Prof. Ram Meghe Institute Of Technology And Research Badnera -444701

An Autonomus College Affiliated to Sant Gadge Baba Amravati University, Amravati, Maharashtra (India)

PROGRAMME SCHEME & SYLLABI

2023-2024

M. Tech.

(CAD/CAM)

Published By
Principal
Prof. Ram Meghe Institute Of Technology And Research, Badnera - Amravati.

Department Vision :

To become a lead center in the field of Mechanical Engineering to minimize human efforts with an eye on environment

Department Mission :

1. To educate, Motivate and prepare the students to know the fundamental and technical skills in Mechanical Engineering Through effective teaching learning Methodologies
2. To impart entrepreneurship and the employability skills to the students through mentoring and healthy interaction with industry.
3. To encourage student to undertake R&D activities for the societal needs with high ethical standards.
4. To imbibe professional and ethical standards in the minds of the young engineers by continuous learning and professional activities.

Program Educational Objectives :

1. The graduates shall be capable to accept challenges in Engineering industries.
2. The graduates shall demonstrate core competency to design, analyze and evaluate various engineering systems.
3. The graduates shall be able to apply computational and professional skills in corporate world.
4. The program shall prepare the graduates for higher studies, entrepreneurship and create awareness about lifelong learning.

Program Outcomes :

Engineering Graduate will be able to :

1) **Engineering Knowledge :** Apply the knowledge of Mathematics, Science, Engineering fundamentals, and engineering specialization to the solution of complex engineering problems.
2) **Problem Analysis :** Identify, Formulate, Review research literature, and analyze complex engineering problems reaching substantiated conclusion using first principles of mathematics, natural science, and engineering sciences.

3) **Design /development of solutions :** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.

4) **Conduct Investigation of complex problems :** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

5) **Modern Tools Usage :** Create, select and apply appropriate techniques resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6) **The Engineer and society :** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7) **Environment and Sustainability :** Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.

8) **Ethics :** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9) **Individual and Team work :** Function effectively as an a member or leader in diverse teams, and in multi disciplinary settings.

10) **Communication :** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentations, make effective presentations, and give and receive clear instructions.

11) **Project Management and Finance** : Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team to manage projects and in multidisciplinary environment.

12) **Life-long learning :** Recognize the need for and have the preparation and ability to engage in independent and life ling learning in the broadest context technological change.

Program Specific Outcomes :

1. Graduates will stand for design, production and operations in core mechanical domain and management of interdisciplinary applications.
2. Graduates will be capable of carrying out the analysis of mechanical and allied systems and provide numerical and computer based solution.

Prof. Ram Meghe Institute of Technology and Research, Badnera-Amravati
(An Autonomous Institute)
Two Year Post Graduate Degree Program in Master of Technology
Choice Based Credit System (Semester Pattern)
Branch : Mechanical Engineering (CAD CAM)

SEMESTER: I

Sr. No.	Course Code	Name of the Course	Teaching Scheme					Examination Scheme										
			Hours/ Week			Total Hours/ Week	Credits	THEORY							PRACTICAL			
										Internal					Max. Marks			
			Lecture	Tutorial	P/D			Duration of paper (Hrs)	Max. Marks ESE/ ESSE	Max. Marks MSE/ MSIE	Max. Marks TA	Total	Min. Passing Marks in ESE/ ESSE	Overall Min Passing Marks	Int.	Ext.	Total	Min. Passing Marks
Theory																		
01	1MCC1	Computer Aided Design	3	1		4	4	3	60	30	10	100	24	50				
02	1MCC2	Computer Aided Manufacturing	3	1		4	4	3	60	30	10	100	24	50				
03	1MCC3	Computer Aided Production Manaagement	3	1		4	4	3	60	30	10	100	24	50				
04	1MCC4	PE - 1	3	1		4	4	3	60	30	10	100	24	50				
05	1MCC5	PE - 2	3	1		4	4	3	60	30	10	100	24	50				
06	1MCC6	Research Methodology & IPR	2			2	2	3	60	30	10	100	24	50				
07	1MCC7	Audit Course-1	2			2	0											
Practical																		
07	1MCC8	Computer Aided Design Lab			2	2	2								25	25	50	25
08	1MCC9	Computer Aided Manufacturing Lab			2	2	2								25	25	50	25
		Total	**19**	**5**	**4**	**28**	**26**					**600**					**100**	
																	Total	**700**

PE - 1 1 Mechatronics 2 Concurrent Engg 3 Management Information System

PE - 2 1 Engg Experimental Techniques 2 Optimization Techniques 3 Design of Manufacturing Assembly & Environment

Audit Course 1 1 English for research paper writing 2 Value Education

Note : Evaluation of Audit Course is based on Case study & Assignments

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SEMESTER: II

Sr. No.	Course Code	Name of the Course	Teaching Scheme					Examination Scheme										
			Hours/ Week			Total Hours/ Week	Credits	THEORY							PRACTICAL			
										Internal					Max. Marks			
			Lecture	Tutorial	P/D			Duration of paper (Hrs)	Max. Marks ESE/ ESSE	Max. Marks MSE/ MSIE	Max. Marks TA	Total	Min. Passing Marks in ESE/ ESSE	Overall Min Passing Marks	Int.	Ext.	Total	Min. Passing Marks
Theory																		
01	2MCC1	Finite Element Analysis	3	1		4	4	3	60	30	10	100	24	50				
02	2MCC2	Robotics & Robot Application	3	1		4	4	3	60	30	10	100	24	50				
03	2MCC3	PE - 3	3	1		4	4	3	60	30	10	100	24	50				
04	2MCC4	PE - 4	3	1		4	4	3	60	30	10	100	24	50				
05	2MCC5	Audit Course-2	2			2												
Practical																		
06	2MCC6	Finite Element Analysis Lab			2	2	1								25	25	50	25
07	2MCC7	Robotics & Robot Application Lab			2	2	1								25	25	50	25
08	2MCC8	Mini Project			2	2	1								25	25	50	25
		Total	**14**	**4**	**6**	**24**	**19**					**400**					**150**	
															Total		**550**	
															Total		**550**	

PE - 3 1. Flexible Manufacturing System 2. Industrial Automation
PE - 4 1 Rapid Prototyping & Tooling 2. Simulation Theory & application 3. Industrial Product Design
Audit Course 2 1Problem solving with creative thinking 2. Sustainable Development 3. Economics & Enterprenurship Management
Note : Evaluation of Audit Course is based on Case study & Assignments

Mini-Project & Seminar -1 : Project shhould be relevant to current technology and must include innovative element,
Seminar1: It will be based on Mini-Project

Exit Option after complition of First Year.: Student has to complete 10 credit online courses (NPTEL/MOOCS/SWAYAM) suitable for Mechanical Engineering (CAD/CAM) to qualify for the **Post-Graduate Diploma in CAD CAM**

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Branch : Mechanical Engineering (CAD CAM)

SEMESTER: III

Sr. No.	Course Code	Name of the Course	Teaching Scheme					Examination Scheme										
			Hours/ Week			Total Hours/ Week	Credits	THEORY							PRACTICAL			
			Lecture	Tutorial	P/D			Duration of paper (Hrs)	Max. Marks ESE/ ESSE	Internal		Total	Min. Passing Marks in ESE/ ESSE	Overall Min Passing Marks	Max. Marks		Total	Min. Passing Marks
										Max. Marks MSE/ MSIE	Max. Marks TA				Int.	Ext.		
Practical																		
01	3MCC1	Compulsary Internship Two months (After completion of 1st year)					6									200	200	50
02	3MCC2	Seminar & Dissertation (Phase -I)		8		8	4								100		100	**150**
		Total		**8**		**8**	**10**				..		..		**100**	**200**	**300**	
															Total		**300**	

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SEMESTER: IV

Sr. No.	Course Code	Name of the Course	Teaching Scheme					Examination Scheme										
			Hours/ Week			Total Hours/ Week	Credits	THEORY							PRACTICAL			
										Internal					Max. Marks			
			Lecture	Tutorial	P/D			Duration of paper (Hrs)	Max. Marks ESE/ ESSE	Max. Marks MSE/ MSIE	Max. Marks TA	Total	Min. Passing Marks in ESE/ ESSE	Overall Min Passing Marks	Int.	Ext.	Total	Min. Passing Marks
Practical																		
01	4MCC	Seminar & Dissertation Phase -II			20	20	10								100	200	300	150
		Total			**20**	**20**	**10**										**300**	
																Total	**300**	

Semester	SEM-I	SEM-II	SEM-III	SEM-IV	Total
Credits	26	19	10	10	65

SYLLABUS PRESCRIBED FOR
TWO YEAR P. G. DEGREE COURSE IN M.Tech. (Full Time)
CAD CAM
FIRST SEMESTER

1SMTMC01 Computer Aided Design

Lectures: 3 Hrs/Week **Credits: 04**

Pre-requisites:

1. Knowledge of mechanical engineering drawing and design

Course Learning Objectives:

CLO1. To understand the concept of computer aided design.
CLO2. To study hardware and software requirement of CAD systems.
CLO3. To study various graphics modeling techniques.
CLO4. To study various CAD modeling packages.

Course Outcomes:

At the end of course, Learner will be able to
1. Understand the application of computers in design.
2. Understand the various graphics modeling and transformation techniques.
3. Understand the Computer aided drafting and documentation systems.
4. Understand the Graphics standards used in CAD.
5. Understand use of different CAD packages
6. Apply the CAD modeling knowledge for modeling of mechanicals parts and assemblies.

