GOVERNMENT COLLEGE OF TECHNOLOGY

(An Autonomous Institution Affiliated to Anna University)
Coimbatore – 641 013

Curriculum and Syllabi For

M.E. (MANUFACTURING ENGINEERING)

(Full Time)

2018

Regulations

OFFICE OF THE CONTROLLER OF EXAMINATIONS
GOVERNMENT COLLEGE OF TECHNOLOGY
THADAGAM ROAD, COIMBATORE – 641 013

PHONE 0422 – 2433355 FAX: +91 0422 – 2433355
Email: gctcoe@gct.ac.in

GOVERNMENT COLLEGE OF TECHNOLOGY
Coimbatore-641 013

VISION AND MISSION OF THE INSTITUTION

VISION

To emerge as a centre of excellence and eminence by imparting futuristic technical education in keeping with global standards, making our students technologically competent and ethically strong so that they can readily contribute to the rapid advancement of society and mankind

MISSION

- To achieve academic excellence through innovative teaching and learning practices.
- To enhance employability and entrepreneurship
- To improve the research competence to address societal needs
- To inculcate a culture that supports and reinforces ethical, professional behaviors for a harmonious and prosperous society

GOVERNMENT COLLEGE OF TECHNOLOGY

VISION AND MISSION OF THE DEPARTMENT

VISION

To drive towards a Global Knowledge Hub, striving continuously in pursuit of excellence in Mechanical Engineering Education, Entrepreneurship and Innovation

MISSION

- To impart total quality education through effective hi-tech teaching-learning techniques and department-industries collaboration.
- To mold the young dynamic potential minds to emerge as full-fledged future professionals so as to achieve top ten ranking status in the national level.
- To achieve international standards to fulfill the Government's "Make In India" industrial policy through innovation and research.

DEPARTMENT OF MANUFACTURING ENGINEERING
GOVERNMENT COLLEGE OF TECHNOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

The following Programme Educational Objectives are designed based on the department mission

The PEO's are to facilitate graduating students to

PEO 1: Acquire basic knowledge and expertise necessary for professional practice in manufacturing engineering for higher studies and research

PEO 2: Attain and practice technical skills to identify, analyze and solve complex problems and issues related to manufacturing engineering

PEO 3: Possess a professional attitude as an individual or a team member with consideration for society, professional ethics, environmental factors and motivation for life-long learning

DEPARTMENT OF MANUFACTURING ENGINEERING
GOVERNMENT COLLEGE OF TECHNOLOGY

PROGRAMME OUTCOMES (POs):

On successful completion of the programme the graduates will be able,

PO 1: To acquire theoretical and practical knowledge to solve real life engineering problems

PO 2: To identify , formulate and solve manufacturing problems by critical thinking

PO 3: To solve manufacturing engineering problems and evaluate optimal solutions

PO 4: To manufacture a system, product or process by using research skills

PO 5: To apply modern tools for complex manufacturing processes

PO 6: To perform collaborate multi disciplinary scientific manufacturing engineering research through self management and team work

PO 7: To apply project and finance management principles for effective project implementation

PO 8: To communicate and write report for knowledge transfer

PO 9: To contribute the society through lifelong learning

PO 10: To exhibit knowledge of professional, ethical and social responsibilities in the manufacturing

PO 11: To demonstrate knowledge on manufacturing through reflective learning

CURRICULUM FOR CANDIDATES ADMITTED DURING 2018-2019 AND ONWARDS

TWO YEAR M.E PROGRAMME

DEPARTMENT OF MANUFACTURING ENGINEERING

CHOICE BASED CREDIT SYSTEM-CURRICULUM

FIRST SEMESTER

S.No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
Theory											
1	18MFFCZ1	Research Methodology and IPR	FC	50	50	100	3	3	0	0	3
2	18MFPC01	Advanced Machining Processes and Automation	PC	50	50	100	3	3	0	0	3
3	18MFPC02	Automated Computer Integrated Manufacturing Systems	PC	50	50	100	3	3	0	0	3
4	18MFPC03	Additive Manufacturing	PC	50	50	100	3	3	0	0	3
5	18MFPEXX	Professional Elective - I	PE	50	50	100	3	3	0	0	3
6	18MFPEXX	Professional Elective - II	PE	50	50	100	3	3	0	0	3
7	18MFACXX	Audit Course 1	AC	50	50	100	2	2	0	0	0
Practical											
8	18MFPC04	Additive Manufacturing and Automation Laboratory	PC	50	50	100	3	0	0	3	1.5
Total				**-**	**-**	**800**	**23**	**20**	**-**	**3**	**19.5**

SECOND SEMESTER

S.No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
Theory											
1	18MFPC05	Materials Testing and Characterization Techniques	PC	50	50	100	3	3	0	0	3
2	18MFPC06	Theory of Metal Cutting	PC	50	50	100	3	3	0	0	3
3	18MFPC07	Advances in Casting and Welding Processes	PC	50	50	100	3	3	0	0	3
4	18MFPEXX	Professional Elective - III	PE	50	50	100	3	3	0	0	3
5	18MFPEXX	Professional Elective - IV	PE	50	50	100	3	3	0	0	3
6	18MFACXX	Audit Course 2	AC	50	50	100	2	2	0	0	0
Practical											
7	18MFEE01	Mini Project	EEC	50	50	100	3	0	0	4	2
8	18MFPC08	Material Processing and Testing Laboratory	PC	50	50	100	3	0	0	3	1.5
Total				-	-	**800**	**23**	**17**	**0**	**7**	**18.5**

THIRD SEMESTER

S.No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
Theory											
1	18MFPEXX	Professional Elective – V	PE	50	50	100	3	3	0	0	3
2	18$OEXX	Open Elective	OE	50	50	100	3	3	0	0	3
Practical											
5	18MFEE02	Project Phase I	EEC	100	100	200	20	0	0	20	10
Total				**-**	**-**	**400**	**26**	**6**	**0**	**20**	**16**

FOURTH SEMESTER

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
Practical											
1	18MFEE03	Project Phase II	EEC	200	200	400	32	0	0	32	16
Total				**-**	**-**	**400**	**32**	**0**	**0**	**32**	**16**

TOTAL CREDITS: 70

CURRICULUM DESIGN
MANUFACTURING ENGINEERING

LIST OF PROFESSIONAL ELECTIVES											
S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
1	18MFPE01	Applied Probability and Statistics	PE	50	50	100	3	3	0	0	3
2	18MFPE02	Design For Manufacture, Assembly and Environment	PE	50	50	100	3	3	0	0	3
3	18MFPE03	Advanced Finite Element Methods	PE	50	50	100	3	0	0	3	1.5
4	18MFPE04	Wear Analysis and Control	PE	50	50	100	3	3	0	0	3
5	18MFPE05	Manufacturing Metrology and Quality	PE	50	50	100	3	3	0	0	3
6	18MFPE06	Corrosion and Surface Engineering	PE	50	50	100	3	3	0	0	3
7	18MFPE07	Advanced Engineering Materials and Metallurgy	PE	50	50	100	3	3	0	0	3
8	18MFPE08	Lean Manufacturing Systems and Implementation	PE	50	50	100	3	3	0	0	3
9	18MFPE09	MEMS and Nanotechnology	PE	50	50	100	3	3	0	0	3
10	18MFPE10	Supply Chain Management	PE	50	50	100	3	3	0	0	3
11	18MFPE11	Fluid Power Control and Automation	PE	50	50	100	3	3	0	0	3
12	18MFPE12	Industrial Automation and Mechatronics	PE	50	50	100	3	3	0	0	3
13	18MFPE13	Vibration Control and Condition Monitoring	PE	50	50	100	3	3	0	0	3
14	18MFPE14	Green Manufacturing	PE	50	50	100	3	3	0	0	3
15	18MFPE15	Diagnostic Techniques	PE	50	50	100	3	3	0	0	3
16	18MFPE16	Industrial Robotics and Robot Applications	PE	50	50	100	3	3	0	0	3
17	18MFPE17	Reliability and Quality Engineering	PE	50	50	100	3	3	0	0	3

18	18MFPE18	Optimization Techniques in Engineering	PE	50	50	100	3	3	0	0	3
19	18MFPE19	Advanced Tool Design	PE	50	50	100	3	3	0	0	3
20	18MFPE20	Industrial Ergonomics	PE	50	50	100	3	3	0	0	3
21	18MFPE21	Manufacturing of Non Metallic Products	PE	50	50	100	3	3	0	0	3
22	18MFPE22	Artificial Intelligence and Expert Systems	PE	50	50	100	3	3	0	0	3
23	18MFPE23	Advanced Metal Joining Techniques	PE	50	50	100	3	3	0	0	3
24	18MFPE24	Non Destructive Evaluation	PE	50	50	100	3	3	0	0	3
25	18MFPE25	Sensors For Intelligent Manufacturing	PE	50	50	100	3	3	0	0	3
TOTAL CREDITS: 75											

LIST OF OPEN ELECTIVES											
SL.No	**Course code**	**Course name**	**Category**	**Continuous Assessment Marks**	**End Sem Marks**	**Total Marks**	**Contacts Periods**	**CREDITS**			
								L	**T**	**P**	**C**
1	18SEOE01	Vastu Science For Building Construction	OE	50	50	100	3	3	0	0	3
2	18SEOE02	Planning of Smart Cities	OE	50	50	100	3	3	0	0	3
3	18SEOE03	Green Building	OE	50	50	100	3	3	0	0	3
4	18EEOE04	Environment, Health and Safety in Industries	OE	50	50	100	3	3	0	0	3
5	18EEOE05	Climate Change and Adaptation	OE	50	50	100	3	3	0	0	3
6	18EEOE06	Waste to Energy	OE	50	50	100	3	3	0	0	3
7	18GEOE07	Energy in built Environment	OE	50	50	100	3	3	0	0	3
8	18GEOE08	Earth and its environment	OE	50	50	100	3	3	0	0	3
9	18GEOE09	Natural hazards and mitigation	OE	50	50	100	3	3	0	0	3
10	18EDOE10	Business Analytics	OE	50	50	100	3	3	0	0	3
11	18EDOE11	Cost Management of Engineering Projects	OE	50	50	100	3	3	0	0	3
12	18EDOE12	Introduction to Industrial Engineering	OE	50	50	100	3	3	0	0	3
13	18MFOE13	Industrial Safety	OE	50	50	100	3	3	0	0	3
14	18MFOE14	Operations Research	OE	50	50	100	3	3	0	0	3
15	18MFOE15	Composite Materials	OE	50	50	100	3	3	0	0	3

16	18TEOE16	Global Warming Science	OE	`50	50	100	3	3	0	0	3
17	18TEOE17	Introduction to Nano Electronics	OE	50	50	100	3	3	0	0	3
18	18TEOE18	Green Supply Chain Management	OE	50	50	100	3	3	0	0	3
19	18PSOE19	Distribution Automation System	OE	50	50	100	3	3	0	0	3
20	18PSOE20	Power Quality Assessment And Mitigation	OE	50	50	100	3	3	0	0	3
21	18PSOE21	Modern Automotive Systems	OE	50	50	100	3	3	0	0	3
22	18PEOE22	Virtual Instrumentation	OE	50	50	100	3	3	0	0	3
23	18PEOE23	Energy Auditing	OE	50	50	100	3	3	0	0	3
24	18PEOE24	Advanced Energy Storage Technology	OE	50	50	100	3	3	0	0	3
25	18AEOE25	Design of Digital Systems	OE	50	50	100	3	3	0	0	3
26	18AEOE26	Advanced Processors	OE	50	50	100	3	3	0	0	3
27	18AEOE27	Pattern Recognition	OE	50	50	100	3	3	0	0	3
28	18VLOE28	VLSI Design	OE	50	50	100	3	3	0	0	3
29	18VLOE29	Analog & Mixed Mode VLSI Circuits	OE	50	50	100	3	3	0	0	3
30	18VLOE30	Hardware Description Languages	OE	50	50	100	3	3	0	0	3
31	18CSOE31	Artificial Intelligence and Machine Learning	OE	50	50	100	3	3	0	0	3
32	18CSOE32	Computer Network	OE	50	50	100	3	3	0	0	3

		Engineering									
33	18CSOE33	Big Data Analytics	OE	50	50	100	3	3	0	0	3

LIST OF AUDIT COURSES

S. No	Course Code	Course Title	Category	Continuous Assessment Marks	End Sem Marks	Total Marks	Contact Periods	L	T	P	C
1	18MFACZ1	English For Research Paper Writing	AC	0	0	0	2	2	0	0	0
2	18MFACZ2	Disaster Management	AC	0	0	0	2	2	0	0	0
3	18MFACZ3	Value Education	AC	0	0	0	2	2	0	0	0
4	18MFACZ4	Constitution of India	AC	0	0	0	2	2	0	0	0
5	18MFACZ5	Pedagogy Studies	AC	0	0	0	2	2	0	0	0
6	18MFACZ6	Stress Management by Yoga	AC	0	0	0	2	2	0	0	0
7	18MFACZ7	Personality Development Through Life Enlightenment Skills	AC	0	0	0	2	2	0	0	0
8	18MFACZ8	Sanskrit For Technical Knowledge	AC	0	0	0	2	2	0	0	0

CURRICULUM DESIGN

S.No	Course Work Subject Area	No of Credits					Percentage
		I	II	III	IV	Total	
1.	Foundation Course	3	0	0	0	03	4.29 %
2.	Professional Cores	10.5	10.5	0	0	21	30 %
3.	Professional Electives	6	6	3	0	15	21.42 %
4.	Employability Enhancement Courses	0	2	10	16	28	40 %
5.	Open Elective Courses	0	0	3	0	03	4.29 %
Total Credits		**19.5**	**18.5**	**16**	**16**	**70**	**100%**

18MFFCZ1 RESEARCH METHODOLOGY AND IPR

(Common to All Branches)

Category : FC

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Definition and objectives of Research*
- *Quantitative methods for problem solving*
- *Data description and report writing*

UNIT - I INTRODUCTION (9)

Definition and objectives of Research – Types of research, Various Steps in Research process, Mathematical tools for analysis, Developing a research question-Choice of a problem Literature review, Surveying, synthesizing, critical analysis, reading materials, reviewing, rethinking, critical evaluation, interpretation, Research Purposes, Ethics in research – APA Ethics code

UNIT - II QUANTITATIVE METHODS FOR PROBLEM SOLVING (9)

Statistical Modeling and Analysis, Time Series Analysis Probability Distributions, Fundamentals of Statistical Analysis and Inference, Multivariate methods, Concepts of Correlation and Regression, Fundamentals of Time Series Analysis and Spectral Analysis, Error Analysis, Applications of Spectral Analysis.

UNIT - III DATA DESCRIPTION AND REPORT WRITING (9)

Tabular and graphical description of data: Tables and graphs of frequency data of one variable, Tables and graphs that show the relationship between two variables , Relation between frequency distributions and other graphs, preparing data for analysis

Structure and Components of Research Report, Types of Report, Layout of Research Report, Mechanism of writing a research report, referencing in academic writing.

UNIT - IV INTELLECTUAL PROPERTY (9)

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development.

International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT - V PATENT RIGHTS (9)

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

Reference Books

1. *Stuart Melville and Wayne Goddard, "**Research methodology: an introduction for science & engineering students**", Juta Academic, 1996.*
2. *Donald H.McBurney and Theresa White, "**Research Methods**", 9th Edition, CengageLearning, 2013.*
3. *RanjitKumar, "**Research Methodology: A Step by Step Guide for Beginners**", 4th Edition, 2014.*
4. *Dr. C. R. Kotharia and GauravGarg, "**Research Methodology: Methods and Trends**", New age international publishers, Third Edition, 2014.*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1:** Develop research question**[Usage]

CO2:** Perform exhaustive literature survey**[Usage]

CO3:** Apply right problem solving methods**[Usage]

CO4:** Prepare data for analysis**[Usage]

CO5:** Write research report**[Usage]

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	L	M	L	L	M	L	L	-	M	M	L
CO 2	M	-	-	-	-	-	-	-	-	-	-
CO 3	H	H	H	M	M	M	M	-	L	L	L
CO 4	M	M	M	M	M	H	M	-	L	L	L
CO 5	L	L	L	L	L	-	-	H	-	-	-

L – Low, M – Moderate (Medium), H- High

18MFPC01 ADVANCED MACHINING PROCESSES AND AUTOMATION

Category : PC

L	T	P	C
3	0	0	3

PRE-REQUISITE: NIL

COURSE OBJECTIVE:

To learn about various machining process parameters, influence on performance, applications and simulation software's.

UNIT – I MECHANICAL MACHINING PROCESSES (9)

Abrasive machining – water jet machining – abrasive water jet machining – ultrasonic machining — construction working principle – steps - types – process parameters – derivations – problems, merits, demerits and applications.

UNIT – II CHEMICAL AND ELECTRO CHEMICAL MACHINING PROCESSES (9)

chemical machining – electro chemical machining-electro chemical grinding(ECG),electrical discharge grinding(EDG),electro chemical discharge grinding(ECDG) – construction working principle – steps - types – process parameters – derivations – problems, merits, demerits and applications.

UNIT – III ELECTRO-THERMAL ANDELECTRIC MACHINING PROCESSES (9)

Electro discharge machining(EDM),Wire cut EDM–Laser beam machining – Electron beam machining – Plasma arc machining – Ion beam machining –construction – principle – types – control - circuits – tool design – merits, demerits and applications.

UNIT – IV MICROFABRICATION TECHNOLOGY (9)

Wafer preparation – monolithic processing – moulding – PCB board hybrid and MCM technology – programmable devices and ASIC – electronic material and processing– stereolithography - SAW devices, Surface Mount Technology.

UNIT – V SIMULATION IN MACHINING PROCESSES (9)

Architecture of CAE-ECM, EDM, USM – CNC-ECM, EDM – Factory automation of ECM, EDM – Integration of computers in non-traditional machining environment.

Contact Periods:

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total : 45 Periods

REFERENCE BOOKS:

1. *V.K. Jain, **"Advanced machining processes"** Allied publishers.*
2. *Seropekel pekijian and Stevan R Schmid **" Manufacturing Process Engg Material",** 2003*
3. *Carl sommer, **"Nontraditional machining processes handbook"** advance publishing inc,2000.*
4. *Brahem T. Smith "**Advanced Machining",** I.F.S. UK 1989*
5. *Pandey P.C. and Shan HS, **"Modern Machining Processes"**, Standard Publishing Co., 1980*
6. *Hassan abdel and gaward EI-Hofy,"**Advanced Machining Processes**" McGraw hills,2005.*
7. *P.K.Mishra "**Unconventional Machining Method**" Allied publishers.*
8. *McGeough," **Advanced Method of Machining**" Chaoman and hall, London.,1998*

COURSE OUTCOMES:

Learners will be able to

***CO 1**: Relate distinctive knowledge of unconventional machining processes and performance parameters.*

***CO 2**: Apply unconventional machining process in various industrial applications.*

***CO 3**: Analyse and simulate various industrial problems in advanced machining processes.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	L	L	L	M	-	L	M	-	L	L	L
CO 2	M	M	M	L	-	L	L	-	L	L	L
CO 3	M	L	M	L	M	L	L	-	L	L	L

L – Low, M – Moderate (Medium), H- High

18MFPC02 AUTOMATED COMPUTER INTEGRATED MANUFACTURING SYSTEMS

Category : PC

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To comprehend about the issues of computer integrated manufacturing and integration of automated process within a modern manufacturing environment.

UNIT – I PRODUCTION PLANNING AND CONTROL **(9)**

Introduction to CIM - Nature of the CIM system - Types of manufacturing systems – Evolution of CIM - Computers in CIM. Process definition and manufacturing planning - Structures of a process plan - CAD based process planning - coding systems - Methods of CAPP – Process planning systems. Background - Role of MRP in CIM systems - Major modules of MRP software.

UNIT – II CNC SYSTEMS **(9)**

CNC Machine tools - Principle of Numerical Control - Types of CNC machine tools – Features and programming of CNC machine tools - CNC programming based on CAD – Applications of CNC machine - Capabilities of a typical NC - CAM software – Integration of computers in CIM environment

UNIT - III NETWORKING **(9)**

Computer communications - Principles of networking, Techniques, components of networking and wiring methods - Network interface cards - Network standards, examples - Operating system - Managing remote systems - design activity in a networked environment – networking in an manufacturing company

UNIT – IV FLEXIBLE MANUFACTURING SYSTEMS **(9)**

Flexible manufacturing - Introduction, types, major elements and optimization of FMS - Operational elements in a typical FMC - Typical FMS layout - Lean manufacturing – Agile manufacturing database and DBMS requirements - Features and architecture of a DBMS – query language - SQL - SQL as a knowledge base query language. Integration and Implementation issues in CAD/CAM/CIM.

UNIT – V ROBOTICS AND ARTIFICIAL INTELLIGENCE **(9)**

Artificial Intelligence - Robots -Elements, types and specifications of robots, robot programming methods, robot operation, applications of industrial robots, integration of robots in CIM systems -Expert system - AI in vision system and scheduling - DSS in CIM environment.

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

1. *Mikell P Groover, "**Automation, Production Systems, and Computer Integrated Manufacturing**", Pearson education (Singapore) Pvt. Ltd., New Delhi, 2003.*
2. *Chris McMahon, and Jimmie Browne, "**CAD/CAM Principles, Practice and Manufacturing Management**", Addison Wesley Longman Limited, England, 1998*
3. *Narahari Y, Viswanadham N., "**Performance Modeling and Analysis of Automated manufacturing systems**", Prentice hall of India, New Delhi, 1998*
4. *Mikell P Groover, Mitchell Weis, Roger N Nagel, Nicholas G Odrey, **"Industrial Robotics Technology, Programming and Applications"**, McGraw Hill, 1986*

COURSE OUTCOMES:

Learners will be able to

***CO 1:** Apply knowledge of manufacturing engineering and management principles to design and evaluate automated manufacturing system.*

***CO 2:** Analyse problems of industrial and manufacturing systems to formulate design requirements for CIM system.*

***CO 3:** Apply professional, ethical, legal, security and social issues in design of manufacturing systems.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	H	L	L	M	H	M	L	H	M	H	M
CO 2	M	M	H	M	M	M	H	M	L	M	H
CO 3	H	H	H	H	H	M	M	M	L	M	L

L – Low, M – Moderate (Medium), H- High

18MFPC03 ADDITIVE MANUFACTURING

Category : PC

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To learn the concepts of rapid product development, apply acquired knowledge to meet global challenges in changing design in time compressed mode.

UNIT – I INTRODUCTION **(9)**

Rapid Product Development (RPD) –Product Development Cycle – Detail design– Prototype and tooling.

UNIT – II ADDITIVE MANUFACTURING (AM) **(9)**

Principle of AM technologies and their classification of AM systems–Stereo lithography systems – Selection of AM process; Issues in AM ; Emerging trends–Direct Metal Laser Sintering (DMLS) system – Principle – process parameters – process details – Applications.

UNIT – III ENGINEERING PROCESS **(9)**

Fusion Deposition Modeling –Laminated Object Manufacturing –Selective Laser Sintering- Three dimensional Printing-Reverse Engineering -Engineering applications–Medical applications.

UNIT – IV PROCESSING POLYHEDRAL DATA **(9)**

Polyhedral B-Rep modeling–STL format– Defects and repair of STL files– Processing STL files; Overview of the algorithms required for RP and RT- slicing, support generation, feature recognition

UNIT – V ADDITIVE TOOLING (AT) **(9)**

Introduction to AT–Indirect AT processes – Silicon rubber molding, Epoxy tooling, Spray metal tooling and Investment Casting; Direct AT processes – Laminated Tooling, Powder Metallurgy based technologies, Welding based technologies, Direct pattern making (Quick Cast, Full Mold Casting); Emerging Trends in AT.

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

1. *C K Chua, K F Leong, C S Lim, "**Rapid Prototyping Principles and Applications**, World Scientific, New Delhi, 2010.*
2. *Frank W.Liou "**Rapid Prototyping and Engineering Applications"**, CRC Press, UK, 2011.*
3. *Terry wohlers, Wohlers Report 2000, Wohlers Associates, USA, 2000.*
4. *Chua Chee Kai and Leong Kah Fai, 1997, **"Rapid Prototyping: Principles and Applications in Manufacturing"**, John Wiley and Sons*
5. *Paul F. Jacobs, 1996, **"Stereo-lithography and Other RP & M Technologies"**: from Rapid Prototyping to Rapid Tooling, SME/ASME*
6. *D. Faux and M. J. Pratt, 1979, "**Computational Geometry for design and manufacture"**, John Wiley and Sons*
7. *Pham, D.T. and Dimov.S.S., **"Rapid Manufacturing"**, Springer-Verlag, London, 2001.*

COURSE OUTCOMES:

Learners will be able to

***CO 1**: Apply the concept of liquid, solid and powder based rapid prototyping techniques for rapid product development.*

***CO 2**: Apply the rapid tooling and software for rapid manufacturing to meet international needs.*

***CO 3**: Select appropriate process for production of a part/component that meet international standards of quality and time constraints.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	L	L	L	M	L	L	M	-	L	L	L
CO 2	M	M	M	L	L	L	L	-	L	L	L
CO 3	M	L	M	L	M	L	L	-	L	L	L

L – Low, M – Moderate (Medium), H- High

18MFPC04 ADDITIVE MANUFACTURING AND AUTOMATION LABORATORY

Category : PC

L	T	P	C
0	0	3	1.5

PREREQUISITES: NIL

COURSE OBJECTIVE:

To demonstrate knowledge of the Additive Manufacturing process, CNC programming and simulate the principles of operations based on automations

LIST OF EXPERIMENTS:

1. Create a prototype model using support structure in FDM.
2. Practical analysis by using slicing software in additive manufacturing.
3. Develop the prototype model using Laminated Object Manufacturing.
4. Design and fabricate the component using Selective Laser Sintering.
5. Demonstrate the principles of programming a robot for pick and place operations.
6. Determination of minimum and maximum position of robots arm using robot software.
7. Evaluation and analysis of the manufacturing process by using IGRIP simulation packages.
8. Investigation of robot simulation by means of robotic simulation softwares.
9. Compute the turning operation by using the computer numerical control machine.
10. Machining components using CNC vertical milling machine.
11. Automate the management of product related data and integrate the data using PLM software.
12. Integrate the various functions into one complete system using ERP software.

