Maharshi Dayanand University Rohtak

Syllabus and Courses of Reading
for

M.Tech (Mechanical Engineering)
(Manufacturing and Automation)

Examination

Session — 2011-2012

Available from :

Incharge (Publication)
Maharshi Dayanand University
Rohtak-124 001 (Haryana)

Price :

At the Counter : Rs. 50/-
By Regd. Parcel : Rs. 90/-
By Ordinary Post : Rs. 70/-

M.TECH (MANUFACTURING AND AUTOMATION)
SYLLABUS 20011-12

The Credit requirements of the course : 65
Core courses : 10
Programme Elective Courses : 02
General Elective : 01

CORE COURSES

First Semester

Subject Code	Subject	Credit	(L-T-P)	Marks Theory	Weightage Sessional
831	Metal Forming Analysis	3	3-0-0	100	50
832	Welding and allied processes	3	3-0-0	100	50
833	Mechatronics & product design	3	3-0-0	100	50
834	Design, Planning and control of production systems	3	3-0-0	100	50
835	Foundry Technology	3	3-0-0	100	50
				Ext.	**Int.**
836	Computational Lab	1	0-0-2	25	25
837	Welding Lab	1	0-0-2	25	25
838	Mechatronics Lab	1	0-0-2	25	25
917	Crash Course	0	3-0-0	*	
	Total	**18**	**18-0-6**	**575**	**325**

* Student has to pass the examination No. credit is given for this subject

SECOND SEMESTER

Subject Code	Subject	Credit	(L-T-P)	Marks Theory	Weightage Sessional
904	Project Management	3	3-0-0	100	50
906	Mechanical Design I	4	3-2-0	100	50
--	Prog. Elective I	3	3-0-0	100	50
--	Prog. Elective- II	3	3-0-0	100	50
908	Automation in Mfg.	3	3-0-0	100	50
				Ext.	**Int.**
912	Automation Lab	1	0-0-2	25	25
914	CAD/CAM Lab	1	0-0-2	25	25
916	Cultural awareness & Communication	1	3-0-0	*	
	Total	**18**	**18-2-4**	**550**	**300**

* Student has to pass the examination No. credit is given for this subject

Third Semester

Subject Code	Subject	Credit	(L-T-P)	Marks Theory	Weightage Sessional
951	Mechanical Design II	4	3-2-0	100	50
953	Simulation and Analysis	3	3-0-0	100	50
--	General Elective	3	3-0-0	100	50
				Ext.	**Int.**
955	CIM Lab	1	0-0-2	25	25
957	Seminar	1	0-0-2	25	25
959	Minor Project	5	0-0-10	100	100
	Total	**17**	**9-2-14**	**425**	**325**

Note : The student will have to select one subject from list of Program Elective-I and one subject from list of Program Elective-II and one subject from list of General Elective as under :

LIST OF PROGRAM ELECTIVE - I

921 ROBOTIC ENGINEERING
923 INDUSTRIAL INSPECTION
925 QUALITY CONTROL TECHNIQUES
927 DESIGN AND METALLURGY OF WELDED JOINTS

LIST OF PROGRAM ELECTIVE - II

970 AUTOMOBILE ENGINEERING
972 FINITE ELELMENT METHOD
974 MACHINE TOOL DYNAMICS
976 ARTIFICIAL INTELLIGENCE IN MANUFACTURING

LIST OF GENERAL ELECTIVE - II

980 VALUE ENGINEERING
982 ADVANCED THEORY OF VIBRATIONS
984 ENERGY, ECOLOGY AND ENVIRONMENT
986 TOTAL QUALITY MANAGEMENT
988 COMPUTER INTERGRATED MFG.

FOURTH SEMESTER

Subject Code	Subject	Credit	(L-T-P)	Marks External	Weightage Sessional
952	Major Project	12	0-0-24	400	100
	Total	**12**	**0-0-24**	**400**	**100**

M.D. University, Rohtak (Haryana)
Scheme of Studies & Examination for
Master of Technology in Mechanical Engineering
(Specialization : Manufacturing & Automation)

The performance of the student of M.Tech Electrical Device & Power System Course shall be graded on the basis of percentage of marks and corresponding grades as mentioned below :

A)

Marks		Grade		Marks
85	≤	A+	≤	100
75	≤	A	<	85
65	≤	B	<	75
50	≤	C	<	65
40	≤	D	<	50
00	≤	E	<	40

Letter Grades	Performance	Division
A+	Excellent	First
A	Very Good	First
B	Good	First
C	Fair	Second
D	Pass	Third
E	Repeat	Fail

Note : The candidate who have passed all the semesters examination in the first attempt obtaining at least 75% marks in aggregate shall be declared to have passed in the first division with Distinction mentioned in the degree.

B) Actual percentage of Marks Obtained and Corresponding grades should be mentioned on detailed marks certificate of student. To obtain 'D' grade a student must have secure at least 40% marks in eac subject of the semester Examination.

C) Student who earned and 'E' grade or less than 40% marks in any subject shall have reappear in that subject.

831 : METAL FORMING ANALYSIS

L	T	P
3	0	0

Sessional : 50 Marks
Theory : 100 Marks
Total : 150 Marks
Duration of Exam : 3 Hrs.

Stress- Strain relations in Elastic and plastic Deformations, Yield Criteria for Ductile Metals, Work hardening and Anisotropy in Yielding, Flow Curves. Formulations of plastic deformation problems, application of theory of plasticity for solving metal forming problems using Slab method, Upper and lower Bound methods, Slip line field theory.

Effects of temperature and strain rate in metal working, friction and lubrication in Hot and Cold working.

Technology and analysis of important metal forming processes- Forging, Roiling, Extrusion. Wire drawing, Sheet Metal forming processes like Deep drawing, Stretch forming, Bending

Application of Finite Element Methods to Metal Forming Processes- special Discretization, Shape function, Stiffness matrices and their assembly, Implicit and explicit formulations, Elasto-plastic approximations, Lagrangian Vs Eularian schemes, Material integration schemes, auxiliary equations for contact, friction and incompressibility, Thermo-mechanical problem formulation, steady state solutions for Drawing, Forging, rolling and extrusion problems

Case Studies- analysis and validation of metal forming processes problems by standard softwares.

Forming defects in products and their critical effects, remedies.

An introduction to use of International standards in Metal Forming Problem solutions and system Design.

