

**M.D.UNIVERSITY, ROHTAK**  
**SCHEME OF STUDIES AND EXAMINATION**  
**M.TECH 1st YEAR (MANUFACTURING & AUTOMATION)**  
**SEMESTER 1**  
**CBCS Scheme effective from 2016-17**

Sl. No	Course Code	Subject	Credit Pattern				Examination Schedule (Marks)				Duration of Exam (Hours)	No of Hours /week
			L	T	P	Total Credits	Marks of Class work	Theory	Practical	Total		
1	16MMA21C1	Metal Forming Analysis	4	0	-	4	50	100	-	150	3	4
2	16MMA21C2	Mechatronics & Product Design	4	0	-	4	50	100	-	150	3	4
3	16MMA21C3	Total Quality Management	4	0	-	4	50	100	-	150	3	4
4	16MMA21C4	Welding & Allied Processes	4	0	-	4	50	100	-	150	3	4
5	16MMA21CL1	Mechatronics Lab	-	-	2	2	50		50	100	3	4
6	16MMA21CL2	Welding Lab	-	-	2	2	50		50	100	3	4
7	16MMA21CL3	CAD/CAM Lab	-	-	2	2	50		50	100	3	4
8	16MMA21C5	Seminar	-		-	2	50	-	-	50		2
9	16MMA21D1 or 16MMA21D2 or 16MMA21D3 OR 16MMA21D4	Elective I	4	-		4	50	100		150	3	4
<b>TOTAL</b>							<b>28</b>					

**Elective I: Choose any one from the following three papers:**

16MMA21D1 - INDUSTRIAL INSPECTION

16MMA21D2 - DESIGN AND METALLURGY OF WELDED JOINTS

16MMA21D3 - FOUNDRY TECHNOLOGY

16MMA21D4-DESIGN PLANNING CONTROL AND PRODUCTION SYSTEM

**NOTE:**

**Examiner will set nine questions in total. Question One will be compulsory and will comprise short answer type questions from all sections and remaining eight questions to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.**

**M.D.UNIVERSITY, ROHTAK**  
**SCHEME OF STUDIES AND EXAMINATION**  
**M.TECH 1st YEAR (MANUFACTURING & AUTOMATION)**  
**SEMESTER 2**  
**CBCS Scheme effective from 2016-17**

Sl. No	Course Code	Subject	Credit Pattern				Examination Schedule (Marks)				Duration of Exam (Hours)	No of Hours/week
			L	T	P	Total Credits	Marks of Class works	Theory	Practical	Total		
1	16MMA22C1	Mechanical Design-I	4	0	-	4	50	100	-	150	3	4
2	16MMA22C2	Diagnostic Maintenance & Monitoring	4	0	-	4	50	100	-	150	3	4
3	16MMA22C3	Seminar	-	-	-	2	50	-	-	50		2
4	16MMA22CL1	CIM Lab	-	-	2	2	50	-	50	100	3	4
5	16MMA22CL2	Diagnostic Maintenance & Monitoring Lab	-	-	2	2	50	-	50	100	3	4
6	16MMA22D1 or 16MMA22D2 or 16MMA22D3	Elective-II	4	0	-	4	50	100	-	150	3	4
7		Open Elective	3	0	-	3						
8		Foundation Elective	2	0	-	2						
		<b>TOTAL</b>	<b>23</b>									

**NOTE: Examiner will set nine questions in total. Question One will be compulsory and will comprise short answer type questions from all sections and remaining eight questions to be set by taking two questions from each unit. The students have to attempt five questions in total, first being compulsory and selecting one from each Unit.**

**Elective II : Choose any one from the following three papers:**

16MMA22D1 - QUALITY CONTROL TECHNIQUES

16MMA22D2 - FINITE ELEMENT METHODS

16MMA22D3 - ARTIFICIAL INTELLEGENCE IN MANUFACTURING

**Open Elective:** A candidate has to select this paper from the pool of Open Electives provided by the University.

**Foundation Elective:** A candidate has to select this paper from the pool of Foundation Electives provided by the University.