Contact Periods:

Lecture : 0 Periods **Tutorial : 0 Periods** **Practical : 45 Periods** **Total : 45 Periods**

COURSE OUTCOMES:

Learners will be able to

CO1: *Apply the concept of liquid, solid and powder based rapid prototyping techniques for rapid product development*

CO2: *Apply robotic systems and develop the part programming of real time control.*

CO3: *Obtain knowledge to work in ERP and PLM softwares.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	H	L	L	M	M	L	L	M	L	-	L
CO 2	H	M	L	M	H	M	L	M	L	-	L
CO 3	H	L	L	M	H	M	L	M	L	-	L

L – Low, M – Moderate (Medium), H- High

18MFPC05 MATERIALS TESTING AND CHARACTERIZATION TECHNIQUES

Category : PC

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To evaluate the microstructure, crystal analysis, electron microscopy, chemical thermal analysis, static and dynamic mechanical testing methods.

UNIT – I MICRO AND CRYSTAL STRUCTURE ANALYSIS **(9)**

Principles of Optical Microscopy – Specimen Preparation Techniques – Polishing and Etching – Polarization Techniques – Quantitative Metallographic – Estimation of grain size – ASTM grain size numbers – Microstructure of Engineering Materials - Elements of Crystallography – X- ray Diffraction – Bragg‘s law – Techniques of X-ray Crystallography– Debye – Scherer camera – Geiger Diffractometer – analysis of Diffraction patterns –Inter planer spacing – Identification of Crystal Structure, Elements of Electron Diffraction.

UNIT – II ELECTRON MICROSCOPY **(9)**

Interaction of Electron Beam with Materials – Transmission Electron Microscopy –Specimen Preparation – Imaging Techniques – BF & DF – SAD – Electron Probe Microanalysis – Scanning Electron Microscopy – Construction & working of SEM –various Imaging Techniques – Applications- Atomic Force Microscopy- Construction &working of AFM - Applications .

UNIT – III CHEMICAL AND THERMAL ANALYSIS **(9)**

Basic Principles, Practice and Applications of X-Ray Spectrometry, Wave Dispersive X Ray Spectrometry, Auger Spectroscopy, Secondary Ion Mass Spectroscopy, Fourier Transform Infra-Red Spectroscopy (FTIR)- Proton Induced X-Ray Emission Spectroscopy, Differential Thermal Analysis, Differential Scanning Calorimetry (DSC)And Thermo Gravity metric Analysis (TGA) -and thermal electron Microscope(TEM).

UNIT – IV MECHANICAL TESTING – STATIC TESTS **(9)**

Hardness – Brinell, Vickers, Rockwell and Micro Hardness Test – Tensile Test – Stress– Strain plot – Proof Stress – Torsion Test - Ductility Measurement – Impact Test –Charpy & Izod – DWTT - Fracture Toughness Test, Codes and standards for testing metallic and composite materials.

UNIT – V MECHANICAL TESTING – DYNAMIC TESTS **(9)**

Fatigue – Low & High Cycle Fatigues – Rotating Beam & Plate Bending HCF tests – S-N curve – LCF tests – Crack Growth studies – Creep Tests – LM parameters – AE Tests modal analysis - Applications of Dynamic Tests.

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

*1. Goldsten,I.J., Dale.E., Echin.N.P.& Joy D.C., "**Scanning Electron Microscopy & X ray- Micro Analysis"**, (2nd Edition), ISBN – 0306441756, Plenum Publishing Corp., 2000.*

*2. Newby J., Metals Hand Book- "**Metallography & Micro Structures"**, (9th Edition), ASM International, 1989.*

*3. Grundy P.J. and Jones G.A., "**Electron Microscopy in the Study of Materials"**, Edward Arnold Limited, 1976.*

*4. Morita.S, Wiesendanger.R, and Meyer.E, —"**Non-contact Atomic Force Microscopy"** Springer, 2002,*

*5. Davis J. R., "**Tensile Testing"**, 2nd Edition, ASM International, 2004.*

*6. ASM Hand book-"**Materials characterization"**, Vol – 10, 2004.*

*7. Angelo.P.C,"**Material Characterization",** Reed Elsevier India Pvt.Ltd,2013.*

*8.Culity B.D., Stock S R"**Elements of X-ray Diffraction",** Prentice Hall, Inc 2001.*

COURSE OUTCOMES:

On completion of this course, learners will be able to

***CO 1:** Identify the test and quantify the mechanical properties of Engineering Materials.*

***CO 2:** Characterize the microstructure of various materials and apply various applications.*

***CO 3:** Analyse the behavior of various materials under static and dynamic condition*

COURSE ARTICULATION MATRIX

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO L	M	M	M	M	H	M	-	-	L	M	H
CO 2	M	M	M	M	H	M	L	-	L	L	M
CO 3	M	M	M	M	H	H	L	-	L	L	H

L – Low, M – Moderate (Medium), H- High

18MFPC06 THEORY OF METAL CUTTING

[Use of approved data book is permitted]

Category : PC

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To acquire advanced information about the metal cutting theory and to enlarge knowledge in metal cutting theory.

UNIT - I ORTHOGONAL CUTTING **(9)**

Introduction - Machining fundamentals – Metal Cutting - Chip formation - types of chips - Chip breakers - Expression for Shear plane angle - Cutting force and velocity relationship - Ernst and Merchant Upper bound solution - Lee and Shaffer Lower bound solution - Oxley's thin shear zone model - Stress and Strain in the chip - Energy consideration in machining.

UNIT – II OBLIQUE CUTTING **(9)**

Direction of Chip flow - Normal, Velocity and Effective Rake angles - Relationship between rake angles - Cutting ratios in oblique cutting - Shear angle and Velocity relationship - Stabler's rule.

UNIT – III THERMAL ASPECTS AND CUTTING FLUIDS **(9)**

. Heat distributions in machining - Experimental determination and Analytical calculation of cutting tool temperature - Cutting fluids - Effects of cutting fluid - Functions - Requirements - Types and Selection of Cutting Fluids.

UNIT – IV CUTTING TOOL MATERIALS, TOOL LIFE AND TOOL WEAR **(9)**

Essential requirements of tool materials – development of tool materials - Tool wear and Tool life - Machinability - Economics of metal machining - Theory of Chatter – ISO specifications for inserts and tool holders.

UNIT – V DESIGN OF CUTTING TOOLS **(9)**

Nomenclature of Single point and Multi point cutting tools - Design of Turning tool, Drills and Milling cutters.

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

1. *Bhattacharyya A., "**Metal Cutting Theory and Practice**", Central Book Publishers, Calcutta, 1984*
2. *Juneja B L., Sekhon G. S., "**Fundamentals of Metal Cutting and Machine Tools**", New Age International (P) Limited, 1995*
3. *Shaw M C., "**Metal Cutting Principles**", Oxford Press, 1984*
4. *Armarego E.J.A., Brown R.H., "**The Machining of Metals**", Prentice Hall Inc., 1969*
5. *Geoffrey Boothroyd, Knight W.A., "**Fundamentals of Machining and Machine Tools**", Marcel Dekkor, New York, 1989*
6. *Rodin P., "**Design and Production of Cutting Tools**", MIR Publishers, 1968*

COURSE OUTCOMES:

Learners will be able to

***CO 1:** Apply the metal cutting theory in engineering materials and employ the various aspects in manufacturing activities.*

***CO 2:** Select tool materials and cutting fluids for machinability and economics.*

***CO 3:** Design the cutting tools for metal removal process.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	L	M	M	M	L	M	-	L	M	M
CO 2	M	M	H	M	M	L	H	-	L	M	M
CO 3	M	H	M	M	M	L	H	-	L	M	M

L – Low, M – Moderate (Medium), H- High

18MFPC07 ADVANCES IN CASTING AND WELDING PROCESSES

Category : PC

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To acquire the metallurgical concepts during solidification of metals and alloys in recent casting and welding processes.

UNIT – I CASTING METALLURGY AND DESIGN (9)

Heat transfer between metal and mould – Solidification of pure metal and alloys – Shrinkage in cast metals – progressive and directional solidification – Principles of gating and rising – Degasification of the melt – Design considerations in casting – Designing for directional solidification and minimum stresses – casting defects

UNIT – II SPECIAL CASTING PROCESSES (9)

Shell moulding – Precision investment casting – CO_2 – moulding – centrifugal casting – Die casting – Continuous casting.

UNIT – III WELDING METALLURGY AND DESIGN (9)

.Heat affected Zone and its characteristics – Weldability of steels, cast iron, Stainless steel, aluminum and Titanium alloys – Hydrogen embrittlement – Lamellar tearing – Residual stress – Heat transfer and Solidification – Analysis of stresses in welded structures – pre and post welding heat treatments – Weld joint design – Welding defects – testing of weldment.

UNIT – IV UNCONVENTIONAL AND SPECIAL WELDING PROCESSES (9)

Friction welding – Explosive welding – Diffusion bonding – High frequency Induction welding – Ultrasonic welding – Electron beam welding – Laser beam welding

UNIT – V RECENT ADVANCES IN CASTING AND WELDING (9)

Layout of mechanized foundry – sand reclamation – Material handling in foundry – pollution control in Foundry – Recent trends in casting – Computer Aided design of Castings, Low pressure die casting, Squeeze casting and full mould casting process – Automation in welding – Welding robots – Overview of automation of welding in aerospace, nuclear, surface transport vehicles and under water welding.

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

1. *R. W. Ruddle, "**Solidification of Castings, Institute of Metals"**, London, 1957*
2. *J. Campbell, "**Casting"**, Elsevier Publishing Amsterdam,2011*
3. *Schwartz, M.M., "**Metal Joining Manual**", McGraw Hill, NY, 1979*
4. *Titoun.D. and Stepanov .YU.A., "**Foundry Practice**", MIR Publishers, 1981*
5. *Iotrowski, "**Robotic welding – A guide to selection and application**", Society of Mechanical Engineers, 1987*
6. *Cornu. J., "**Advanced Welding systems**", Volumes I,II and III, JAICO Publishers, 1994*
7. *Lancaster. J.F., "**Metallurgy of Welding**", George Allen AND Unwin Publishers, 1980*
8. *SeropeKalpakjian**, "Manufacturing Engineering and Technology"** Third Edition, Addison Wesley Publishing Co.1995*
9. *P.N.Rao, "**Manufacturing Technology (Foundry, Forming and Welding)",** Second Edition**,** Tata McGraw Hill Pub.Co. Ltd, 2004.*
10. *John Campbell,"**10 rules of casting**"Elsevier Publications,Boston,2004.*
11. *Chakrabarti A K "**Casting technology and casting alloys**," PHI Publishing co, New Delhi 2009.*

COURSE OUTCOMES:

Learners will be able to

CO 1: Analyze the thermal, metallurgical aspects during solidification in casting and welding.

CO 2: Relate the casting methods for industrial production of components.

CO 3: Apply on special welding process for specific applications.

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	L	M	M	M	L	M	-	L	M	M
CO 2	M	M	H	M	M	L	H	-	L	M	M
CO 3	M	H	M	M	M	L	H	-	L	M	M

L – Low, M – Moderate (Medium), H- High

18MFPC08 MATERIAL PROCESSING AND TESTING LABORATORY

Category : PC

L	T	P	C
0	0	3	1.5

PREREQUISITES: NIL

COURSE OBJECTIVE:

To learn the principles of material testing and characterization and to apply for the manufacturing engineering applications.

LIST OF EXPERIMENTS:

1. Identification of microstructures of ferrous and non ferrous alloys
2. Micro structure analysis using image analysis software
3. Investigation on effects of heat treatment and cooling conditions on microstructure and mechanical properties of metals and composite materials.
4. Measurement of hardness by using Rockwell hardness, Brinell hardness, Vicker hardness and Jominy hardenability test.
5. Evaluate the energy absorbing characteristics of metal materials at room temperature using the Charpy and Izod impact method.
6. Analysis of wear characteristics from Pin-on-disc wear measuring machine by varying the process parameter.
7. Preparation of a component by using Stir casting, vacuum casting and squeeze casting methods.
8. Fabricate a sample using powder metallurgy process of milling, compaction and sintering.
9. Examine through demonstration of rolling, forging and sheet metal forming processes.
10. A butt joint with mild steel strip using FSW and LBW technique.
11. To detect the surface breaking defects using Dye Penetrant test.

Contact Periods:

Lecture : 0 Periods **Tutorial : 0 Periods** **Practical : 45 Periods** **Total : 45 Periods**

COURSE OUTCOMES

Learners will be able to

C01: Relate distinctive knowledge of material processing and performance parameters

CO2: Apply Material processing techniques in various industrial applications

CO3: Analyze the behavior of various materials under static and dynamic conditions

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	H	L	L	M	M	L	L	M	L	-	L
CO 2	H	M	L	M	H	M	L	M	L	-	L
CO 3	H	L	L	M	H	M	L	M	L	-	L

L – Low, M – Moderate (Medium), H- High

18MFEE01 MINI PROJECT

Category : EEC

L	T	P	C
0	0	4	2

PREREQUISITES: NIL

COURSE OBJECTIVE :

- *To make the student to feel/understand the magnitude of numbers being used in the energy sector.*

COURSE CONTENT :

Students can take up small problems in the field of manufacturing engineering as mini project. It can be related to solution to an engineering problem, verification and analysis of experimental data available, conducting experiments on various engineering subjects, material characterization, studying a software tool for the solution of an engineering problem etc.

COURSE OUTCOMES :

Learners will be able to

CO1 : *Students will get an opportunity to work in actual industrial environment if they opt for internship.*

CO2 : *In case of mini project, they will solve a live problem using software/analytical/computational tools.*

CO3 : *Students will learn to write technical reports.*

CO4 : *Students will develop skills to present and defend their work in front of technically.*

Contact Periods:

LECTURE: 0 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 60 PERIODS TOTAL: 60 PERIODS

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	H	M	H	H	M	L	H	H	M	L	L
CO 2	H	M	H	H	M	L	M	H	M	L	M
CO 3	H	M	H	H	H	L	M	H	M	L	L

L – Low, M – Moderate (Medium), H- High

18MFEE02 PROJECT PHASE I

Category : EEC

L	T	P	C
0	0	20	10

PREREQUISITES: NIL

COURSE OBJECTIVE:

To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature and to develop the methodology to solve the identified problem then publish paper at least in conference.

COURSE CONTENT:

1. The learner individually works on a specific topic approved by the head of the division under the guidance of a faculty member who is familiar in this area of interest.
2. The student can select the specific topic related to the area of manufacturing engineering. The topic may be theoretical or industrial case studies.
3. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work.
4. The learners will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

COURSE OUTCOMES:

Learners will be able to

CO 1: *Identify the project work scientifically in a systematic way.*

CO 2: *Analyze the problem and data of literatures clearly to explore the ideas and methods.*

CO 3: *Formulate the objectives and methodology to solve the identified problem.*

Contact Periods:

LECTURE: 0 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 300 PERIODS TOTAL: 300 PERIODS

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	H	M	H	H	M	L	H	H	M	L	L
CO 2	H	M	H	H	M	L	M	H	M	L	M
CO 3	H	M	H	H	H	L	M	H	M	L	L

L – Low, M – Moderate (Medium), H- High

18MFEE03 PROJECT PHASE II

Category : EEC

L	T	P	C
0	0	32	16

PREREQUISITES: NIL

COURSE OBJECTIVE:

To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature and to develop the methodology to solve the identified problem then publish paper at least in conference.

COURSE CONTENT:

1. The learner individually works on a specific topic approved by the head of the division under the guidance of a faculty member who is familiar in this area of interest.
2. The student can select the specific topic related to the area of manufacturing engineering. The topic may be theoretical or industrial case studies.
3. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work.
4. The learners will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

COURSE OUTCOMES:

Learners will be able to

CO 1: *Identify the project work scientifically in a systematic way.*

CO 2: *Analyze the problem and data of literatures clearly to explore the ideas and methods.*

CO 3: *Formulate the objectives and methodology to solve the identified problem.*

Contact Periods:

LECTURE: 0 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 480 PERIODS TOTAL: 480 PERIODS

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	H	M	H	H	M	L	H	H	M	L	L
CO 2	H	M	H	H	M	L	M	H	M	L	M
CO 3	H	M	H	H	H	L	M	H	M	L	L

L – Low, M – Moderate (Medium), H- High

18MFPE01 APPLIED PROBABILITY AND STATISTICS

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

- *To acquire knowledge to understand the basics of probability.*
- *To develop an understanding of decision-making problems.*
- *To acquire knowledge to understand the designed experiments in manufacturing and development.*

UNIT - I PROBABILITY AND RANDOM VARIABLES **(9)**

Sample Space and Events – Axiomatic Definition of probability – Properties of Probability –Conditional Probability – Total Probability and Baye's Theorem – Independent Events – Random variables: Discrete and Continuous Random variables – Probability mass and density functions – Moments – Moment Generating Functions.

UNIT - II STANDARD PROBABILITY DISTRIBUTIONS **(9)**

Distributions: Binomial, Poisson, Geometric, Uniform, Exponential, Normal, Gamma – Chebyshev's inequality (Simple problems) – Two dimensional random variable – Jointly probability mass function – Marginal and conditional probability density functions.

UNIT – III TEST OF HYPOTHYSIS **(9)**

Tests for Means, Variances and Proportions – Tests for Means, Variances and Attributes using t, F, Chi square distribution– Goodness of fit –Interval estimation for mean-Standard deviation –Proportion.

UNIT – IV DESIGN OF EXPERIMENTS **(9)**

Randomized Block Design – One-way classification, two-way classification– Latin Square Design.

UNIT – V STATISTICAL QUALITY CONTROL AND CORRELATION ANALYSIS **(9)**

Statistical basis for Control charts – Control limits – Control charts for variables:$\overline{X}$, R– charts Control chart for defective: P, np charts – Control charts for defects: C– chart. Correlation –Regression – Multiple and Partial Correlation – Partial Regression (Problems only).

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

1. *S.C. Gupta and V. K. Kapoor, "**Fundamentals of Mathematical Statistics**", Sultan Chand & Sons, New Delhi – 2014.*
2. *S. P. Gupta, "**Statistical Methods**", Sultan Chand & Sons, New Delhi – 2012.*
3. *Miller and Freud "**Probability and Statistics for Engineers**", Prentice Hall of India Ltd., New Delhi, Seventh Edition,2015.*
4. *T. Veerarajan, "**Probability , Statistics and Random Processes (with Queueing Theory and Queueing Networks**)" , Tata McGraw Hill Publishing Company Ltd., Fourth Edition, New Delhi – 2008.*
5. *P. Kandasamy, K.Thilagavathy and K.Gunavathy, "**Probability and Random Process**", S.Chand and Co. Ltd., New Delhi – 2010.*
6. *Richard A.Johnson and Dean W.Wichem**, "Applied Multivariate Statistical Analysis",** Pearson Education, Asia, Fifth Edition, 2011.*

COURSE OUTCOMES:

Learners will be able to

***CO1:** Understand axioms of probability, discrete and continuous probability distributions.*

***CO2:** Understand test of hypothesis for both small and large samples based on normal distribution.*

***CO3:** Develop analysis and conclusions for design of experiment problems and evaluate control limits using control charts to examine whether the product is within control.*

***CO4:** Understand multivariate correlation analysis and forming regression plane.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	L	M	H	H	H	M	M	L	L	L
CO 2	M	L	-	M	M	-	-	-	L	L	-
CO 3	M	M	H	L	M	M	L	L	H	H	M
CO4	M	L	M	H	L	M	-	-	L	M	M

L – Low, M – Moderate (Medium), H- High

18MFPE02 DESIGN FOR MANUFACTURE, ASSEMBLY AND ENVIRONMENT

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

- *To acquire knowledge about design principles and possible methodology to accomplish feasibility in manufacturing environment.*
- *To enhance specified design concepts and skill in material selection, form design of castings and machining process.*

UNIT – I INTRODUCTION **(9)**

General design principles for manufacturability –Factors influencing design-Types of problems to be solved- evaluation of customer's requirements-Systematic working plan for the designer-Types of problems to be solved-Possible Solutions-Evaluation method- Process capability - Feature tolerances -Geometric tolerances - Assembly limits -Datum features - Tolerance stacks-Interchangeable part manufacture and selective assembly.

UNIT – II FACTORS INFLUENCING FORM DESIGN **(9)**

Materials choice - Influence of basic design, mechanical loading, material, production method, size and weight on form design- form design of welded members and forgings-case studies

UNIT – III COMPONENT DESIGN – CASTING CONSIDERATION **(9)**

Form design of grey iron, steel, malleable iron and aluminium castings. Redesign of castings based on parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores-case studies

UNIT – IV COMPONENT DESIGN - MACHINING CONSIDERATION **(9)**

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 machinability - Design for economy - Design for clampability - Design for accessibility - Design for assembly. Identification of uneconomical design - Modifying the design - group technology -Computer Applications for DFMA- case studies

UNIT – V DESIGN FOR ENVIRONMENT **(9)**

Introduction – Importance of DFE -Environmental objectives – Global issues – Regional and local issues– Design guidelines for DFE –Lifecycle assessment – EPS system - ATANDT's environmentally responsible product assessment - Weighted sum 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.

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

1. *Boothroyd, G, **"Design for Assembly Automation and Product Design",** New York, Marcel Dekker, 1980*
2. *Bralla, **"Design for Manufacture Handbook**", McGraw hill, 1999*
3. *Boothroyd, G, Heartz and Nike, **"Product Design for Manufacture**", Marcel Dekker, 1994*
4. *Dickson, John. R, and Corroda Poly, **"Engineering Design and Design for Manufacture and Structural Approach"**, Field Stone Publisher, USA, 1995.*
5. *Fixel, J. "**Design for the Environment**", McGraw hill. 1996*
6. *Graedel T. Allen By. B, "**Design for the Environment**", Angle Wood Cliff, Prentice Hall. Reason Pub.1996*
7. *Kevien Otto and Kristin Wood, "**Product Design**", Pearson Publication, 2004.*
8. *Dr. ING. Robert Matouslk, **"Engineering Design**". Blackie & son limited, 1962.*
9. *Harry peck, **"Designing for Manufacture"**, Pitman publishing.*

COURSE OUTCOMES

Learners will be able to

***CO 1**: Formulate the feasibility of design features in manufacturing area and smart development in manufacturability.*

***CO 2**: Capable in developing new concepts and methods for re-design of castings and simplified machining process.*

***CO 3**: Develop artifact and translate the concepts of economics in design, optimization of design and human factors approach in manufacturing.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	M	M	M	H	H	M	M	L	L	L
CO 2	L	L	-	L	M	-	-	-	L	L	-
CO 3	M	H	H	M	M	H	L	L	H	H	M

L – Low, M – Moderate (Medium), H- High

18MFPE03 ADVANCED FINITE ELEMENT METHODS

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To introduce non- linear computational methods to solve problems in solids and structure.

UNIT – I MATHEMATICAL MODELS (9)

Modeling and Discretization – Interpolation, Elements, Nodes and degrees-of-freedom. Computational Procedures–Stiffness Matrices – Boundary Conditions-Solution of Equations-Ritz method, Variation Method, Method of weighted residuals.

UNIT – II BASIC ELEMENTS (9)

Interpolation and shape functions - element matrices-linear triangular elements (CST)-quadratic triangular elements – bilinear rectangular elements-quadratic rectangular elements-solid elements-higher order elements-nodal loads-stress calculations-example problems.

UNIT - III ISOPARAMETRIC ELEMENTS (9)

Introduction-bilinear quadrilateral elements – quadratic quadrilaterals – hexahedral elements – Determination of Shape Functions - Numerical Integration – quadrature - static condensation – load considerations – stress calculations – examples of 2D and 3D applications.

UNIT –IV FINITE ELEMENT FORMULATION FOR STRUCTURAL APPLICATIONS (9)

Linear elastic stress analysis-2D, 3D and ax symmetric problems – Analysis of structural vibration – mass and damping matrices – damping – Harmonic response – direct integration techniques – explicit and implicit methods.

UNIT – V HEAT TRANSFER AND FLUID MECHANICS APPLICATIONS (9)

Nonlinear Problems – Element formulation – Heat Conduction, Fluid flow, etc–Transient Thermal Analysis-Acoustic frequencies and modes- Incompressible and rotational flows.

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

1. *Cook, Robert Davis et al **"Concepts and Applications of Finite Element Analysis"**, Wiley, John AND Sons, 1981*
2. *O.C Zienkiewicz, **"The Finite Element Method"**, 3rd Edition, Tata McGraw-Hill, 2005.*
3. *C.S. Desai and J.F. Abel, **"Introduction to Finite Element Method**", Affiliated East-West Press, 1972*
4. *Chandrupatla & Belagundu, **"Finite Elements in Engineering**", Prentice Hall of India Private Ltd., 2002.*

COURSE OUTCOMES:

Learners will be able to

***CO 1**: Create mathematical models of physical systems and solve using numerical techniques.*

***CO 2**: Appreciate the usage of the types of elements and apply them suitably for specific applications.*

***CO 3**: Solve structural dynamics and non-linear problems through appropriate techniques.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	M	H	H	L	L	L	-	L	M	M
CO 2	M	M	L	L	M	L	L	-	M	L	M
CO 3	M	M	M	H	M	L	L	-	M	L	M

L – Low, M – Moderate (Medium), H- High

18MFPE04 WEAR ANALYSIS AND CONTROL

(Common to Engineering Design)

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To know the fundamentals of mechanism, prediction and control of wear under different working conditions.