REFERENCE BOOKS:

1. Metal Forming Analysis- R. H. Wagoner, Cambridge University Press.
2. Theory of Elasticity- Dally and Riley
3. Mechanical Metallurgy- Dieter, McGraw Hill Inc.

   Metal Forming Handbook by H Frontzek, M Kasparbauer , Springer Verleg

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only five questions.

832 : WELDING AND ALLIED PROCESSES

L T P — Sessional : 50 Marks

3 0 0 — Theory : 100 Marks

Total : 150 Marks

Duration of Exam : 3 Hrs.

Review of welding processes like gas, arc and resistance welding.

Welding Power Sources: Types of power sources, External V-I characteristics for constant current and constant voltage power sources, Rectifiers, Solid-state Rectifiers, Inverter systems, Duty cycle.

Arc welding consumables : Types of electrodes, AWS and Indian system of classification and coding of covered electrode for mild steel, Shielding gases and associated mixtures.

Metal transfer : Short circuit/ dip transfer. Free flight. Globular type. Spray type, Forces affecting metal transfer. Weld bead geometry and shape factors, Weld dilution.

Arc welding processes : Electric arc welding principle, MIG: - welding equipment and processes, shielding gas, types of metal transfer. Tungsten inert gas arc welding (GTAW): - welding equipment, electrodes, inert gases and torches. Submerged arc welding (SAW):- principle of processes, applications, fluxes and welding electrodes used. CO_2 welding: - difference from MIG welding, Principle of operation, equipment, welding parameters and applications.

Solid state welding: Introduction, main features and applications of Ultrasonic welding, Friction welding and Explosive welding.

Welding of plastics: Difficulties in welding of Plastics, Processes for welding of Plastics.

Weldability of specific materials: Stainless Steel, Aluminum and Cast Iron,

Surfacing and metal spraying: Surfacing methods such as SMAW, MIG, TIG, SAW.Thermal spraying: Introduction, Procedures, Applications, Advantages and Disadvantages.

Thermal cutting of metals: introduction, types, principle and operation of flame and plasma cutting.

Under water Welding: Introduction, methods and applications.

Automation in Welding: Introduction, Semiautomatic welding, Automatic welding, Welding mechanization, Flexible Automated Welding, Robotic welding, Types of Welding Robots, Robot Selection Mechanics, Joint tracking system.

REFERENCE BOOKS:

1. Modern welding technology:- carry H. B. (PH).
2. Weldin" technology :- A. C. Devis
3. Welding and welding Technology :- Little (TMH)
4. Welding technology :- R. S. Parmar

5. AWS- welding handbook (IV - VI) Edition

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only five questions.

833 : MECHATRONICS PRODUCT DESIGN

L T P — Sessional : 50 Marks

3 0 0 — Theory : 100 Marks

Total : 150 Marks

Duration of Exam : 3 Hrs.

Introduction to Mechatronics systems and components, Principles of basic electronics - Digital logic, number system logic gates, Sequence logic flip flop system, JK flip flop, D-flip flop.

Microprocessors and their applications - Microcomputer computer structure/rnicrocontrolles, Integrated circuits - signal conditioning processes, various types of amplifiers, low pass and high pass filters.

Sensors -sensors and transducers. Displacement, position proximity sensors, velocity, force sensors. Fluid pressure temperature, liquid level and light sensors. Selection of sensors., Actuators, Pneumatic and hydraulic systems, Mechanical actuation system. Electrical actuation system. Other Electrical/ Electronic hardware in Mechatronic system.

Principles of Electronic system communication, Interfacing, A.D. and D.A.converters. Software and hardware principles and tools to build mechatronic systems., Basic system models mathematical models, mechanical and other system Building blocks.

System models - Engg. Systems, rotational, translation, elected mechanical, Hydraulic mechanical system., System Transfer functions. First-second order system in series.

Design and selection of Mechatronics systems namely sensors line encoders and revolvers, stepper and servomotors Ball screws, solenoids, line actuators and controllers with application to CNC system, robots, consumer electronics products etc, Design of a Mechatronic Product using available software CAD packages MATLAB and SIMULINK.

REFERENCE BOOKS:

1. Mechatronics by W.Bolton, published by Addison Worley Longman Pvt. Ltd., India Brander, Delhi.
2. Automation Production System System and CIMS by Mikel P Grooer, Phentice Hall of India Pvt. Ltd, New Delhi.

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only fivwe questions.

835 : FOUNDRY TECHNOLOGY

L T P — Sessional : 50 Marks

3 0 0 — Theory : 100 Marks

Total : 150 Marks

Duration of Exam : 3 Hrs.

1. Items (Domestic and Engg.) made by foundry technology. Advantage and limitations of foundry technology and other manufacturing process.
2. Castability and factors favoring castability. Ferrous and Non ferrous casting metals and alloys and items made of them.

3. Melting furnaces for cast iron , cast steels, aluminium alloys, brass and bronzes.
4. Solidification of castings.
5. Mold design considerations: Conceptual, functional and production phase. Pattern and core design considerations, traffic rules applications. Examples, case studies.
6. Gating system elements: objectives,practical rules,optimal time filling, types of pouring basin, types of gates, types of risers.
7. Special casting methods: Gravity die casting, cold chamber die casting, hot chamber die casting, investment casting, centrifugal casting,shell mold casting.continuous casting.
8. Rough cleaning (Fettling) and surface cleaning of castings.
9. Casting inspection.
10. Repair and salvage of castings.
11 .Heat treatment of castings.
12. Quality control of castings.
13. Pollution control in foundry.
14. Modernisation of foundry.

REFERENCE BOOKS:

1. Principal of metal casting by Richard W.Heine , Carl R Hoper. Philip C. RosenthaT, Tata Me Graw Hill.
2. Principal of foundary technology by P. L. Jain , Tata Me Graw Hill
3. Foundary practice by W.H. Salmon
4. Principles of manufacturing materials and processes by J. S. Campbell, Tata Me Graw Hill.

5. Materials and processes in manufacturing by E. P. degnamo, McMillan publishing
6. Production technology by P. C. Sharma, S. Chand and Co.
7. American Standard of metals (ASM) (Vol. 1-14)

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only five questions.

836 : COMPUTATIONAL LAB

L	T	P
-	-	2

Sessional : 25 Marks
Theory : 25 Marks
Total : 50 Marks
Duration of Exam : 3 Hrs.

Experiment No. 1 & 2

Modelling in 2- D & Image scanning using Pro- E.