## 16MMA21C1- METALFORMINGANALYSIS

**L T P CREDIT**  
**4 0 0 4**  
**TOTAL :150 Marks**

**SESSIONAL:50 Marks**  
**THEORY :100 Marks**

**DURATION OF EXAM. :3 Hrs.**

### **Unit 1**

Stress-Strain relations in Elastic and plastic Deformations ,True stress and true strain, true stress-strain curves, selection of stress-strain curves for cold and hot working, yield of isotropic plastic material, yield criteria .Tresca maximum sheer-strain- energy criterion, plastic incompressibility, Poisson's ratio for plastic deformation flow rule, application of theory of plasticity for solving metal forming Problems using Slab method, Upper and lower Bound methods, Slip line field theory.

### **Unit 2**

Technology and analysis of important metal forming processes- Forging, Rolling ,Extrusion. Wiredrawing ,Sheet Metal forming processes like Deep drawing, Stretch forming, Bending, defects in various metal forming processes like rolling, forging, extrusion, wiredrawing and deep drawing and their causes and remedial measures, Effects of temperature and strain rate in metal working, friction and lubrication in Hot and Cold working.

### **Unit 3**

Lubrication in metal forming processes, principles and mechanism of lubrications, hydrodynamic and their film lubrication, boundary and extreme pressure lubricants, solid lubricants ,lubricants used for rolling and cold drawing, forging,

### **Unit 4**

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 Eulerian schemes, Material integration schemes, auxiliary equations for contact, friction and incompressibility, Thermo-mechanical problem formulation

### **REFERENCEBOOKS:**

1. Metal Forming Analysis- R.H. Wagoner ,Cambridge University Press.
2. Theory of Elasticity-Dally and Riley
3. Mechanical Metallurgy- Dieter, McGraw Hill Inc.
- 4.An Introduction to the Principles of Metal working by Rowe, Arnold.
5. Metal forming analysis by Avitzter , McGraw hill.

## 16MMA21C2-MECHATRONICS& PRODUCT DESIGN

**L T P CREDIT**  
**4 0 0 4**  
**TOTAL :150 Marks**

**SESSIONAL:50 Marks**  
**THEORY :100 Marks**

**DURATION OF EXAM. :3 Hrs.**

### **Unit 1**

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

Microprocess and their applications- Micro computer computer structure/ micro controlles, Integrated circuits-signal conditioning processes, various types of amplifiers, low pass and high pass filters.

### **Unit 2**

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 .Electri calactuation system .Other Electrical/ Electronic hardware in Mechatronic system.

### **Unit 3**

Principles of Electronic system communication, Interfacing, A. D.andD.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

### **Unit 4 .**

Design and selection of Mechatronics systems namely sensors line encoders and revolvers, steppe rand 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

### **REFERENCEBOOKS:**

1. Mechatronics by W.Bolton ,published by Addison Worley Longman Pvt. Ltd. ,India Brander, Delhi.
- 2.Automation Production System and CIMS by Mikel P Groover, Phentice Hall of India Pvt. Ltd, NewDelhi.
3. Production Systems and CIM, Groover ,PHI.
4. Flexible Manufacturing systems ,by Maleki, Prentic Hall.

## 16MMA21C3- TOTAL QUALITY MANAGEMENT

L T P CREDIT  
4 0 0 4  
TOTAL :150 Marks

SESSIONAL:50 Marks  
THEORY :100 Marks

DURATION OF EXAM. :3 Hrs.

### Unit1

#### 1. TQM Perspective and TQM Implementation:

Quality, Chain Reaction ,Dimensions of Quality, Evolution Of Quality, Quality Control, Quality Assurance, Quality Planning, Quality Improvement, Quality Management, Total Quality Management, Cost Of Quality, Classification of Failure Cost, Reducing Costs, Juran's Model Of Optimum Quality Costs, Analysis of COQ For Improvement, Analysis Of External Nd Internal Failure Costs ,TQM, Elements Of TQM, Leadership For TQM, Deeming 14 Points For Top Management, TQM Tools And Techniques, PDSA, Barriers For TQM Implementation