Section A

Unit I Introduction to computer technology, Introduction to CAD systems, Computer Aided Design workstation and peripherals, Graphics input/output devices. Design process and CAD models, Applications and benefits of CAD.

Unit II Computer graphics, Coordinate systems, 2D geometry transformations, mapping of geometry models.

Unit III 3D geometry transformations. Graphics manipulation and editing.

Section B

Unit IV CAD software: Graphics system and functions of a graphics package. Wireframe, solid and surface modeling. Approaches to solid modeling.

Unit V Computer aided drafting and documentation, Principles and concepts of automated drafting, drafting packages, Data exchange standards. Graphics standards like GKS, PHIGS, OpenGL, etc.

Unit VI Introduction of CAD packages like AutoCAD, Autodesk, FreeCAD, SOLIDWORKS, CATIA, Creo, etc.

TEXT BOOKS :

1. CAD/CAM Computer-Aided Design and Manufacturing; by M. Groover, E. Zimmers (Pearson)
2. CAD/CAM Principles and Applications; by P N Rao (Tata McGraw Hill)
3. Computer Aided Design & Manufacturing; by Dr. Sadhu Singh (Khanna Publishers)

REFERENCE BOOKS :

1. CAD/CAM Theory and Practice; by Ibrahim Zeid, R Sivasubramanian (Tata McGraw Hill)
2. Computer Graphics; by Donald Hearn, M. Pauline Baker (Pearson Education)

1SMTMC02 Computer Aided Manufacturing

Lectures: 3 Hrs/Week **Credits: 04**

Pre-requisites:

1) Knowledge of mechanical engineering drawing and design

Course Learning Objectives:

1) To understand the concept of NC and CNC Machines.
2) To understand the working of DDA
3) To evaluate the part programming of NC/CNC Machines.

Course Outcomes:

After the completion of course students will be able to…

CO1: Understand the basics construction and working of NC Machines.
CO2: Understand the basics principle of working and construction and working of CNC Machines.
CO3: Understand the working of DDA and software interpolator also knows the types of motion control.
CO4: Able to do the manual part programming and APT programming of NC/CNC machines.
CO5: Understand the concept and architecture in Direct Numerical Control systems.
CO6: Understand the concept and use of adaptive control in Machining with CNC.

Section-A

UNIT I Numerical control (NC): Fundamentals of NC, merits and demerits of NC, classification of NC systems, basic components of N C systems. NC tape and coding, control units, features of machine tools and system devices (6 Hrs)

UNIT II Computer Numerical Control CNC: Problems in conventional NC, CNC controller technology, computer numerical control, designing CNC systems. NC/CNC machine tools: Types and features (6 Hrs)

UNIT III DDA integrator, DDA hardware interpolator, software interpolators, reference word interpolator, point to point, straight line and contouring Controls in CNCs. (6 Hrs)

Section-B

UNIT IV NC/CNC part programming: Introduction, computer-aided part programming (APT), CNC part programming (6 Hrs)

UNIT V Direct numerical control (DNC), Types of DNC Systems. combined DNC/CNC systems. Difference Between CNC & DNC\ systems.\ (6 Hrs)

UNIT VI Adaptive control: ACC and ACO systems, optimization of AC. Benefits off AC in Machining. Problems in implementing Generative AC. (6 Hrs)

REFERENCE BOOKS :

1) Yoram Koren- Computer control of manufacturing, McGraw Hill.
2) Mikell P. Groover- Automation, Production Systems and CAD/CAM-Prentice-Hall of India pvt. Ltd.
3) Kundar T.K., Rao P.N., Tewari N.K.-Numerical control and computer aided manufacturing; Tata McGraw Hill.
4) D. Kochan- CAM Development in computer integrated manufacturing- Springer Verlag, Berlin

1SMTMC03 Computer Aided Production Management

Lectures/week: 03 **Credits: 03**

Pre-requisites:

1. Knowledge of Computer Applications & Management Principles

Course Learning Objectives:

CL01. To understand the concept of Production & Operations Management.
CL02. To study Computer solutions to Linear Programming & Material Requirement Planning Problem
CL03. To study the Plant Layout concept & Computer based program for Layout Analysis.
CL04. To study the types of Production Systems & Scheduling.
CL05. To study the Advanced Manufacturing Systems.

Course Outcomes:

At the end of course, Learner will be able to

1. Understand the concept & objectives of Production Management
2. Understand the application of Linear Programming & Computer Software Packages.
3. Understand the functions & objectives of MRP, ERP & CRP
4. Understand the types of layout & computer based program for layout analysis
5. Understand the use of computer for Scheduling
6. Understand the advanced manufacturing technologies & systems.

Section A

Unit I: Production & Operations Management Function: History of the Production & Operations Management, Criteria of Performance, Jobs/Decisions, Classification of Decision Areas, (6 Hrs)

Unit II: Linear Programming: Formulation of a Linear Programming Problem, Mathematical Procedures & Computer Software Packages, Application of Linear programming, Computer Solution of the Problem, Sensitivity Analysis, Slack Variables & Shadow Prices (6 Hrs)

Unit III: Material Requirement Planning (MRP):Functions & Objectives of MRP, MRP Calculations, Handling Uncertainties, Evolution of MRP into MRP II & further to Enterprise Resource Planning (ERP), Capacity Requirements Planning (CRP) (6 Hrs)

Section B

Unit IV : Plant Layout: Layout Concept, Developing Process & Product Layout (Models & Behavior), Optimization of Process & Product Layout, Computer Based Program for Layout Analysis CRAFT (Computerized Relative Allocation of Facilities Technique), CORELAP (Computerized Relationship Layout Planning), ALDEP (Automated Layout Design Programme) (6 Hrs)

Unit V: Scheduling: Sequencing or Prioritization, Use of Computer for Scheduling, Scheduling in Mass, Continuous, Job-Shop & Project Type Production Systems, Line of Balance Technique (6 Hrs)

Unit VI: Advanced Manufacturing Technologies and Systems: Advanced Manufacturing Philosophies, Growth of Technologies, CAD, CAM, CAPP (Computer Aided Process Planning), CIM, FMS, Lean & Agile Manufacturing (6 Hrs)

TEXT BOOKS:

1. Production & Operation Management; by S N Chary (McGraw Hill)
2. Industrial Engineering & Production Management; by M. Mahajan (Dhanpat Rai & Co.)

REFERENCE BOOKS:

1. Production & Operation Management; Everett E. Adam, Jr., & Ronald J. Ebert (PHI)
2. Industrial Engineering & Production Management; by Martand Telsang (S.Chand)

PROFESSIONAL ELECTIVE I
1SMTMC04-1 Mechatronics

Lectures/week: 03 **Credits: 03**

Pre-requisites:

1. Knowledge of mechanical measurement systems

Course Learning Objectives:

CLO1. To study various types of switches, sensors, motors and their working.
CLO 2. To study various parts of mechatronic system.
CLO 3. To study various types of valves and their working.
CLO4. To understand and create pneumatic and hydraulic circuits for various industrial applications.

Course Outcomes:

At the end of course, Learner will be able to
1. Understand the importance and principles of various sensors,
2. Understand the working & applications of pneumatic, hydraulic & electric actuators for mechatronic systems.
3. Understand the computer processes, electronic circuits, and controllers for mechatronics systems.
4. Understand the working principles of various control valves in mechatronics systems.
5. Design pneumatic circuits for various industrial applications.
6. Design hydraulic circuits for various industrial applications

Section A

Unit I Introduction: Definition, Scope , Block diagram & Example. **Sensors-** selection, contact & non contact optical types, performance, Proximity Sensors & Switches, LVDT, Digital optical encoder, Temperature Sensors, Piezoelectric Transducers. (6 Hrs.)

Unit II Actuators: Principal, types of hydraulic, pneumatic, electrical actuators. Contact speed, multispeed, step and continuous variable, actuators with stepping motors. (6 Hrs.)

Unit III Computer process controls: Computer process interface, interface hardware, direct digital control, supervisory computer control. Design of mechatronics elements: Measuring system, control software and user interface, gauging, tool monitoring system, spindle drives, feed drives, servo principles, configuration CNC systems, interfacing, monitoring, diagnostics. (6 Hrs.)

Section B

Unit IV Control Valves : Study of different control components and pneumatic & Hydraulic system- Construction, working and function of Directional control valve, Flow control valves, Pressure relief valve, Standard symbols for control valves. (6 Hrs.)

Unit V Pneumatic system: Different control components of pneumatic systems and there conversion valves, auxiliary devices, synchronizing, clamping, declamping, application to robotics. (6 Hrs.)

Unit VI Hydraulic systems: Different control components of hydraulic systems, valves and auxiliary devices, design and analysis of hydraulic circuits sequencing, synchronizing, pneumo-hydraulic, CNC lubrication, machine tool applications. (6 Hrs.)

TEXT BOOKS :

1. Industrial Automation by Turgam, Mir Publication.

2. Pneumatics and Hydraulics by Stewar

3. Mechatronics – A multidisciplinary approach 4/e by W.Bolton- Pearson Publication

REFERENCE BOOKS :

1. Mechatronics by HMT

2. Introduction to Mechatronics and Measurment Systems by Michal B. Histand & David G. Aiciatore.

PROFESSIONAL ELECTIVE I

1SMTMC04-2 CONCURRENT ENGINEERING

Lectures/week: 03 **Credits: 03**

Pre-requisites:

1. Students should have a knowledge of Industrial Engineering and Automated fabrication systems.

2. Students should have a knowledge of design of Products andProcesses.

Course Learning Objectives:

CLO1. To study principles of concurrent approach.
CLO 2. To study the basic process issues.
CLO 3. To study various types of concurrent engineering approaches in manufacturing systems.
CLO4. To study the application of concurrent engineering in real life examples

Course Outcomes:

At the end of course, Learner will be able to
1. Understand the principles of concurrent approach,
2. Understand the basic process issues.
3. Understand the concurrent automated fabrication systems.
4. Apply concurrent engineering approach in manufacturing systems.
5. Evaluated the Technical performance.
6. Apply concurrent engineering in real life.