Experiment No. 3 & 4

Modelling in 3- D of machine tool parrs like gear details, machine tool beds, tai'stocks, and assembly drawings of machine tools like lathe machine components, power drives, jigs & fixtures, power presses etc. using Pro- E.

Experiment No. 5 & 6

Use of various types of surfaces in 3- D modelling, animation features and other editing entities in machine tool assemblies in Pro- E.

Experiments No. 7 & 8

Kinematic and dynamic simulation of various mechanisms in machines, process simulation like Pro- Cast, Pro- Mould and other machining features.

Experiment No. 9 & 10

Tool path generation, Part programming- G& M Codes development for machining operations using Pro- E, Physical interpretation of machining features and tool geometries.

Note : Students will have to perform at least 8 experiments out of the above list.

837 : WELDING LAB

L	T	P	
-	-	2	Sessional : 25 Marks
			Theory : 25 Marks
			Total : 50 Marks
			Duration of Exam : 3 Hrs.

List of Experiments in Welding

1. To study Heat flow in Welding

   (Equipment for use-Gas Welding equipment)

2. To study Bead Geometry, Hardness of Bead, Micro structure of welding Bead in case of:

   i) MIG Welding ii) SAW Welding

   iii) FCAW Welding (By changing electrode diameter & carriage speed)

3. To conduct under water welding (to study bead shape & microstructure)

Note : Students will have to perform at least 8 experiments out of the above list.

838 : MECHATRONICS LAB

L	T	P	
-	-	2	Sessional : 25 Marks
			Theory : 25 Marks
			Total : 50 Marks
			Duration of Exam : 3 Hrs.

LIST OF EXPERIMENTS:

1. To verify truth table of various gates such as AND,OR,NOR.NOT,etc.
2. To realize a logic equation Y=AB+CD.
3. Selection of sensor for a particular application from Catalogue/ Internet.
4. Design a mechatronics product/system and incorporate application of mechatroiiics for enhancing product values.
5. To study the hardwares and softwares of mechatronics kit.
6. To move a table in X-direction within the range of proximity sensors using Control-X software.
7. To rotate a table using DAC system.
8. To move a table in Y-direction within the range of proximity sensors using Control-X software.
9. To run a motor with PLC.
10. To run a conveyor with computer.
11. To study the movement of actuating cylinders and sensors.
12. To study mechatronics and their interfacing in a CNC machine.
13. Life prediction from computer programme based on mathematical model.

Note : Students will have to perform at least 8 experiments out of the above list.

904 : PROJECT MANAGEMENT

L	T	P	
3	0	0	Sessional : 50 Marks
			Theory : 100 Marks
			Total : 150 Marks
			Duration of Exam : 3 Hrs.

1. Theory & Background : Definitions, hard & soft projects, multi-project management, program management , project phases, project control project groups. Go/no go decisions.
2. Idea Phase : Idea selction, development of project contract, determination of project organization, development of project order.
3. Defintion Phase : Phase steps : Project description, project results, work breakdown structure, Input management, Project leader ship.
4. Planning Phase : Development of responsibility matrix, detail project planning, risk & change analysis, arranging input.
5. Implementation Phase : Project monitoring & control, project adjustment, dealing with people.
6. Implementation & After Care : Evaluation and closure of a project.

REFERENCE BOOKS:

1. Project Management handbook, Cleland , D.I. and W.R. King, USA.
2. Project Management Body of Knoweldge (PMBOK), Project.
3. Handbook for project oriented organization, Rath S. Hoogland, R. and Turner, J.R.

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only five questions.

906 : MECHANICAL DESIGN-I

L	T	P	
3	2	-	Sessional : 50 Marks
			Theory : 100 Marks
			Total : 150 Marks
			Duration of Exam : 4 Hrs.

1. Concept Desgin : Brainstorming methods and sketching
2. Quality Function Development.
3. Material Characteristics : Mechanical, thermal and electrical properties.
4. Design : Design for assembly. Design for manufacturing.
5. Production technologies : Metal forming, casting , maching, surface treatment, welding, bonding, fastening, clinching.

REFERENCE BOOKS:

1. Quality Function development ,L. Cohen.
2. Manfacturing Engg. : Principles for Organization, D.T. Koenig.
3. Materials Science and Engineering : An Introduction , W.D. Callister Jr.
4. Handbook of Aluminum : Alloy Production and Materials Manfacturing Vol. 2, G.E. Totten.
5. CAD Software Catia, Dassault system.

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only five questions.

908 : AUTOMATION IN MANUFACTURING

L T P — Sessional : 50 Marks

3 0 0 — Theory : 100 Marks

Total : 150 Marks

Duration of Exam : 3 Hrs.

1. **Introduction:** Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations, introduction to automation productivity.
2. **Material handling systems:** Overview of Material Handling Systems-Rotary feeders, oscillating force feeder, vibratory feeder, elevator type and Centrifugal type feeders, Principles and Design Consideration, Material Transport Systems, Storage Systems.
3. **Automated Manufacturing Systems:** Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation, Flow lines & Transfer Mechanisms, Fundamentals and Analysis of Transfer Lines, product design for automatic assembly.
4. **Control Technologies in Automation:** Industrial Control Systems, Process Industries Verses Discrete-Manufacturing Industries, Continuous Verses Discrete Control, Computer Process and its Forms. Sensors, Actuators and other Control System Components.
5. **Evaluation of automatic production:** product manufacturabiiity, orientation devices- active and passive devices, parts orientation and escapement.
6. **Pneumatic and hydraulic components and circuits:** Boolean algebra, pneumatic sensors and amplifiers, jet

destruction devices, logic devices, schimit triggering devices, developing pneumatic circuits for automatic die casting machine.

7. **Modeling and Simulation for manufacturing Plant Automation:** Introduction/ need for system Modeling, Building Mathematical Model of a manufacturing Plant, Modern Tools-Artificial neural networks in manufacturing automation, AI in manufacturing, Fuzzy decision and control, robots and application of robots for automation.

REFERENCE BOOKS:

1. Handbook of design, manufacturing and Automation : R.C. Dorf, John Wiley and Sons.
2. Automation, Production Systems and Computer Integrated Manufacturing, M.P.Groover, Pearson Education.
3. Industrial Automation : W.P. David, John Wiley and Sons.
4. Computer Based Industrial Control, Krishna Kant, EEE-PHI
5. An Introduction to Automated Process Planning Systems, Tiess Chiu Chang & Richard A. Wysk
6. Manufacturing assembly Handbook:- BrunoLotter
7. Anatomy of Automation, Amber G.H & P. S. Amber, Prentice Hall.
8. Performance Modeling of Automated Manufacturing Systems, Viswanandham, PHI.
9. Automatic process control system and Hardware - R.P. Hunter, Prentice Hall.