### Unit 2

#### 2. TQM principles and Strategies:

Customer Satisfaction & Employee Involvement.  
Service Quality, Features Of Services, The Kano Model ,Employee Motivation, Motivation Theory Of Individual Employees ,Effective Communications, Training And Mentoring ,Recognition And Reward.  
Continuous Process Improvement and Process Approach.  
Juran's Trilogy , Kaizan ,PDCA, Seven Quality Tools ,BPR ,Seven Deadly Wastes ,ETX Model, Lean Manufacturing, Kabana System, Cellular Manufacturing, Single Piece Flow,Zero Defects

### Unit3

#### 3. Statistical Process Control & TQM Tools

The Seven Quality Control Tools, Standard Normal Distribution, AQL, Seven Management Tools, Benchmarking, QFD, Taguchi's Design, TPM, FMEA

### Unit 4

#### 4. Quality Systems

ISO9000 standard, EMS14001, Quality Awards  
Supplier Partnership and Performance Measures-  
Importance Of Suppliers, Selection And Standards, Quality Audit, Product Audit, Vendor Rating System, PDCA For Measurements, Performance Measure Design, BSC.

### REFERENCEBOOKS:

1. "Total Quality Management "by Oakland (Butterworth- Heinamann Ltd.)
2. "Managing for total quality from Deming to Taguchiand SPC"by Logothetis N.(PHI)
3. "Total Quality Control" by Feigenbaum A.V.(MGH)
4. "Total Quality Management "by Besterfield Dale H (PearsonEducation)
5. "A slice by slice guide to TQM" byJohn Gilbert (AffiliatedEastWestPress).
6. "The TQM toolkit- aguide to practical techniques fo rTQM" by Waller Jenny, Allen  
Derekand Burna Andrew (KoganPage

## 16MMA21C4- WELDING AND ALLIED PROCESSES

L T P CREDIT  
4 0 0 4  
TOTAL :150 Marks

SESSIONAL:50 Marks  
THEORY :100 Marks

DURATION OF EXAM. :3 Hrs.

### Unit 1

**Introduction** :Basic classification of welding processes, weld ability, weld thermal cycle, metallurgy of fusion welds, solidification mechanism and micro structural products in weld metal, epitaxial, cellular and dendrite solidification, metallurgical changes in weld metal, phase transformation during cooling of weld metal in carbon and low alloy steel, prediction of micro structures and properties of weld metal. Heat affected zone, re-crystallization and grain growth of HAZ, gas metal reaction, effects of alloying elements on welding of ferrous metals.

### Unit 2

**Welding Arc** :Arc efficiency, temperature distribution in the arc; arc forces, arc blow, electrical characteristics of an arc, mechanism of arc initiation and maintenance, role of electrode polarity on arc behavior and arc stability, analysis of the arc.

Types of electrodes, AWS and Indian system of classification and coding of covered electrode for mild steel, Shielding gases and associated mixtures

### Unit 3

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

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<sub>2</sub> welding:-difference from MIG welding, Principle of operation, equipment, welding parameters and applications.

### Unit 4

**Solid state welding** :Introduction, main features and applications of Ultrasonic welding, Friction welding and Explosive welding friction stir processing and welding.

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

**Underwater Welding**: Introduction, methods and applications.

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

## REFERENCE BOOKS

1. Welding processes & technology by Dr .R S Parmar Khanna Publishers
2. Welding Engineering& Technology by Dr. R. S .Parmar Khanna Publishers
3. Modern Arc Welding Technology by S.V. Nandkarni Oxford & IDH publishing Co.  
Principles of Welding Technology by L.M. Gourd ELBS/Edward Arnold
4. The Physics of welding by Lancaster Pergaman Press.
5. The Metallurgy of welding by Lancaster ;George Allen & Un win Ltd. U.K.  
Weldinghandbook,Vol.1&2,seventh edition;Americanweldingsociety. MetalHandbook,Vol6,  
73;ASME
6. Procedure Handbook of ARC welding; LincolnElectricCo.USA.
7. The Solid phase welding of metals by Tylecote ;Edward Arnold Pvt .Ltd. Welding&Welding  
Technology RichardL. Little ,McGraw Hill. WeldingTechnologybyRossi;McGrawHill.
8. Welding Technology by Koenigs bergerand Adaer; Macmillan.