Section-A

Unit 1: Introduction : Principles, traditional versus concurrent approach, schemes and tools of concurrent engineering, Applications of computers in CE. (6 Hrs.)

Unit 2: Basic process issues : Process models, types, importance, relation between models, specifications, technology, automation and process improvement. (6 Hrs.)

Unit 3: Concurrent engineering approach in manufacturing systems: Systemdesign procedure, features, assembly resource alternatives, tasks assignments. (6 Hrs.)

Section-B

Unit 4: Concurrent automated fabrication systems : Introduction, methodology, preliminary and details work content analysis, humanresource considerations, 'Technical Economic' performance evaluation. (6 Hrs.)

Unit 5: Assembly work stations: Strategic issues, technical issues, economicanalysis. (6 Hrs.)

Unit 6: Case studies of concurrent engineering practice. (6 Hrs.)

REFERENCE BOOKS :

1) David Bedwarth, M.R. Handerson & Philip Wilze- Computer integrated Design and manufacturing.

2) J.L. Nevines and D.E. Whitney-Concurrent Design of Products andProcesses.

3) Proceeding of the "Summer school on Application of ConcurrentEngineering to Product Development" at P.S.G.College of Technology.

PROFESSIONAL ELECTIVE I

1SMTMC04-3 Management Information Systems

Lectures/week: 03 **Credits: 03**

Pre-requisites:

1. Students should have a knowledge of management of Products andProcesses.

Course Learning Objectives:

CLO1. To study principles of Management of Information system
CLO 2. To study the basic Planning Technique's
CLO 3. To study the tele-processing system.
CLO4. To study the application of decision support system

Course Outcomes:

At the end of course, Learner will be able to
1. Understand the principles of Management of Information system
2. Understand the basic Planning Technique's
3. Understand the tele-processing system.
4. Understand the decision support system.

Section-A

Unit 1 Objectives and cost benefits of Management Information Systems (MIS). Decision and MIS. A decision environment model, Decision strategies. Characteristics of information: Measurement and amount of Information, Information search, storage and retrieval, Information feed back systems. (6 Hrs.)

Unit 2 Planning techniques: Project proposals, reporting and controlling, Determination for information needs and sources, development of conceptual design, development of detailed design, selection of final design, design report, (6 Hrs.)

Unit 3 Organization for implementation, training of operational personnel, forms and files for data collection, evaluation control and maintenance of information system. (6 Hrs.)

Section-B

Unit 4 Computer Based Information System, MIS and CBIS family, MIS in total CBIS environment, an MIS model and dimensions of MIS model, (6 Hrs.)

Unit 5 an overview of tele-processing system(TPS):Techniques for TPS processing models, MIS and TPS, decision support system : definition : characteristics of DSS difference in DSS and development of DSS and its applications, (6 Hrs.)

Unit 6 Production of sub-systems : Marketing sub-systems, finance sub-systems, personnel sub-system, office automation system : definition, importance, planning and implementation of Automated computer based office communication system. (6 Hrs.)

REFERENCE BOOKS :

1) Essentials of MIS by K.C. Laudon, J.P. Laudon; PH
2) Strategic Management and MIS: An Integrated Approach by W. Robson; Pitman Pub.
3) Information systems for Managers by G.W.Reynolds; West Pub.
4) IT for Management by Turban E and McLean E; John Wiley Pub.
5) Foundations of Information systems by Zwass V; Irwin/ McGraw Hill

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PROFESSIONAL ELECTIVE II

1SMTMC05-1 Engineering Experimental Techniques

Lectures/week: 03 **Credits: 03**

Pre-requisites:

1. Students should have a knowledge of various experiments in engineering.

Course Learning Objectives:

CLO1. To study principles of generalized measurement system
CLO 2. To study the basic of intermediate instrumentation
CLO 3. To study the dynamic response system.
CLO4. To study the Experimental planning

Course Outcomes:

At the end of course, Learner will be able to

1. Understand the principles of generalized measurement system
2. Understand the basic intermediate instrumentation
3. Understand the dynamic response system.
4. Understand the Experimental planning

Section-A

Unit 1 Generalized measuring systems, different transducers for measurement of different mechanical parameters such as thickness (length), temperature, pressure, force, torque, etc., their design consideration, characteristics, limitation and uses. (8 Hrs.)

Unit 2 Intermediate stage instrumentation, Impedance matching, selection of intermediate instrumentation equipments. (6 Hrs.)

Unit 3 Terminating stage devices- characteristics, limitations (4 Hrs.)

Section-B

Unit 4 Dynamic response of instruments, Effect of different instruments used in the measuring system on the accuracy, sensitivity and performance of the instrument designed to measure a particular mechanical parameter. (6 Hrs.)

Unit 5 Experimental planning, parliamentary, intermediate and final stages, a experimental investigations, (6 Hrs.)

Unit 6 selection of instruments based on static, dynamic characteristics and allowable errors, analysis of experimental data, curve fitting, report writing. (6 Hrs.)

REFERENCE BOOKS :

1) Experimental methods for engineering by J.P. Holman
2) Measurement System, Application and Design by E.D. Doeblein

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PROFESSIONAL ELECTIVE II

1SMTMC05-2 OptimizationTechniques

Lectures/week: 03 **Credits: 03**

Pre-requisites:

1. Students should have a knowledge of optimization s in engineering.

Course Learning Objectives:

CLO1. To study various types of Classical Optimization Techniques
CLO 2. To study the Constrained Optimization Techniques
CLO 3. To study the Genetic Algorithm
CLO4. To study the Theory of Constraints

Course Outcomes:

At the end of course, Learner will be able to
1. Understand the various types of Classical Optimization Techniques
2. Understand the Constrained Optimization Techniques
3. Understand the Genetic Algorithm
4. Understand the Theory of Constraints

Section-A

Unit 1 Classical Optimization Techniques: Single-variable and Multi-variable Optimization, Hessian Matrix, Saddle Point, Lagrange Multipliers Method, Kuhn-Tucker Condition (6 Hrs.)

Unit 2 Single-variable Optimization Techniques: Unrestricted Search, Exhaustive Search, Dichotomous Search, Interval-halving Method, Fibonacci Method, Golden-section Method, Quadratic Interpolation Method, Newton Method, Quasi-Newton Method, Secant Method (6 Hrs.)

Unit 3 Multi-variable Optimization Techniques: Evolutionary Optimization Method, Simplex Search Method, Pattern Search Method, Conjugate Direction Method, Steepest Descent Method, Newton's Method, Conjugate Gradient Method, Davidon- Fletcher-Powell Method (6 Hrs.)

Section-B

Unit 4 Constrained Optimization Techniques: Interior Penalty Function Method, Exterior Penalty function Method. (5 Hrs.)

Unit 5 Genetic Algorithm, Simulated Annealing, Artificial Neural Networks. (5 Hrs.)

Unit 6 Theory of Constraints: Introduction to TOC, Optimized Production Technology (OPT), Nine principles of OPT, Five Focusing Steps (The 5FS) of TOC, Capacity Constrained Resources and the Time Buffer, Modeling the Time Buffer, Modeling Return-On-Investment (ROI) in TOC, Comparison of TOC and Local Optimization Approaches (8 Hrs.)

REFERENCE BOOKS :

1. Deb K (2004). Optimization for Engineering Design: Algorithms and Examples, Prentice Hall of India.
2. Dennis J Jr, Schnabel R (1996). Numerical Methods for Unconstrained Optimization and Nonlinear Equations, Society for Industrial and Applied Mathematics.
3. Rao S (1996). Engineering optimization, Theory and Practice, New Age International Publishers
4. Ravindran A, Ragsdell K and Reklaitis G (2006). Engineering Optimization: Methods and Applications, 2nd edition, John Wiley and Sons Inc.
5. Goldratt, E. M. and Cox, J. (2004). The Goal: A Process of Ongoing Improvement. 3rd Edition, North River Press. ISBN-10: 0884271781, ISBN-13: 978-0884271789
6. Dettmer, H. William (1997). Goldratt's Theory of Constraints: A Systems Approach to Continuous Improvement, American Society for Quality. ISBN 0873893700, 9780873893701

PROFESSIONAL ELECTIVE II

1SMTMC05-3 Design for Manufacturing Assembly and Environment

Lectures/week: 03 **Credits: 03**

Pre-requisites:

1. Students should have knowledge of manufacturing process in engineering.

Course Learning Objectives:

CLO1. To study General design principles for manufacturability
CLO 2. To study the basic of Component design-machining consideration
CLO 3. To study the Component design - casting consideration
CLO4. To study the Design for the environment

Course Outcomes:

At the end of course, Learner will be able to

1. Understand the General design principles for manufacturability
2. Understand the Component design-machining consideration
3. Understand the Component design - casting consideration
4. Understand the Design for the environment

Section-A

Unit 1 Introduction: General design principles for manufacturability, Strength and mechanical factors, Mechanism selection, Evaluation method, Process capability, Feature tolerances, Geometric tolerances, Assembly limits -Datum features, Tolerance stacks. (6 Hrs.)