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only five questions.

912 : AUTOMATION LAB

L	T	P	
-	-	2	Sessional : 25 Marks
			Theory : 25 Marks
			Total : 50 Marks
			Duration of Exam : 3 Hrs.

List of experiments :

1. To study the hardware of a retrofit and CNC machine tools.
2. Selection of various equipments required with the specifications from Internet/Catalogue: To convert a manual machine tool/system into an automatic machine tool/system.
3. To write programme with G code and M code for a component.
4. To simulate machining of component using PRO- E.
5. Study and applications of Hydaulic software.
6. Study and applications of Pneumatic software.
7. Study and applications of Robotic software.
8. Study and applications of PLC software.
9. To design an automated part feeder.
10. Developing pneumatic circuits for machines and systems.

Note : Students will have to perform at least 8 experiments out of the above list.

914 : CAD/CAM LAB

L	T	P	
-	-	2	Sessional : 25 Marks
			Theory : 25 Marks
			Total : 50 Marks
			Duration of Exam : 3 Hrs.

List of Practicals

SECTION -I

1. Develop a general purpose code to cany out the Rotation of

an object about an axis passing through two points.

2. Develop a general purpose code to carry out
   i) an Orthographic projection
   ii) Dimetric projection , given foreshortening factor Fz.
   iii) An Isometric projection
   iv) A Perspective Projection given Zc, ϕ, θ.
3. Develop general purpose code, given two arbitrary projections and the respective transformation matrices and the reconstructed coordinates of the vertices of the Object.
4. Develop a general purpose code to carry out the Reflection of an Object about an arbitrary plane passing through Three points.

SECTION -II

1. Develop a general purpose code for integrated
   i) Cubic Spline with Different Boundary conditions
   ii) Bezier curve
   iii) B- spline - its Various types and Best Fit B- spline.

   Given:
   a) Coordinates of the Control Points
   b) Boundary conditions , if any.
   c) Order of the curve, if required, and Match the output to projected image of any CAD/CAM package.

SECTION - III

1. Develop an optimized Tool Path for Economic Machining and generate the same in GUI (IDEAS/PRO-E/any CAD software) for interpretation.

2. Study of Graphics Formats and Conversion from one format to another.
3. Generate the Meshing of the CONICAL Cylindrical Surface (a part of stepped cylindrical surface) using any simulation Package.
4. study of OpenGL programming for the customization of any CAD package.
5. Development of following surface patches :
   i) Bilinear Coons Patch
   ii) Tensor Product Bezier Surface.

SECTION - IV

1. Solid Modelling Exercises using any CAD/CAM package. (from a given list of 10 Tutorials)
2. Generative machining interpretation for various tool paths for machining of Curved surfaces.

Note : Students will have to do at least half of practicals in each sectoin.

951 : MECHANICAL DESIGN-II

L	T	P	
3	2	-	Sessional : 50 Marks
			Theory : 100 Marks
			Total : 150 Marks
			Duration of Exam : 4 Hrs.

1. Cost Engineering : Integrated cost price calculation, Activity based costing, Toolibng Amortizing based costing, Tooling amortizing, Budgeting,cost estimating, cost down emgineerign.
2. Tolerance Design ; Geometry Dimensioning & Tolerancing
3. Dimensioning and Packaging

4. Prototying : Rapid prototyping, hammer forming.
5. Design of Experiments, test methods.
6. Risk Analysis : Failure modes and effect analysis, root cause analysis.

REFERENCE BOOKS:

1. Rapid prototying ; Principles and applications, R.I.Noorani.
2. GD & T for Mechanical Design, G.R. Cogono.

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only five questions.

953 : SIMULATION AND ANALYSIS

L	T	P	
3	0	0	Sessional : 50 Marks
			Theory : 100 Marks
			Total : 150 Marks
			Duration of Exam : 3 Hrs.

1. Finite Element Analysis
2 Computational Fluid Dynamics

REFERENCE BOOKS:

1. Finit Element Analysis with Error Estimators : An Introduction to the FEM and Adaptive Error Analysis for Engineering Students, J.E. Akin.
2. Computational Methods for Fluid Dynamics, J.H. ferziger.
3. Accident Injury , A.M. Nahum.
4. The Multibody System Approach to Vehicle Dynamics, M. Blundell.

5. Introduction to Physical Modelling with Modelling, m. Tiller.
6. Vehicle Refinement : controlling Noise and Vibration in Road, M. Harrison.

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only five questions.

955 : CIM LAB

L T P
- - 2

Sessional : 25 Marks
Theory : 25 Marks
Total : 50 Marks
Duration of Exam : 3 Hrs.

LIST OF EXPERIMENTS :

1. To study general features of Machining Center.
2. To prepare the CNC part program for machining a prismatic component on CNC machining centre.
3. To study the general features of a CNC Turning center.
4. To prepare the CNC part program for machining of a Cylindrical Component.
5. Study and Applications of Robotic system in Automated storage and Retrieval system.
6. Application and Control of robotic system in Flexible manufacturing System.
7. To study the general features of Automated Guided Vehicle.
8. To study the general configuration of CMM and its Application in CIM environment.
9. Machine Vision and Quality Control in CIM environment.
10. Study and Applications of Conveyer System in CIM system.
11. Study and application of CIM software.

Note : Students will have to perform at least 8 experiments out of the above list.

Programmes Electives - I

921 : ROBOTIC ENGINEERING

L T P
3 0 0

Sessional : 50 Marks
Theory : 100 Marks
Total : 150 Marks
Duration of Exam : 3 Hrs.