## 16MMA21CL1- MECHATRONICSLAB

L T P CREDIT

0 0 4 2

TOTAL :100 Marks

SESSIONAL:50 Marks

PRACTICAL :50Marks

DURATION OF EXAM. :3 Hrs.

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 mechatronics for enhancing product values
- 5 To study the hardware's 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 at a bleusing DAC system.
- 8 To move a table in Y-direction within the range of proximity sensors using Control-X software.
- 9 To ornament to with PLC.
- 10 To run a conveyer with computer.
- 11 To study the movement of actuating cylinders and sensors.
- 12 To study mechatronics and the reinter facing in a CNC machine.
- 13 Life prediction from computer programme based on mathematical model.

## **16MMA21CL2- WELDINGLAB**

**L T P CREDIT**  
**0 0 4 2**  
**TOTAL :100 Marks**

**SESSIONAL:50 Marks**  
**PRACTICAL :50Marks**

**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 tensile property, Bead Geometry, Hardness of Bead, Micro structure of welding Bead in case of:

i) MIG Welding                      ii) TIG Welding

iii) SAW Welding                      iv) Arc welding

3 To study mechanical behavior ( tensile strength Hardness of Bead, Micro structure of welding Bead ,impact strength ,corrosion and wear ,fatigue behaviour ) in case of.

1. Friction stir welding

2. Friction stir processing

## 16MMA21CL3- CAD/CAM LAB

**L T P CREDIT**  
**0 0 4 2**  
**TOTAL :100 Marks**

**SESSIONAL:50 Marks**  
**PRACTICAL :50Marks**

**DURATION OF EXAM. :3 Hrs.**

### SECTION-I

1. Develop a general purpose code to carryout the Rotation of an object about an axis passing through out points
2. Develop a general purpose code to carryout
  - i) an Ortho graphic projection
  - ii) Dimetric projection ,given fore shortening factor Fz
  - iii) An Isometric projection·
  - iv) A Perspective Projection given Zc ,IT
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 o fan 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 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 Open GL 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. (fromagivenlistof10Tutorials)
2. Generative machining interpretation for various tool paths for machining of Curved surfaces.

**List of Soft Core –I**

16MMA21D1- INDUSTRIAL INSPECTION

16MMA21D2- DESIGN AND METALLURGY OF WELDED JOINTS

16MMA21D3- FOUNDRY TECHNOLOGY

16MMA21D4- DESIGN, PLANNING AND CONTROL OF PRODUCTION SYSTEMS

## 16MMA21D1: INDUSTRIAL INSPECTION

L T P  
4 0 0

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

### **UNIT1.**

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

### **UNIT2.**

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

### **UNIT3**

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.

### **UNIT 4**

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

## 16MMA21D2 . DESIGN AND METALLURGY OF WELDED JOINTS

**L T P Sessional : 50 Marks**

**4 0 0 Theory : 100 Marks**

**Total : 150 Marks**

**Duration of Exam : 3 Hrs**

### UNIT 1.

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.

### UNIT2.

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.

### UNIT3.

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.

### UNIT4.

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.

## 16MMA21D3 FOUNDRY TECHNOLOGY

L T P  
4 0 0

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

### UNIT 1

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.

### UNIT 2

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.

### UNIT 3

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.

### UNIT 4

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. Rosenthal, Tata Me Graw Hill.
2. Principal of foundry technology by P. L. Jain , Tata Me Graw Hill
3. Foundry practice by W.H. Salmon

## **16MMA21D4: DESIGN PLANNING AND CONTROL OF PRODUCTION SYSTEM**

**L-T-P**

**4 0 0**

**Sessional :50**

**Theory :100 marks**

**Total :150 marks**

**Duration of Exam :3hrs**

### **UNIT 1**

Introduction to production systems : Aim of production system, generalized model and types of production systems Features compiling service organizations, life cycle approach to production management.

### **UNIT 2**

Product development and design : New product development and process selection, stages in new product development, uses of decision tree, Break even analysis, Make// buy decision, Problems for break even analysis non linearity in B.E. analysis, selection of location among alternatives- A case study, systematic layout planning, objectives , types, comparison and application of different types of layouts,.