Unit 2 Factors influencing form design: Working principle, Material, Manufacture, Design, Possible solutions, Materials choice, Influence of materials on form design , Form design of welded members, Forgings and castings(6 Hrs.).

Unit 3 Component design-machining consideration : Design features to facilitate machining, Drills, Milling cutters, keyways, Doweling procedures, Counter sunk screws, Reduction of machined area, Simplification by separation, Simplification by amalgamation, Design for machineability, Design for economy, Design for clampability, Design for accessibility, Design for assembly. (6 Hrs.)

Section-B

Unit 4 Component design - casting consideration: Redesign of castings based on parting line considerations, Minimizing core requirements, machined holes, Redesign of cast members to obviate cores. Identification of uneconomical design, Modifying the design, Group technology, Computer Applications for DFMA. (6 Hrs.)

Unit 5 Design for the environment: Introduction, Environmental objectives, Global issues, Regional and local issues, Basic DFE methods, Design guide lines, Applications, (5 Hrs.)

Unit 6 Lifecycle assessment: Basic method, AT&T's environmentally responsible product assessment, Weighted sum assessment method, Lifecycle assessment method, Techniques to reduce environmental impact, Design to minimize material usage, Design for disassembly: Design for recyclability, Design for remanufacture, Design for energy efficiency, Design to regulations and standards. (7 Hrs.)

REFERENCE BOOKS :

1. Bralla, "Design for Manufacture handbook ", McGraw hill, 1999.
2. Boothroyd, G, Heartz and Nike, "Product Design for Manufacture", Marcel Dekker, 1994.
3. Dixon, John. R, and Corroda Poli, "Engineering Design and Design for Manufacture and Structural Approach", Field Stone Publisher, USA, 1995.
4. Fixel, J. "Design for the Environment", McGraw Hill., 1996.
5. Kevien Otto and Kristin Wood, "Product Design", Pearson Publication, 2004.

1SMTMC06 Research Methodology and IPR

Lectures/week: 2 **Credits: 2**

Course Learning Objectives:

CLO 1: To understand the role of research methodology, literature review process and formulation of a research problem
CLO 2: To understand data collection methods and statistical tools for data analysis
CLO 3: To learn technical writing skills required for research
CLO 4: To create awareness about intellectual property rights and research ethics

Course Outcomes:

Student will be able to:
CO 1: Understand the role of research methodology in Engineering
CO 2: Understand literature review process and formulation of a research problem
CO 3: Understand data collection methods and basic instrumentation
CO 4: Learn various statistical tools for data analysis
CO 5: Learn technical writing skills required for research
CO 6: Create awareness about intellectual property rights and patents

Section A

Unit 1: Definition of research, Characteristics of research, Types of research- Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, Overview of research methodology in various areas, Introduction to problem solving, basic research terminology such as proof, hypothesis etc. (6 Hrs.)

Unit 2: Literature review, sources of literature, various referencing procedures, Identifying the research areas from the literature review and research database, Problem Formulation, Identifying variables to be studied, determining the scope, objectives, limitations and or assumptions of the identified research problem, Justify basis for assumption, Formulate time plan for achieving targeted problem solution. (6 Hrs.)

Unit 3: Important steps in research methods: Observation and Facts, Laws and Theories, Development of Models, Developing a research plan: Exploration, Description, Diagnosis and Experimentation (6 Hrs.)

Section B

Unit 4: Static and dynamic characteristics of instruments, calibration of various instruments, sampling methods, methods of data collection, Basic Concepts concerning testing of hypotheses, procedures of hypothesis testing, generalization and interpretation (6 Hrs.)

Unit 5: Introduction: Structure and components of scientific reports, types of report, developing research proposal. Thesis writing: different steps and software tools in the design and preparation of thesis, layout, structure and language of typical reports, Illustrations and tables, bibliography, referencing and footnotes, (6 Hrs.)

Unit 6: IPR and ethics in Research: Intellectual property rights and patent law, techniques of writing a Patent, filing procedure, technology transfer, copy right, royalty, trade related aspects of intellectual property rights Publishing: design of research paper, citation and acknowledgement, plagiarism tools, reproducibility and accountability. (6 Hrs.)

Reference Books:

1. Ranjit Kumar, "Research Methodology: A Step by Step Guide for Beginners", SAGE Publications Ltd., 2011.
2. Wayne Goddard, Stuart Melville, "Research Methodology: An Introduction" JUTA and Company Ltd, 2004.
3. C.R. Kothari ,"Research Methodology: Methods and Trends", New Age International,2004
4. S.D. Sharma , "Operational Research", Kedar Nath Ram Nath & Co.,1972
5. B.L. Wadehra,"Law Relating to Patents,Trademarks, Copyright Designs and Geographical Indications", Universal Law Publishing, 2014.
6. Donald Cooper, Pamela Schindler, "Business Research Methods", McGraw-Hill publication, 2005.

Audit Course-I

1SMTMC07-1 ENGLISH FOR RESEARCH PAPER WRITING

Lectures/week: 02 **Credits: 00**

Pre-requisites:

1. Students should have knowledge of English.

Course Learning Objectives:

CLO1. To Understand your writing skills and level of readability
CLO 2. To study what to write in each section
CLO 3. To study the Component design - casting consideration
CLO4. To study the skills needed when writing a good quality of paper.

Course Outcomes:

Students will be able to:
1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title Ensure the good quality of paper at very first time submission.

Section A

Units 1: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness (6 Hrs.)

Unit 2: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction (6 Hrs.)

Unit 3: Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. (6 Hrs.)

Section B

Unit 4: key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, (6 Hrs.)

Unit 5: skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions (6 Hrs.)

Unit:6 useful phrases, how to ensure paper is as good as it could possibly be the first- time submission (6 Hrs.)

REFERENCE BOOKS :

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Audit Course-I

1SMTMC07-2 Value Education

Lectures/week: 2 **Credits: 0**

Course Learning Objectives:

CLO 1: To enable the students to understand meaning of values and select their goals by self- Investigation based on personal values

CLO 2: To enable the students to understand value of truth, commitments, honesty, sacrifice, care, unity, team work and relationship

CLO 3: To educate and make the young generation students aware of their social responsibilities

CLO 4: To increase awareness among students about environment and create attitude towards sustainable lifestyle

Course Outcomes:

Student will be able to:

CO 1: Understood human values, their significance and role in life

CO 2: Promote self-reflection and critical inquiry that foster critical thinking of one's value and the values of others

CO 3: Practice respect for human rights and democratic principles

CO 4: Familiarized with various living and non-living organisms and their interaction with environment

CO 5: Understood the basics regarding the leadership and to become a conscious professional

Section A

UNIT 1: Introduction of Value Education : Definition, Need, Content, Process and relevance to present day. Concept of Human Values, self introspection. (6 Hrs.)

UNIT 2: Salient values for life :Truth, commitment, honesty and integrity, forgiveness and love, empathy and ability to sacrifice, care, unity, punctuality, Interpersonal and Intra personal relationship, Team work , Positive and creative thinking. (6 Hrs.)

UNIT 3: Human Rights : Universal Declaration of Human Rights, Right to Information Act -2005, National Integration, Peace and non-violence, Dr. A P J Kalam's ten points for enlightened Citizenship. The role of media in value building. (6 Hrs.)

Section B

UNIT 4: Environment and Ecology : Ecological balance, interdependence of all beings – living and non-living. Man and nature, Environment conservation and enrichment. (6 Hrs.)

UNIT 5: Social values - Social consciousness and responsibility, Consumer rights and responsibilities. (6 Hrs.)

Unit 6: Ethical values - Professional ethics, Code of ethics of engineers, Influence of ethics on family life, Leadership qualities and Personality development. (6 Hrs.)

REFERENCE BOOKS :

1. Chakroborty S.K., Values and Ethics for organizations theory and practice, Oxford University Press, New Delhi.

Audit Course-I

1SMTMC07-3 PEDAGOGY STUDIES

Lectures/week: 2 **Credits: 0**

Course Learning Objectives:

CLO 1: To enable the students to understand existing evidence on the review topic to inform programme design

CLO 2: To Identify critical evidence gaps to guide the development

Course Outcomes:

Student will be able to:

CO 1: . Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers

CO 2: Identify critical evidence gaps to guide the development.

Section A

Units 1: Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching. (6 Hrs.)

Unit 2: Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education. (6 Hrs.)

Unit 3: Evidence on the effectiveness of pedagogical practices Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy. (6 Hrs.)

Section B

Unit 4: Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies. (6 Hrs.)

Unit 5: Professional development: alignment with classroom practices and follow-up support Peer support Support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes (6 Hrs.)

Unit 6: Research gaps and future directions Research design Contexts Pedagogy Teacher education Curriculum and assessment Dissemination and research impact. (6 Hrs.)

REFERENCE BOOKS:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

1SMTMC08 Computer Aided Design Lab

Lectures/week: 2 **Credits: 02**

Pre-requisites:

1. Knowledge of mechanical engineering drawing and design

Course Learning Objectives:

CLO1. To apply the concept of computer aided design.

CLO2. To identify hardware and software requirement of CAD systems.

Course Outcomes:

At the end of course, Learner will be able to

1. Understand the apply the concept of computer aided design.
2. Identify hardware and software requirement of CAD systems.

At least Five practical's based on syllabus of Computer Aided design.

1SMTMC09 Computer Aided Manufacturing Lab

Lectures/week: 2 **Credits: 02**

Course Learning Objectives:

1) To understand the working of NC and CNC Machines.
2) To evaluate the part programming of NC/CNC Machines.