1. **Introduction :** Automation and Robotics, Historical Development, Definitions, Basic Structure of Robots, Robot Anatomy, complete classification of robots, Fundamentals about Robot technology, Factors related to use Robot performance, Basic robot configurations and their relative merits and demerits, Types of drive systems and their relative merits, the wrist and Gripper subassemblies. Concepts and Model about basic control system, transformation and block diagram of spring mass system, control loops of robotics systems, PTP and CP Trajectory planning, Different Types of controllers, control approaches of robots.
2. **Kinematics of Robot Manipulator :** Introduction, General description of robot manipulator, Mathematical Preliminaries on vectors and Matrices, Homogenous representation of objects, Robotic manipulator joint Co-ordinate system, Euler Angle and Euler Transformations, Roll-Pitch-Yaw (RPY), Transformation, Relative Transformation, Direct and inverse Kinematics; solution, D H Representation and displacement Matrices for standard configurations, Geometrical approach to Inverse Kinematics. Homogeneous Robotic differential transformation : Introduction, Jacobian transformation in Robotic Manipulation.
3. **Robotic Workspace and Motion Trajectory :** Introduction, General structures of robotic workspaces, Manipulations with in revolute joints, Robotic workspace performance index, Extreme reraches of Robotic hands, Robotic Task

Description. **Robotic Motion Trajectory Design :** Introduction, Trajectory Interpolators, Basic structure of Trajectory Interpolators, Cubic Joint Trajectories. General Design consideration on Trajectories : 4-3-4 & 3-5-3 Trajectories, Admissible Motion Trajactories.

4. **Dynamics of Robotic Manipulators :** Introduction, Bond Graph Modeling of robotic manipulators, examples of bond Graph dynamic modeling of robotic manipulator. Brief Discussionon Lagrange - Euler (LE) Dynamic modeling of robotic manipulators : Preliminary definitions, Generalized robotic coordinates, Dynamic constraints, velocity and Acceleration of moving frames, Robotic Mass distribution and Inertia Tensors, Newton's equation, Euler Equations, The Lagrangian and Lagrange's Equations. Application of Lagrange - Euler (LE) Dynamic Modeling of Robotic Manipulators : Velocity of Joints, Kinetic Energy T of Arm, Potential Energy V of Robotic Arm, The Lagrange L, Two Link Robotic Dynamics with distributed Mass, Dynamic Equations of Motion for A General Six Axis Manipulator.
5. **Robot Teaching :** Introduction, Various Teaching Methods, Task Programming, Survey of Robot Level Programming Languages, A Robot Program as a Path in Space, Motion Interpolation., WAIT, SIGNAL & DELAY Commands, Branching, Robot Language Structure, various Textual Robot Languages Such as VAL II, RAIL, AML and their Features, Typical Programming Examples such as Palletizing, Loading a Machine Etc,
6. **Robot Sensing & Vision:** Various Sensors and their Classification, Use of Sensors and Sensor Based System in Robotics, Machine Vision System, Description, Sensing, Digitizing, Image Processing and Analysis and Application of Machine Vision System, Robotic Assembly Sensors and Intelligent Sensors.
7. **Industrial Applications:** Objectives, Automation in

Manufacturing, Robot Application in Industry, Task Programming, Goals of AI Research, AI Techniques, Robot Intelligence and Task Planning, Modern Robots, Future Application and Challenges and Case Studies.

8. Languages Such as VAL II, RAIL, AML and their Features, Typical Programming Examples such as Palletizing, Loading a Machine Etc,
9. **Robot Sensing & Vision:** Various Sensors and their Classification, Use of Sensors and Sensor Based System in Robotics, Machine Vision System, Description, Sensing, Digitizing, Image Processing and Analysis and Application of Machine Vision System, Robotic Assembly Sensors and Intelligent Sensors.
10. **Industrial Applications:** Objectives, Automation in Manufacturing, Robot Application in Industry, Task Programming, Goals of AI Research, AI Techniques, Robot Intelligence and Task Planning, Modern Robots, Future Application and Challenges and Case Studies.

REFERENCE BOOKS:

1. A Robot Engineering Textbook - Mohsen Shahinpoor - Harper & Row publishers, New York.
2. Robotics, control vision and intelligence, Fu, Lee and Gonzalez. McGraw Hill International.
3. Introduction to Robotics, John 1 Craig, Addison Wesley Publishing.
4. Robotics for Engineers , Yoram Koren, McGraw Hill International.
5. Industrial Robotics, Groover, Weiss, Nagel, McGraw Hill International.
6. Robot Technology Fundaments, Keramas, Thomson Vikas Publication House Company.
7. Fundamentals of Robotics Analysis and Control, Schilling, PHI.
8. Introduction to Robotics, Niku, Pearson Education, Asia.
9. Foundation of Robotics, Yoshikawa, PHI (EEE).

10. Robotic Engineering - An Integrated approach, Klafter, Chmielewski and Negin, PHI.
11. Robot Vision and Sensor Controls, Rooks B, Vol-3 North Holland.
12. Robot Engineering Textbook - Mohsen Shahinpoor - Harper &. Row publishers, New York.
13. Robotics, control vision and intelligence, Fu, Lee and Gonzalez. McGraw Hill International.
14. Introduction to Robotics, John 1 Craig, Addison Wesley Publishing.

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only five questions.

923 : INDUSTRIAL INSPECTION

L	T	P	
3	0	0	Sessional : 50 Marks
			Theory : 100 Marks
			Total : 150 Marks
			Duration of Exam : 3 Hrs.

Design consideration for Gauges and measuring instruments: material selection for gauges, hardness and surface finish, tolerance for linear and dimensional chains, limits, fits and tolerance as per Indian and international standards, design of plug gauge, snap gauge, center distance gauge.

Inspection of threads and gears : thread gauge design, thread size measurement by two wire and three wire methods, vernier gear tooth gauge design.

Surface textures: components of machined surface texture, specification of surface texture, surface roughness measuring device and techniques, design of pneumatic gauges in process gauging methods.

Geometrical and positional tolerances

Geometrical and physical limitations in measuring devices.

REFERENCES:

1. Metrology:-1 .C. Gupta (Dhanpat Rai Pub.)
2. Engg. Metrology :- R. K. Rajput (S. K. Kataria and sons)
3. Metrology :- R. K. Jain.
4. PSG design data book for Gauge design.

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only five questions.

925 : QUALITY CONTROL TECHNIQUES

L	T	P	
3	0	0	Sessional : 50 Marks
			Theory : 100 Marks
			Total : 150 Marks
			Duration of Exam : 3 Hrs.

Statistical concepts in Quality Control, Graphical Representation of Grouped Data, Continuous and Discrete Probability Distributions, control limit Theorem,

Introduction to Quality Control, process Control and Product Control, Chance and Assignable causes of Quality variation, Advantages of shewhart control charts, Process Control charts for variables, X, R and P charts, fixation of control limits. Type I and Type II Errors, Theory of runs, Interpretation of Out of Control points, Probability limits, Initiation of control charts, Trial control limits, Determination of aimed at value of Process Setting, Rational method of sub grouping, control chart parameters, control limits and specification limits, Natural tolerance limits, Relationship of a process in Control to upper and lower specification limits, process capability studies.

