Innovator's Dilemma by Clayton M. Christensen.

6. The Invisible Advantage: How to Create a Culture of Innovation by Soren Kaplan.