Course Outcomes:

After the completion of course students will be able to…

CO1: Understand the basics the working of NC and CNC Machines.

CO2: Understand to evaluate the part programming of NC/CNC Machines.

At least Five practical's based on syllabus of Computer Aided Manufacturing

SYLLABUS PRESCRIBED FOR

TWO YEAR P. G. DEGREE COURSE IN M.Tech. (Full Time)
CAD CAM
SECOND SEMESTER

2SMTMC01 Finite Element Analysis

Lectures/week: 03 **Credits: 04**

Pre-requisites:
Knowledge of mechanical engineering design and CAD modeling

Course Learning Objectives:

CLO 1: To study the basic Concepts of Finite Element Analysis
CLO 2: To study Elements and Formulation Techniques
CLO 3: To understand and analyze plates, 2D and 3D solids.

Course Outcomes:

At the end of course, Learner will be able to

1. Understand the basic Concepts of Finite Element Analysis.
2. Understand the properties of elements and its formulation techniques.
3. Formulation and Analysis of plates, 2D and 3D solids.
4. Understand for selection of 1D, 2D & 3D elements.
5. Understand and apply the FEA Techniques for heat transfer and fluid mechanics.
6. Understand the applicability of Finite element analysis software.

Section A

Unit I: Introduction (6 Hrs)
Introduction: basic Concepts of Finite Element Analysis, Introduction to Elasticity, Steps in Finite Element Analysis, application of boundary conditions.
General procedure of FEM: Discretization, element shapes, interpolation functions, shape functions, element stiffness matrix, Global stiffness matrix and its properties

UNIT II: Properties of Elements and Formulation Techniques (6 Hrs)
Element Properties: Natural Coordinates, Triangular Elements, Rectangular Elements, Solid Elements, Isoparametric Formulation, Stiffness Matrix of Isoparametric Elements
Finite Element Formulation Techniques: Virtual Work and Variational Principle, Galerkin Method, Displacement Approach, Stiffness Matrix.

Unit III: Finite Element Analysis of Plates (6 Hrs)
FEA for Plates: Introduction to Plate Bending Problems, Finite Element Analysis of Thin Plate
Finite Element Analysis of Thick Plate, Finite Element Analysis of Skew Plate, Introduction to Finite Strip Method,

Section B

UNIT IV: Finite Element Analysis for 2D & 3D Solids (8 Hrs)
FEA for Two Dimensional Solids: Constant Strain Triangle, Linear Strain Triangle, Rectangular Elements Numerical Evaluation of Element Stiffness, Computation of Stresses, Axisymmetric Element.
FEA for Three Dimensional Solids: Finite Element Formulation for 3 Dimensional Elements.

UNIT V: Applications in Heat Transfer and Fluid Mechanics (6 Hrs)
Application of FEA in Heat Transfer and Fluid Mechanics: FEA of 2-D single variable problems, application of Heat transfer, fluid mechanics.

UNIT VI: Finite Element Analysis Packages (6 Hrs)
Software's in FEA: Introduction and study of open source FEA packages. Comparison related to software features and applications, Processing and Post Processing.

TEXT BOOKS:

1. Fundamentals of Finite Element Analysis; by David V. Hutton (Tata McGraw Hill)
2. Introduction to Finite Elements in Engineering; by Tirupathi R. Chandrupatla, Ashok D. Belegundu (Prentice-Hall India)
3. A First Course in the Finite Element Method; by Daryl L. Logan (Thompson, Brks/Cole).

REFERENCE BOOKS:

1. The Finite Element Method in Engineering; by S.S. RAO (ELSEVIER)
2. Textbook of finite Element Analysis; by P. Seshu (Prentice-Hall India)
3. Finite Element Analysis: Theory and Application with ANSYS; by Saeed Moaveni (Pearson)

2SMTMC02 Robotics and Robot Applications

Lectures/week: 03 **Credits: 04**

Pre-requisites:

Basic Knowledge of Robotics

Course Learning Objectives:

CLO 1: To study the basic Robot Configurations

CLO 2: To study levels of Control and Understand the robot Transformations

CLO 3: Robot Industrial applications

Course Outcomes:

At the end of course, Learner will be able to

CO1: Distinguish the types of Robot Configurations anticipate the work extremities of the robot motion.

CO2: Understand the operations and requirements of end effectors.

CO3: Understand the principles and applications of Robot Sensors.

CO4: Know the levels of Control and Understand the robot Transformations.

CO5: Know the Robot Industrial applications and able to specify the technical details of robot.

CO6: To study the Robot requirements of various processing operations.

Section-A

UNIT I Introduction: Definition, need, robot classification, terminology and systems, benefits and limitations. Robot system: Robot physical configuration, work spaces, basic robot motions. (6 Hrs.)

UNIT II End effectors: Grippers and Toolings- Types , Applications, Construction and Operation. (6 Hrs.)

UNIT III Robot sensors: Contact and Non-Contact types. Vision, Tactile , Proximity, Force, Torque, voice, Vision Sensors. Work cell control and interlocks. (6 Hrs.)

Section-B

UNIT IV Robot control and Types of Robot control systems. Robot arm kinematics: Homogenous transformation matrix. (6 Hrs.)

UNIT V Robot Industrial applications: Part Handling, Part Building and Part Processing. General considerations and problems. Robot Specifications. (6 Hrs.)

UNIT VI Robot Processing applications: Welding, Spray coating and other processing operations, assembly, inspection, robots in FMS. (6 Hrs.)

REFERENCE BOOKS:

1) Handbook of Industrial robotics.
2) Aures R.U. & Miller S.M.- Robotics applications and social implications.
3) Tanner W.R. – Industrial Robots Vol.-1 & Vol.-2.
4) Groover M.P. and Zimmer E.W.- Computer Aided Design and Manufacturing

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Professional Elective III

2SMTMC03-1 FLEXIBLE MANUFACTURING SYSTEMS

Lectures/week: 03 **Credits: 03**

Pre-requisites:

1. Students should have a knowledge of Industrial Engineering, various automated material handling and storage system.

Course Learning Objectives:

CLO1. To study functions of FMS, FMS host and area controller function distribution.
CLO 2. To study the development and implementation of FMS.
CLO 3. To study various automated material handling and storage system.
CLO4. To study the Modelling and analysis of FMS.

Course Outcomes:

At the end of course, Learner will be able to

1. Understand functions of FMS, FMS host and area controller function distribution.
2. Able to develop and implement FMS.
3. Understand AGV System.
4. Understand automated material handling and storage system.
5. Analysed storage system performance.
6. Modelling and analysis of FMS.

Section-A

Unit 1: FMS an overview: types and configuration, concept, types of flexibility and performance measures, functions of FMS, (6 Hrs.)

Unit 2: Development and implementation of FMS: Planning phases, integration, system configuration, FMS layout, (6 Hrs.)

Unit 3: FMS project development steps. FMS hostand area controller function distribution. (5 Hrs.)

Section-B

Unit 4: Automated material handling and storage: Functions- types- analysis of material handling equipments, design of conveyors and AGV systems. (5 Hrs.)

Unit 5: Automated Storages: Storage system performance- AS/RS- carausalstorage system- WIP storage system- interfacing handling, storagewith manufacturing. (6 Hrs.)

Unit 6: Modeling and Analysis of FMS: Analytical, heuristic, queuing, simulation and petrinet modeling techniques- scope, applicability and limitations (6 Hrs.)

REFERENCE BOOKS:

1. Groover M.P.- Automation, Production Systems and CIM.
2. Ranky P.G.- The Design and Operation of FMS.
3. Parrish D.J.- Flexible Manufacturing.

Professional Elective III

2SMTMC03-2 Virtual Manufacturing

Lectures/week: 03 **Credits: 03**

Pre-requisites:

1. Students should have a knowledge of Manufacturing

Course Learning Objectives:

CLO1. To study Virtual reality in engineering.

CLO 2. To study the manufacturing characterization

CLO 3. To study Design centered and production centered VM.

CLO4. To study the Virtual reality modeling languages.

Course Outcomes:

At the end of course, Learner will be able to

1. Understand Virtual reality in engineering.
2. Understand the manufacturing characterization
3. Understand Design centered and production centered VM.
4. Analysed the Virtual reality modeling languages.

Section-A

Unit 1: Virtual reality in engineering, rapid prototyping and near net shape manufacturing, visualization, (6 Hrs.)

Unit 2: Environment construction technologies, modeling technologies, metamodeling, (6 Hrs.)

Unit 3: Integrated infrastructure and architecture, simulation, integration of ligacy data, manufacturing characterization, verification, validation and measurement, work flow, cross functional treads. (6 Hrs.)

Section-B

Unit 4: Design centered and production centered VM, CAD data translation, manufacturing resource models for distributed manufacturing, (6 Hrs.)

Unit 5: design of production systems, Virtual manufacturing over INTERNET, IMACS (interactive manufacturability analysis and critiquing system), (6 Hrs.)

Unit 6: optimal selection of partner in Agile Manufacturing, Virtual reality modeling languages. (6 Hrs.)

REFERENCE BOOKS:

1) Considine D.M. and Considine G.D. – Standard Handbook of Industrial Automation.
2) Kusiak A.- Intelligent Manufacturing Systems.
3) Fundamentals of Industrial Automation by Turgan.