Special control charts for variables, group control chart, arithmetic moving X and R charts. Geometric moving chart, control chart with reject limits, steady trend in Process average

with constant dispersion, trend chart with sloping limits, variable subgroup size.

Variables inspection and Attributes inspection, Relative merits and demerits, Control charts for Attributes, p chart and np chart, varying control limits, high defectives and low defectives, special severe test limits, C chart, U chart, Dodge demerit chart. Quality rating, CUSUM or Cumulative sum control chart, Average run length (ARL) Relative efficiency or sensitivity of control chart.

Probability theory, binomial and Poisson distribution, Acceptance Inspection, 100% Inspection, No Inspection and sampling Inspection, operating characteristic curve (O.C. curve). Effect of sample size and Acceptance number, type A and type B O.C. curves, Single, Double and Multiple sampling Plans, SS Plan. Acceptance/Rejection and Acceptance/Rectification Plans, Producers Risk and Consumer's Risk, Indifference Quality level, Average Outgoing quality (AOQ) curve, AOQL, quality protection offered by a sampling Plan, Average sample Number (ASN) curve, Average Total Inspection (ATI) curve.

REFERENCE BOOKS

1. Statistical Quality control by E.L. Grant
2. Quality control and Industrial Statistics, by A.J. Duncan
3. Quality control by Dale H. Bestefield
4. Total Quality Control by A.Y. Feigenboum
5. Elementary S.O.L. by I.W.Burr, M. Dekkar

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only five questions.

927 : DESIGN AND METALLURGY OF WELDED JOINTS

L	T	P	
3	0	0	Sessional : 50 Marks
			Theory : 100 Marks
			Total : 150 Marks
			Duration of Exam : 3 Hrs.

Weld defects: common weld defects like weld cracks, LOP, LOF, porosity, blow holes etc., remedies and control, welding symbols.

Cost analysis of welded joints: costing factors of welding jobs-fabrication cost, material cost, preparation cost, finishing cost, overhead cost etc., economy in preparation and welding a job, labour accomplishment factor, cost calculation of welded jobs.

Prediction and control of distortion: calculation of longitudinal contraction, transverse contraction, angular contraction due to single weld pass, control of welded distortion, and calculation of shrinkage.

Residual stresses: introduction, types, effect of thermal stresses, control of residual welding stresses.

Destructive and non destructive testing of welds: destructive tests, equipment required and test piece geometry for tensile test, bend test, impact test, hardness test, brittle and fatigue failure tests, non destructive tests for welds:-dye penetrate inspection, magnetic particle inspection etc.

Weldability tests: definition and concept of weldability, purpose and types of weldability tests such as hot cracking test, root cracking tests, hydrogen induced cracking test, cruciform test.

Weld ability of metals: welding techniques, preparation of joints and electrode types for gray cast iron welding, aluminium welding, austenitic steels , titanium and its alloys.

Welding metallurgy: thermal effect of welding on parent metal, structure of fusion welds, effect of cooling rate, weld metal solidification and heat affected zone.

Automation in welding: introduction and concept, classification

of welding automation, economics of welding automation.

REFERENCE BOOKS:

1. Modern welding technology:- carry H. B. (PH).
2. Welding technology: - A. C. Devis.
3. Welding and welding Technology : Little (TMH)
4. Welding technology : R. S. Parmar.
5. AWS - welding handbook (IV- VI) Edition.
6. Elements of machine design : Pandya and shah.

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only five questions.

Programme Electives -II

970 : AUTOMOBILE ENGINEERING

L T P — Sessional : 50 Marks
3 0 0 — Theory : 100 Marks
Total : 150 Marks
Duration of Exam : 3 Hrs.

1. Chassis, Steering and suspension system : Chassis, steering column, steering rack, wheel alignment, tires, sprung and unsprung mass, springs, shock absorbers, wishbones, uprights.
2. Power train system : Engines, transmission, clutch, shafts, differentials, fuel system,, ignition system, cooling system, exhaust system (incl. after treatment).
3. Brake passive and active safety system : Energy absorption pedestrain protection, two circuit brake system, brake calipers, discs, master brake cylinder, brake booster, ABS, ASR, ESP, airbag systems, safety belts system.
4. Body systems and configurations : Roadster, convertible, sallon, coupe, hatchback, 2+2, SUV panels, glazing system, mirror system.

5. Interior System (INCL.HVAC, Climate Control).
6. Electric & Electronics System and Vehicle Architecture : Wiring, data bus systems, power supply system, diagnositic and OBD systems, sensors and actuators, ECU's EMC.

ATTRIBUTES :

- Performance, economy and emissions
  – Power train efficiency, acceleration, deceleration, lunch, shiftability.
- Vehicle dynamics
  – Steering, ride, handling, braking, comfort
- Noise and Vibration harshness (NVH)
  – Power NVH, wind NVH, road NVH
- Vehicle durability
  – Chassis, body, power train, other systems.
- Driving environment
  – Occupant accommodation, controls and displays, night and whether acclimatization
- Vehicle certification
  – EU law, US law, world specification.

REFERENCE BOOKS:

1. The Automotive Chassis, Reimpell, UK
2. Advanced Engine technology, H. Heisler, GE
3. Voertuigtechiniek I,II and, Wide.
4. Fahrwerktechnik : Grundlagen , Reimpell, Stoll, Betzek, Germany.
5. Fahrzeuggetriebe, Grundlagen, Auswahl, Aualegung and Konstruktion, Lecher, Naunheimer, Germany.
6. Intelligent Vehicle technology and Trend, Richard Bishop, UK.

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only five questions.

972 : FINITE ELEMENT METHODS

L	T	P	
3	0	0	Sessional : 50 Marks
			Theory : 100 Marks
			Total : 150 Marks
			Duration of Exam : 3 Hrs.

1. Review of basic FEM concepts

FEM Discretization and the Direct Stiffness Method: Basic concepts of structural modeling, Review of the stiffness method of structural analysis, Modeling stiffness, loads and displacement boundary conditions

Formulation of Finite Elements: Mathematical interpretation of finite elements, variational formulation, Development of continuum elements, shape functions, consistent loads, Isoparametric elements for plane stress, Numerical integration, Convergence requirements.

Computer Implementation of the Finite Element Method : Pre processing: model definition, Element level calculations, Equation assembly, Equation solver, Post processing: strain and stress recovery.