### **UNIT 3**

Assembling line balancing concept and problems for maximum line efficiency. Planning for production : Importance, objective and types of forecasting methods, Analysis and comparison standard error of estimate, Material Requirement planning, (MRP ) objective, dependent demand, input to MRP, MRP model, Production schedule, MRP logic comparison.

### **UNIT 4**

Sequencing & Scheduling : Criteria for sequencing, Priority sequencing and rules, n job 2 machine, n job 3 machine, n job m machine problems. Element of monitoring and follow up\

Reference Books ; 1. Production operations management : Buffa, Edwood 2. Elements of production , planning and control - Eilon Samuel A 3. Production control: A quantitative approach - Biegel. J 4. Industrial engineering and production management - MartandTelsang 5. Operations management- Theory and problems- Joseph Monks

## 16MMA22C1- MECHANICAL DESIGN-I

L	T	P	CREDIT
4	0	0	4

**SESSIONAL:50 Marks**  
**THEORY :100 Marks**  
**TOTAL :150 Marks**  
**DURATION OF EXAM. :3 Hrs.**

### **Unit 1**

1. Concept Design: Brain storming method and sketching

### **Unit 2**

- 2 Quality Function Development
- 3 Material Characteristics Mechanical, thermal and electrical properties.

### **Unit 3**

- 4 Design :Design for assembly. Design for manufacturing.

### **Unit 4**

- 5.Production technologies: Metal forming ,casting ,machining, surface treatment, welding, bonding ,fastening ,clenching.

### **REFERENCEBOOKS:**

1. Quality Function development, L.Cohen.
2. Manufacturing 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 Manufacturing Vol.2,G.E.Totten.
5. CAD Software Catia, Dassault system.

## 16MMA22C2- Diagnostic Maintenance & Monitoring

**L T P CREDIT**  
**4 0 0 4**

**SESSIONAL:50 Marks**  
**THEORY :100 Marks**  
**TOTAL :150 Marks**  
**DURATION OF EXAM. :3 Hrs.**

### Unit 1

#### **Maintenance Management**

Relevance of maintenance ,maintenance: an over view ,maintenance services ,problems of the plant manager, automation and maintenance ,maintenance objectives and costs, quality and quality circle in maintenance ,Engineering reliability, maintainability

### Unit 2

#### **Failure analysis**

Defect generation types of failures ,FTA ,FMEA,FMECA

Maintenance Types/systems

Planned and unplanned maintenance ,breakdown, corrective,opportunistic,routine,preventive,predictive,CBM,Design out maintenance

### Unit 3

#### **Condition monitoring**

NDT concepts ,visual and temperature monitoring, leakage monitoring ,vibration monitoring, lubricant monitoring methods

,equipments,ferrography,spectroscopy,cracksmonitoring,thicknessmonitoieng,corrosionmonit oing,noise monitoring ,sound monitoring, smell monitoring

### Unit 4

#### **Total productive maintenance**

Development and scope of concept ,tero technology,basic systems of TPM procedure and steps of TPM, productivity circle

#### Books:

Maintenanceplanningandcontrol-Kelly,A.Buttersworth&Co.1984

MaintenanceandsparepartsManagement–KrishananG,PrenticeHall–1991

## 16MMA22CL1- CIM LAB

**L T P CREDIT**  
**0 0 4 2**  
**TOTAL : 100 Marks**

**SESSIONAL:50 Marks**  
**PRACTICAL :50Marks**

**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

## **16MMA22CL2 – Diagnostic Maintenance & Monitoring Lab**

**L T P CREDIT**  
**0 0 4 2**  
**TOTAL :100 Marks**

**SESSIONAL:50 Marks**  
**PRACTICAL :50Marks**

**DURATION OF EXAM. :3 Hrs.**

### **List of Experiments.**

- 1.** To study the introduction to maintenance techniques. Preventive and predictive Maintenance
- 2.** To study and perform Non-Destructive Testing techniques , liquid dye penetrate and leak testing.
- 3.** To study and perform, Boroscope , Flexiscope.
- 4.** To study and perform Eddy current testing & Ultrasonic testing .
- 5.** To study and perform Magnetic particle detection and Particle counter.
- 6.** To study wear Analysis through thermo graphy and Ferrography.
- 7.** To study the applications of Diagnostic Maintenance to Industrial Machines and plants such as Sugar Industry or Textile Mills or Thermal Power plant sand Railways.
- 8.** To study the Maintenance planning and control of a large factory, work planning and work control.