Professional Elective III

2SMTMC03-3 Industrial Automation

Lectures/week: 03 **Credits: 03**

Pre-requisites:

1. Students should have a knowledge of Automation Engineering

Course Learning Objectives:

CLO1. To study the Automation in production systems
CLO 2. To study Industrial Control Systems
CLO 3. To study Automated Manufacturing Systems
CLO4. To study the Modelling and Simulation for Plant Automation
CLO5. To study the Industrial Control Applications
CLO6. To Identify the various Intelligent Controllers

Course Outcomes:

At the end of course, Learner will be able to

1. Understand the Automation in production systems
2. Understand the Industrial Control Systems
3. Understand Automated Manufacturing Systems
4. Analysed the Modelling and Simulation for Plant Automation
5. Apply the concept of Industrial Control Applications
6. Identify the various Intelligent Controllers

Section-A

Unit 1 Introduction to Industrial Automation: Automation in production systems, Opportunities of automation and computerization in a production system, Automated manufacturing systems, Computerized manufacturing support systems, reasons for automating, automation principles and strategies, basic elements of an automated system, advanced automation functions, levels of automation. (6 Hrs.)

Unit 2 Industrial Control Systems**:** Process industries, discrete manufacturing industries, continuous and discrete control, computer process control and the forms of computer process control, sensors, actuators and other control system components. (6 Hrs.)

Unit 3 Automated Manufacturing Systems**:** Fundamentals of automated production lines, applications of automated production lines, transfer lines, automated assembly systems. (6 Hrs.)

Section-B

Unit 4 Modelling and Simulation for Plant Automation: Need of system modeling, uses of system simulation, mathematical modeling of a plant, model evaluation and improvement, modern tools for modeling and simulation of systems, applications. (6 Hrs.)

Unit 5 Industrial Control Applications: Introduction, cement plant, thermal power plant, water treatment plant, irrigation canal management, steel plant, etc. (6 Hrs.)

Unit 6 Intelligent Controllers: Introduction, model based controllers, predictive control, artificial intelligence based systems, expert controller, fuzzy logic system, fuzzy controller, fuzzy logic tools, artificial neural networks, neural controllers, VLSI implementation of neural networks, neuro-fuzzy control systems. (6 Hrs.)

REFERENCE BOOKS:

1. Automation, Production Systems and Computer-Integrated Manufacturing, by M. P. Groover, Pearson Education Pub.
2. Computer-Based Industrial Control, by Krishna Kant, Prentice Hall of India.

Professional Elective IV

2SMTMC04-1 Rapid Prototyping and Tooling.

Lectures/week: 03 **Credits: 03**

Pre-requisites:

1. Students should have a knowledge of Rapid Prototyping

Course Learning Objectives:

CLO1:To Understand the process of product development and concept of Rapid Prototyping.
CLO2: To Know the Stereolithography and FDM processes of 3D Printing.
CLO3: To Understand the Concept, process and Applications of Laser sintering.
CLO4: To Know the LOM and BPM processes of 3D Printing.
CLO5: To Understand and apply the concept of Reverse Engineering and Rapid Tooling.
CLO6: To Slicing Process and File formats ,Softwares for 3D printing.

Course Outcomes:

At the end of course, Learner will be able to

CO1:Understand the process of product development and concept of Rapid Prototyping.
CO2: Know the Stereolithography and FDM processes of 3D Printing.
CO3: Understand the Concept, process and Applications of Laser sintering.
CO4: Know the LOM and BPM processes of 3D Printing.
CO5: Understand and apply the concept of Reverse Engineering and Rapid Tooling.
CO6: Slicing Process and File formats ,Softwares for 3D printing.

Section-A

UNIT I Introduction: Need for time compression in product development, Product development conceptual design, Development, Detail design, Rapid Prototyping, Applications of RP. Stereolithography system: Principle, Process parameters, Process details, Machine details, Applications. (6 Hrs.)

UNIT II Fusion deposition modeling: Principle, Process parameters, Process details, Machine details, Applications. (6 Hrs.)

UNIT III Laser sintering systems: Principle, Methods and Processes, Process parameters, Process details, Machine details, Applications. (6 Hrs.)

Section-B

UNIT IV Laminated object manufacturing: Principle, Process parameters, process details, Machine details, Applications. Laser engineering net shaping (lens): Ballistic Particle Manufacturing (BPM), (6 Hrs.)

UNIT V Introduction to rapid tooling, Direct and indirect method, Rapid tooling techniques- vacuum casting, DMLS, etc.Introduction to reverse engineering. (6 Hrs.)

UNIT VI 3D printing principle, Commercial softwares for RP, Slicing the Model, STL file generation. Post Processing for Printed Parts. (6 Hrs.)

REFERENCE BOOKS:

1. Pham, D.T. & Dimov.S.S., "Rapid manufacturing", Springer -Verlag, London, 2001.
2. Terry wohlers, "Wohlers Report 2007", Wohlers Associates, USA, 2007.
3. Ghosh A., "Rapid Protopyping: A Brief Introduction", Affiliated East West,
4. Kenneth G. Cooper, "Rapid Prototyping Technology: Selection and Application", CRC Press, 2001.
5. Chua Chee Kai, Leong Kah Fai, Lim Chu -Sing, "Rapid Prototyping: Principles and Applications", World Scientific, 2003.

Professional Elective IV

2SMTMC04-2 Simulation Theory and Applications

Lectures/week: 03 **Credits: 03**

Pre-requisites:

Knowledge of Operation Research Techniques and

Course Learning Objectives:

CLO 1: To study the basic Concepts of Simulation theory
CLO 2: To study simulation techniques and its application
CLO 3: To study Queuing Systems, Random Number generations.
CLO4: To study of Simulation Tools and Language.

Course Outcomes:

At the end of course, Learner will be able to

1. Understand the basic Concepts of simulation.
2. Understand the concept of simulation and modeling of real time systems.
3. Understand the simulation techniques and its application.
4. Understand the Queuing Systems.
5. Understand the Random Number generations.
6. Understand the Simulation Tools and Language.

Unit I: Introduction (8 Hrs)

System and System Environment, Components of System, Discrete and Continuous System, System Simulation, Model of a System, Types of Model, Use of Differential and Partial differential equations in Modeling, Advantages, Disadvantages and Limitations of Simulation, Application Areas, Phases in Simulation Study

UNIT II: Simulation Techniques (6 Hrs)

System simulation: The techniques of simulation, Monte Carlo method, comparison of simulation and analytical methods, Analog computers and methods, hybrid computer, simulators.

UNIT III: Simulation of Continuous and Discrete System (6 Hrs)

Continuous system simulation languages, system dynamics, growth models, logistic curves, multi-segment models, probability concepts in simulation, system simulation, events, representation of time, arrival pattern.

UNIT IV: Random Numbers (6 Hrs)

Random Numbers and its properties, Pseudo Random Numbers, Methods of generation of Random Number, Tests for Randomness - Uniformity and independence, Random variate Generation.

UNIT V: Analysis of simulation output (6 Hrs)

Estimation method, simulation run statistics, replications of runs, elimination of initial bias, batch means, regenerative techniques, time series analysis, spectral analysis, auto regression. Applications of simulation in manufacturing

UNIT V: Simulation of Computer Systems (6 Hrs)

Simulation Tools, Simulation Languages: GPSS, Case Studies of different types of Simulation Models and Construction of sample mathematical models

TEXT BOOKS:

1. Geoffrey Gordon- System Simulation
2. Narsingh Deo- System Simulation with Digital Computers.
3. Naylor T.H. et. Al.- Computer Simulation Techniques.

REFERENCE BOOKS:

1. Gottfried B.S- Elements of Stochastic Process Simulation
2. Product Design & Manufacture by John Lindbeck , Prentice Hall International.
3. Integrated Product & Process Design by Edward Magrab, RC Press.

Professional Elective IV

2SMTMC04-3 Industrial Product Design

Lectures/week: 03 **Credits: 03**

Pre-requisites:

1. Manufacturing Technology/Processes

Course Learning Objectives:

CLO1 To understand modern product design and product development processes
CL02 To understand and explain the concept of Industrial design and robust design concepts.
CLO3 To understand the concept of Design for manufacture and assembly.
CLO4 To understand the legal factors, social issues, engineering ethics related to product design.

Course Outcomes:

At the end of course, Learner will be able to:

CO1 Use the Product Design and Development Process, as a means to manage the development of an idea from concept through to production.

CO2 Assess the customer requirements in product design.

CO3 Apply structural approach to concept generation, concept selection and concept testing.

CO4 Identify various aspects of design such as industrial design, design for manufacture, assembly, and product architecture.

CO5 Explain various principles and technologies used for the preparation of prototype models of products.

CO6 Explain legal factors, social issues, engineering ethics related to intellectual property rights.

SECTION – A

UNIT I Introduction: Characteristics of Successful Product Development, Challenges of Product Development, Development processes and organizations: Adapting the Generic Product Development Process, Product Development Process FlowsProduct Planning : Product Planning Process(6 Hrs.)
UNIT II Customer Needs: Importance, process of identification of customer needs Product Specifications: Establishing Target Specifications, Setting the Final Specifications(6 Hrs.)
UNIT III Concept Generation: Five-Step Method Concept Selection: Methodology, Concept Testing(6 Hrs.)

SECTION – B

UNIT IV Product Architecture: Implications of the Architecture, Establishing the Architecture
Industrial Design: Need for Industrial Design, Impact of Industrial Design, The Industrial Design Process (6 Hrs.)

UNIT V Selection of Materials and Processes, Design for Manufacturing: DFM Process
Product Design for Manual Assembly Prototyping: Principles of Prototyping, Prototyping Technologies (6 Hrs.)
UNIT VI Robust Design: Design of Experiments, Robust Design Process Patents and Intellectual Property: Introduction to Intellectual Property, Overview of Patents, preparing an invention disclosure – (patent application) (6 Hrs.)