2. Advanced topics in linear problems : Static condensation and sub-structuring, Patch test and incompatible element, p-formulation

3. Advanced Beam, Plate and Shell elements :
   a. Timoshenko beam theory (shear locking)
   b. Plate and shell theory
      i. Thin plate and Mindlin plate (shear and membrane locking)
      ii. Mixed formulation for plate and shell iii. Degenerated shell formulation
4. Dynamic analysis using FEM
   a. Consistent mass and lumped mass, mass lumping technique

   b. Time integration methods: explicit, implicit, explicit-implicit methods.
   c. Stability, convergence and consistency
   d. Hyperbolic systems: structural dynamics and wave propagation
   e. Parabolic system: transient heat transfer
   f. Modal solution for natural frequencies and mode shapes
   g. Modal Superposition method for structural dynamics
5. Nonlinear analysis
   a. Nonlinear solution procedures
   b. Newton-Raphson, modified Newton-Raphson, and secant methods
   c. Line search algorithm
   d. Automatic time step control
6. Material nonlinearity
   a. Rate independent elastoplasticity with return-mapping algorithm
   b. Isotropic and kinematic hardening with Baushinger effect
   c. Consistent tangent operator
   d. Objective rate and finite rotation elastoplasticity
   e. Multiplicative decomposition and finite deformation elastoplasticity
7. Geometric nonlinearity
   a. Generalized strain and stress
   b. Total and Updated Lagrangian formulation
   c. Kirchhoff stress and Cauchy stress
8. Boundary nonlinearity
   a. Frictionless contact problems
   b. Penalty, Lagrange multiplier, augmented Lagrange multiplier, and perturbed Lagrange multiplier methods
   c. Frictional contact problems including frictional return-

mapping algorithm

d. Rigid-flexible contact and flexible-flexible contact

e. Multiplicative decomposition and finite deformation elastoplasticity

9. Geometric nonlinearity
   a. Generalized strain and stress
   b. Total and Updated Lagrangian formulation
   c. Kirchhoff stress and Cauchy stress
10. Boundary nonlinearity
   a. Frictionless contact problems
   b. Penalty, Lagrange multiplier, augmented Lagrange multiplier, and perturbed Lagrange multiplier methods
   c. Frictional contact problems including frictional return-mapping algorithm
   d. Rigid-flexible contact and flexible-flexible contact

Assignments and Tutorials are essential part of this course. Various programming and formulation problems will be assigned through the course of study. In addition, students are required to complete one project is related to computer implementation of FEM concepts, application to plasticity, solving nonlinear structural problems using commercial programs.

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only five questions.

974 : MACHINE TOOL DYNAMICS

L	T	P
3	0	0

Sessional : 50 Marks
Theory : 100 Marks
Total : 150 Marks
Duration of Exam : 3 Hrs.

Chatter in machine Tools : sources of chatter, primary chatter, regenerative chatter, chatter frequency, forced vibration for machine tools, forced vibration due to perturbance of the cutting process, forced vibration due to perturbance of equivalent elastic system, theories of machine tool chatter: Tlusty's, Kudinovs, Tobias theories.

Machine tool stability: dynamic characteristic of the cutting process, general procedure for assessing the dynamic characteristic of machine tool in single degree and many degree of freedom system, methods of reducing the instability in machine tool, dynamic acceptance tests

Damping in machine tools: requirements of damping system,. Viscous dampers, active dampers.

Static and dynamic analysis of machine tools: lumped parameter method, finite element method.

Chatter in grinding machine.

REFERENCE BOOKS :

1. Principles of machine Tools:- G.C.Sen and Amitabh Bhattacharya(New central book agency Calcutta)
2. Machine Tool Design: - S.K. Mehta (TMH)

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only five questions.

976 : ARTIFICIAL INTELLIGENCE IN MANUFACTURING

L T P
3 0 0

Sessional : 50 Marks
Theory : 100 Marks
Total : 150 Marks
Duration of Exam : 3 Hrs.

Definition, basic concepts of artificial Intelligence, scope, role and potential of artificial intelligence in manufacturing, Expert systems, Popular AI application.

Overview of Expert systems, architecture, comparison with procedural programming, developing Expert system for typical manufacturing domains, implementation and maintenance, state-of- art Expert system application, case study.

Al theory problems, problem spaces and search, Heuristic search technique, Knowledge acquisition and knowledge representation, predicate logic, procedurals, Declarative knowledge, forward V/s backward reasoning AI architecture, overview of advanced features, planning, learning, natural language processing, neural nets, fuzzy logic, object oriented programs.

Case studies, examples of AI, theoretical concepts to manufacturing problems, CAD, CAPP, scheduling GT, CIM system.

Domains welding, casting, forming, metal cutting, maintenance.

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only five questions.

980 : VALUE ENGINEERING

L T P
3 0 0

Sessional : 50 Marks
Theory : 100 Marks
Total : 150 Marks
Duration of Exam : 3 Hrs.

Introduction, Life cycle of a Product, Definition, objectives and

methodology of value Engineering, Comparison with other cost reduction techniques, unnecessary cost.

Quantitative definition of values, alternatives to increase value, Type of value, estimation of product quality/performance,

Functions: definition, types and relationship between different functions in design of a Product, functional cost, functional worth, test for poor value, aim of value engineering. Systematic approach, Phases of value engineering Job plan: General phase, information phase, function phase creation/speculation phase, evaluation phase, investigation phase, recommendation and implementation phase.

Decision /evaluation Matrix: Quantitative comparison of alternatives, estimation of weight factors and efficiency.

FAST diagramming: Critical path of function, How, why and when logic, supporting and all time functions. Ground rule for FAST diagram.

CASE STUDIES

1. Value Engineering - A systematic Approach - A.E. Mudge
2 Techniques of value analysis and value engineering - L. D. Miles
3 Value engineering for cost reduction and product improvement - HSMittal

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only five questions.

982 : ADVANCED THEORY OF VIBRATIONS

L T P
3 0 0

Sessional : 50 Marks
Theory : 100 Marks
Total : 150 Marks
Duration of Exam : 3 Hrs.

Single degree of freedom systems, two degree of freedom systems: spring coupled, mass coupled, vibration absorbers, and vibration isolation.