UNIT – I INTRODUCTION TO WEAR (9)

Types of wear, Adhesive wear, two-body and three-body abrasive wear, erosive wear, cavitation wear, wear due to surface fatigue – chemical reaction

UNIT – II SURFACE ROUGHNESS AND WEAR MEASUREMENTS (9)

Tribo systems and tribo-elements, Measurement of Surface roughness Re, Rz, Experimental studies on friction on various tribo systems using pin-on-ring (POR) and pin-on-disc (POD) machines. Sample preparation, wear measurement of various tribo-elements, using POR and POD machines. Calculation of wear volume and wear coefficient, comparison with existing data.

UNIT- III WEAR IN LUBRICATED CONTACTS (9)

Rheological lubrication regime, Functional lubrication regime, Fractional film defect,
Load sharing in lubricated contacts, Adhesive wear equation, Fatigue wear equation, Numerical example.

UNIT – IV DIAGNOSIS AND CONTROL OF WEAR (9)

Diagnosis of wear mechanisms using optical microscopy and scanning electron microscopy, Wear resistant materials, wear resistant coatings, eco-friendly coatings designing for wear, systematic wear analysis, wear coefficients, filtration for wear control.

UNIT – V WEAR IN MECHANICAL COMPONENTS (9)

Component wear, bushings, lubricated piston rings and cylinder bore wear, dry piston rings, rolling bearings, seal wear, gear wear, gear couplings, wear of brake materials, wear of cutting tools, chain wear.

Contact Periods:

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total : 45 Periods

References :

*1. Czichos, H., **"Tribology:A system approach to the science & technology of friction, lubrication and wear",** Series 1, Elsevier Publications,1982.*

*2. Glaeser,W. A., **"Tribology series – Vol. 20,"** Elsevier Publications,1992.*

*3. Neale, M.J., **"The Tribology Hand Book,"** Butterworth Heinemann, London, 1995.*

*4. Peterson, M. B., Winer, W.O., **"Wear Control Handbook,"** ASME, NY. 1980.*

*5. Stolarski.T.A. **"Tribology in Machine Design"** Buttorworth Heinemann, Oxford, 2000.*

COURSE OUTCOMES

On completion of this course, the student will be able to

CO1: Appreciate wear behavior of materials under different environment

CO2: Diagnose and control wear in metallic parts

CO3: Assess wear in different mechanical components

COURSE ARTICULATION MATRIX

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M	H	L	-	M	L	-	-	L	M	L
CO2	L	H	-	-	-	-	-	-	L	L	L
CO3	L	H	-	-	-	-	-	-	L	L	L

L – Low, M – Moderate (Medium), H- High

18MFPE05 MANUFACTURING METROLOGY AND QUALITY CONTROL

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To learn the principle of light wave interference and applications of light wave interference for measurements, surface finish measurements, co-ordinate measuring machine and vision system and quality control.

UNIT – I LASER METROLOGY **(9)**

Introduction – types of lasers – laser in engineering metrology – metrological laser methods for applications in machine systems – Interferometer applications – speckle interferometer – laser interferometers in manufacturing and machine tool alignment testing – calibration systems for industrial robots laser Doppler technique – laser Doppler anemometry.

UNIT – II MEASUREMENT OF SURFACE FINISH AND MEASURING MACHINES **(9)**

Definitions – Types of Surface Texture: Surface Roughness Measurement Methods- Comparison, Profilometer, 3D Surface Roughness Measurement – Instruments.

UNIT - III CO-ORDINATE MEASURING MACHINE **(9)**

Co-ordinate metrology – CMM configurations – hardware components – software –Probe sensors – displacement devices – Performance Evaluations – Software –Hardware – Dynamic errors – Thermal effects diagram – temperature variations environment control – applications.

UNIT – IV OPTO ELECTRONICS AND VISION SYSTEM **(9)**

Optoelectronic devices – CCD – On-line and in-process monitoring in production –applications image analysis and computer vision – Image analysis techniques – spatial feature – Image extraction – segmentation – digital image processing – Vision system for measurement – Comparison laser scanning with vision system.

UNIT – V QUALITY IN MANUFACTURING ENGINEERING **(9)**

Importance of manufacturing planning for quality – concepts of controllability – need for quality management system and models – quality engineering tools and techniques –statistical process control – six sigma concepts – Poka Yoke – Computer controlled systems used in inspection.

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

1. *John A. Bosch, Giddings and Lewis Dayton,"* ***Co-ordinate Measuring Machines and Systems"****, Marcel Dekker, Inc, 1999*
2. *Zuech, Nello "****Understanding and Applying Machine Vision****", Marcel Dekker, Inc, 2000*
3. *Logothetis, N. "****Managing for total quality from Deming to Taguchi and SPC****", PHI, 1997*
4. *Dale H.Besterfield,* ***"Quality Improvement",*** *PHI, 2010*

COURSE OUTCOMES:

Learners will be able to

CO 1: *Apply principle, working of various measuring instruments.*

CO 2: *Select and use different measuring instruments to measure the qualitative and quantitative characteristics of components.*

CO 3: *Analyze the data statistically and decide action to be taken for controlling the quality complying with international standards.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	H	M	M	L	H	L	M	-	L	L	M
CO 2	M	L	L	M	M	-	M	-	L	M	M
CO 3	M	H	H	M	M	L	M	-	L	M	M

L – Low, M – Moderate (Medium), H- High

18MFPE06 CORROSION AND SURFACE ENGINEERING

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To learn the type of corrosions, behavior of materials and prevention of corrosion for improving wear resistance.

UNIT – I MECHANISMS AND TYPES OF CORROSION **(9)**

Principles of direct and Electro Chemical Corrosion, Hydrogen evolution and Oxygen absorption mechanisms – Galvanic corrosion, Galvanic series-specific types of corrosion such as uniform, Pitting, Intergranular, Cavitations, Crevice Fretting, Erosion and Stress Corrosion – Factors influencing corrosion

UNIT – II TESTING AND PREVENTION OF CORROSION **(9)**

Corrosion testing techniques and procedures- Prevention of Corrosion-Design against corrosion –Modifications of corrosive environment –Inhibitors – Cathodic Protection – Protective surface coatings.

UNIT – III CORROSION BEHAVIOR OF MATERIALS **(9)**

Corrosion of steels, stainless steel, Aluminum alloys, copper alloys, Nickel and Titanium alloys-corrosion of Polymers, Ceramics and Composite materials.

UNIT – IV SURFACE ENGINEERING FOR WEAR AND CORROSION RESISTANCE **(9)**

Diffusion coatings –Electro and Electroless Plating –Hot dip coating –Hard facing-Metal spraying, Flame and Arc processes- Conversion coating –Selection of coating for wear and Corrosion resistance.

UNIT – V THIN LAYER ENGINEERING PROCESSES **(9)**

Laser and Electron Beam hardening –Effect of process variables such as power and scan speed - Physical vapor deposition, Thermal evaporation, Arc vaporization, Sputtering, Ion plating - Chemical vapor deposition – Coating of tools, TiC, TiN, Al_2O_3 and Diamond coating – Properties and applications of thin coatings.

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

1. *Fontana. G., **"Corrosion Engineering"**, McGraw Hill, 2008*
2. *SeropeKalpakjian, **"Manufacturing Engineering and Technology"** Addison Wesley Publishing Co; New York 1995*
3. *Schweitzer. P.A., **"Corrosion Engineering Hand Book"**, 3rd Edition, Marcel Decker, 1996.*
4. *Winston Revie.R. Uhlig, "**Corrosion, Hand Book",** 2nd Edition. John Wiley, 2000.*
5. *Kenneth G.Budinski, **"Surface Engineering for Wear Resistance"**, Prentice hall, 1988*
6. *ASM Metals Hand Book –Vol. 5, "**Surface Engineering"**, 1996*

COURSE OUTCOMES:

Learners will be able to

***CO 1:** Identify the types of corrosion occurring in materials and choose appropriate protective surface coating.*

***CO 2:** Test the corrosion of ferrous, non-ferrous alloy, ceramics and composites.*

***CO 3:** Select appropriate protective surface coatings to improve corrosion resistance.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	M	L	M	L	L	M	-	M	L	M
CO 2	M	L	M	H	L	L	M	-	M	M	M
CO 3	M	M	M	H	L	M	M	-	M	M	M

L – Low, M – Moderate (Medium), H- High

18MFPE07 ADVANCED ENGINEERING MATERIALS AND METALLURGY

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To acquire the concepts and interpret the engineering materials that governs the design and selection of materials based on their processing, properties and stability.

UNIT – I ELASTIC AND PLASTIC BEHAVIOUR (9)

Elasticity in metals and polymers An elastic and visco-elastic behavior – Mechanism of plastic deformation and non-metallic shear strength of perfect and real crystals –Strengthening mechanisms, work hardening, solid solutioning, grain boundary strengthening, poly phase mixture, precipitation, particle, fiber and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behavior – Super plasticity – Deformation of non-crystalline materials.

UNIT – II FRACTURE BEHAVIOUR (9)

Griffith's theory, stress intensity factor and fracture toughness – Toughening mechanisms – Ductile, brittle transition in steel – High temperature fracture, creep –Larson Miller parameter – Deformation and fracture mechanism maps – Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law. Effect of surface and metallurgical parameters on fatigue – Fracture of non metallic materials – Failure analysis, sources of failure, procedure of failure analysis.

UNIT – III SELECTION OF MATERIALS (9)

Motivation for selection, cost basis and service requirements – Selection for mechanical properties, strength, toughness, fatigue and creep – Selection for surface durability Corrosion and wear resistance – Relationship between materials selection and processing – Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications – Computer aided materials selection.

UNIT – IV MODERN METALLIC MATERIALS (9)

Dual phase steels, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) Steel, Maraging steel, Nitrogen steel – Intermetallics, Ni and Tialuminides – smart materials, shape memory alloys – Metallic glass and nano crystalline materials.

UNIT – V NON - METALLIC MATERIALS (9)

Polymeric materials – Formation of polymer structure – Production techniques of fibers, foams, adhesives and coating – structure, properties and applications of engineering polymers – Advanced structural ceramics, WC, TiC, TaC, Al_2O_3, SiC, Si_3N_4 CBN and diamond – properties, processing and applications.

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

1. *George E.Dieter, "**Mechanical Metallurgy**", McGraw Hill, 2001*
2. *Thomas H. Courtney, "**Mechanical Behavior of Materials**", (2nd edition), McGraw Hill,2000*
3. *Charles, J.A., Crane, F.A.A. and Fumess, J.A.G., "**Selection and use of engineering materials**", (3rd edition), Butterworth-Heiremann, 2001.*
4. *Flinn, R.A., and Trojan, P.K., "**Engineering Materials and their Applications**", (4th Edition) Jaico, 1999*
5. *ASM Hand book, Vol.LL, "**Failure Analysis and Prevention**", (10th Edition), ASM, 2002.*
6. *Ashby M.F., "**Material Selection in Mechanical Design**", (3rd Edition, Butter Worth 2005*
7. *Brian cantor, "**Automotive Engineering: Light weight, functional and novel materials", Taylor and Francis, 2010.***
8.

COURSE OUTCOMES:

Learners will be able to

***CO 1**: Analyze the concepts of material behavior for specific applications.*

***CO 2**: Identify the performance requirements of a desired material for a specific engineering application.*

***CO 3:** Select modern materials for automotive and aerospace applications.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	L	L	L	-	-	M	-	M	L	M
CO 2	M	M	L	M	L	-	M	-	M	L	M
CO 3	M	M	L	L	M	L	H	-	H	M	M

L – Low, M – Moderate (Medium), H- High

18MFPE08 LEAN MANUFACTURING SYSTEMS AND IMPLEMENTATION

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To acquire the concepts of lean manufacturing tools and implementation for productivity increase.

UNIT – I LEAN MANUFACTURING **(9)**

Evolution of Lean, Traditional versus Lean Manufacturing, Business of Survival and Growth, Business Model Transformation, Ford Production System, Job Shop Concepts, Concept of Lean, Toyota's foray in Lean.

UNIT – II DESIGN - VALUE STREAM MANAGEMENT **(9)**

Definition, VSM Types, Product Family Selection, Value Stream Manager; Current State Map, Process Box, Value Stream Icons, 3 MS - Muda, Mura, Muri - Types of Muda, Future State Map, Value Stream Plan, Process Stability - Loss Reduction -Major Losses Reduction.- Demand Stage, Market Dynamics, Customer Demand, PQ Analysis, PR Analysis; TAKT Time, Pitch, Finished Goods Stock, Cycle Stock, Buffer Stock, Safety Stock.

UNIT – III FUNDAMENTAL LEAN TOOLS **(9)**

Flow Stage, Continuous Flow, Cell Layout, Line Balancing, Macro and Micro Motion, Analysis, Standardized Work, Concept of Kaizen, Steps involved in Kaizen Deployment, Industrial Engineering - Concepts and Fundamentals, Kanban Concepts, Types of Kanbans and Practical Application, Concept of Pull, Changeover Time Reduction - External and Internal, Single Minute Exchange of Die, Quick Die Change, Quality-Vendor, In Process and Customer, Line.

UNIT – IV LEAN IMPLEMENTATION **(9)**

Concept of PPM, Pokayoke, Prevention and Detection Types, Maintenance - Preventive, Time Based and Condition Based; Human Development for Lean (Training and Involvement through Autonomous Maintenance) Leveling Stage of Lean Implementation, Production Leveling, Leveling Box, Concept of Water Spider.

UNIT – V LEAN METRICS AND LEAN SUSTENANCE **(9)**

Identify Lean Metrics, Steps involved in Goal Setting; Corporate Goals, Kaizen Cloud, identification in VSM, Lean Assessment, Cultural Change, Reviews, Recognition, Improving Targets and Benchmarks.

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

1. Askin R G and Goldberg J B, ***"Design and Analysis of Lean Production Systems"****, John Wiley & Sons, New York, 2003.*

*2. Don Tapping, Tom Luyster and Tom Shuker,"****Value Stream Management****" Productivity Press, 2002.*

*3. Tom Luyster and Don Tapping, "****Creating Your Lean Future State: How to Move from Seeing to Doing****", Productivity Press, 2006.*

*4. Mike Rother and Rick Harris, "****Creating Continuous Flow****", Publisher: Lean Enterprise Institute, Inc., 2001.*

*5. Rick Harris, Chris Harris & Earl Wilson, "****Making Materials Flow****", Publisher: Lean Enterprise Institute, Inc., 2003.*

*6. Micheal Wader, "****Lean Tools: A Pocket guide to Implementing Lean Practices****", Productivity and Quality Publishing Pvt Ltd, 2002.*

COURSE OUTCOME:

Learners will be able to

CO 1: *Identify the production system and value stream mapping.*

CO 2: *Apply lean tools in manufacturing sector to face globalization and competitiveness.*

CO 3: *Implement the lean against the bench mark the targets for sustainable business growth.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	M	H	M	M	L	L	-	L	L	L
CO 2	M	M	M	M	M	L	M	-	L	L	L
CO 3	M	M	M	H	M	L	M	-	L	L	M

L – Low, M – Moderate (Medium), H- High

18MFPE09 MEMS AND NANOTECHNOLOGY

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To learn the evolution of micro electromechanical systems, fabrication techniques of micro actuators, nano materials and nano measurements techniques.

UNIT – I MEMS AND MICROSYSTEMS **(9)**

Definition – historical development – fundamentals – properties, micro fluidics, design and fabrication micro-system, microelectronics, working principle, applications and advantages of micro system, MEMS Simulation and Design tools-Behavioral modelling simulation tools and Finite element simulation tools.

UNIT – II MATERIALS, FABRICATION PROCESSES AND MICRO SYSTEM PACKAGING **(9)**

Substrates and wafers, silicon as substrate material, mechanical properties of Si, Silicon Compounds, silicon piezo resistors, Gallium arsenide, quartz, polymers for MEMS, conductive polymers. Photolithography, photo resist applications, light sources, ion implantation, diffusion process, oxidation – thermal oxidation, silicon dioxide, chemical vapour deposition, sputtering - deposition by epitaxy – etching – bulk and surface machining – LIGA process Micro system packaging – considerations packaging – levels of micro system packaging die level, device level and system level.

UNIT – III MICRO DEVICES **(9)**

Sensors – classification – signal conversion ideal characterization of sensors micro actuators, mechanical sensors – displacement sensors, pressure and flow sensors- sensitivity, reliability and response of micro-sensor- applications of micro actuators.

UNIT – IV SCIENCE OF SYNTHESIS OF NANO MATERIALS **(9)**

Classification of nano structures – Effects of nano scale dimensions on various properties – structural, thermal, chemical, mechanical, magnetic, optical and electronic properties. Nano particles- Sol-Gel synthesis- plasma synthesis- Synthesis of carbon nano tubes- Fabrication methods – Top down processes – bottom up process.

UNIT – V CHARACTERIZATION OF NANO MATERIALS **(9)**

Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, scanning electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, diffraction techniques – spectroscopy techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Nano positioning systems

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

1. *Tai – Ran Hsu, **"MEMS and Microsystems Design and Manufacture"**, Tata-McGraw Hill, New Delhi, 2002.*
2. *Mark Mado, **"Fundamentals of Microfabrication"**, CRC Press, New York, 1997*
3. *Norio Taniguchi, **"Nano Technology"**, Oxford University Press, New York, 2003*
4. *Mohamed Gad-el-Hak, **"The MEMS Hand book"**, CRC Press, New York, London.*
5. *Charles P Poole, Frank J Owens, **"Introduction to Nano technology"**, John Wiley and Sons, 2003*
6. *Julian W. Hardner , **"Micro Sensors, Principles and Applications"**, CRC Press 1993*
7. *Stephen Beeby, Graham Ensell, Michael Kraft and Neil White, **"MEMS Mechanical Sensors"** Artech House, Inc. Boston 2003.*

COURSE OUTCOMES:

Learners will be able to

***CO 1:** Comprehend the trends in manufacturing of micro components and measuring systems to nano scale.*

***CO 2:** Apply the operation of micro- and nano-scale devices, applications.*

***CO 3:** Analyze the nano materials using advanced microscopy.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	M	H	H	M	L	L	-	M	L	M
CO 2	M	M	M	M	M	L	L	-	M	L	M
CO 3	M	M	H	M	M	L	L	-	M	M	M

L – Low, M – Moderate (Medium), H- High

18MFPE10 SUPPLY CHAIN MANAGEMENT

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OJECTIVE:

To learn the importance of terminologies and major decisions in supply chain management for gaining competitive advantage.

UNIT – I INTRODUCTION **(9)**

Definition of Logistics and SCM: Evolution, Scope, Importance and Decision Phases – process view of a supply chain - Supply chain flows- Examples of supply chains- Competitive and supply chain strategies- Achieving strategic fit- Expanding strategic scope- Drivers of supply chain performance- Framework for structuring drivers –Obstacles to achieving fit.

UNIT – II LOGISTICS MANAGEMENT **(9)**

Factors – Modes of Transportation - Design options for Transportation Networks-Routing and Scheduling – Inbound and outbound logistics- Reverse Logistics – 3PL- Integrated Logistics Concepts- Integrated Logistics Model – Activities - Measuring logistics cost and performance – Warehouse Management - Case Analysis

UNIT – III SUPPLY CHAIN NETWORK DESIGN **(9)**

Distribution in Supply Chain – Factors in Distribution network design –Design options-Network Design in Supply Chain – Framework for network Decisions - Managing cycle inventory and safety.

UNIT – IV SOURCING AND PRICING IN SUPPLY CHAIN **(9)**

Supplier selection and Contracts - Design collaboration - Procurement process. Revenue management in supply chain.

UNIT – V COORDINATION AND TECHNOLOGY IN SUPPLY CHAIN **(9)**

Supply chain coordination - Bullwhip effect – Effect of lack of co-ordination and obstacles – IT and SCM - supply chain IT frame work. E-Business and SCM. Metrics for SC performance – Case Analysis

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

1. *Sunil Chopra and Peter Meindl* ***"Supply Chain Management Strategy, Planning, and Operation",*** *PHI, Second edition, 2007*
2. *David J.Bloomberg, Stephen Lemay and Joe B.Hanna "****Logistics"****,, PHI 2002*
3. *Martin Christopher,* ***"Logistics and Supply Chain Management"****, Strategies for Reducing Cost and Improving Service. Pearson Education Asia, Second Edition*
4. *Jeremy F.Shapiro, Thomson Duxbury,* ***"Modeling the Supply Chain"****, 2002*
5. *James B.Ayers,* ***"Handbook of Supply Chain Management"****, St.Lucle Press, 2000*

COURSE OUTCOMES:

Learners will be able to

CO 1*: Identify and analyze supply chain problems in various business sectors.*

CO 2: *Devise strategies, plans and operations to solve supply chain problems and/or to improve supply chain efficiency.*

CO 3: *Apply information technology in e-business for corporate demand.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	L	M	H	-	L	M	L	-	L	H	L
CO 2	L	M	M	-	L	H	M	L	L	M	M
CO 3	L	M	L	M	M	L	M	-	L	M	L

L – Low, M – Moderate (Medium), H- High

18MFPE11 FLUID POWER CONTROL AND AUTOMATION

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To acquire the knowledge on advanced features and applications of fluid power engineering in automation of power transmission systems.

UNIT – I OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS **(9)**

Hydraulic Power Generators – Selection and specification of pumps- types of pumps- pump characteristics. Linear and Rotary Actuators – selection, specification and characteristics.

UNIT – II CONTROL AND REGULATION ELEMENTS **(9)**

Pressure - direction and flow control valves - relief valves, non-return and safety valves - actuation systems.

UNIT - III HYDRAULIC CIRCUITS **(9)**

Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits – regenerative and High-low circuits - industrial circuits - press circuits - hydraulic milling machine - grinding, planning – hydraulic copying circuit - forklift and other earth mover circuits- design and selection of components.

UNIT – IV PNEUMATIC SYSTEMS AND CIRCUITS **(9)**

Pneumatic fundamentals - control elements- position and pressure sensing - logic circuits - switching circuits - sequential circuits - cascade method – step counter method - KV mapping method - compound and combinational circuit designs.

UNIT – V INSTALLATION, MAINTENANCE AND SPECIAL CIRCUITS **(9)**

Pneumatic equipment- selection of components - design calculations – application -fault finding - hydro pneumatic circuits - use of microprocessors and PLC for sequencing –PLC programming, Robotic circuits. Introduction to Software for pneumatic / hydraulic systems simulation.

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

1. *Antony Espossito, "**Fluid Power with Applications**", Prentice Hall, 2000.*
2. *FESTO, **"Fundamentals of pneumatics",**Vol I,II, and III*
3. *Dudleyt, A. Pease and John J. Pippenger, "**Basic fluid power**", Prentice Hall, 1987*
4. *MajumderS.R.,"**Oil Hydraulics",**Tata McGraw Hill,2002*
5. *Michael J., Pinches and John G.Ashby, "**Power Hydraulics**", Prentice Hall, 1989*
6. *Bolton. W., "**Pneumatic and Hydraulic Systems**", Butterworth –Heinemann, 1997*
7. *Joji P., "**Pneumatic Controls**", Wiley India Pvt. Ltd., New Delhi, 2008*
8. *Andrew Parr, "**Hydraulic and Pneumatic**" (HB), Jaico Publishing House, 1999*

9. *http:// www.pneumatics .com*
10. *http:// www.fluidpower.com.tw*
11. *W.Boltan, "**Mechatronics, Electronic control systems in Mechanical and Electrical Engineering, Pearson Education"**, 2003*

COURSE OUTCOMES:

Learners will be able to

***CO 1**: Select the components for fluid power applications.*

***CO 2**: Design the circuit building and interpretation with PLC programs.*

***CO 3**: Apply the knowledge on logic controls and troubleshooting of the components.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	M	M	L	M	L	L	-	M	M	M
CO 2	M	M	M	M	M	M	L	-	L	L	L
CO 3	M	H	H	M	M	M	L	-	L	M	M

L – Low, M – Moderate (Medium), H- High

18MFPE12 INDUSTRIAL AUTOMATION AND MECHATRONICS

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To learn the various types of control valves and to Select appropriate hydraulic and pneumatic circuits

UNIT – I INTRODUCTION **(9)**

Need for Automation, Hydraulic & Pneumatic system Comparison – ISO symbols for fluid power elements, Hydraulic, pneumatics system – Selection criteria. Hydraulic system components selection and specification-characteristics – Linear actuator– construction. Reservoir capacity, heat dissipation, accumulators - standard circuit symbols, circuit (flow) analysis. Direction, flow and pressure control valves-operating-characteristics-electro hydraulic servo valves-types, characteristics and performance.

UNIT – II HYDRAULIC CIRCUITS **(9)**

Typical industrial hydraulic circuits-Design methodology – Ladder diagram-cascade, method-truth table-Karnaugh map method-sequencing circuits-combinational and logic circuit.

UNIT – III PNEUMATIC CIRCUITS **(9)**

Electrical control of pneumatic and hydraulic circuits-use of relays, timers, counters, Ladder diagram.

UNIT – IV PLC CIRCUITS **(9)**

Programmable logic control of Hydraulics and Pneumatics circuits, Sensors, PLC ladder diagram for various circuits, motion controllers, use of field busses in circuits. Electronic drive circuits for various Motors.

UNIT – V AUTOMATION **(9)**

Semi automats-automats-transfer lines - automatic assembly - transfer devices and feeders-classifications and applications-job orienting and picking devices- setting of automats and transfer lines.