TEXT BOOKS:

Product Design and Development, Karl T. Ulrich, Steven D. Eppinger ISBN 978-0-07-802906-6
TATA McGraw-Hill Education

Product Design for Manufacture and Assembly, Geoffrey Boothroyd, Peter Dewhurst, Winston Knight
ISBN: 0-8247-0584-X

REFERENCE BOOKS:
Selection and Use of Engineering Material, J.A. Charles, F.A.A. Crane, J.A.G. Furness ISBN:-13:978-81-312-0173-2 Elservier Publishers

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OPEN ELECTIVE I

2SMTMC05 -1 Business Analytics

Lectures/week: 03 **Credits: 03**

Course Learning Objectives:
CLO1 In this course students will learn R. data analytics, data visualization and statistical model for data analytics.
CLO2 Students will be able to become business data analyst.
Course Outcomes:
After successful completion of this course students will be able to-
CO1 Demonstrate skill in data management.
CO2 Understand the basic concept of R programming.
CO3 Demonstrate skills in data visualization.
CO4 Describe their proficiency in business statistical analysis of data.

Section A

Unit 1: Introduction to Analytics Meaning, application areas of business analytics, techniques of analytics, Statistics for Business Analytics Central tendencies and dispersion, central, limit theorem, sampling distribution, hypothesis testing, simple linear regression, categorical data analysis, analysis of variance (ANOVA), non-parametric tests. (6 Hrs.)

Unit 2: Advanced Excel Proficiency Describing Numeric Data, Pivot Table Analysis, Linear Regression, Comparing Two Sample Variances, Comparing Two Sample Means, Pair T Test, One Way ANOVA, Two Way ANOVA, Generating Random Numbers, Rank and Percentile, Histogram Procedure, Exponential Smoothing and Moving Average, Sampling, Covariance and Correlation, Goal Seek and Solver. (6 Hrs.)

Unit 3: Data Mining using Decision Tree Introduction to decision trees, model design and data audit, demo of decision tree development, algorithm behind decision tree and other decision tree. Understanding R Using R Studio, working with data in R, R procedures, Data Mining using clustering in R Discussion and Data mining techniques, Understanding cluster analysis using R, clustering as strategy, hierarchical clustering, non-hierarchical clustering - K means clustering, variants of hierarchical clustering, different distance and linkage functions. (6 Hrs.)

Section B

Unit 4: Time Series Forecasting Time series vs causal models moving averages, exponential smoothing, trend, seasonality, cyclicity causal modelling using linear regression forecast accuracy, Predictive Modelling – Logistic Regression using R Data import and sanity check, development and validation, important categorical variable selection, important numeric variable selection, indicator variable creation, stepwise regression, dealing with multicollinearity, logistic regression score and probability, KS calculation, coefficient stability check, iterate for final model. (6 Hrs.)

Unit 5: Overview of Big Data and Hadoop Big data and Hadoop and concept, application, cloud computing, generators of big-data. Data Analysis and Applications Credit risk analytics, fraud risk analytics, financial services marketing (6 Hrs.)

Unit 6: Probability: Definition, Types of Probability, Mutually Exclusive events, Independent Events, Marginal Probability, Conditional Probability, Bayes Theorem. Probability Distributions – Continuous, Normal, Central Limit theorem, Discrete distribution, Poison distribution, Binomial distribution. (6 Hrs.)

TEXT BOOKS:

1. Dr. Bharti Motwani, Data Analytics with R , Wiley
2. B. Uma Maheswari (Author), R. Sujatha (Author), Introduction to Data Science: Practical Approach with R and Python, Wiley
3. W. N. Venables, D.M. Smith and the R Development Core Team: An Introduction to R, Notes on R : A Programming Environment for Data Analysis and Graphics.

OPEN ELECTIVE I

2SMTMC05 -2 COMPUTATIONAL FLUID DYNAMICS

Lectures/week: 03 **Credits:03**

Pre-requisites:

1. Basic knowledge about CAD Modeling.
2. Basic knowledge about governing equations.
3. Basic knowledge about linear differential equation.

Course Learning Objectives:

CLO 1: To numerically solve governing partial differential equations for physical problems in fluid mechanics and heat transfer.

CLO 2: To analyze different mathematical models and computational methods for transport processes.

CLO 3: To study, and apply discretization methods & schemes and analyze its effect on the accuracy of numerical solution and computational time.

CLO 4: To demonstrate the ability to use modern CFD software tools.

Course Outcomes:

At the end of course, Learner will be able to

1. Numerically solve the governing partial differential equations of fluid flow and heat transfer problems.
2. Construct and solve the different mathematical models and computational methods for fluid flows.
3. Apply the discretization methods to solve fluid flow and heat transfer problems.
4. Choose and justify the CFD schemes for the respective fluid flow/transport phenomena problem.
5. Perform verification and validation of numerical model

SECTION – A

UNIT I. **Review of Governing Equations:** Governing Equations of Fluid flow and heat transfer, review of numerical methods. (6 Hrs.)

UNIT II. **Discretization:** Introduction to finite differences, difference equations, explicit and implicit approaches: definition and contrasts, errors and analysis of stability. (6 Hrs.)

UNIT III. **Classification of Partial Differential Equations:** Explicit and Implicit methods, solution of select model equations; Laplace heat and wave equation, laminar boundary layer solution(6 Hrs.)

SECTION - B

UNIT IV. **CFD Techniques:** The lax -wendroff technique, Mac Cormack's technique, Relaxation technique and its use with low speed inviscid flows, aspects of numerical dissipation and dispersion; artificial viscosity, (7 Hrs.)

UNIT V. **CFD Techniques:** Alternating Direction Implicit (ADI) technique, pressure correction technique with application to incompressible viscous flow. (6 Hrs.)

UNIT VI. **Initial and Boundary Value Problems:** Free falling of a spherical. (5Hrs.)

TEXT BOOKS :

1. Computational Fluid Flow and Heat Transfer, Muralidhar, K. and Sundararajan, T., Narosa Pub., 2004.
2. Computational Fluid Dynamics: The Basics with Applications, Anderson, J. D., Jr. McGraw Hill, 2002.
3. Computational Fluid Dynamics: An Introduction for Engineers, Abbot, M. B. and Basco, D. R., John Wiley & Sons, 2006.
4. Computational Fluid Dynamics: Principles and Applications, Blazek, J., Elsevier Science, 2001.

OPEN ELECTIVE I

2SMTMC05 -4 Cost Management of Engineering Projects

Lectures/week: 3 **Credits: 3**

Pre-requisites:

1. Knowledge of basic factors related to various types of costs.
2. Knowledge of project management.

Course Learning Objectives: (3 to 4)

CLO 1: Understand the concept of cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost.

CLO 2: Understand the Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution.

CLO 3: Understand the behavior of profit planning, marginal costing, distinction between marginal costing and absorption costing, break-even analysis.

CLO 4: Able to analyze the linear Programming, PERT/CPM, Transportation Problems.

Course Outcomes:

At the end of course, Learner will be able to

1. Understand the concepts of strategic cost management process.
2. Apply cost concepts in decision-making and cost management projects.
3. Implement various stages of project execution with a team project.
4. Analyse various decision-making problems.
5. Evaluate different qualitative techniques and cost behaviour.

SECTION A

Unit 1: **INTRODUCTION**

Introduction and Overview of the Strategic Cost Management Process. Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.' (6 Hrs.)

Unit 2: COST CONCEPTS

Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision Making. (6 Hrs.)

Unit 3: **PROJECT MANAGEMENT**

Project: meaning, Different types, why to manage, cost overruns centers, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities. Detailed Engineering activities. Pre project execution main clearances and documents. Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process. (6 Hrs.)

SECTION B

Unit 4: **COST BEHAVIOR**

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, (6 Hrs.)

Unit 5: **PROFIT PLANNING**

Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets. (6 Hrs.)

Unit 6: **QUANTITATIVE TECHNIQUES**

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation Problems, Assignment problems, Simulation, Learning Curve Theory. (6 Hrs.)

TEXT BOOKS :

1 Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting.
2 N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

REFERENCE BOOKS :

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi.
2. Charles T. Horngren and George Foster Advanced Management Accounting.
3. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher.

Audit Course-II

2SMTMC06 -1 DISASTER MANAGEMENT

Lectures/week: 2 **Credits: 0**

Pre-requisites:

1. Knowledge of basic Hazard and Disaster

Course Learning Objectives:

CLO 1: Understand the concept of Hazard and Disaster.
CLO 2: Understand the Disaster Preparedness and Response Concept
CLO 3: Understand the Disaster Management
CLO 4: Able to analyze the Rehabilitation and The vulnerability atlas of India

Course Outcomes:

At the end of course, Learner will be able to

1 Understand the concepts of Hazard and Disaster
2 Apply Disaster Preparedness and Response Concept.
3 Implement various stages of Disaster Management
4 Analyse various Rehabilitation and The vulnerability atlas of India

Section-A

Unit 1: Introduction – Hazard and Disaster. Concepts of Hazard, Vulnerability, Risks. Different Types of Disaster : A) Natural Disaster: such as Flood, Cyclone, Earthquakes, Landslides etc B) Manmade Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea, Rail & Road), Structural failures(Building and Bridge), War & Terrorism etc. Slow Disasters (famine, draught, epidemics) and Rapid Onset Disasters(Air Crash, tidal waves, Tsunami) Causes, effects and practical examples for all disasters. Water and Climate Disaster: flood, hail storms, cloudburst, cyclones, heat and snow avalanches, cold waves, droughts, sea erosion, thunder and lightning. Geological Disaster: landslides, earthquakes, Tsunami, mine fires, dam failures and general fires. Biological Disaster: epidemics, pest attacks, cattle epidemic and food poisoning. Nuclear and Industrial Disaster: chemical and industrial disasters , nuclear accidents. Accidental Disaster: urban and forest fires, oil spill, mine flooding incidents, collapse of huge building structures. (6 Hrs.)