Multi degree of freedom systems: Lagrange's equation, close couples and far coupled systems, Dunkerley's approximation method, Rayleigh method, matrix method, matrix iteration, orthogonality principle, orthogonality, expansion theorem and modal analysis, Stodola method, Holzer method, Galerkin method, Rayleigh- ritz method, .Myklested -prohl method for far coupled systems, transfer matrix method

Experimental methods in vibration analysis: vibration instruments, vibration exciters, transducers and measurement devices, analyzers, vibration tests:- free and forced vibration tests.

Vibration of continuous systems: Transverse, flexural, torsional vibration of beams, Timoshenko beam, Hamilton principle, vibration of plates, collocation method, Myklested - prohl method.

Transient vibrations: Duhame's integral, method of step input, phase plane -method, method of laplace transformation, drop test spectra by laplace transformations.

Non linear vibrations: non linear vibrations and superposition principle, examples of non linear vibrations, method of dealing with non linear vibrations, phase plane trajectories, method of direct integration, perturbation method, iteration method, Fourier series.

REFERENCE BOOKS:

1. Theory of vibration with applications:- W. T. Thomson (PHI)
2. Theory and practice of mechanical vibrations:- J. S. Rao & K. Gupta (Wiley eastern)
3. Mechanical vibration :- S. S. Rao (Addison Wesley)
4. Vibration and noise for Engineers :- Kewal Pujara (Dhanpat Rai and Co.).
5. Mechanical vibrations :- G. K. Grover and Nigam (Nem chand and sons)

6. An introduction to mechanical vibrations :- Steidel (John Wiley)
7. Elements of vibration analysis :- Meirovitch (TMH)

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only five questions.

984 : ENERGY, ECOLOGY AND ENVIRONMENT

L	T	P	
3	0	0	Sessional : 50 Marks
			Theory : 100 Marks
			Total : 150 Marks
			Duration of Exam : 3 Hrs.

Origin of the earth, Earth's temperature and atmosphere. Sun as a source of energy, nature of its radiation, Biological processes, photo-synthesis, Food chains, Marine ecosystem. Ecosystem theories, Autoecology. sources of energy, classification of energy sources, quality and concentration of an energy source, characteristics temperature. Fossil Fuels: coal, oil, gas, geothermal, tidal and nuclear energy. Solar, wind, hydropower, biomass. Reasources of energy and energy use pattern in different regions of the world. Environmental degradation, primary and secondary pollutants. Thermal and radioactive pollution, air and water pollution. Micro climatic effects of pollution, Pollution from stationary and mobile sources. Biological effects of radiation, heat and radioactivity disposal. Pollution abatement methods.

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only five questions.

986 : TOTAL QUALITY MANAGEMENT

L T P
3 0 0

Sessional : 50 Marks
Theory : 100 Marks
Total : 150 Marks
Duration of Exam : 3 Hrs.

Introduction : Quality - Basic concepts, dimensions, economics of quality, quality Gurus. TQM: Definition, evolution, journey from inspection to TQM, comparison at different stages, dimensions of TQM, TQM viewpoints, reasons for adopting TQM.

Introspection to TQM environment: Sphere of TQM. components of TQM. TQM - Managing Total Quality, Factors affecting TQM environment, Classification and interaction among factors. Researchers' viewpoint, TQM as a system, steps in TQM implementation, Roadblocks in TQM implementation, Reasons for TQM failure.

Role of soft options in TQM : Hard vs. Soft factors, Role and expectation of employer, employee, customer and supplier from organization and vice versa. Human factors in TQM, Role of top management commitment, work culture, motivation, coordination, attitude, innovation.

Quality initiatives in organizations : Role of tools and techniques in TQM, Classification of tools and techniques - Problem identification, Data analysis, Graphical, Creativity, Company wide. Brief description of Quality awards - MBNQA, Deming award, European quality award, Australian quality award.

TQM Effectiveness : Impact of TQM, Need and difficulty in measuring TQM effect, Parameters governing effect of TQM and the attributes thereof.

REFERENCE BOOKS:

1. "Total Quality Management" by Oakland (Butterworth - Heinamann Ltd.)
2. "Managing for total quality from Deming to Taguchi and SPC" by Logothetis N. (PHI)
3. "Total Quality Control" by Feigenbaum A.V. (MGH)
4. "Total Quality Management" by Besterfield Dale H (Pearson Education)
5. "A slice by slice guide to TQM" by John Gilbert (Affiliated East West Press).
6. "The TQM toolkit - a guide to practical techniques for TQM" by Waller Jenny, Allen Derek and Burna Andrew (Kogan Page).

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only five questions.

988 : COMPUTER INTEGRATED MANUFACTURING

L T P — Sessional : 50 Marks

3 0 0 — Theory : 100 Marks

Total : 150 Marks

Duration of Exam : 3 Hrs.

Introduction: CAD/ CAM defined, computer technology: introduction, central processing unit, types of memory, input/ output, the binary number system, computer programming languages. Automation: CIM, reasons of automation, automation strategy.

Conventional Numerical Control: basic components of NC system, NC motion control system, applications of NC, advantages and disadvantages of NC, problems with conventional NC, NC controller technology, computer Numerical control, advantages of CNC, functions of CNC, Direct Numerical Control, components of a DNC system, functions of DNC, advantages of DNC.

NC part programming: introduction, punched tapes in NC, tape coding and format, NC words, manual part programming, computer assisted part programming, The part programmer's job, the computer's job, NC part programming languages, APT language, geometry statements, motion statements, post processor statements, auxiliary statements.

Robotics technology: joints and links, common robot configuration, work volume, drive systems, types of robot control, accuracy and repeatability, end effectors, sensors in robotics, applications of robots.

Automated material Handling and FMS.: material handling function, types of material handling equipments, conveyor systems, types of conveyors, automated guided vehicle system, applications, FMS, components of a FMS, types of systems,

where to apply FMS technology, FMS workstation, planning the FMS.

Computer aided quality control: Introduction, terminology in quality control, the computer in QC, contact and non contact Inspection methods- optical and non optical , computer aided testing.

Computer Integrated Manufacturing systems: Introduction, types of manufacturing systems, machine tools and related equipments, material handling system, computer control system, functions of a computer in CIMS. benefits of CIMS.

REFERENCE BOOKS:

1. Automation, Production systems and Computer Integrated Manufacturing :- Groover M. P. (PHI)
2. CAD/CAM : - Zimmers and Groover (PHI)
3. Approach to computer integrated design and manufacturing :- Nanua Singh (John Wiley and sons)

Note : In the Semester Examination, the exmainer will set eight questions in all, covering the entire syllabus and the students will be required to attempt only five questions.