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

*1. Antony Esposito, "**Fluid Power Systems and control"** Prentice-Hall, 1988*

*2. Herbert R. Merritt, "**Hydraulic control systems**", John Wiley & Sons, Newyork, 1967*

*3. Dudbey.A.Peace, "**Basic Fluid Power**", Prentice Hall Inc, 1967*

*4. Peter Rohner, "**Fluid Power logic circuit design**". The Macmillan Press Ltd.,London, 1979*

*5. E.C.Fitch and J.B.Suryaatmadyn. "**Introduction to fluid logic"**, McGraw Hill, 1978.*

*6. W.Bolton, Mechatronics, "**Electronic control systems in Mechanical and Electrical Engineering"** Pearson Education, 2003.*
*7. Peter Rohner**, "Fluid Power Logic Circuit Design"**, Mcmelan Prem, 1994.*

COURSE OUTCOMES:

Learners will be able to

***CO 1:** Identify the various types of control valves*

***CO 2:** Apply PLCs in circuits*

***CO 3:** Select appropriate hydraulic and pneumatic circuits*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	L	M	M	M	L	M	-	L	M	M
CO 2	M	M	H	M	M	L	H	-	L	M	M
CO 3	M	H	M	M	M	L	H	-	L	M	M

L – Low, M – Moderate (Medium), H- High

18MFPE13 VIBRATION CONTROL AND CONDITION MONITORING

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To learn the operations, applications of vibration measuring instruments and its control strategies.

UNIT – I INTRODUCTION **(9)**

Review of Fundamentals of single Degree Freedom Systems-Two Degree Freedom systems- Multi Degree Freedom systems - Continuous systems - Determination of Natural frequencies and mode shapes - Numerical methods in Vibration Analysis.

UNIT – II VIBRATION CONTROL **(9)**

Introduction - Reduction of Vibration at the source - Control of vibration - by structural design - Material selection - Localized Additions - Artificial Damping - Resilient isolation - Vibration isolation - Vibration absorbers.

UNIT - III ACTIVE VIBRATION CONTROL **(9)**

Introductions - Concepts and Applications - Review of smart materials -Types and characteristic review of smart structures - Characteristic Active vibration control in smart structures.

UNIT – IV CONDITION BASED MAINTENANCE PRINCIPLES AND APPLICATIONS **(9)**

Introduction - condition monitoring methods - Design of Information system - Selecting methods of monitoring - Machine condition monitoring and diagnosis - Vibration severity criteria - Machine Maintenance Techniques - Machine condition monitoring techniques - Vibration monitoring techniques - Instrumentation systems - choice of monitoring parameter.

UNIT – V DYNAMIC BALANCING AND ALLIGNMENT OF MACHINERY **(9)**

Introduction - Dynamic balancing of Rotors - Field Balancing in one plane - two planes and in several planes - Machinery alignment - Rough Alignment methods - The Face Peripheral Dial Indicator Method - Reverse indicator Method - Shaft-to-coupling spool method.

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

1. *SingiresuS.Rao, "**Mechanical vibrations**", Addison - Wesley Publishing Co., 1995*
2. *K.J.Bathe and F.I., Wilson, "**Numerical Methods in Finite Element Analysis**" - Prentice Hall of India Pvt.m, Ltd., 1978*
3. *J.O.DenHartog, "**Mechanical Vibrations**"- McGraw Hill, NewYork, L985*

4. *Rao J S, "**Vibratory Condition Monitoring of Machines**", Narosa Publishing House, 2000.*
5. *Collacot R.A.- "**Mechanical fault diagnosis and condition monitoring"** , Chapman and Hall, Ltd.,, John Wiley & Sons, 1977*
6. *Hunt, T.M, "**Handbook of wear debris analysis and particle detection in liquids, Elsevier applied science"**, London and New York*
7. *Rao, B. "**Handbook of condition monitoring, Elsevier advanced technology"**, Oxford.*
8. *A Davis – "**Handbook of condition monitoring"**.*
9. *P Girdhar – "**Machinery vibration analysis and predictive maintenance"**, Elsevier publications 2012*
10. *R G Eisenmann – "**Machinery malfunction diagnosis and correction"**.*
11. *John S Mitchell – "**Machinery analysis and monitoring".***

COURSE OUTCOMES:

Learners will be able to

***CO 1**: Analyze the importance of vibration in engineering field.*

***CO 2:** Select vibration measuring instruments and techniques in the operating machines.*

***CO 3:** Identify the maintenance and balancing techniques of different machineries.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	L	M	M	M	L	M	-	L	M	M
CO 2	M	M	H	M	M	L	H	-	L	M	M
CO 3	M	H	M	M	M	L	H	-	L	M	M

L – Low, M – Moderate (Medium), H- High

18MFPE14 GREEN MANUFACTURING

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To learn on green manufacturing, recycling and life cycle assessment for environment.

UNIT – I SUSTAINABLE MANUFACTURING AND EMS **(9)**

Sustainable Manufacturing - Concepts and Methodologies to Help Promote Industrial Ecology - ISO L4000 series standards - Concepts of ISO 14001 - requirements of ISO 14001 – Environmental Management System benefits - Environmentally Conscious Manufacturing.

UNIT - II GREEN MANUFACTURING **(9)**

Green Design and Quality Initiatives - Environmental Cost Accounting and Business Strategy - Accounting for an Environmentally Conscious Setting - The Development of Eco labeling Schemes

UNIT - III RECYCLING **(9)**

Recycling as Universal Resource Policy - Innovation towards Environmental Sustainability in Industry - A Systematic Framework for Environmentally Conscious Design

UNIT – IV ENVIRONMENTAL ATTRIBUTES OF MANUFACTURING **(9)**

Environmental Attributes of Manufacturing Processes - Environmental Decision Support Systems - Decision Models for Reverse Production System Design - Environmentally Sound Supply Chain Management

UNIT - V LIFE CYCLE ASSESSMENT **(9)**

Life Cycle Assessment - Multipath way and Cumulative Risk Assessment - Reclamation and Recycling of Waste

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

*1. L.Madu, C.N., **"Handbook of Environmentally Conscious Manufacturing"**, Kluwer Academic Publisher, 2001.*

*2. Besterfield, D.H., Besterfield, C.M., Besterfield, G.H. and Besterfield, M.S.,**"Total Quality Management ",** Pearson Education, 2002.*

*3. Gupta, S.M. and Lambert, A.J.D**., "Environment Conscious Manufacturing"**, CRC Press, 2008.*

*4. Swamidass, P.M., **"Encyclopedia of Production and Manufacturing Management",** Kluwer Academic Publisher, 2000*

COURSE OUTCOMES:

Learners will be able to

CO 1*: Comprehend the green manufacturing tools and sustainable engineering concepts.*

CO 2: *Evaluate the environmental attributes of manufacturing.*

CO 3: *Create eco-friendly products and processes by life cycle assessment.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	L	M	M	M	L	M	-	L	M	M
CO 2	M	M	H	M	M	L	H	-	L	M	M
CO 3	M	H	M	M	M	L	H	-	L	M	M

L – Low, M – Moderate (Medium), H- High

18MFPE15 DIAGNOSTIC TECHNIQUES

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To learn the maintenance systems and its diagnostics techniques.

UNIT – I DEFECTS AND FAILURE ANALYSIS (9)

Defect generation - types of failures - Defects reporting and recording - Defect analysis - Failure analysis - Equipment down time analysis-Breakdown analysis-TA,FMEA, FMECA.

UNIT – II MAINTENANCE SYSTEMS (9)

Planned and unplanned maintenance-Breakdown maintenance - Corrective maintenance – Opportunistic maintenance - Routine maintenance - Preventive maintenance, Predictive maintenance - Condition based maintenance system - Design out maintenance - selection of maintenance system.

UNIT – III SYSTEMATIC MAINTENANCE (9)

Codification and Cataloguing-Instruction manual and operating manual-Maintenance manual and Departmental manual-Maintenance time standard-Maintenance work order and work permit -job monitoring-Feedback and control-Maintenance records and documentation.

UNIT – IV COMPUTER MANAGED MAINTENANCE SYSTEM (9)

Selection and scope of computerization-Equipment classification-Codification of breakdown, material and facilities-Job sequencing-Material management module-Captive Engineering module.

UNIT – V CONDITION MONITORING (9)

Condition monitoring techniques-Visual monitoring-Temperature monitoring-vibration monitoring -Lubricant monitoring-Cracks monitoring-Thickness monitoring-Noise and sound monitoring - condition monitoring of hydraulic system. Machine diagnostics-Objectives-Monitoring strategies - Examples of monitoring and Diagnosis - Control structures for machine diagnosis.

Contact Periods:

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total : 45 Periods

REFERENCES:

1. *Sushil Kumar Srivastava, **"Industrial Maintenance Management"**, S.Chand and company Ltd., NewDelhi-2011.*
2. *Manfred Weck, H.Bibring, **"Handbook of Machine Tools,Vol 3."**, John Wiley and Sons, 1992.*
3. *Garg H.P, **"Industrial Maintenance"**, S.Chand & company Ltd., NewDelhi-2009.*
4. *Ram, Mangey, Davim, J. Paulo, **"Diagnostic Techniques in Industrial Engineering"**, Springer Publications, 2012.*
5. *Mangey Ram, J. Paulo Davim, **"Diagnostic Techniques in Industrial Engineering"**, springer, 2017*

COURSE OUTCOMES:

Learners will be able to

CO 1: *Analyze the importance of diagnostic techniques.*

CO 2: *Apply computer managed maintenance system in defect and failure analysis.*

CO 3: *Identify the maintenance and balancing techniques of different machineries.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	L	M	M	M	L	M	-	L	M	M
CO 2	M	M	H	M	M	L	H	-	L	M	M
CO 3	M	H	M	M	M	L	H	-	L	M	M

L – Low, M – Moderate (Medium), H- High

18MFPE16 INDUSTRIAL ROBOTICS AND ROBOT APPLICATIONS

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To familiarize with the concepts and techniques of robot manipulator, its kinematics, programming and build confidence to choose, evaluate and incorporate robots in engineering systems.

UNIT – I ROBOTIC KINEMATICS **(9)**

Definition need and scope of industrial robots-Robot anatomy-work volume-Precision movement-End effectors - sensors. Robot kinematics- Direct and inverse kinematics- Robot trajectories- Control of robot manipulators- Robot dynamics- Methods for orientation and location of objects.

UNIT – II ROBOT DRIVES AND CONTROL **(9)**

Controlling the robot motion-Position and velocity sensing devices-Design of drive systems-Hydraulic and Pneumatic drives-Linear and rotary actuators and control valves-Electro hydraulic servo valves, electric drives- Motors-designing of end effectors-Vacuum, magnetic and air operated grippers.

UNIT – III ROBOT SENSORS **(9)**

Transducers and sensors-Sensors in robot-Tactile sensor-Proximity and range sensors-Sensing joint forces- Robotic vision system-Image Gripping-Image processing and analysis-Image segmentation-Pattern recognition- Training of vision system

UNIT – IV ROBOT CELL DESIGN AND APPLICATION **(9)**

Robot work cell design and control-Safety in Robotics-Robot cell layouts-Multiple robots and machine Interference - Robot cycle time analysis - application of robotics in machine shop, assembly, automation, tele operated robot, MHS, Processing operation.

UNIT – V ROBOT PROGRAMMING AND ARTIFICIAL INTELLIGENCE **(9)**

Methods of robot programming-characteristics of task level languages lead through programming methods-Motion interpolation. Artificial intelligence- Basics- Goals of artificial intelligence- AI techniques.

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

1. *Mikell P Groover, Mitchell Weis, Roger N Nagel, Nicholas G Odrey, "**Industrial Robotics Technology, Programming and Applications"**, McGraw Hill, 2012.*
2. *Richard D Klafter, Thomas A Chmielewski, Machine Negin, "**Robotics Engineering - An Integrated Approach**", Prentice Hall of India Pvt., Ltd., 1984*
3. *K.S.Fu, R.C.Gomaler, C.S.G.Lee, "**Robotics control, Sensing, Vision andIntelligence**",*

McGraw Hill, 1987

4. *Lorenzo Scarvicco "**Modelling and control of Robot Manipulator** ", Tata McGraw Hill, 1999*
5. *James G Kerames, "**Robot technology fundamentals** ", Delmia Publisher-2000.*

COURSE OUTCOMES:

On completion of this course, learners will be able to

***CO 1:** Appreciate the importance of robot in the emerging trend of manufacturing and to select and design robots for various applications taking kinematic aspects and precision into account.*

***CO 2:** Apply production systems with sensors and advanced techniques such as machine vision.*

***CO 3:** Identify the potential applications of robots in industries at reasonable cost to meet challenges of globalisation.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	L	M	M	M	L	M	-	L	M	M
CO 2	M	M	H	M	M	L	H	-	L	M	M
CO 3	M	H	M	M	M	L	H	-	L	M	M

L – Low, M – Moderate (Medium), H- High

18MFPE17 RELIABILITY AND QUALITY ENGINEERING

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To learn the quality control techniques, control charts and concepts for reliable system and maintenance aspects in industries.

UNIT – I QUALITY CONCEPTS **(9)**

Quality objectives - Quality control - Quality Assurance - Quality systems, economics, Statistical tolerance - Quality loss functions.

UNIT - II STATISTICAL PROCESS CONTROL **(9)**

Process variability - Control charts for variables and attributes, Moving average control charts, multi variant chart- Cumulative chart - demerit control chart - process capability studies.

UNIT - III DESIGN OF EXPERIMENTS **(9)**

Factorial experiments - fractional replication - Taguchi methods - Use of orthogonal arrays –Response surface methodology- Cases.

UNIT - IV RELIABILITY AND QUALITY MANAGEMENT **(9)**

Reliability function – failure rate – mean time between failures (MTBF) – mean time to failure (MTTF) – A priori and a posteriori concept - mortality curve – useful life – availability – maintainability – system effectiveness Reliability prediction and testing - Quality circles - Zero defects program - ISO 9000 and TQM - Total quality organization.

UNIT – V RELIABILITY MANAGEMENT AND RISK ASSESSMENT **(9)**

Reliability testing – Reliability growth monitoring – Non-parametric methods – Reliability and life cycle costs – Reliability allocation – Replacement model-Definition and measurement of risk – risk analysis techniques – risk reduction resources – industrial safety and risk assessment.

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

1. *Logothetis.N, "**Managing for total quality from Deming to Taguchi and SPC**", PHI, 1997*
2. *Fiegenbarum.A. V,"**Total Quality Control"**, McGraw Hill Inc., 1991*
3. *Douglas, C.Montgomery, "**Introduction to Statistical quality control"**, Second Edition John Wiley &Sons,1991*
4. *Srinath L.S, "**Reliability Engineering**", Affiliated East-West Press Pvt Ltd, New Delhi, 1998*
5. *Modarres, "**Reliability and Risk analysis"**, Maral Dekker Inc.L993*
6. *Dale H.Besterfield, **"Quality Improvement",** PHI, 2010*

COURSE OUTCOMES:

Learners will be able to

CO 1: Identify quality concepts and process controls tools.

CO 2: Design the experiments and quality management.

CO 3: Analyze techniques and assess risk in industries

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	L	M	M	M	L	M	-	L	M	M
CO 2	M	M	H	M	M	L	H	-	L	M	M
CO 3	M	H	M	M	M	L	H	-	L	M	M

L – Low, M – Moderate (Medium), H- High

18MFPE18 OPTIMIZATION TECHNIQUES IN ENGINEERING

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To explain the theory of optimization methods and algorithms developed for solving various types of optimization problems.

UNIT – I EVOULUTION OF OPTIMIZATION **(9)**

Optimization – Historical Development – Engineering applications of optimization – Statement of an Optimization problem – classification of optimization problems.

UNIT – II CLASSIC OPTIMIZATION TECHNIQUES **(9)**

Linear programming - Graphical method – simplex method – dual simplex method – revised simplex method – duality in LP – Parametric Linear programming – Goal Programming.

UNIT – III NON-LINEAR PROGRAMMING **(9)**

Introduction – Lagrangeon Method – Kuhn-Tucker conditions – Quadratic programming – Separable programming – Stochastic programming – Geometric programming

UNIT - IV INTEGER PROGRAMMING, AND DYNAMIC PROGRAMMING NETWORK TECHNIQUES **(9)**

Integer programming - Cutting plane algorithm, Branch and bound technique, Zero-one implicit enumeration – Dynamic Programming – Formulation, Various applications using Dynamic Programming. Network Techniques – Shortest Path Model – Minimum Spanning Tree Problem – Maximal flow problem.

UNIT - V ADVANCES IN SIMULATION **(9)**

Genetic algorithms – Simulated annealing – Neural Network, Fuzzy systems and Particle swam optimization

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

*1. R. Panneerselvam, "**Operations Research**", Prentice Hall of India Private Limited, New Delhi L, 2005*

*2. P.K. Guptha and Man-Mohan**, "Problems in Operations Research"** – Sultan Chand & Sons, 1994*

*3. Ravindran, Philips and Solberg, "**Operations Research Principles and Practice"**, John Wiley & Sons, Singapore, 1992*

*4. J.K.Sharma, "**Operations Research – Theory and Applications"** – Macmillan India Ltd., 1997*

*5. Hamdy A. Taha "**Operations Research – An Introduction"**, Prentice Hall of India, 1997*

COURSE OUTCOMES:

At the end of the course the learner should be able to

CO 1: *Apply basic theoretical principles in optimization and formulate the optimization models.*

CO 2: *Implement optimization techniques in engineering problems.*

CO 3: *Solve the constraints for optimal solution to interface in industrial scenario.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	L	M	M	M	L	M	-	L	M	M
CO 2	M	M	H	M	M	L	H	-	L	M	M
CO 3	M	H	M	M	M	L	H	-	L	M	M

L – Low, M – Moderate (Medium), H- High

18MFPE19 ADVANCED TOOL DESIGN

Category: PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To conquer design of moulds, jigs, fixtures, dies and applies the technology in industrial applications.

UNIT - I TOOL-DESIGN METHODS (9)

Introduction – The Design Procedure – Statement of the problem – The Needs Analysis – Research and Ideation – Tentative Design Solutions – The Finished Design – Drafting and Design Techniques in Tooling drawings – Screws and Dowels – Hole location – Jig-boring practice – Installation of Drill Bushings – Punch and Die Manufacture – Electro-discharge machining – Electro-discharge machining for cavity.

UNIT – II TOOLING MATERIALS AND HEAT TREATMENT (9)

Introduction – Properties of Materials – Ferrous Tooling Materials – Tool steels – Cast Iron – Mild, or low-carbon Steel – Nonmetallic Tooling Materials – Nonferrous Tooling Materials – Metal cutting Tools – Single-point cutting tools – Milling cutters – Drills and Drilling – Reamer classification – Taps – Tap classification- the selection of carbide cutting tools – Determining the insert thickness for carbide tools.

UNIT – III DESIGN OF DRILL JIGS (9)

Introduction – Fixed Gages – Gage Tolerances – The selection of material for Gages – Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – Chip formation in drilling – General considerations in the design of drill jigs – Drill bushings – Methods of construction – Drill jigs and modern manufacturing.

UNIT – IV DESIGN OF FIXTURES AND DIES (9)

Introduction – Fixtures and economics – Types of Fixtures – Vise Fixtures – Milling Fixtures – Boring Fixtures – Broaching Fixtures – Lathe Fixtures – Grinding Fixtures – Types of Die construction – Die-design fundamentals – Blanking and Piercing die construction – Pilots – Strippers and pressure pads- Presswork materials – Strip layout – Short-run tooling for Piercing – Bending dies – Forming dies – Drawing operations.

UNIT – V TOOL DESIGN FOR NUMERICALLY CONTROLLED MACHINE TOOLS (9)

Introduction – The need for numerical control – A basic explanation of numeric control – Numerical control systems in use today – Fixture design for numerically controlled machine tools – Cutting tools for numerical control – Tool holding methods for numerical control – Automatic tool changers and tool petitioners – Tool presetting – Introduction – General explanation of the Brown and sharp machine – tooling for Automatic screw machines

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

1. *Cyril Donaldson, George H.LeCain, V.C. Goold, "**Tool Design"**, Tata McGraw Hill Publishing Company Ltd., 2000.*
2. *Prakash Hiralal Joshi, **"Tooling data"**, Wheeler Publishing, 2000*
3. *George.E.Dieter **"Engineering Design",** McGraw Hill, 2012*
4. *J.R.Paquin, **"Die Design Fundamentals"** Industrial Press, 1962*
5. ***Blazynski**, T. Z, **"Design of Tools for Deformation Processes"**, springer, 1986*

COURSE OUTCOMES:

Learners will be able to

***CO 1:** Relate tool design solutions and select tooling materials.*

***CO 2:** Design press tools, plastic moulds, die casting dies, jigs and fixtures.*

***CO 3:** Develop modern tool design for automatic operations.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	L	M	M	M	L	M	-	L	M	M
CO 2	M	M	H	M	M	L	H	-	L	M	M
CO 3	M	H	M	M	M	L	H	-	L	M	M

L – Low, M – Moderate (Medium), H- High

18MFPE20 INDUSTRIAL ERGONOMICS

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To learn concepts of ergonomics to design of man and machine system.

UNIT – I INTRODUCTION **(9)**

Concepts of human factors engineering and ergonomics – Man – machine system and design philosophy – Physical work – Heat stress – manual lifting – work posture –repetitive motion.

UNIT - II ANTHROPOMETRY **(9)**

Physical dimensions of the human body as a working machine – Motion size relationships – Static and dynamic anthropometry – Anthropometric aids – Design principles – Using anthropometric measures for industrial design – Procedure for anthropometric design.

UNIT – III DESIGN OF SYSTEMS **(9)**

Displays – Controls – Workplace – Seating – Work process – Duration and rest periods – Hand tool design – Design of visual displays – Design for shift work.

UNIT – IV ENVIRONMENTAL FACTORS IN DESIGN **(9)**

Temperature – Humidity – Noise – Illumination –Vibration – Measurement of illumination and contrast – use of photometers – Recommended illumination levels. The ageing eye– Use of indirect (reflected) lighting – cost efficiency of illumination – special purpose lighting for inspection and quality control – Measurement of sound – Noise exposure and hearing loss – Hearing protectors – analysis and reduction of noise – Effects of Noise on Performance – annoyance of noise and interference with communication – sources of vibration discomfort.

UNIT – V WORK PHYSIOLOGY **(9)**

Provision of energy for muscular work – Role of oxygen physical exertion –Measurement of energy expenditure Respiration – Pulse rate and blood pressure during physical work – Physical work capacity and its evaluation.

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

1. *Martin Helander, **"A Guide to the Ergonomics of Manufacturing"**, East West press, 1996*
2. *E.J. McCormic, "**Human Factors in Engineering Design"**, McGraw Hill, 1976*
3. *R.S. Bridger, **"Introduction to Ergonomics"**, McGraw Hill, 1995*
4. *Neville A Stanton, **"Guide to Methodology in Ergonomics"**, CRC Press, 2014*
5. *Lakhwinder Pal Singh, "**Work Study and Ergonomics"**, Cambridge University Press, 2017*

COURSE OUTCOMES:

Learners will be able to

CO 1: *Apply the ergonomic principle in various industries.*

CO 2: *Design the ergonomic system for different industries.*

CO 3: *Select the environmental factors in work place.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	L	M	M	M	L	M	-	L	M	M
CO 2	M	M	H	M	M	L	H	-	L	M	M
CO 3	M	H	M	M	M	L	H	-	L	M	M

L – Low, M – Moderate (Medium), H- High

18MFPE21 MANUFACTURING OF NON-METALLIC PRODUCTS

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To learn the application, types of glass and ceramics and their manufacturing methods and to get knowledge in types of composites and their manufacturing techniques

UNIT – I INTRODUCTION (9)

Polymers - classification - Thermoplastics and thermosetting plastics - Thermoforming processes - compression and transfer molding - injection molding - extrusion - blow molding - calendaring - lamination and pultrusion.

UNIT – II RUBBER MANUFACTURING (9)

Rubber - additives - applications. Stages in raw rubber and latex rubber technology - Processing of rubbers –Manufacturing techniques - tires - belts - hoses - foot wears - cellular products - cables. Manufacture of latex based products

UNIT – III TYPES OF GLASS AND ITS MANUFACTURING (9)

Glass - characteristics - application - glass making - Glass forming machines - hollow wares flat glasses, fiberglass, bulbs, bottles, heat absorbing glasses, amber glass and their manufacturing methods, general plant layouts for manufacture of different types of glasses.

UNIT- IV CERAMICS AND ITS TECHNIQUES (9)

Ceramics - classification - traditional ceramics - structural ceramics - fine ceramics - bio ceramics - ceramic super conductors. Ceramic processing techniques - hot pressing - hot isostatic pressing (HIP) - Sintering - injection molding - slip casting - tape casting - gel casting - extrusion.

UNIT – V COMPOSITE MANUFACTURING (9)

Composites - requirements of reinforcement and matrix - Manufacturing of composites - casting - solid state diffusion - cladding - HIP - liquid metal infiltration - liquid phase sintering - preparation of molding compounds and prepregs - hand layup method - autoclave method - filament winding method - compression molding - reaction injection molding - knitting - braiding.