Unit 2: Natural disasters- Earthquakes, Tsunami, Floods, Drought, Landslides, Cyclones and Volcanic eruptions. Their case studies. Coastal disasters. Coastal regulation Zone. Risk and Vulnerability Analysis 1. Risk : Its concept and analysis 2. Risk Reduction 3. Vulnerability : Its concept and analysis 4. Strategic Development for Vulnerability Reduction . Disaster Prevention and Mitigation. Refugee operations during disasters, Human Resettlement and Rehabilitation issues during and after disasters, Inter-sectoral coordination during disasters, Models in Disasters. (6 Hrs.)

Unit 3: Disaster Preparedness and Response Concept and Nature Disaster Preparedness Plan Prediction, Early Warnings and Safety Measures of Disaster. Role of Information, Education, Communication, and Training, (6 Hrs.)

Section-B

Unit 4: Disaster Management : Role of Government, International and NGO Bodies. Role of IT in Disaster Preparedness Role of Engineers on Disaster Management. Response Disaster Response : Introduction Disaster Response Plan Communication, Participation, and Activation of Emergency Preparedness Plan Search, Rescue, Evacuation and Logistic Management Role of Government, International and NGO Bodies Psychological Response and Management (Trauma, Stress, Rumor and Panic) Relief and Recovery Medical Health Response to Different Disasters. (6 Hrs.)

Unit 5: Rehabilitation, Reconstruction and Recovery Reconstruction and Rehabilitation as a Means of Development. Damage Assessment Post Disaster effects and Remedial Measures. Creation of Long-term Job Opportunities and Livelihood Options, Disaster Resistant House Construction Sanitation and Hygiene Education and Awareness, Dealing with Victims' Psychology, Longterm Counter Disaster Planning Role of Educational Institute. (6 Hrs.)

Unit 6: The vulnerability atlas of India. Disaster Prevention and Mitigation. Agencies involved in Disaster Management. Warning and Prediction (6 Hrs.)

REFERENCE BOOKS:

1. Pandey, M., 2014. Disaster Management, Wiley India Pvt. Ltd., 240p.

2. Tushar Bhattacharya, Disaster Science and Management, McGraw Hill Education (India) Pvt. Ltd

3. Jagbir Singh, Disaster, Management: Future Challenges and Opportunities, K W Publishers Pvt. Ltd.

4. J.P. Singhal, Disaster Management, Laxmi Publications

5. C. K. Rajan, Navale Pandharinath, Earth and Atmospheric Disaster Management : Nature and Manmade, B S Publication 6. Shailesh Shukla, Shamna Hussain, Biodiversity, Environment and Disaster Management, Unique Publications

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Audit Course-II

2SMTMC06 -2 Constitution of India

Lectures/week: 2 **Credits: 0**

Pre-requisites:

1. Knowledge of Constitution of India

Course Learning Objectives:

CLO 1: Understand the historical background of the constitution
CLO 2: Understand the functioning of three wings of the government
CLO 3: Understand the value of the fundamental rights and duties
CLO 4: Able to analyze the decentralisation of power between central, state and local self government

Course Outcomes:

At the end of course, Learner will be able to
CO1: Describe historical background of the constitution making and its importance for building a democratic India.
CO2: Explain the functioning of three wings of the government i.e., executive, legislative and judiciary.
CO3: Explain the value of the fundamental rights and duties for becoming good citizen of India.
CO4: Analyse the decentralisation of power between central, state and local self government.
CO5: Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.

Section A

UNIT-I Introduction to Indian Constitution: Constitution' meaning of the term, Indian Constitution - Sources and constitutional history, Features - Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy. (6 Hrs.)

UNIT-2 Union Government and its Administration Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha, The Supreme Court and High Court: Powers and Functions; (6 Hrs.)

UNIT-3 State Government and its Administration Governor - Role and Position - CM and Council of ministers, State Secretariat: Organisation, Structure and Functions (6 Hrs.)

Section B

Unit 4: Local Administration - District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative - CEO of Municipal Corporation(6 Hrs.)

Unit 5: Pachayati Raj: Functions PRI: Zilla Panchayat, Elected officials and their roles, CEO Zila Panchayat: Block level Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials - Importance of grass-root democracy (6 Hrs.)

UNIT 6: Election Commission: Role of Chief Election Commissioner and Election Commission; State Election Commission: Functions of Commissions for the welfare of SC/ST/OBC and women (6 Hrs.)

REFERENCE BOOKS:

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt.Ltd.. New Delhi
2. SubashKashyap, Indian Constitution, National Book Trust J.A. Siwach, Dynamics of Indian Government & Politics D.C. Gupta, Indian Government and Politics
3. H.M.Sreevai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
4. J.C. Johari, Indian Government and Politics Hans J. Raj IndianGovernment and Politics
5. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt.Ltd.. New Delhi
6. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges to Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012

E-Resources: nptel.ac.in/courses/109104074/8 nptel.ac.in/courses/109104045/ nptel.ac.in/courses/101104065/
www.hss.iitb.ac.in/en/lecture-details
www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

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Audit Course-II

2SMTMC06 -3 Stress Management by Yoga

Lectures/week: 2 **Credits: 0**

Pre-requisites:

1. Knowledge of Yoga

Course Learning Objectives:

CLO 1: Understand the Importance of Yoga
CLO 2: Understand the concept of streee management

Course Outcomes:

At the end of course, Learner will be able to
CO1: Understand the Importance of Yoga
CO2: Explain the functioning of three wings of the government i.e., executive, legislative and judiciary.
CO3: Understand the concept of stress management.

Section A

UNIT 1 Definitions of Eight parts of yog. (Ashtanga) (6 Hrs.)
UNIT 2 Yam and Niyam. Do‟sand Don‟t‟s in life. (6 Hrs.)

UNIT 3 i) Ahinsa, satya, astheya, bramhacharya and aparigraha. ii)Shaucha, santosh, tapa, swadhyay, ishwarpranidhan. (6 Hrs.)

Section B

UNIT 4 Asan and Pranayam(6 Hrs.)
UNIT 5 Various yog poses and their benefits for mind & body. (6 Hrs.)
UNIT 6 Regularization of breathing techniques and its effects-Types of pranayam. (6 Hrs.)
REFERENCE BOOKS:
1.''Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur.

2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata.

2SMTMC07 Finite Element Analysis-Lab

Lectures/week: 02 **Credits: 02**

Pre-requisites:
Knowledge of mechanical engineering design and CAD modeling
Course Learning Objectives:
CLO 1: To study the basic Concepts of Finite Element Analysis
CLO 2: To study Elements and Formulation Techniques
CLO 3: To understand and analyze plates, 2D and 3D solids.
Course Outcomes:
At the end of course, Learner will be able to
1. Determine deflections and stresses under static loads on bars, trusses and beams.
2. Understand the properties of elements and its formulation techniques.
3. Formulation and Analysis of plates, 2D and 3D solids.
4. Analyze plate with hole for stresses and deflection
5. Calculate temperatures in steady state thermal analysis.

Practical's: At least **six** from the following list

1. Determine deflection and stresses of a loaded bar
2. Calculate the forces and stress in Trusses
3. Perform static structural analysis on corner bracket
4. Stress and deflection analysis in beams with different support conditions
5. Determine stresses and deflection in corner bracket
6. Stress analysis of flat plate with hole using 2D elements
7. Stress analysis of axi-symmetric components
8. Determine the thermal stresses of plate
9. Determine deflection and stresses by transient analysis on beam
10. Perform thermal analysis of a heat sink
11. Perform combined thermo-mechanical stresses analysis of on a bracket

2SMTMC08 Robotics and Robot Applications lab

Lectures/week: 02 **Credits: 02**

Pre-requisites:
Basic Knowledge of Robotics and Robot Applications

Course Learning Objectives:

CLO 1: To Identify the basic Robot Configurations

CLO 2: To Operate the Control and Understand the robot Transformations

Course Outcomes:

At the end of course, Learner will be able to

CO1: Identify the basic Robot Configurations.

CO2: Understand the Operation of Control the Robot and

CO3: Understand Understand the robot Transformations.

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At least Six practicals based on syllabus of Robotics and Robot Applications

2SMTMC09 Mini Project

Lectures/week: 02 **Credits: 02**

Pre-requisites:
Basic Knowledge of Robotics and Robot Applications

Course Learning Objectives:

CLO 1: To Identify the specific problem and give solution.

CLO 2: To Solve, interpret/ correlate the results and discussions .

Course Outcomes:

At the end of course, Learner will be able to

CO1: Formulate a specific problem and give solution.

CO2: Develop model theoretical/ practical/ numerical form.

CO3: Solve, interpret/ correlate the results and discussions.

CO4: Conclude the results obtained and write the documentation in standard form.

Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original. Mini projects should have inter disciplinary/ industry relevance. The students can select a mathematical modeling based/Experimental investigations or Numerical modeling. All the investigations are clearly stated and documented with the reasons/explanations. All the projects should contain A clear statement of the research objectives, background of work, Literature review, techniques used, prospective deliverables, benefit from this [line of] research, Detailed discussion on results, Conclusions and references.