**List of Soft Core –II**

**16MMA22D1- QUALITY CONTROL TECHNIQUES**

**16MMA22D2- FINITE ELEMENT METHODS**

**16MMA22D3- ARTIFICIAL INTELLIGENCE IN MANUFACTURING**

## 16MMA22D1- QUALITY CONTROL TECHNIQUES

**L T P CREDIT**  
**4 0 0 4**

**SESSIONAL:50Marks**  
**THEORY :100 Marks**  
**TOTAL :150Marks**  
**DURATION OF EXAM. :3 Hrs.**

### UNIT I

Statistical concepts in Quality Control, variables and attributes, Graphical Representation, 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,

### UNIT II

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.

### UNIT III

Special control charts for variables, group control chart, control charts with large sub groups, control chart with reject limits, use of control limits for moving averages

Variables inspection and Attributes inspection, Relative merits and demerits, Control charts for Attributes, p chart and n p chart, varying control limits, high defectives and low defectives, CUSUM or Cumulative sum control chart, Average run length (ARL) Relative efficiency or sensitivity of control chart.

### UNIT IV

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,

### REFERENCEBOOKS

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

## 16MMA22D2- FINITE ELEMENT METHODS

L T P CREDIT  
4 0 0 4

SESSIONAL:50 Marks  
THEORY :100 Marks  
TOTAL :150 Marks  
DURATION OF EXAM. :3 Hrs.

### UNIT I

#### 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 , variation formulation ,Development of continuum elements, shape functions ,consistent loads, Iso parametric 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.

### UNIT II

**Advanced topics in linear problems :**Static condensation and sub-structuring, Patched stand in compatible element ,p- formulation

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

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

Non linear analysis

- a. Non linear solution procedures
- b. Newton-Raphson ,modified Newton-Raphson and secant methods
- c. Line search algorithm
- d. Automatic time step control

### UNIT III

#### Material non linearity

- a. Rate independent elastic plasticity with return-mapping algorithm
- b. Isotropic and kinematic hardening with Baushingere ffect c. Consistent tangent operator
- d. Objectiverate and finite rotation elasto plasticity
- e. Multiplicative decomposition and finite deformation elastoplasticity

#### Geometric non linearity

- a. Generalized strain and stress
- b. Total and Update d L arranging formulation c. Kirchhoff stress and Cauchy stress

#### Boundary non linearity

- a. Frictionless contact problems
- b. Penalty, Lagrange multiplier, augmented Lagrange multiplier, and perturbed Lagrange multiple methods
- c. Frictional contact problems including frictional return mapping algorithm
- d. Rigid-flexible contact and flexible-flexible contact
- e. Multiplicative decomposition and finite deformation elasto plasticity

### UNIT IV

#### Geometric non linearity

- a. Generalized strain and stress
- b. Total and Updated Lagrangian formulation c. Kirchhoff stress sand Cauchy stress

#### Boundary non linearity

- a. Frictionless contact problems
  - b. Penalty ,Lagrange multiplier ,augmented Lagrange multiplier ,and perturbed Lagrange multiple methods
  - c. Frictional contact problems including frictional return- mapping algorithm
  - d. Rigid-flexible contact and flexible-flexible contact
- Assignments and Tutorial 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 projects related to computer implementation ,application to plasticity, solving non linear structural problem using commercial programs

**16MMA22D3- ARTIFICIALINTELLIGENCEINMANUFACTURING**

**L T P CREDIT**  
**4 0 0 4**

**SESSIONAL:50 Marks**  
**THEORY :100 Marks**  
**TOTAL :150 Marks**  
**DURATION OF EXAM. :3 Hrs.**

**UNIT I**

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

**UNIT II**

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

**UNIT III**

All 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 ,n planning, learning, natural language processing, neural nets, fuzzy logic ,object oriented programs.

**UNIT IV**

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

Domains welding, casting, forming, metal cutting, maintenance