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

*1. Ghosh, "**Polymer Science and Technology – Plastics, Rubber, Blends, and Composites"** Tata-Mcgraw hill, 1989.*

*2. J.L.White,"**Rubber Processing Technology, Materials and Principles"**, Hanser Publishers, 1995.*

*3. E. B. Shand, "**Glass Engineering Handbook"**, McGraw-Hill, 2nd Edition, 1958.*
*4. Kingery, w d &etc "**Introduction to ceramics" 2nd edtion**, John Wiley & Sons publ 2004*
*5. ASM Handbook, Vol. 21 Composites, 2001 Lubin, "**Handbook of Composites"**, Springer, 1st Edition, 1982.*

COURSE OUTCOMES:

Learners will be able to

***CO 1:** identify the types of polymers and its manufacturing techniques*

***CO 2:** find the application, types of glass and ceramics and their manufacturing methods*

***CO 3:** Knowledge in types of composites and their manufacturing techniques*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	L	M	M	M	L	M	-	L	M	M
CO 2	M	M	H	M	M	L	H	-	L	M	M
CO 3	M	H	M	M	M	L	H	-	L	M	M

L – Low, M – Moderate (Medium), H- High

18MFPE22 ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To acquire the knowledge on concepts of artificial intelligence and different tools in expert system.

UNIT – I KNOWLEDGE REPRESENTATION FOR SMART SYSTEMS (9)

Concepts of fifth generation computing -. Forward chaining, backward chaining, use of probability and fuzzy logic. Semantic nets, structure and objects, ruled systems for semantic nets; certainty factors, automated learning.

UNIT - II LANGUAGES USED IN AI (9)

Programming in AI environment - developing artificial intelligence system, natural language processing, neural networks Using PROLOG to design expert systems, converting rules to PROLOG, conceptual example, introduction to LISP, function evaluation, lists, predicates, rule creation.

UNIT - III EXPERT SYSTEM DEVELOPMENT (9)

Definition, choice of domain, collection of knowledge base, selection of inference mechanism, case studies of expert system development in design and manufacturing -Expert systems, controlling reasoning, rule based system, canonical systems, rules and meta rules, associative nets and frame systems, graphs trees and networks, representing uncertainty, probability in expert systems-learning, forms of learning, inductive learning.

UNIT - IV EXPERT SYSTEM TOOLS (9)

Decision trees, knowledge in learning, heuristic classification, heuristic matching, case studies in expert systems, MYCIN, Meta- Dental, general structure of an expert system shell, examples of creation of an expert system using an expert system tool, fundamentals of object oriented programming, creating structure and object, object operations, invoking procedures, programming applications, object oriented expert system.

UNIT - V INDUSTRIAL APPLICATION OF AI AND EXPERT SYSTEMS (9)

Robotic vision systems, image processing techniques, application to object recognition and inspection, automatic speech recognition – applications in automotive industries and nuclear power projects.

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

1. *Robert Levine et al, "**A Comprehensive Guide to AI and Expert Systems**", McGraw Hill Inc, 1988*
2. *Henry C Mishkoff, "**Understanding AI**", BPB Publication, New Delhi, 1986*
3. *Peter Jackson, "**Introduction to Expert Systems**", First Indian Reprint, 2000, Addison, Wesley.*

4. *Stuart Russell and Peter Norvig, "**Artificial Intelligence: A Modern Approach"**, Prentice Hall, 1995*
5. *Elaine Rich et al., **"Artificial Intelligence"**, McGraw Hill, 1995*
6. *Winston P H, **"Artificial Intelligence"**, Addison Wesley, Reading, Massachusetts, Third Edition,1992*

COURSE OUTCOMES:

Learners will be able to

***CO 1**: Comprehend in solving the contemporary issues using Artificial Intelligence.*

***CO 2**: Develop the ability to use techniques in rules based systems.*

***CO 3**: Apply knowledge on vision system, image processing in automotive and nuclear fields.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	L	M	M	M	L	M	-	L	M	M
CO 2	M	M	H	M	M	L	H	-	L	M	M
CO 3	M	H	M	M	M	L	H	-	L	M	M

L – Low, M – Moderate (Medium), H- High

18MFPE23 ADVANCED METAL JOINING TECHNIQUES

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To acquire the knowledge on principles, operations and applications of different welding processes and analyze the effects of process parameters on the quality of weld products

UNIT – I INTRODUCTION (9)

Welding processes classification, arc welding processes- solid state welding processes, plasma arc welding and ultrasonic welding - Resistance welding process- different types weld joints, welding positions. Brazing, soldering and adhesive bonding, process principles & applications.

UNIT – II WELDING AND ITS TYPES (9)

Electron beam welding, laser beam welding, Hybrid welding– explosive welding – diffusion bonding – high frequency induction welding –twin wire active TIG welding-A-TIG welding- Hot wire TIG welding- Weld Surfacing & cladding.

UNIT – III FRICTION WELDING AND EXPLOSIVE WELDING (9)

. Friction Surfacing, Friction stir spot welding, Explosive Welding, Welding of Ni and Ti based alloys, Friction welding with Cu interlayer.

UNIT – IV MIAB WELDING (9)

Magnetically impelled arc butt (MIAB) welding - under water welding -Welding of Cu, Al, Ti and Ni alloys – processes, difficulties, microstructures, defects and remedial measures -Hydrogen embrittlement – Lamellar tearing – Residual stress – Distortion and its control .

UNIT – V HEAT TRANSFER AND ITS ANALYSIS (9)

Heat transfer and solidification - Analysis of stresses in welded structures – pre and post welding heat treatments – weld joint design – welding defects-Inspection & testing of weld joints - Safety aspects in welding.

Contact Periods:

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total : 45 Periods

REFERENCE BOOKS:

*1. Dr.R.S.Parmer "**Welding processes and Technology**" Khanna Publishers.*
*2. H.S.Bawa "**Manufacturing Technology-I**" Tata Me Graw Hill Publishers New Delhi, 2007.*
*3. S.V.Nadkami, "**Modem Arc Welding Technology"**, Oxford & IBH Publishing Co. Pvt. Ltd.*
*4. CORNU.J. "**Advanced welding systems – Volumes I, II and III"**, JAICO Publishers,1994.*
*5. LANCASTER.J.F. –" **Metallurgy of welding"** – George Alien & Unwin Publishers, 1980*
*6. Carry B.," **Modern Welding Technology"**, Prentice Hall Pvt Ltd., 2002*
*7. P .L. Jain "**Principles of foundry Technology**" Tata Mc Graw Hill Publishers.*

COURSE OUTCOMES:

Learners will be able to

***CO 1**: Discriminate the knowledge of principles, operations and applications of different welding processes*

***CO 2**: Analyze the effects of process parameters on the quality of cast and weld products*

***CO 3**: Select the NDT techniques for the evaluation of cast and weld components*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	L	M	M	M	L	M	-	L	M	M
CO 2	M	M	H	M	M	L	H	-	L	M	M
CO 3	M	H	M	M	M	L	H	-	L	M	M

L – Low, M – Moderate (Medium), H- High

18MFPE24 NON DESTRUCTIVE EVALUATION

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To familiarize the principles of nondestructive techniques and to introduce non-destructive evaluation in engineering applications.

UNIT - I CONCEPTS OF NDT (9)

Relative merits and limitations of NDT Vs Conventional testing –Visual inspection, thermal inspection methods. Liquid penetrate Inspection

UNIT – II LIQUID PENETRANT AND MAGNETIC PARTICLE TESTS (9)

Characteristics of liquid penetrates - different washable systems - Developers - applications - Methods of production of magnetic fields - Principles of operation of magnetic particle test - Applications - Advantages and limitations.

UNIT - III RADIOGRAPHY (9)

Sources of ray-X-ray production - properties of d and X rays - film characteristics - exposure charts - contrasts - operational characteristics of X ray equipment - applications.

UNIT – IV ULTRASONIC AND ACOUSTIC EMISSION TECHNIQUES (9)

Production of ultrasonic waves - different types of waves - general characteristics of waves - pulse echo method – A, B, C scans - Principles of acoustic emission techniques - Advantages and limitations - Instrumentation - applications.

UNIT - V THERMOGRAPHY (9)

Thermography - Principles, types, applications, advantages and limitations. Optical and Acoustical holography- Principles, types, applications, advantages and limitations. Case studies: weld, cast and formed components.

Contact Periods:

Lecture : 45 Periods **Tutorial : 0 Periods** **Practical : 0 Periods** **Total : 45 Periods**

REFERENCE BOOKS:

1. *Barry Hull and Vernon John, "**Non Destructive Testing** ", MacMillan, 1988*
2. *American Society for Metals, "**Metals Hand Book** ", Vol.II, 1976*
3. *Hull. **"Non Destructive Testing"**. ELBS Edition. 1991*
4. *Baldevraj.,Jayakumar.T., Thavasimuthu. M., **"Practical Non-destructive Testing"**. Narosa Publishers. 1997*
5. *McGonnagle. W.T. **"Non-Destructive Testing"**, McGraw Hill. 1961*
6. *ASM Metals Hand Book. Vol. (9). **"Non-destructive Testing and Inspection"**, 1988*
7. *C.Hellier, Hand Book **"Non-Destructive Evaluation",** McGraw-Hill Professional,1st Edition,2001.*

COURSE OUTCOMES:

Learners will be able to

CO 1*: Identify the difference in the different methods of nondestructive techniques.*

CO 2*: Apply the appropriate technique for a given application.*

CO 3:*.Analyze the defects formed by nondestructive techniques.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	L	M	M	M	L	M	-	L	M	M
CO 2	M	M	H	M	M	L	H	-	L	M	M
CO 3	M	H	M	M	M	L	H	-	L	M	M

L – Low, M – Moderate (Medium), H- High

18MFPE25 SENSORS FOR INTELLIGENT MANUFACTURING

(Common to Engineering Design)

Category : PE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE

To expose the students to the various sensors and their applications in manufacturing systems

UNIT – I INTRODUCTION (9)

Introduction – role of sensors in manufacturing automation – operation principles of different sensors – electrical, optical, acoustic, pneumatic, magnetic, Electro optical and vision sensors.

UNIT – II CONDITION MONITORING OF MANUFACTURING SYSTEMS (9)

Condition monitoring of manufacturing systems – principles – sensors for monitoring force, vibration and noise, selection of sensors and monitoring techniques

UNIT – III ACOUSTIC EMISSION SENSORS (9)

Acoustic emission – principles and applications – concepts of pattern recognition. Sensors for CNC machine tools – linear and angular position and velocity sensors.

UNIT – IV MACHINE VISION SENSORS (9)

Automatic identification techniques for shop floor control – bar code scanners, radio frequency systems – optical character and machine vision sensors.

UNIT – V ADAPTIVE CONTROL OF MACHINE TOOLS (9)

Smart / intelligent sensors – integrated sensors, Robot sensors, Micro sensors, Nano sensors.
Adaptive control of machine tools.

Contact Periods:

Lecture: 45 Periods Tutorial:0 Periods Practical:0 Periods Total: 45 Periods

References :

1. ***"Sensors: Hand Book"*** *by SabrieSoloman ; McGraw Hill*
2. ***"Thermal Sensors: Vo. IV, Sensors: A Comprehensive Survey"*** *by JorgScholz (Editor), John wiley& Sons*
3. ***"Mechanical Sensors: Vo. VII, Sensors: A Comprehensive Survey"*** *by H.H. Bau (Editor), John wiley& Sons*
4. ***"Sensor Technology & Devices"*** *by LjubisaRistia (Editor), Artech House Publishers.*
5. ***"Sensors and control system in manufacturing"*** *by SabrieSoloman,The McGraw-Hill Companies, Inc.*

COURSE OUTCOMES

On completion of this course, students will be able to

CO1: Appreciate the capabilities of various sensors and apply them in condition monitoring.

CO2: Apply advanced sensor based systems for identification and inspection functions in shop floor.

CO3: Appreciate and use special type of sensors for hi-tech manufacturing systems.

COURSE ARTICULATION MATRIX

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L	L	L	L	L	L	-	-	L	L	L
CO2	L	L	L	L	L	L	-	-	L	L	L
CO3	L	L	L	L	L	L	-	-	L	L	L

L – Low, M – Moderate (Medium), H- High

18SEOE01- VASTU SCIENCE FOR BUILDING CONSTRUCTION
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVE:
To impart basic knowledge of vastu science and its impact on human well being.

UNIT I - INTRODUCTION (9)
Traditional definition - Meaning of Vastu and Vaastu -its classification -Relationship to earth - concept of existence and manifestation – planatory influence on earth.

UNIT II - SPACE THEORY IN VASTU (9)
Features of good building site -good building shapes -macro, micro, enclosed and material spaces - relationship between built space, living organism and universe -impact of built space on human psyche. Flow of energy within built space and outside - zoning of functional areas -fitting of components in the building -significance of water bodies and energy -The cube as the basic structure.

UNIT III - COSMOGRAM & SETTLEMENT CONCEPTS (9)
Orientation of building, site, layout and settlement -positive and negative energies -importance of cardinal and ordinal directions -The celestial grid or-mandala and its type. The Vaastu Purusha Mandala and its significance in creation of patterns, and lay-outs, extension of this to aural and visual fields -Types of Lay-Outs

UNIT IV - INTERFACE OF TIME, VIBRATION AND RHYTHM (9)
Theory of vibration and energy transfer – equation of time and space – manifestation in living organism – human beings – measurement of the energy– Kirlian energy of various forms-documentation of objects – filaments and streamers.

UNIT V - MEASUREMENTS & MATERIALS (9)
Units of measurement -Mana shastra -Ayadi techniques -Tala system and Hasta system of measures -Musical measurements compared to space measurements -resultant ambience in built space. Use of wood, stone, metal, brick and time- making technology, corbelling technology, jointing technology -foundations for heavy and light structures -Landscaping in and around buildings -Aesthetic in Indian Architecture.

Contact Periods:
Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

*1. Dr.Prasanna Kumar Acharya-"**Manasara**" -Ox ford1 University Press1927 -(English version)*
*2. K.S.Subramanya Sastri –"**Maya Matam**" -Thanjavur Maharaja Sarjoji saraswathil Mahal Library -Thanjavur-1966.*
*3. Stella Kramresh –"**The Hindu Temple"** Vol.1 & II Motital Banarsidass Publishers Pvt. Ltd., Delhi -1994.*

*4. Bruno Dagens –"**Mayamatam"**, Vol.1 & IIIGNCA and Motilal Bamarsidars, .Publishers Pvt. Ltd-s Delhi -1994.*
*5. George Birdsall –"**Feng Shui: The Key Concepts**" -January 2011*

COURSE OUTCOMES:

The students are able to

CO 1: Obtain exposure on various concepts of vastu

CO 2: Understand the theories in Vastu.

CO 3: Familiarize with the Cosmogram and settlement concepts of vastu

CO 4: Understand the role of vasthu in energy flow manifestation in living beings.

CO 5: Plan a structure considering various vastu techniques.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	***H***										
CO2	***H***										
CO3	***H***										
CO4	***H***								***M***		
CO5	***M***				***M***						

L – Low, M – Moderate (Medium), H- High

18SEOE02 - PLANNING OF SMART CITIES
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVE:

To have an exposure on development of smart cities considering various fields related and their challenges.

UNIT I – SMART CITIES DEVELOPMENT POTENTIALS AND CHALLENGES (9)

Perspectives of Smart Cities: Introduction and Overview - Implementation Challenges - Methodological issues - Spatial distribution of start up cities – Re imagining post industrial cities - Implementation Challenges for Establishing Smart Urban Information and Knowledge Management System

UNIT II – ROLE OF ICT, REMOTE SENSING, AND GEOGRAPHICAL INFORMATION SYSTEM (9)

Optimising Green Spaces for Sustainable Urban Planning - 3D City Models for Extracting Urban Environmental Quality Indicators - Assessing the Rainwater Harvesting Potential - The Strategic Role of Green Spaces - Monitoring Urban Expansion

UNIT III – ENVIRONMENT, ENERGY, DISASTER MANAGEMENT AND SUSTAINABLE DEVELOPMENT (9)

Alternatives for Energy Stressed Cities - Social Acceptability of Energy-Efficient Lighting - Energy Management - Urban Dynamics and Resource Consumption - Issues and Challenges of Sustainable Tourism - Green Buildings: Eco-friendly Technique for Modern Cities

UNIT IV– MULTIFARIOUS MANAGEMENT FOR SMART CITIES (9)

An Assessment of Domestic Water Use Practices - An Issue of Governance in Urban Water Supply - Assessment of Water Consumption at Urban Household Level - Water Sustainability - Socio-economic Determinants and Reproductive Healthcare System - Problems and Development of Slums.

UNIT V – INTELLIGENT TRANSPORT SYSTEM

(9) Introduction to Intelligent Transportation Systems (ITS)- The Range of ITS Applications -Network Optimization-Sensing Traffic using Virtual Detectors- In-Vehicle Routing, and Personal route information-The Smart Car-Commercial Routing and Delivery-Electronic Toll Collection-The Smart Card-Dynamic Assignment- Traffic Enforcement. Urban Mobility and Economic Development

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. *Poonam Sharma, Swati Rajput, "**Sustainable Smart Cities in India_ Challenges and Future Perspectives Springer"** 2017 Co.(P) Ltd. 2013*
2. *Ivan Nunes Da Silva,"**Rogerio Andrade Flauzino-Smart Cities Technologies**"-ExLi4EvA (2016)*
3. *Stan McClellan, Jesus A. Jimenez, George Koutitas (eds**.)-"Smart Cities_ Applications, Technologies, Standards, and Driving Factors"-**Springer International Publishing (2018)*
4. *Stan Geertman, Joseph Ferreira, Jr., Robert Goodspeed, John Stillwell, "**Planning Support Systems and Smart Cities"** , Springer, 2015*

COURSE OUTCOME:

CO 1: Identify the potential and challenges in smart city development.

CO 2: Apply the different tools for sustainable urban planning.

CO 3: Understand the concepts of environment, energy and disaster management.

CO 4: Identify the proper methods for water and waste water management.

CO 5: Familiarize with the intelligent transport systems.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1											
CO2											
CO3									***M***	***M***	
CO4						***M***					
CO5	***L***	***H***				***L***					

L – Low, M – Moderate (Medium), H- High

18SEOE03 - GREEN BUILDING
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVE:

- *To introduce the different concepts of sustainable design and green building techniques and how they may be synthesized to best fit a specific construction project.*

UNIT I - INTRODUCTION (9)

Life Cycle impacts of materials and products – sustainable design concepts – strategies of Design for the Environment -The sun-earth relationship and the energy balance on the earth's surface, climate, wind – Solar radiation and solar temperature – Sun shading and solar radiation on surfaces – Energy impact on the shape and orientation of buildings – Thermal properties of building materials.

UNIT II - ENERGY EFFICIENT BUILDINGS (9)

Passive cooling and day lighting – Active solar and photovoltaic- Building energy analysis methods- Building energy simulation- Building energy efficiency standards- Lighting system design- Lighting economics and aesthetics- Impacts of lighting efficiency – Energy audit and energy targeting- Technological options for energy management.

UNIT III - INDOOR ENVIRONMENTAL QUALITY MANAGEMENT (9)

Psychrometry- Comfort conditions- Thermal comfort- Ventilation and air quality-Air conditioning requirement- Visual perception- Illumination requirement- Auditory requirement- Energy management options- -Air conditioning systems- Energy conservation in pumps- Fans and blowers- Refrigerating machines- Heat rejection equipment- Energy efficient motors- Insulation.

UNIT IV - GREEN BUILDING CONCEPTS (9)

Green building concept- Green building rating tools- Leeds and IGBC codes. – Material selection Embodied energy- Operating energy- Façade systems- Ventilation systems- Transportation- Water treatment systems- Water efficiency- Building economics

UNIT V - GREEN BUILDING DESIGN CASE STUDY (9)

Students to work through a controlled process of analysis and design to produce drawings and models of their own personal green building project. Topics include building form, orientation and site considerations; conservation measures; energy modeling; heating system and fuel choices; renewable energy systems; material choices; and construction budget-Case Study on green construction and design.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. *Kibert, C. "**Sustainable Construction: Green Building Design and Delivery**", John Wiley & Sons, 2005*
2. *Edward G Pita, "**An Energy Approach- Air-conditioning Principles and Systems**", Pearson Education, 2003.*
3. *Colin Porteous, "**The New Eco-Architecture**", Spon Press, 2002.*
4. *Energy Conservation Building Codes: www.bee-india.nic.in*
5. *Lever More G J, "**Building Energy Management Systems**", E and FN Spon, London, 2000.*
6. *Ganesan T P, "**Energy Conservation in Buildings**", ISTE Professional Center, Chennai, 1999.*
7. *John Littler and Randall Thomas, "**Design with Energy: The Conservation and Use of Energy in Buildings**", Cambridge University Press, 1984.*

COURSE OUTCOMES:

The students are able to

CO 1: Describe the concepts of sustainable design

CO 2: Familiarize with green building techniques including energy efficiency management.

CO 3: Understand the indoor environmental quality management in green building.

CO 4: Perform the green building rating using various tools.

CO 5: Create drawings and models of their own personal green building project.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	***L***										
CO2					***M***	***M***					
CO3						***M***					
CO4						***M***					
CO5	***M***								***L***	***M***	***M***

L – Low, M – Moderate (Medium), H- High

18EEOE04 - ENVIRONMENT, HEALTH AND SAFETY IN INDUSTRIES

(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES : NIL

COURSE OBJECTIVES:

On completion of this course the students are able to:

1. *Get knowledge about occupational health hazard and safety measures at work place*
2. *Learn about accident prevention and safety management*
3. *Learn about general safety measures in industries*

UNIT I - OCCUPATIONAL HEALTH AND HAZARDS (8)

Occupation, Health and Hazards - Safety Health and Management: Occupational Health Hazards - Ergonomics - Importance of Industrial Safety Radiation and Industrial Hazards : Types and effects - Vibration - Industrial Hygiene - Different air pollutants in industries and their effects Electrical, fire and Other Hazards - General causes, Machine Guards and its types, Automation.

UNIT II - SAFETY A WORKPLACE (10)

Safety at Workplace - Safe use of Machines and Tools: Safety in use of different types of unit operations - Ergonomics of Machine guarding - working in different workplaces - Operation, Inspection and maintenance Plant Design and Housekeeping, Industrial lighting, Vibration and Noise.

UNIT III - ACCIDENT PREVENTION (9)

Accident Prevention Techniques - Principles of accident prevention - Definitions, Theories, Principles - Hazard identification and analysis, Event tree analysis, Hazop studies, Job safety analysis - Theories and Principles of Accident causation - First Aid : Body structure and functions - Fracture and Dislocation, Injuries to various body parts.

UNIT IV - SAFETY MANAGEMENT (9)

Safety Management System and Law - Legislative measures in Industrial Safety: Various acts involved in Detail- Occupational safety, Health and Environment Management : Bureau of Indian Standards on Health and Safety, 14489, 15001 - OSHA, Process safety management (PSM) and its principles - EPA standards- Safety Management : Organisational & Safety Committee - its structure and functions.

UNIT V - GENERAL SAFETY MEASURES (9)

Plant Layout for Safety -design and location, distance between hazardous units, lighting, colour coding, pilot plant studies, Housekeeping - Accidents Related with Maintenance of Machines - Work Permit System : Significance of Documentation Directing Safety : Definition, Process, Principles and Techniques Leadership : Role, function and attribution of a leader Case studies - involving implementation of health and safety measures in Industries.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total 45 Periods

REFERENCE BOOKS :

1. *R.K. Jain and Sunil S. Rao, "**Industrial safety, Health and Environment Management"**, Khanna publishers, New Delhi (2006).*
2. *Frank P. Lees –" **Loss of Prevention in Process Industries"**, Vol 1 and 2, Butterworth - Heinamann Ltd., London (1991)*
3. *Industrial Safety - National Council of India*
4. *Factories Act with Amendments 1987, Govt. of India Publications DGFASLI, Mumbai*

COURSE OUTCOMES:

At the end of the course student will be able to:

CO1 : *Gain the knowledge about occupational health hazard and safety measures at work place*

CO2 : *Be Able to learn about accident prevention and safety management*

CO3 : *Understand occupational health hazards and general safety measures in industries*

CO4 : *Got to know various laws, standards and legislations.*

CO5 : *Able to learn about safety and proper management of industries*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L	M		H			L		H	H	L
CO2	H	H	M	H			L		M	H	H
CO3	H	H		M			L		L	M	M
CO4							L		L	L	L
CO5							L		L	L	L

L-Low, M-Moderate(Medium), H-High

18EEOE05 - CLIMATE CHANGE AND ADAPTATION

(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES : NIL

COURSE OBJECTIVES:

On completion of this course the students are able to:

1. *Able get knowledge about Climate system and its changes and causes*
2. *Able to learn about impacts, adaptation and mitigation of climate change*
3. *Able to learn about clean technology and clean energy*

UNIT I - EARTH'S CLIMATE SYSTEM (09)

Introduction-Climate in the spotlight - The Earth's Climate Machine – Climate Classification - Global Wind Systems – Trade Winds and the Hadley Cell – The Westerlies - Cloud Formation and Monsoon Rains – Storms and Hurricanes - The Hydrological Cycle – Global Ocean Circulation – El Nino and its Effect - Solar Radiation – The Earth's Natural Green House Effect – Green House Gases and Global Warming – Carbon Cycle.

UNIT II - OBSERVED CHANGES AND ITS CAUSES (09)

Observation of Climate Change – Changes in patterns of temperature, precipitation and sea level rise – Observed effects of Climate Changes – Patterns of Large Scale Variability – Drivers of Climate Change – Climate Sensitivity and Feedbacks – The Montreal Protocol – UNFCCC – IPCC – Evidences of Changes in Climate and Environment – on a Global Scale and in India – climate change modeling.

UNIT III - IMPACTS OF CLIMATE CHANGE (09)

Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem – Water Resources – Human Health – Industry, Settlement and Society – Methods and Scenarios – Projected Impacts for Different Regions – Uncertainties in the Projected Impacts of Climate Change – Risk of Irreversible Changes.

UNIT IV - CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES (09)

Adaptation Strategy/Options in various sectors – Water – Agriculture –- Infrastructure and Settlement including coastal zones – Human Health – Tourism – Transport – Energy – Key Mitigation Technologies and Practices – Energy Supply – Transport – Buildings – Industry – Agriculture – Forestry - Carbon sequestration – Carbon capture and storage (CCS) - Waste (MSW & Bio waste, Biomedical, Industrial waste – International and Regional cooperation.

UNIT V - CLEAN TECHNOLOGY AND ENERGY (09)

Clean Development Mechanism – Carbon Trading - examples of future Clean Technology – Biodiesel – Natural Compost – Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio-fuels – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total 45 Periods

REFERENCE BOOKS:

1. *Jan C. van Dam, "**Impacts of Climate Change and Climate Variability on Hydrological Regimes**", Cambridge University Press, 2003.*
2. *IPCC fourth assessment report - The AR4 synthesis report, 2007*
3. *IPCC fourth assessment report –Working Group I Report, **" The physical Science Basis",** 2007*
4. *IPCC fourth assessment report - Working Group II Report, " **Impacts, Adaptation and Vulnerability",** 2007*
5. *IPCC fourth assessment report – Working Group III Report" **Mitigation of Climate change**", 2007*
6. *Bates, B.C., Z.W. Kundzewicz, S. Wu and J.P. Palutikof, Eds., '**Climate Change and Water**'. Technical Paper of the Intergovernmental Panel on Climate Change, IPCC Secretariat, Geneva, 2008.*
7. *Dash Sushil Kumar, "**Climate Change – An Indian Perspective**", Cambridge University Press India Pvt. Ltd, 2007.*

COURSE OUTCOMES:

At the end of the course the student will be able:

CO1: *To understand the climatic system and the factors influencing the climatic changes*

CO2: *To assess the uncertainty and impact of climatic changes*

CO3 : *To develop strategies for adaptation and mitigation of climatic changes*

CO4 : *To identify clean technologies for sustainable growth*

CO5: *To identify clean technologies for sustainable growth*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M			M			H		L	M	M
CO2	M			M			M		L	L	M
CO3	M			M			H		L	M	M
CO4	M	M	M	H	M	M	L	M	M	L	M
CO5	M			M			M		L	L	L

L-Low, M-Moderate(Medium), H3-High

18EEOE06 - WASTE TO ENERGY

(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

On completion of this course the students are able to:

Able to get knowledge about the utilization of waste and its purpose.

UNIT I - INTRODUCTION (09)

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forestresidue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II - BIOMASS PYROLYSIS (09)

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods -Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III - BIOMASS GASIFICATION (09)

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers –Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV - BIOMASS COMBUSTION (09)

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V - BIOGAS (09)

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total 45 Periods

REFERENCE BOOKS:

1. ***"Non Conventional Energy"****, Desai, Ashok V., Wiley Eastern Ltd., 1990.*
2. ***"Biogas Technology - A Practical Hand Book"*** *- Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.*
3. ***"Food, Feed and Fuel from Biomass"****, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.*
4. ***"Biomass Conversion and Technology"****, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.*

COURSE OUTCOMES:

At the end of the course the student will be able :

CO1: *Understand solid waste management techniques*

CO2: *Know what is biomass*

CO3 : *Study Methods and factors considered for biomass gasification*

CO4 : *Know equipment meant for biomass combustion*

CO5 : *Understand about biogas and its development in India*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M			M			H		L	L	L
CO2	M			M			H		L	L	L
CO3	M			M			H		L	L	L
CO4	M		M	M			H		L	L	L
CO5	M			M			H		L	L	L

L-Low, M-Moderate(Medium), H-High

18GEOE07 - ENERGY IN BUILT ENVIRONMENT
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES : NIL

COURSE OBJECTIVES:

On completion of this course students are able to:

1. *About energy use and its management*
2. *Understand constructional requirements of buildings*
3. *Know relationship of energy and environment*

UNIT I - INTRODUCTION (09)

Indoor activities and environmental control - Internal and external factors on energy use -Characteristics of energy use and its management -Macro aspect of energy use in dwellings and its implications - Thermal comfort - Ventilation and air quality - Air-conditioning requirement -Visual perception - Illumination requirement - Auditory requirement

UNIT II - LIGHTINGREQUIREMENTS IN BUILDING (09)

The sun-earth relationship - Climate, wind, solar radiation and temperature - Sun shading and solar radiation on surfaces - Energy impact on the shape and orientation of buildings – Lighting and daylighting: Characteristics and estimation, methods of day-lighting – Architectural considerations for day-lighting

UNIT III - ENERGY REQUIREMENTS IN BUILDING (09)

Steady and unsteady heat transfer through wall and glazed window - Standards for thermal performance of building envelope - Evaluation of the overall thermal transfer - Thermal gain and net heat gain - End-use energy requirements - Status of energy use in buildings - Estimation of energy use in a building

UNIT IV - ENERGY AUDIT (09)

Energy audit and energy targeting - Technological options for energy management - Natural and forced ventilation – Indoor environment and air quality - Airflow and air pressure on buildings -Flow due to stack effect

UNIT V - COOLING IN BUILT ENVIRONMENT (09)

Passive building architecture – Radiative cooling - Solar cooling techniques - Solar desiccant dehumidification for ventilation - Natural and active cooling with adaptive comfort –Evaporative cooling – Zero energy building concept.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total 45 Periods

REFERENCE BOOKS:

1. *J. Krieder and A. Rabl (2000), "**Heating and Cooling of Buildings: Design for Efficiency",**McGraw-Hill.*
2. *S. M. Guinnes and Reynolds (1989), "**Mechanical and Electrical Equipment for Buildings",**Wiley.*
3. *A. Shaw (1991), "**Energy Design for Architects",** AEE Energy Books.*
4. *ASHRAE (2001), "**Handbook of Fundamentals",** ASHRAE, Atlanta, GA.*

5. *Reference Manuals of DOE-2 (1990), Orlando Lawrence-Berkeley Laboratory, University of California, and Blast, University of Illinois, USA.*

COURSE OUTCOMES:

At the end of the course the student will be able :

CO1: *Understand energy and its usage*
CO2: *To know lighting to be given to a building*
CO3 : *To study energy requirements in a building*
CO4 : *Understand energy audit*
CO5 : *To study architectural specifications of a building.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M			M			M		L	L	L
CO2	M			M			M		L	L	L
CO3	M			M			M		L	L	L
CO4	M			M		M	M		L	L	L
CO5	M			M			M		L	L	L

L-Low, M-Moderate(Medium), H-High

18GEOE08 - EARTH AND ITS ENVIRONMENT

(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE

To know about the planet earth, the geosystems and the resources like ground water and air and to learn about the Environmental Assessment and sustainability.

UNIT I-EVOLUTION OF EARTH (09)

Evolution of earth as habitable planet - Evolution of continents - oceans and landforms - evolution of life through geological times - Exploring the earth's interior - thermal and chemical structure - origin of gravitational and magnetic fields.

UNIT II-GEOSYSTEMS (09)

Plate tectonics - working and shaping the earth - Internal Geosystems – earthquakes – volcanoes - climatic excursions through time - Basic Geological processes - igneous, sedimentation - metamorphic processes.

UNITIII-GROUND WATER GEOLOGY (09)

Geology of groundwater occurrence - recharge process - Groundwater movement - Groundwater discharge and catchment hydrology - Groundwater as a resource - Natural groundwater quality and contamination - Modeling and managing groundwater systems.

UNITIV- ENVIRONMENTAL ASSESMENT AND SUSTAINABILITY (09)

Engineering and sustainable development - population and urbanization - toxic chemicals and finite resources - water scarcity and conflict - Environmental risk - risk assessment and characterization - hazard assessment - exposure assessment.

UNITV-AIR AND SOLIDWASTE (09)

Air resources engineering - introduction to atmospheric composition – behaviour - atmospheric photochemistry - Solid waste management – characterization - management concepts.

Contact Periods:

Lecture: 45 periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. John Grotzinger and Thomas H. Jordan, Understanding Earth, Sixth Edition, W. H. Freeman, 2010.
2. Younger, P. L., "**Groundwater in the Environment: An introduction"**, Blackwell Publishing, 2007.
3. Mihelcic, J. R., Zimmerman, J. B., "**Environmental Engineering: Fundamentals, Sustainability and Design"**, Wiley, NJ, 2010.

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Know about evolution of earth and the structure of the earth.

CO2: Understand the internal Geosystems like earthquakes and volcanoes and the various geological processes.

CO3:Understand the geological process of occurrence and movement of groundwater and the modeling systems.

CO4: Assess the Environmental risks and the sustainability developments.

CO5: Learn about the photochemistry of atmosphere and the solid waste management concepts.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	***L***			***M***	***M***			***H***	***H***		
CO2	***H***		***H***	***H***		***H***					
CO3	***M***						***H***			***M***	
CO4		***M***			***L***		***H***	***H***	***H***		***H***
CO5	***M***	***M***		***L***				***H***			

L-Low, M-Moderate(Medium), H-High

18GEOE09 - NATURAL HAZARDS AND MITIGATION
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE

To get idea about the various natural hazards like Earthquakes, slope stability, floods, droughts and Tsunami and the mitigation measures.

UNIT I - EARTHQUAKES (09)

Definitions and basic concepts - different kinds of hazards – causes - Geologic Hazards – Earthquakes - causes of earthquakes – effects - plate tectonics - seismic waves - measures of size of earthquakes - earthquake resistant design concepts.

UNIT II - SLOPE STABILITY (09)

Slope stability and landslides - causes of landslides - principles of stability analysis - remedial and corrective measures for slope stabilization.

UNIT III - FLOODS (09)

Climatic Hazards – Floods - causes of flooding - regional flood frequency analysis - flood control measures - flood routing - flood forecasting - warning systems.

UNIT IV - DROUGHTS (09)

Droughts – causes - types of droughts - effects of drought - hazard assessment - decision making - Use of GIS in natural hazard assessment – mitigation - management.

UNIT V - TSUNAMI (09)

Tsunami – causes – effects – undersea earthquakes – landslides – volcanic eruptions – impact of sea meteorite – remedial measures – precautions – case studies.

Contact Periods:

Lecture: 45 periods Tutorial:0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. Donald Hyndman and David Hyndman, **Natural Hazards and Disasters**, Brooks/Cole Cengage Learning, 2008.
2. Edward Bryant, Natural Hazards, Cambridge University Press, 2005.
3. J Michael Duncan and Stephan G Wright, **Soil Strength and Slope Stability**, John Wiley & Sons, Inc, 2005.
4. Amr S Elnashai and Luigi Di Sarno, **Fundamentals of Earthquake Engineering**, John Wiley & Sons, Inc, 2008

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Understand the basic concepts of earthquakes and the design concepts of earthquake resistant buildings.

CO2: Acquire knowledge about the causes and remedial measures of slope stabilization.

CO3: Gain knowledge about the causes and control measures of flood.

CO4: Understand the types, causes and mitigation of droughts.

CO5: Know the causes, effects and precautionary measures of Tsunami.

COURSE ARTICULATION MATRIX:

	PO1	***PO2***	***PO3***	***PO4***	***PO5***	***PO6***	***PO7***	***PO8***	***PO9***	***PO10***	***PO11***
CO1	***H***	***M***	***H***			***H***		***M***		***H***	***M***
CO2	***H***			***H***	***H***		***L***		***M***	***H***	***M***
CO3	***H***		***H***				***M***			***H***	***M***
CO4	***H***		***M***		***L***					***H***	***M***
CO5	***H***				***L***		***M***			***H***	***M***

L-Low, M-Moderate(Medium), H-High

18EDOE10 - BUSINESS ANALYTICS

(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISTES :NIL

COURSE OBJECTIVE:

- *Understand the role of business analytics within an organization.*
- *Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.*

UNIT - I BUSINESS ANALYTICS AND PROCESS (9)

Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

UNIT - II REGRESSION ANALYSIS (9)

Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.

UNIT - III STRUCTURE OF BUSINESS ANALYTICS (9)

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.

UNIT - IV FORECASTING TECHNIQUES (9)

Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

UNIT - V DECISION ANALYSIS AND RECENT TRENDS IN BUSINESS ANALYTICS (9)

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Recent Trends: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism

Contact Periods:

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total : 45 Periods

Reference:

1. *Marc J. Schniederjans, Dara G.Schniederjans, Christopher M. Starkey***"Business analytics Principles, Concepts, and Applications"**, Pearson FT Press.

***2. PurbaHalady Rao,2013"Business Analytics: An application focus",* PHI Learning Pvt. Ltd..**

3.*R.N.Prasad, Seema Acharya,2011"Fundamentals of Business Analytics ", Persons Education.*

4.*James Evans***"Business Analytics"**, Persons Education.

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: *Students will demonstrate knowledge of data analytics.*

CO2: *Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.*

CO3: *Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.*

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	L	L	L	L	M	L	-	L	M	-	L
CO2	-	H	L	L	L	L	-	-	L	-	-
CO3	L	L	-	-	L	-	L	M	L	-	L

L-Low, M-Moderate (Medium), H-High

18EDOE11-COST MANAGEMENT OF ENGINEERING PROJECTS
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISTES :NIL

COURSE OBJECTIVE :

- *To be familiar with cost management and project planning.*
- *To acquire knowledge of decision making, price strategies and total quality management tools.*

UNIT - I INTRODUCTION TO COST MANAGEMENT (9)

Introduction and Overview of the Strategic Cost Management Process, 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.

UNIT - II PROJECT PLANNING ACTIVITIES (9)

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.

UNIT - III COST ANALYSIS (9)

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis.

UNIT - IV PRICING STRATEGIES AND BUDGETORY CONTROL (9)

Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing, Costing of service sector, Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT - V TQM AND OPERATIONS REASEARCH TOOLS (9)

Total Quality Management and Theory of constraints, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Contact Periods:

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total : 45 Periods

References:

1. *"***Cost Accounting a Managerial Emphasis"***, Prentice Hall of India, New Delhi.*
2. *Charles T. Horngren and George Foster, "****Advanced*** **Management Accounting".**
3. *Robert S Kaplan Anthony A. Alkinson, "***Management & Cost Accounting".**
4. *Ashish K. Bhattacharya, "***Principles & Practices of Cost Accounting"** *A. H. Wheeler publisher.*
5. *N.D. Vohra, "***Quantitative Techniques in Management"***, Tata McGraw Hill Book Co. Ltd.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1:*Understanding methods concepts of cost management.*

CO2:*Developing the skills for project planning.*

CO3:*Evaluating the cost behavior and profit.*

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	L	L	L	L	M	L	L	-	L
CO2	-	L	L	M	L	L	M	L	L	-	L
CO3	L	-	L	-	-	-	H	-	L	L	L

L-Low, M-Moderate (Medium), H-High

18EDOE12-INTRODUCTION TO INDUSTRIAL ENGINEERING
(Common to All Branches)

Category: OE

L	T	P	C
3	0	0	3

PREREQUISTES :NIL

COURSE OBJECTIVE :

- *The objective of this course is to provide foundation in Industrial Engineering in order to enable the students to make significant contributions for improvements in different organisations.*

UNIT - I INTRODUCTION (9)

Concepts of Industrial Engineering – History and development of Industrial Engineering – Roles of Industrial Engineer – Applications of Industrial Engineering – Production Management Vs Industrial Engineering – Operations Management – Production System – Input Output Model –Productivity – Factors affecting Productivity – Increasing Productivity of resources – Kinds of Productivity measures.

UNIT - II PLANT LOCATION AND LAYOUT (9)

Factors affecting Plant location – Objectives of Plant Layout – Principles of Plant Layout – Typesof Plant Layout – Methods of Plant and Facility Layout – Storage Space requirements – PlantLayout procedure – Line Balancing methods.

UNIT - III WORK SYSTEM DESIGN (9)

Need – Objectives – Method Study procedure – Principles of Motion Economy – WorkMeasurement procedures – Work Measurement techniques.

UNIT - IV STATISTICAL QUALITY CONTROL (9)

Definition and Concepts – Fundamentals – Control Charts for variables – Control Charts forattributes – Sampling Inspection – Sampling Plans – Sampling Plans.

UNIT - V PRODUCTION PLANNING AND CONTROL (9)

Forecasting – Qualitative and Quantitative forecasting techniques – Types of production – Processplanning – Economic Batch Quantity – Tool control – Loading – Scheduling and control ofproduction – Dispatching–Progress control.

Contact Periods:

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total : 45 Periods

References:

*1.O.P.Khanna, 2010,"**Industrial Engineering and Management",** Dhanpat Rai Publications.*

*2.Ravi Shankar, 2009, **"Industrial Engineering and Management",** Galgotia Publications & Private Limited.*

*3. Martand Telsang,2006,"**Industrial Engineering and Production Management",** S. Chand and Company.*

*4. M.I. Khan,2004, **"Industrial Engineering and Production Management",** New Age International..*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1:*Understanding thefunctioning of various kinds of Industries.*

CO2:*Developing the knowledge in plant location layout and work system design.*

CO3:*Evaluating the cost optimization in industries.*

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	-	-	L	L	L	L	L	L	M
CO2	L	L	L	L	L	L	-	-	L	H	M
CO3	L	L	-	-	-	-	H	-	-	L	-

L-Low, M-Moderate (Medium), H-High

18MFOE13 INDUSTRIAL SAFETY
(Common to All Branches)

Category: OE

PREREQUISITES: NIL

L	*T*	*P*	*C*
3	*0*	*0*	*3*

COURSE OBJECTIVES:

- *To be familiar with industrial safety equipments and techniques.*
- *To acquire practical knowledge of maintenance techniques available in industry.*

UNIT –I INDUSTRIAL SAFETY (9)

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT –II FUNDAMENTALS OF MAINTENANCE ENGINEERING (9)

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT –III WEAR AND CORROSION (9)

.Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT –IV FAULT TRACING (9)

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT –V PERIODIC AND PREVENTIVE MAINTENANCE (9)

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

Contact Periods:

Lecture : 45 Periods Tutorial : 0 Periods Practical : 0 Periods Total : 45 Periods

References:

*1. Higgins & Morrow **"Maintenance Engineering Handbook",** Da Information Services, 2008*
*2. H.P.Garg **"Maintenance Engineering"**, S. Chand and Company, 2010.*
*3. Audels **"Pump-hydraulic Compressors",** Mcgrew Hill Publication, 1943.*
*4. Winterkorn, Hans **"Foundation Engineering Handbook"**, Chapman & Hall London, 1975.*

COURSE OUTCOMES :

On completion of this course, students will be able to

***CO1:** Understand types of industrial safety equipments and techniques available.*

***CO2:** Acquire practical knowledge of maintenance techniques available in industry.*

***CO3:** Acquire knowledge on fault tracing techniques in industrial safety.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	M	L	L	L	-	L	L	-	M	M	L
CO 2	M	H	M	L	L	L	L	-	L	H	M
CO 3	H	H	H	L	-	L	M	-	M	L	-

L – Low, M – Moderate (Medium), H – High

18MFOE14 OPERATIONS RESEARCH
(Common to All Branches)

Category: OE

PREREQUISITES: NIL

L	*T*	*P*	*C*
3	*0*	*0*	*3*

COURSE OBJECTIVE :

- *To familiarize students with the basic concepts, models and statements of the operations research theory.*

UNIT- I INTRODUCTION **(9)**

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

UNIT- II LINEAR PROGRAMMING PROBLEM **(9)**

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

(9)

UNIT-III NON LINEAR PROGRAMMING PROBLEM

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

(9)

UNIT -IV SEQUENCING AND INVENTORY MODEL

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT -V GAME THEORY **(9)**

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

References:

*1. H.A. Taha **"Operations Research, An Introduction"**, PHI, 2008*

*2. H.M. Wagner **"Principles of Operations Research"**, PHI, Delhi, 1982.*

*3. J.C. Pant **"Introduction to Optimisation: Operations Research"**, Jain Brothers, Delhi, 2008*

*4. Hitler Libermann **"Operations Research"**, McGraw Hill Pub. 2009*

*5. Pannerselvam **"Operations Research"**, Prentice Hall of India 2010*

*6. Harvey M Wagner **"Principles of Operations Research"** Prentice Hall of India 2010*

COURSE OUTCOMES :

On completion of this course, students will be able to

CO1: *Apply basic theoretical principles in optimization and formulate the optimization models.*

CO2: *Develop mathematical skills to analyse and solve integer programming, network models arising from a wide range of industrial applications.*

CO3: *Implement optimization techniques in engineering problems.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	H	H	H	L	H	L	M	-	-	L	L
CO 2	H	H	H	L	-	L	L	-	-	L	-
CO 3	L	M	H	L	L	L	-	-	-	L	M

L – Low, M – Moderate (Medium), H – High

18MFOE15 COMPOSITE MATERIALS
(Common to All Branches)

Category: OE

PREREQUISITES: NIL

L	*T*	*P*	*C*
3	*0*	*0*	*3*

COURSE OBJECTIVES :

- *To be familiar with composite materials and their advantages, applications.*
- *To acquire knowledge of reinforcement, manufacturing and strength analysis of composites*.

UNIT- I INTRODUCTION **(9)**

Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

(9)

UNIT- II REINFORCEMENT

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT- III MANUFACTURING OF METAL MATRIX COMPOSITES **(9)**

Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

(9)

UNIT-IV MANUFACTURING OF POLYMER MATRIX COMPOSITE

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT-V STRENGTH ANALYSIS OF COMPOSITES **(9)**

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

References:

1. ***Lubin****, George,* ***"Hand Book of Composite Materials",*** *Springer, 1982.*

*2. K.K.Chawla, "****Composite Materials"****, Springer, 2011*

3. Deborah D.L. Chung ***, "Composite Materials Science and Applications"*** *, Springer, 2010.*

*4. Danial Gay, Suong V. Hoa, and Stephen W.Tasi, "****Composite Materials Design and Applications"****, CRC Press,2002.*

*5. R.W.Cahn, "****Material Science and Technology – Vol 13– Composites",*** *VCH, West Germany, 1996.*

*6. WD Callister, Jr., Adapted by R. Balasubramaniam, "****Materials Science and Engineering, An introduction"****, John Wiley & Sons, NY, Indian edition, 2007.*

COURSE OUTCOMES:

On completion of this course, students will be able to

CO1: *Understand the nature of composite materials and composite reinforcements.*

CO2: *Develop the skills for manufacturing of composites.*

CO3: *Evaluate the strength of composite materials.*

COURSE ARTICULATION MATRIX

CO/ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11
CO 1	H	L	L	M	L	L	-	-	L	-	L
CO 2	L	M	H	L	L	L	-	-	L	L	L
CO 3	M	L	H	M	L	L	-	-	L	L	L

L – Low, M – Moderate (Medium), H – High

18TEOE16 – GLOBAL WARMING SCIENCE
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

- *To make the students to learn about the material consequences of climate change, sea level change due to increase in the emission of greenhouse gases and to examine the science behind mitigation and adaptation proposals.*

UNIT- I INTRODUCTION (9)

Terminology relating to atmospheric particles – Aerosols-types, characteristics, measurements – Particle mass spectrometry. Anthropogenic-sources, effects on humans.

UNIT- II CLIMATE MODELS (9)

General climate modeling- Atmospheric general circulation model, Oceanic general circulation model, Sea ice model, Land modelconcept, Paleo-climate, Weather prediction by Numerical process. Impacts of climate change, Climate Sensitivity, Forcings and feedbacks.

UNIT- III EARTH CARBON CYCLE AND FORECAST (9)

Carbon cycle-process, importance, advantages. Carbon on Earth, Global carbon reservoirs, Interactions between human activities and Carbon cycle. Geologic time scales, Fossil fuels and energy, Perturbed

UNIT- IV GREEN HOUSE GASES

Blackbody Radiation, Layer model, Earth's atmospheric composition and Green house gases effects on weather and climate. Radiative equilibrium. Earth's energy balance.

UNIT- V GEO ENGINEERING (9)

Solar mitigation, Strategies – Carbon dioxide removal, solar radiation management, Recent observed trends in global warming for sea level rise, drought, glacier extent.

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCE BOOKS:

1 *Archer, David. "**GlobalWarming: Understanding the Forecast"**, Wiley, 2011*

2 *Budyko, "**Climate Changes, American Geophysical Society"**, Washington, D.C.,244 pp.*

3 *Bodansky, "**May we engineer the climate?"**Clim. Change 33, 309-321.*

4 *Dickinson, "**Climate Engineering-A review of aerosol approaches to changing the global energy"** balance, Clim. Change 33, 279-290.*

5 *Climate Change 2007-"**The Physical Science Basis: Working Group I Contribution to the Fourth Assessment Report of the IPCC"**. Cambridge University Press,2007.*

COURSE OUTCOMES:

On completion of this course, the students will be able to:

***CO1:** Understand the current warming in relation to climate changes throughout the Earth.*

***CO2:** Assess the best predictions of current climate models.*

***CO3:** Able to know about current issues, including impact from society, environment, economy as well as ecology related to greenhouse gases.*

COURSE ARTICULATION MATRIX

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11
CO 1	M	L	L	L	L	M	H	M	L	M	L
CO 2	L	L	L	L	L	M	H	M	L	M	L
CO 3	L	L	L	L	L	H	M	M	L	L	L

L – Low, M – Moderate (Medium), H – High

18TEOE17 – INTRODUCTION TO NANO ELECTRONICS
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

- *To make the students to provide strong, essential, important methods and foundations of quantum mechanics and apply quantum mechanics on engineering fields.*

UNIT- I INTRODUCTION L(9)

Particles and Waves, Operators in quantum mechanics, The Postulates of Quantum Mechanics, The Schrodinger Equation Values and Wave Packet Solutions, Ehrenfest's Theorem.

UNIT- II ELECTRONIC STRUCTURE AND MOTION (9)

Atoms- The Hydrogen Atom, Many-Electron Atoms, Many-Electron Atoms.Pseudopotentials, Nuclear Structure, Molecules, Crystals. Translational motion – Penetration through barriers – Particle in a box. Two Terminal Quantum Dot Devices, Two Terminal Quantum Wire Devices.

UNIT- III SCATTERING THEORY (9)

The formulation of scattering events- scattering cross section, stationary scattering state. Partial wave stationary scattering events, Multi-channel scattering, Solution for Schrodinger Equation- radial and wave equation, Greens' function.

UNIT- IV CLASSICAL STATISTICS (9)

Probabilities and microscopic behaviors, Kinetic theory and transport processes in gases, Magnetic properties of materials, The partition function.

UNIT- V QUANTUM STATISTICS (9)

Statistical mechanics- Basic Concepts, Statistical models applied to metals and semiconductors. The thermal properties of solids- The electrical properties of materials. Black body radiation, Low temperatures and degenerate systems.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. *Peter L. Hagelstein, Stephen D. Senturia, and Terry P. Orlando,"**Introductory Applilied Quantum Statistical Mechanics"**, Wiley (2004).*
2. *A. F. J. Levi, "**Applied Quantum Mechanics"** (2nd Edition), Cambridge (2006).*
3. *Walter A Harrison, "**Applied Quantum Mechanics"**, Stanfor University (2008).*
4. *Richard Liboff, "**Introductory Quantum Mechanics"**, 4th edition, Addison Wesley (2003).*
5. *P.W. Atkins and R.S. Friedman, "**Molecular Quantum Mechanics"** Oxford University Press, 3rd edition 1997.*

COURSE OUTCOMES:

On completion of this course, students will be able to:

***CO1:** The student should be familiar with certain nanoelectronic systems and building blocks such as: low-dimensional semiconductors, hetero structures.*

***CO2:** The student should be able to set up and solve the Scfrödinger equation for different types of potentials in one dimension as well as in 2 or 3 dimensions for specific cases.*

***CO3:** Potentially be able to join a research group in nanoscience / nanotechnology as a student researcher.*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11
CO 1	M	M	L	M	L	M	L	L	L	L	L
CO 2	M	M	L	M	L	M	L	L	L	L	L
CO 3	M	M	L	M	L	H	L	L	L	L	L

L – Low, M – Moderate (Medium), H – High

18TEOE18 – GREEN SUPPLY CHAIN MANAGEMENT
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

- *To make the students to learn and focus on the fundamental strategies, tools and techniques required to analyze and design environmentally sustainable supply chain systems.*

UNIT- I INTRODUCTION (9)

Logistics – aim, activities, importance, progress, current trends. Integrating logistics with an organization.

UNIT- II ESSENTIALS OF SUPPLY CHAIN MANAGEMENT (9)

Basic concepts of supply chain management, Supply chain operations – Planning and sourcing, Making and delivering. Supply chain coordination and use of Technology. Developing supply chain systems.

UNIT- III PLANNING THE SUPPLY CHAIN (9)

Types of decisions – strategic, tactical, operational. Logistics strategies, implementing the strategy. Planning resources – types, capacity, schedule, controlling material flow, measuring and improving performance.

UNIT- IV ACTIVITIES IN THE SUPPLY CHAIN (9)

Procurement – cycle, types of purchase. Inventory management – EOQ, uncertain demand and safety stock, stock control. Material handling – purpose of warehouse and ownership, layout, packaging. Transport – mode, ownership, routing vehicles.

UNIT- V SUPPLY CHAIN MANAGEMENT STRATEGIES (9)

Five key configuration components, Four criteria of a good supply chain strategies, Next generation strategies- New roles for end to end supply chain management. Evolution of supply chain organization.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. *Rogers,Dale., and Ronald Tibben-Lembke."**An Examination of Reverse Logistics Practices."** Journal of Business Logistics 22, no. 2 (2001) : 129-48.*
2. *Guide, V., Kumar Neeraj, et al. "**cellular Telephone Reuse: The ReCellular Inc. Case."** Managing Closed-Loop Supply Chains. Case: Part 6, (2005): 151-156.*
3. *Mark, K. "**Whirlpool Corrporation: Reverse Logistics."** Richard Ivey School of Business. Case: 9B11D001, August 8, 2011.*
4. *Porter, Michael E., and Mark R. Kramer. "**Strategy and Society: The Link between Competitive Advantage and Corporate Social Responsibility."** Harvard Business Revies 84, no. 12 (2006): 78-92.*
5. *Shoshnah Cohen, Josep Roussel, "**Strategic Supply Chain Management",** the five disciplines for top performance, McGraw-Hill, (2005.)*

COURSE OUTCOMES:

On completion of this course, students will be able to:

***CO1:** Evaluate complex qualitative and quantitative data to support strategic and operational decisions.*

***CO2:** Develop self-leadership strategies to enhance personal and professional effectiveness.*

***CO3:** The importance of the design and redesign of a supply chain as key components of an organization's strategic plan.*

COURSE ARTICULATION MATRIX

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO 1	M	L	L	L	L	H	L	M	L	L	L
CO 2	M	L	L	L	L	H	L	M	L	L	L
CO 3	M	L	L	L	L	H	L	M	L	L	L

L – Low, M – Moderate (Medium), H – High

18PSOE19 DISTRIBUTION AUTOMATION SYSTEM
(Common to all Branches)

Category:OE

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To study about the distributed automation and economic evaluation schemes of power network

UNIT-I INTRODUCTION (09)

Introduction to Distribution Automation (DA) - Control system interfaces- Control and data requirements- Centralized (vs) decentralized control- DA system-DA hardware-DAS software.

UNIT-II DISTRIBUTION AUTOMATION FUNCTIONS (09)

DA capabilities - Automation system computer facilities- Management processes- Information management- System reliability management- System efficiency management- Voltage management- Load management.

UNIT-III COMMUNICATION SYSTEMS (09)

Communication requirements - reliability- Cost effectiveness- Data requirements- Two way capability- Communication during outages and faults - Ease of operation and maintenance- Conforming to the architecture of flow.Distribution line carrier- Ripple control-Zero crossing technique- Telephone, cableTV,radio, AM broadcast, FM SCA,VHF radio, microwave satellite, fiber optics-Hybrid communication systems used in field tests.

UNIT-IV ECONOMIC EVALUATION METHODS (09)

Development and evaluation of alternate plans- select study area – Select study period- Project load growth-Develop alternatives- Calculate operating and maintenance costs-Evaluate alternatives.

UNIT-V ECONOMIC COMPARISON (09)

Economic comparison of alternate plans-Classification of expenses - capital expenditures-Comparison of revenue requirements of alternative plans-Book life and continuing plant analysis- Year by year revenue requirement analysis, Short term analysis- End of study adjustment-Break even analysis, sensitivity analysis - Computational aids.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. *IEEE Tutorial course "**Distribution Automation**",IEEE Working Group on Distribution Automation, IEEE Power Engineering Society. Power Engineering Education Committee, IEEE Power Engineering Society. Transmission and Distribution Committee, Institute of Electrical and Electronics Engineers, 1988*
2. *Maurizio Di Paolo Emilio, "**Data Acquisition Systems: From Fundamentals to Applied Design**", Springer Science & Business Media, 21-Mar-2013*
3. *Taub, "**Principles Of Communication Systems**", Tata McGraw-Hill Education, 07-Sep-2008*
4. *M.K. Khedkar, G.M. Dhole, "**A Textbook of Electric Power Distribution Automation**", Laxmi Publications, Ltd., 2010.*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

***CO1:** Analyse the requirements of distributed automation*

***CO2:** Know the functions of distributed automation*

***CO3:** Perform detailed analysis of communication systems for distributed automation.*

***CO4:** Study the economic evaluation method*

***CO5:** Understand the comparison of alternate plans*

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	M	M	L	M	L	L	L	L	L
CO2	H	H	L	L	L	L	L	L	L	L	L
CO3	M	L	M	L	L	L	L	L	L	L	L
CO4	M	M	M	L	L	L	L	L	L	L	L
CO5	M	M	M	L	L	L	M	M	L	L	L

L – Low, M – Moderate (Medium), H- High

18PSOE20 POWER QUALITY ASSESSMENT AND MITIGATION Category : OE
(Common to all Branches)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To identify, analyze and create solutions for the power quality problems in power system networks.

UNIT-I : INTRODUCTION (09)

Importance of power quality - Terms and definitions as per IEEE std.1159 for transients, short and long duration voltage variations, interruptions, short and long voltage fluctuations, imbalance, flickers - Symptoms of poor power quality- Definitions and terminology of grounding- Purpose of groundings- Good grounding practices - problems due to poor grounding.

UNIT-II : FLICKERS AND TRANSIENT VOLTAGES (09)

RMS voltage variations in power system, complex power, voltage regulation and per unit system - Basic power flow and voltage drop - Devices for voltage regulation and impact of reactive power management - Causes and effects of voltage flicker - Short term and long term flickers -Methods to reduce flickers- Transient over voltages, impulsive transients, switching transients - Effect of surge impedance and line termination - control of transient voltages.

UNIT-III : VOLTAGE INTERRUPTIONS (09)

Definitions -Voltage sags versus interruptions - Economic impact, Major causes and consequences -characteristics, assessment, Influence of fault location and fault level on voltage sag - Areas of vulnerability, Assessment of equipment sensitivity, Voltage sag limits for computer equipment-CBEMA, ITIC, SEMI F 42curves, Report of voltage sag analysis, Voltage sag indices, Mitigation measures for voltage sag- DSTATCOM, UPQC,UPS, DVR, SMEs, CVT, utility solutions and end user solutions.

UNIT-IV : WAVEFORM DISTORTION (09)

Definition of harmonics, inter-harmonics, sub-harmonics- Causes and effects - Voltage versus current distortion, Fourier analysis, Harmonic indices, A.C. quantities under non-sinusoidal conditions, Triplet harmonics, characteristic and non characteristic harmonics- Series and Parallel resonances- Consequence - Principles for controlling and Reducing harmonic currents in loads, K-rated transformer -Computer tools for harmonic analysis- Locating sources of harmonics, Harmonic filtering- Passive and active filters - Modifying the system frequency response- IEEE Harmonic standard 519-1992.

UNIT-V : ANALYSIS AND CONVENTIONAL MITIGATION METHODS (09)

Analysis of power outages, Analysis of unbalance condition: Symmetrical components inphasor quantities, Instantaneous symmetrical components, Instantaneous real and reactive powers - Analysis of distortion: On–line extraction of fundamental sequence components from measured samples – Harmonic indices – Analysis of voltage sag: Detorit Edison sag score, Voltage sag energy, Voltage Sag Lost Energy Index (VSLEI)- Analysis of voltage flicker, Reduced duration and customer impact of outages, Classical load balancing problem: Open loop balancing, Closed loop balancing, current balancing, Harmonic reduction, Voltage sag reduction.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

1. M. H. J. Bollen, ***"Understanding Power Quality Problems, Voltage Sag and Interruptions",*** *IEEE Press, series on Power Engineering, 2000.*
2. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso and Wayne Beaty H., ***"Electrical Power SystemQuality"****, Second Edition, McGraw Hill Publication Co., 2008.*
3. G.T.Heydt, ***"Electric Power Quality",*** *Stars in a Circle Publications, 1994(2nd edition).*
*4. Enrique Acha, Manuel Madrigal****, "Power System Harmonics: Computer Modeling and Analysis****", John Wiley and Sons, 2001.*
*5. Arrillaga J. and Watson N.****"Power System Harmonics"****2nd edition on; John Willey&sons, 2003*
6. IEEE Std. 519-1992/ IEEE Std. 1159 IEEE recommended practices and requirements for harmonics control in electrical power system.

COURSE OUTCOMES:

CO1: *Acquire knowledge about the power quality issues and standards like IEEE,IEC on voltage,Frequency and harmonics.*

CO2: *Recognize the practical issues in the power system*

CO3: *Analyze the impact of power electronic devices and techniques in power system*

CO4: *Develop trouble shooting skills and innovative remedies for various power quality problems in power system*

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	M	M	-	-	-	-	-	-	L
CO2	H	H	H	H	L	L	-	L	L	-	L
CO3	H	H	H	H	M	M	-	-	L	L	-
CO4	H	H	H	M	H	M	M	L	L	L	L

L – Low, M – Moderate (Medium), H- High

18PSOE21 **MODERN AUTOMOTIVE SYSTEMS** **Category : OE**

(Common to all Branches)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To expose the students with theory and applications of Automotive Electrical and Electronic Systems.

UNIT-I : INTRODUCTION TO MODERN AUTOMOTIVE ELECTRONICS (08)

Introduction to modern automotive systems and need for electronics in automobiles- Role of electronics and microcontrollers- Sensors and actuators- Possibilities and challenges in automotive industry- Enabling technologies and industry trends.

UNIT-II : SENSORS AND ACTUATORS (09)

Introduction- basic sensor arrangement- Types of sensors- Oxygen sensor, engine crankshaft angular position sensor – Engine cooling water temperature sensor- Engine oil pressure sensor- Fuel metering- vehicle speed sensor and detonation sensor- Pressure Sensor- Linear and angle sensors- Flow sensor- Temperature and humidity sensors- Gas sensor- Speed and Acceleration sensors- Knock sensor- Torque sensor- Yaw rate sensor- Tyre Pressure sensor- Actuators - Stepper motors – Relays.

UNIT-III : POWER TRAIN CONTROL SYSTEMS IN AUTOMOBILE (09)

Electronic Transmission Control - Digital engine control system: Open loop and close loop control systems- Engine cooling and warm up control- Acceleration- Detonation and idle speed control - Exhaust emission control engineering- Onboard diagnostics- Future automotive power train systems.

UNIT-IV : SAFETY, COMFORT AND CONVENIENCE SYSTEMS (10)

Cruise Control- Anti-lock Braking Control- Traction and Stability control- Airbag control system- Suspension control- Steering control- HVAC Control.

UNIT-V : ELECTRONIC CONTROL UNITS (ECU) (09)

Need for ECUs- Advances in ECUs for automotives - Design complexities of ECUs- V-Model for Automotive ECU‘s- Architecture of an advanced microcontroller (XC166 Family, 32-bit Tricore) used in the design of automobile ECUs- On chip peripherals, protocol interfaces, analog and digital interfaces.

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCE BOOKS:

1. M. H. J. Bollen, ***"Understanding Power Quality Problems, Voltage Sag and Interruptions",*** *IEEE Press, series on Power Engineering, 2000.*

2. Roger C. Dugan, Mark F. McGranaghan, Surya Santoso and Wayne Beaty H., ***"Electrical Power SystemQuality"****, Second Edition, McGraw Hill Publication Co., 2008.*

3. G.T.Heydt, ***"Electric Power Quality",*** *Stars in a Circle Publications, 1994(2nd edition).*

*4. Enrique Acha, Manuel Madrigal****, "Power System Harmonics: Computer Modeling and Analysis****", John Wiley and Sons, 2001.*

*5. Arrillaga J. and Watson N****."Power System Harmonics"****2nd edition on; John Willey&sons, 2003*

6. IEEE Std. 519-1992/ IEEE Std. 1159 IEEE recommended practices and requirements for harmonics control in electrical power system.

COURSE OUTCOMES:

CO1: *Acquire knowledge about the power quality issues and standards like IEEE,IEC on voltage, Frequency and harmonics.*

CO2: *Recognize the practical issues in the power system*

CO3: *Analyze the impact of power electronic devices and techniques in power system*

CO4: *Develop trouble shooting skills and innovative remedies for various power quality Problems in power system*

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	M	M	-	-	-	-	-	-	L
CO2	H	H	H	H	L	L	-	L	L	-	L
CO3	H	H	H	H	M	M	-	-	L	L	-
CO4	H	H	H	M	H	M	M	L	L	L	L

L – Low, M – Moderate (Medium), H- High

18PEOE22 **VIRTUAL INSTRUMENTATION**
(Common to All Branches) **Category:OE**

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:
To comprehend the Virtual instrument action programming concepts towards measurements and control.

UNIT-I : INTRODUCTION (07)
Introduction - advantages - Block diagram and architecture of a virtual instrument - Conventional Instruments versus Traditional Instruments - Data-flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT-II : GRAPHICAL PROGRAMMING AND LabVIEW (09)
Concepts of graphical programming - LabVIEW software - Concept of VIs and sub VI - Display types - Digital - Analog - Chart and Graphs. Loops - structures - Arrays – Clusters- Local and global variables – String - Timers and dialog controls.

UNIT-III : VI MANAGING FILES & DESIGN PATTERNS (11)
High-level and low-level file I/O functions available in LabVIEW – Implementing File I/O functions to read and write data to files – Binary Files – TDMS – sequential programming – State machine programming – Communication between parallel loops –Race conditions – Notifiers & Queues – Producer Consumer design patterns

UNIT-IV : PC BASED DATA ACQUISITION (09)
Introduction to data acquisition on PC, Sampling fundamentals, ADCs, DACs, Calibration, Resolution, - analog inputs and outputs - Single-ended and differential inputs - Digital I/O, counters and timers, DMA, Data acquisition interface requirements - Issues involved in selection of Data acquisition cards - Use of timer-counter and analog outputs on the universal DAQ card.

UNIT-V : DATA AQUISTION AND SIGNAL CONDITIONING (09)
Components of a DAQ system, Bus, Signal and accuracy consideration when choosing DAQ hardware – Measurement of analog signal with Finite and continuous buffered acquisition- analog output generation – Signal conditioning systems – Synchronizing measurements in single & multiple devices – Power quality analysis using Electrical Power Measurement tool kit.
Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCE BOOKS:

*1. Jeffrey Travis, Jim Kring, **'LabVIEW for Everyone: Graphical Programming Made Easy and Fun (3rd Edition),** Prentice Hall, 2006.*
*2. Sanjeev Gupta, **'Virtual Instrumentation using LabVIEW'** TMH, 2004*
*3. Gary W. Johnson, Richard Jennings, **'Lab-view Graphical Programming'**, McGraw Hill Professional Publishing, 2001*
*4. Robert H. Bishop, **'Learning with Lab-view'**, Prentice Hall, 2003.*
*5. Kevin James, '**PC Interfacing and Data Acquisition: Techniques for Measurement**, Instrumentation and Control', Newness, 2000*

COURSE OUTCOMES:

CO1: *Gain Knowledge of graphical programming techniques using LabVIEW software.*

CO2: *Explore the basics of programming and interfacing using related hardware.*

CO3: *Outline the aspects and utilization of PC based data acquisition and Instrument interfaces.*

CO4: *Create programs and Select proper instrument interface for a specific application.*

COURSE ARTICULATION MATRIX

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	-	M	H	-	-	-	-	-	-
CO2	H	H	-	M	H	-	M	-	-	-	L
CO3			H	M	H						L
CO4	H	H	H	M	H	-	-	-	M	-	L

L – Low, M – Moderate (Medium), H- High

18PEOE23 **ENERGY AUDITING** **Category: OE**

(Common to All Branches)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVE:

To Comprehend energy management schemes and perform economic analysis and load management in electrical systems.

UNIT-I : BASICS OF ENERGY MANAGEMENT (09)

Energy Scenario – Energy Sector Reforms – Impact on environment – Strategy for future and conservation – Basics of Energy and it forms (Thermal and Electrical). Energy Audit: Need – Types and Methodology - Audit Report – Energy Cost, Benchmarking and Energy performance – System Efficiency. Facility as an energy system – Methods for preparing process flow, Material and energy balance diagrams.

UNIT-II : ACTION PLANNING AND MONITORING (09)

Energy Management System – Performance assessment – Goal setting by Manager – Action plan implementation – Financial Management: Investment - Financial analysis techniques, ROI, Risk and sensitivity analysis, role of Energy Service Companies. Project management: Steps in detail. – Energy monitoring and interpretance of variances for remedial actions. Environmental concerns: UNFCC – Kyoto protocol – COP – CDM – PCF – Sustainable development.

UNIT-III : STUDY OF THERMAL UTILITIES (09)

Combustion of Oil, Coal and Gas – Performance Evaluation of Boilers – Boiler blow down – Boiler water treatment – Energy Conservation Opportunity – Cogeneration: Principal – Options - Classification – Influencing Factors and technical parameters. Waste heat recovery: Classification – application – benefits - Different heat recovery devices.

UNIT-IV : STUDY OF ELECTRICAL UTILITIES (09)

Electricity Billing – Electricity load management – Motor efficiency and tests – Energy efficient motors – Factors affecting motor efficiency and loss minimization – Motor load survey. Lighting System: Types and features – recommended luminance levels – Lighting system energy efficiency study – Energy Efficient Technologies: Maximum demand controllers – Intelligent PF controllers – Soft starters and VFDs – Variable torque load uses – Energy efficient transformers, Light controllers and Electronic ballasts.

UNIT-V : ENERGY ASSESSMENT IN UTILITY SYSTEMS (09)

Performing Financial analysis: Fixed and variable costs – Payback period – methods – factors affecting analysis – Waste Minimization Techniques: Classification – Methodology. Performance assessment of HVAC Systems: Measurements, Procedure – Evaluation. Assessment of Pumps: Measurements, Procedure – Evaluation.

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCE BOOKS:

*1. Murphy W.R. and G.Mckay Butter worth , "**Energy Management**", Heinemann Publications.*
*2. Paul o' Callaghan, **"Energy Management",** Mc-Graw Hill Book Company – 1st edition; 1998.*
*3. John.C.Andreas, **"Energy Efficient Electric Motors",** Marcel Dekker Inc Ltd – 2nd edition; 1995.*
*4. W.C.Turner, **"Energy Management Handbook",** John Wiley and Sons, Fifth edition, 2009.*
*5. **"Energy Management and Good Lighting Practice: fuel efficiency**" – booklet 12 – EEO.*
6. www.em-ea.org/gbook1.asp

COURSE OUTCOMES:

CO1: *Possess knowledge on energy management.*

CO2: *Analyze the feature of energy audit methodology and documentation of report.*

CO3: *Able to plan energy management action and develop the understanding of implementation.*

CO4: *Familiarize with thermal utilities.*

CO5: *Familiarize with electrical utilities.*

CO6: *Perform assessment of different systems.*

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	-	M	L	L	-	M	M	L	-	M
CO2	-	-	M	L	L	-	M	M	L	-	M
CO3	-	-	M	L	-	-	M	M	L	-	M
CO4	-	-	M	-	-	-	M	-	L	-	M
CO5	-	-	M	-	-	-	M	-	L	-	M
CO6	-	-	M	-	-	-	M	-	L	-	M

L – Low, M – Moderate (Medium), H- High

18PEOE24 ADVANCED ENERGY STORAGE TECHNOLOGY Category : OE
(Common to All Branches)

L	T	P	C
3	0	0	3

PREREQUISITES: NIL

COURSE OBJECTIVES:

To explore the fundamentals, technologies and applications of energy storage.

UNIT-I : ENERGY STORAGE: HISTORICAL PERSPECTIVE, INTRODUCTION AND CHANGES (09)

Storage Needs- Variations in Energy Demand- Variations in Energy Supply- Interruptions in Energy Supply- Transmission Congestion - Demand for Portable Energy-Demand and scale requirements - Environmental and sustainability issues.

UNIT-II : TECHNICAL METHODS OF STORAGE (09)

Introduction: Energy and Energy Transformations, Potential energy (pumped hydro, compressed air, springs)- Kinetic energy (mechanical flywheels)- Thermal energy without phase change passive (adobe) and active (water)-Thermal energy with phase change (ice, molten salts, steam)- Chemical energy (hydrogen, methane, gasoline, coal, oil)- Electrochemical energy (batteries, fuel cells)- Electrostatic energy (capacitors), Electromagnetic energy (superconducting magnets)- Different Types of Energy Storage Systems.

UNIT-III: PERFORMANCE FACTORS OF ENERGY STORAGE SYSTEMS (09)

Energy capture rate and efficiency- Discharge rate and efficiency- Dispatch ability and load flowing characteristics, scale flexibility, durability – Cycle lifetime, mass and safety – Risks of fire, explosion, toxicity- Ease of materials, recycling and recovery- Environmental consideration and recycling , Merits and demerits of different types of Storage.

UNIT-IV: APPLICATION CONSIDERATION (09)

Comparing Storage Technologies- Technology options- Performance factors and metrics- Efficiency of Energy Systems- Energy Recovery - Battery Storage System: Introduction with focus on Lead Acid and Lithium- Chemistry of Battery Operation, Power storage calculations, Reversible reactions, Charging patterns, Battery Management systems, System Performance, Areas of Application of Energy Storage: Waste heat recovery, Solar energy storage, Green house heating, Power plant applications, Drying and heating for process industries, energy storage in automotive applications in hybrid and electric vehicles.

UNIT-V : HYDROGEN FUEL CELLS AND FLOW BATTERIES (09)

Hydrogen Economy and Generation Techniques, Storage of Hydrogen, Energy generation - Super capacitors: properties, power calculations – Operation and Design methods - Hybrid Energy Storage: Managing peak and Continuous power needs, options - Level 1: (Hybrid Power generation) Bacitor "Battery + Capacitor" Combinations: need, operation and Merits; Level 2: (Hybrid Power Generation) Bacitor + Fuel Cell or Flow Battery operation-Applications: Storage for Hybrid Electric Vehicles, Regenerative Power, capturing methods.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

*1. DetlefStolten,**"Hydrogen and Fuel Cells: Fundamentals, Technologies and Applications"**, Wiley,2010.*

*2. Jiujun Zhang, Lei Zhang,Hansan Liu, Andy Sun, Ru-Shi Liu**, "Electrochemical Technologies for Energy Storage and Conversion",** John Wiley and Sons, 2012.*

*3. Francois Beguin and ElzbietaFrackowiak ,**"Super capacitors"**, Wiley, 2013.*

*4. Doughty Liaw, Narayan and Srinivasan, **"Batteries for Renewable Energy Storage"**, The Electrochemical Society, New Jersy,2010.*

COURSE OUTCOMES:

***CO1:** Recollect the historical perspective and technical methods of energy storage.*

***CO2:** Learn the basics of different storage methods.*

***CO3:** Determine the performance factors of energy storage systems.*

***CO4:** Identify applications for renewable energy systems.*

***CO5:** Understand the basics of Hydrogen cell and flow batteries.*

COURSE ARTICULATION MATRIX:

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	L	-	-	-	-	-	-	L	-	-
CO2	L	M	M	-	-	-	-	-	L	-	-
CO3	-	-	M	L	-	M	-	-	L	-	-
CO4	L	L	M	L	-	-	-	-	L	-	-
CO5	L	M	L	L	-	-	-	-	L	-	-

L – Low, M – Moderate (Medium), H- High

18AEOE25 DESIGN OF DIGITAL SYSTEMS Category : OE

(Common to all Branches)

L	T	P	C
3	0	0	3

PREREQUISITES*: Nil*

***COURSE OBJECTIVES*:**

- *Design synchronous and asynchronous sequential circuits*
- *Develop VHDL code for digital circuits*
- *Implementation in PLDs*
- *Fault diagnosis*

UNIT-I SYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN (9)

Analysis of Clocked Synchronous Sequential Circuits - Modeling, state table reduction, state assignment, Design of Synchronous Sequential Networks, Design of iterative circuits - ASM chart - ASM realization.

UNIT-II ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN (9)

Analysis of Asynchronous Sequential Circuits - Races in ASC – Primitive Flow Table - Flow Table Reduction Techniques, State Assignment Problem and the Transition Table – Design of ASC – Static and Dynamic Hazards – Essential Hazards – Data Synchronizers.

UNIT-III SYSTEM DESIGN USING PLDS (9)

Basic concepts – Programming Technologies - Programmable Logic Element (PLE) - Programmable Array Logic (PLA) - Programmable Array Logic (PAL) –Design of combinational and sequential circuits using PLDs – Complex PLDs (CPLDs)

UNIT-IV INTRODUCTION TO VHDL (9)

Design flow - Software tools – VHDL: Data Objects - Data types - Operators – Entities and Architectures – Components and Configurations – Signal Assignment –Concurrent and Sequential statements — Behavioral, Data flow and Structural modeling – Transport and Inertial delays – Delta delays - Attributes – Generics – Packages and Libraries

UNIT-V LOGIC CIRCUIT TESTING AND TESTABLE DESIGN (9)

Digital logic circuit testing - Fault models - Combinational logic circuit testing - Sequential logic circuit testing-Design for Testability - Built-in Self-test, Board and System Level Boundary Scan. Case Study: Traffic Light Controller

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

*1. Donald G. Givone, "**Digital principles and Design**", Tata McGraw Hill, 2002.*

*2. Nelson, V.P., Nagale, H.T., Carroll, B.D., and Irwin, J.D., "**Digital Logic Circuit Analysis and Design**", Prentice Hall International, Inc., New Jersey, 1995*

*3. Volnei A. Pedroni, "**Circuit Design with VHDL**", PHI Learning, 2011.*

*4. Parag K Lala, "**Digital Circuit Testing and Testability**", Academic Press, 1997*

*5. Charles H Roth, "**Digital Systems Design Using VHDL**," Cencage 2nd Edition 2012.*

*6. Nripendra N Biswas "**Logic Design Theory**" Prentice Hall of India,2001*

COURSE OUTCOMES:

Upon completion of the course the students will be able to:

CO1: Design synchronous and asynchronous sequential circuits based on specifications

CO2: Develop algorithm and VHDL code for design of digital circuits

CO3: Illustrate digital design implementation on PLDs .

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	M	-	H	-	-	-	-	-	-	-
CO2	-	-	M	M	-	-	-	-	-	-	-
CO3	L	M	-	-	H	-	-	-	-	-	-

L-LOW M-MEDIUM H-HIGH

18AEOE26 ADVANCED PROCESSORS
(Common to all Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

***COURSE OBJECTIVES*:**

- *To introduce the basics of CISC and RISC*
- *Describe the architectural features of Pentium processors*
- *Describe ARM and Special processors*

UNIT-I MICROPROCESSOR ARCHITECTURE **(9)**

Instruction set – Data formats – Instruction formats – Addressing modes – Memory hierarchy – register file – Cache – Virtual memory and paging – Segmentation – Pipelining – The instruction pipeline – pipeline hazards – Instruction level parallelism – reduced instruction set – Computer principles – RISC versus CISC – RISC properties – RISC evaluation.

UNIT-II HIGH PERFORMANCE CISC ARCHITECTURE –PENTIUM **(9)**

The software model – functional description – CPU pin descriptions – Addressing modes – Processor flags – Instruction set – Bus operations – Super scalar architecture – Pipe lining – Branch prediction – The instruction and caches – Floating point unit– Programming the Pentium processor.

UNIT-III HIGH PERFORMANCE CISC ARCHITECTURE – PENTIUM INTERFACE **(9)**

Protected mode operation – Segmentation – paging – Protection – multitasking – Exception and interrupts - Input /Output – Virtual 8086 model – Interrupt processing.

UNIT-IV HIGH PERFORMANCE RISC ARCHITECTURE: ARM **(9)**

ARM architecture – ARM assembly language program – ARM organization and implementation – ARM instruction set - Thumb instruction set.

UNIT-V SPECIAL PURPOSE PROCESSORS **(9)**

Altera Cyclone Processor – Audio codec – Video codec design – Platforms – General purpose processor – Digital signal processor – Embedded processor – Media Processor – Video signal Processor – Custom Hardware – Co-Processor.

Contact Periods:

Lecture: 45 Periods **Tutorial: 0 Periods** **Practical: 0 Periods** **Total: 45 Periods**

REFERENCE BOOKS:

1. *Daniel Tabak, "**Advanced Microprocessors**", McGraw Hill. Inc., 2011.*
2. *James L. Antonakos, "**The Pentium Microprocessor**", Pearson Education, 1997.*
3. *Steve Furber, "**ARM System –On –Chip architecture**",Addison Wesley, 2009.*
4. *Gene .H. Miller, "**Micro Computer Engineering**", Pearson Education, 2003.*

*5. Barry. B. Brey, "**The Intel Microprocessors Architecture, Programming and Interfacing**", PHI, 2008.*
*6. Valvano, "**Embedded Microcomputer Systems**" Cencage Learing India Pvt Ltd, 2011.*
*7. Iain E.G.Richardson, "**Video codec design**", John Wiley & sons Ltd, U.K, 2002.*

COURSE OUTCOMES:

Upon completion of the course the students will be able to:

CO1: Distinguish between RISC and CISC generic architectures.
CO2: Describe the architectural features of Pentium processors
CO3: Develop simple applications using ARM processors

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	**M**	**H**	**-**	**-**	**M**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**H**	**-**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**-**	**M**	**H**	**M**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

L-LOW M-MEDIUM H-HIGH

Category : OE

18AEOE27 PATTERN RECOGNITION	**L**	**T**	**P**	**C**
(Common to all Branches)	**3**	**0**	**0**	**3**

PREREQUISITES: Nil

COURSE OBJECTIVES:

- *To get knowledge in pattern recognition in computer vision techniques*
- *To get knowledge in structural pattern methods*
- *To get knowledge on neural networks and fuzzy systems*.

UNIT-I PATTERN CLASSIFIER (9)

Overview of pattern recognition -Discriminant functions-Supervised learning –Parametric estimation- Maximum likelihood estimation –Bayesian parameter estimation- Perceptron algorithm-LMSE algorithm – Problems with Bayes approach –Pattern classification by distance functions-Minimum distance pattern classifier.

UNIT-II UNSUPERVISED CLASSIFICATION (9)

Clustering for unsupervised learning and classification - Clustering concept-C-means algorithm-Hierarchical clustering procedures- Graph theoretic approach to pattern clustering - Validity of clustering solutions.

UNIT-III STRUCTURAL PATTERN RECOGNITION (9)

Elements of formal grammars-String generation as pattern description - recognition of syntactic description- Parsing-Stochastic grammars and applications - Graph based structural representation.

UNIT-IV FEATURE EXTRACTION AND SELECTION (9)

Entropy minimization – Karhunen - Loeve transformation-feature selection through functions approximation- Binary feature selection.

UNIT-V NEURAL NETWORKS (9)

Neural network structures for Pattern Recognition –Neural network based Pattern associators-Unsupervised learning in neural Pattern Recognition-Self organizing networks-Fuzzy logic-Fuzzy classifiers-Pattern classification using Genetic Algorithms.

Contact Periods:

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS:

*1. R. O Duda, P.E Hart and Stork, "**Pattern Classification**", Wiley, 2012.*

*2. Robert J. Sehalkoff, **"Pattern Recognition: Statistical, Structural and Neural Approaches**", JohnWiley & Sons Inc., 2007.*

*3. Tou & Gonzales, "**Pattern Recognition Principles**", Wesley Publication Company, 2000.*

*4. Morton Nadier and P. Eric Smith, "**Pattern Recognition Engineering**", John Wiley &* Sons, 2000.

COURSE OUTCOMES:

Upon completion of the course, the students will have:

CO1: Apply parametric estimation and supervised learning techniques for pattern classification

CO2: Describe the structural pattern recognition methods

CO3: Apply neural networks, fuzzy systems and Genetic algorithms to pattern recognition and classification.

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	-	**M**	-	**M**	-	-	-	-	-	-	-
CO2	-	-	**H**	-	-	-	-	-	-	-	-
CO3	**M**	**L**	-	**M**	**M**	-	-	-	-	-	-

L-LOW M-MEDIUM H-HIGH

Category : OE

18VLOE28 VLSI DESIGN	**L**	**T**	**P**	**C**
(Common to all Branches)	**3**	**0**	**0**	**3**

PREREQUISITES :Nil

COURSE OBJECTIVES

- *To gain knowledge on MOS and CMOS Circuits with its characterization*
- *To design CMOS logic and sub-system*
- *To understand low power CMOS VLSI Design*

UNIT-I INTRODUCTION TO MOS CIRCUITS (9)

MOS Transistor Theory -Introduction MOS Device Design Equations -MOS Transistor as a Switches - Pass Transistor - CMOS Transmission Gate -Complementary CMOS Inverter - Static Load MOS Inverters - Inverters with NMOS loads - Differential Inverter - Tri State Inverter - BiCMOS Inverter.

UNIT-II CIRCUIT CHARACTERIZATION AND PERFORMANCE ESTIMATION (9)

Delay Estimation, Logical Effort and Transistor Sizing, Power Dissipation, Sizing Routing Conductors, Charge Sharing, Design Margin and Reliability.

UNIT-III CMOS CIRCUIT AND LOGIC DESIGN (9)

CMOS Logic Gate Design, Physical Design of CMOS Gate, Designing with Transmission Gates, CMOS Logic Structures, Clocking Strategies, I/O Structures.

UNIT-IV CMOS SUB SYSTEM DESIGN (9)

Data Path Operations - Addition/Subtraction, Parity Generators, Comparators, Zero/One Detectors, Binary Counters, ALUs, Multipliers, Shifters, Memory Elements, Control-FSM, Control Logic Implementation.

UNIT-V LOW POWER CMOS VLSI DESIGN (9)

Introduction to Low Power Design, Power Dissipation in FET Devices, Power Dissipation in CMOS, Low-Power Design through Voltage Scaling – VTCMOS Circuits, MTCMOS Circuits, Architectural Level Approach – Pipelining and Parallel Processing Approaches, Low Power Basics CMOS Gate and Adder Design.

Contact Periods:

LECTURE : 45 PERIODS TUTORIAL : 0 PERIODS PRACTICAL : 0 PERIODS TOTAL : 45 PERIODS

REFERENCE BOOKS:

1. *Sung Ms Kang, Yusuf Lablebici, "**CMOS Digital Integrated Circuits: Analysis & Design**", Tata Mc-Graw Hill, 2011.*
2. *N. Weste and K. Eshranghian, "**Principles of CMOS VLSI Design**", Addison Wesley, 1998.*
3. *Neil H.E. Weste, David Harris, Ayan Banerjee,"**CMOS VLSI Design:A Circuits and Systems Perspective** ", 2013, Pearson Education*
4. *Kiat-Seng Yeo, Kaushik Roy, "**Low-Voltage, Low-Power VLSI Subsystems**" – McGraw-Hill Professional, 2004.*
5. *Gary K. Yeap,"**Practical Low Power Digital VLSI Design**", Kluwer Academic Press, 2002.*
6. *Jan M. Rabaey,"**Digital Integrated Circuits: A Design Perspective**",Pearson Education, 2003.*

COURSE OUTCOMES:

After completing this course, the students will have:

- *CO1: knowledge on MOS and CMOS Circuits with its characterization*
- *CO2: an ability to design CMOS logic and sub-system*
- *CO3: an understanding of low power CMOS VLSI Design*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	**H**	**L**	**M**	**-**	**L**	**-**	**-**	**-**	**M**	**-**	**-**
CO2	**H**	**L**	**M**	**-**	**L**	**-**	**-**	**-**	**M**	**-**	**-**
CO3	**H**	**L**	**M**	**-**	**L**	**-**	**-**	**-**	**M**	**-**	**-**

L-LOW M-MEDIUM H-HIGH

Category : OE

18VLOE29 ANALOG & MIXED MODE VLSI CIRCUITS
(Common to all Branches)

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES:

- *To acquire knowledge on MOS circuit configuration and CMOS amplifier*
- *To analyze and design Operational amplifier*
- *To understand mixed signal circuits*

UNIT-I MOS CIRCUIT CONFIGURATION (9)

Basic CMOS Circuits - Basic Gain Stage - Gain Boosting Techniques - Super MOS Transistor - Primitive Analog Cells, Current Source, Sinks and References MOS Diode/Active resistor, Simple current sinks and mirror, Basic current mirrors, Advance current mirror, Current and Voltage references, Bandgap references.

UNIT-II CMOS AMPLIFIER (9)

CMOS Amplifier Performances matrices of amplifier circuits, Common source amplifier, Common gate amplifier, Cascode amplifier, Frequency response of amplifiers and stability of amplifier.

UNIT-III CMOS DIFFERENTIAL AMPLIFIER (9)

CMOS Differential Amplifier Differential signalling, source coupled pair, Current source load, Common mode rejection ratio, CMOS Differential amplifier with current mirror load, Differential to single ended conversion. Linear Voltage - Current Converters - CMOS, Bipolar and Low – Voltage BiCMOS Op - Amp Design - Instrumentation Amplifier Design.

UNIT-IV BICMOS CIRCUIT TECHNIQUES AND CURRENT-MODE SIGNAL PROCESSING(9)

Basic BiCMOS Circuit Techniques, Current - Mode Signal Processing: Continuous - Time Signal Processing – Sampled - Data Signal Processing – Switched - Current Data Converters.

UNIT-V ANALOG FILTERS AND A/D CONVERTERS (9)

Sampled - Data Analog Filters, Over Sampled A/D Converters and Analog Integrated Sensors: First - order and Second SC Circuits - Bilinear Transformation – Cascade Design – Switched - Capacitor Ladder Filter

Contact Periods:

LECTURE : 45 PERIODS TUTORIAL : 0 PERIODS PRACTICAL : 0 PERIODS TOTAL : 45 PERIODS

REFERENCE BOOKS:

1. *Behzad Razavi, "**Design of Analog CMOS Integrated circuits"**, Tata McGraw Hill Education, 2002.*
2. *Mohammed Ismail, Terri Fiez, "**Analog VLSI signal and Information Processing**", McGraw- Hill International Editons, 1994.*
3. *R. Jacob Baker, Harry W. Li, and David E. Boyce, CMOS: Circuit Design ,"**Layout and Simulation"**, Prentice Hall of India, 1997.*
4. *David A. Johns and Ken Martin, "**Analog Integrated circuit Design"**, John Wiley & Son, 2013*
5. *Greogorian and Tames, "**Analog Integrated Circuit for Switched Capacitor Circuits,** John Wiley & Sons Inc., 4th Edition, 1986.*

COURSE OUTCOMES:

Upon completion of this course, the students will have:

CO1: Knowledge on MOS circuit configuration and CMOS amplifier

CO2: To analyze and design Operational amplifier

CO3: An understanding on mixed signal circuits

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	**H**	**-**	**L**	**-**	**-**	**-**	**-**	**-**	**M**	**L**	**-**
CO2	**H**	**-**	**L**	**-**	**-**	**-**	**-**	**-**	**M**	**L**	**-**
CO3	**H**	**-**	**L**	**-**	**-**	**-**	**-**	**-**	**M**	**L**	**-**

L-LOW M-MEDIUM H-HIGH

Category : OE

18VLOE30 HARDWARE DESCRIPTION LANGUAGES

(Common to all Branches)

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES

- *To gain knowledge on HDLs and Modeling styles*
- *To understand the VHDL and Verilog HDL.*
- *To design sub-systems USING VHDL/VERILOG*

UNIT-I BASIC CONCEPTS OF HARDWARE DESCRIPTION LANGUAGES (9)

VLSI Design flow, Features of VHDL, Capabilities, Hierarchy, Syntax and Semantics of VHDL; Basic Language Elements - Data objects - Variable signal, and constant, Data types, Operators and signal assignments, Design Suits - Entities, architecture declaration, configurations, Packages.

UNIT-II MODELING STYLES (VHDL) (9)

Behavioral Modeling - Process statement, Sequential assignment statements, Loops, wait statement, assertion statement, Delay Model – Inertial delay Model, Transport delay model; Gate Level Modeling – Component instantiation statements; Data flow Modeling - Concurrent assignment statement, Conditional assignment statements, Procedures, functions, Generics, attributes, Model simulation - Writing a test bench, Logic Synthesis.

UNIT-III INTRODUCTION TO VERILOG HARDWARE DESCRIPTION LANGUAGE (9)

Key features, Capabilities, Language Constructs and Conventions in Verilog, Syntax and Semantics of Verilog; Basic Language Elements: Operators, nets, registers, vectors, arrays, parameters, system tasks, complier directives, Module, port connection rules.

UNIT-IV MODELING STYLES (VERILOG) (9)

Gate Level Modeling - Gate types, Gate delays; Dataflow Modeling – continuous assignment, Behavioral Modeling - Initial & Always Construct, Assignments with Delays, wait construct, Multiple always blocks, If and if - else, assign, Loop Construct, Sequential and Parallel blocks, Switch level modeling - MOS switches, CMOS switches.

UNIT-V DESIGN SUB-SYSTEMS USING VHDL/VERILOG (9)

Combinational logics – Adder, Subtractor, Decoders, Encoders, Multiplexer, code Converter; Flip flop, state machines – Mealy type FSM, Moore type FSM, Counters and Shift register. Synthesis of digital logic circuits.

Contact Periods:

LECTURE : 45 PERIODS TUTORIAL : 0 PERIODS PRACTICAL : 0 PERIODS TOTAL : 45 PERIODS

REFERENCE BOOKS:

1. *J. Bhaskar, "**A VHDL Primer"**, 3rd Edition, Pearson Education, 2015.*
2. *Douglas Perry, "**VHDL**", McGraw Hill International, New York, 1998.*
3. *S. Brown & Z. Vransesic, "**Fundamental of digital Logic with Verilog design**", Tata McGraw Hill, 2002.*
4. *S. Palnitkar, "**Verilog HDL: A Guide to Digital Design and Synthesis**", Prentice Hall (NJ, USA), 2003.*
5. *Frank Vahid, "**Digital Design**", Wiley, 2006.*
6. *Peter J Ashenden, "**The Designer's Guide to VHDL**", Morgan Kaufmann Publishers, 2008.*
7. *Navabi, "**VHDL Analysis & Modeling of digital systems**", McGraw Hill, 1998.*

COURSE OUTCOMES:

After completing this course, the students will have:

- *CO1: Knowledge on HDLs and Modeling styles*
- *CO2: To write the VHDL and Verilog HDL codes*
- *CO3: To design sub-systems USING VHDL/VERILOG*

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	**H**	**L**	**H**	**L**	**M**	**-**	**-**	**-**	**M**	**-**	**-**
CO2	**H**	**L**	**H**	**-**	**M**	**-**	**-**	**-**	**M**	**-**	**-**
CO3	**H**	**L**	**H**	**-**	**M**	**-**	**-**	**-**	**M**	**-**	**-**

L-LOW M-MEDIUM H-HIGH

18CSOE31 ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Artificial Intelligence and intelligent agents, history of Artificial Intelligence*
- *Building intelligent agents (search, games, constraint satisfaction problems)*
- *Machine Learning algorithms*
- *Applications of AI (Natural Language Processing, Robotics/Vision)*
- *Solving real AI problems through programming with Python, Tensor Flow and Keras library.*

UNIT I FOUNDATIONS OF AI L(9)

Introduction - History of Artificial Intelligence - Intelligent Agents - Uninformed Search Strategies - Informed (Heuristic) Search Strategies - Adversarial Search - Constraint Satisfaction Problems.

UNIT II SUPERVISED AND UNSUPERVISED LEARNING L(9)

Maximum likelihood estimation -Regression -Linear, Multiple, Logistic - bias-variance, Bayes rule, maximum a posteriori inference- Classification techniques - k-NN, naïve Bayes - Decision Trees - Clustering - k-means, hierarchical, high-dimensional- Expectation Maximization.

UNIT III ENSEMBLE TECHNIQUES AND REINFORCEMENT LEARNING L(9)

Graphical Models - Directed and Undirected Models - Inference - Learning- maximum margin, support vector machines - Boosting and Bagging - Random Forests - PCA and variations - Markov models, hidden Markov models -Reinforcement Learning- introduction - Markov Decision Processes - Value-based methods - Q-learning- Policy-based methods

UNIT IV DEEP LEARNING

L(9)

Neural Network Basics - Deep Neural Networks - Recurrent Neural Networks (RNN) - Deep Learning applied to Images using CNN - Tensor Flow for Neural Networks & Deep Learning

UNIT V AI APPLICATIONS L(9)

Applications in Computer Vision : Object Detection- Face Recognition - Action and Activity Recognition -Human Pose Estimation.

Natural Language Processing - Statistical NLP and text similarity - Syntax and Parsing techniques - Text Summarization Techniques - Semantics and Generation - Application in NLP - Text Classification -speech Recognition - Machine Translation - Document Summarization - Question Answering

Applications in Robotics : Imitation Learning - Self-Supervised Learning -Assistive and Medical Technologies - Multi-Agent Learning

Contact Periods:

Lecture: 45 Periods Tutorial : 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS

1. *Peter Norvig and Stuart J. Russell,* ***"Artificial Intelligence: A Modern Approach****", Third edition*
2. *Tom Mitchell,* ***"Machine Learning"****, McGraw-Hill, 1997*
3. *Ian Goodfellow, Yoshua Bengio, and Aaron Courvillem, "****Deep Learning****", MIT press, 2016.*
4. *Michael Nielson ,* ***"Neural Networks and Deep Learning"***
5. *Christopher Bishop,* ***"Pattern Recognition and Machine Learning",*** *Springer, 2006*
6. *Richard Sutton and Andrew Barto,* ***Reinforcement Learning: An introduction",*** *MIT Press,1998*
7. *Kevin P. Murphy,* ***"Machine Learning: A Probabilistic Perspective"****, MIT Press, 2012.*
8. *Trevor Hastie, Robert Tibshirani, Jerome Friedman, "****The Elements of Statistical Learning"****, Second Edition ,Springer, 2011*

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Develop expertise in popular AI & ML technologies and problem-solving methodologies. ***[Familiarity]***

CO2: Use fundamental machine learning techniques, such as regression, clustering, knearest neighbor methods, etc. ***[Usage]***

CO3: Distinguish between supervised and unsupervised machine learning methods. ***[Usage]***

CO4: Gain knowledge of the different modalities of Deep learning currently used. ***[Familiarity]***

CO5: Use popular AI & ML technologies like Python, Tensorflow and Keras todevelop Applications. ***[Usage]***

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	**H**	**H**	**H**	**M**	**H**	**H**			**L**		**M**
CO2	**H**	**M**	**M**	**M**	**M**	**M**			**L**		**M**
CO3	**H**	**H**	**H**	**M**	**H**	**M**			**L**		**L**
CO4	**H**	**H**	**M**	**H**	**M**	**H**			**L**		**L**
CO5	**H**	**H**	**H**	**M**	**H**	**M**			**L**		**L**

L-LOW M-MEDIUM H-HIGH

18CSOE32 COMPUTER NETWORK ENGINEERING
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES

Upon completion of this course, the students will be familiar with:

- *The hardware and software architecture of Computer Networks*
- *The concepts of internetworking*
- *Issues in resource allocation*
- *End-to-end protocols and data transmission*
- *Network management models*

UNIT I FOUNDATION L(9)

Applications – Requirements – Network Architecture – Implementing Network software – Performance – Perspectives on connecting – Encoding – Framing – Error detection – Reliable transmission – Ethernet and Multiple Access Networks – Wireless.

UNIT II INTERNETWORKING L(9)

Switching and bridging – IP – Routing – Implementation and Performance – Advanced Internetworking – The Global Internet – Multicast – Multiprotocol and Label Switching – Routing among Mobile devices.

UNIT III CONGESTION CONTROL AND RESOURCE ALLOCATION L(9)

Issues in Resource allocation – Queuing disciplines – Congestion Control – Congestion avoidance mechanism – Quality of Service.

UNIT IV END-TO-END PROTCOLS AND DATA L(9)

Simple Demultiplexer – Reliable Byte Stream –Remote Procedure Call – RTP – Presentation formatting - Multimedia data.

UNIT V NETWORK MANAGEMENT L(9)

SNMPv1 and v2 Organization and information model - Communication model – Functional model - SNMP proxy server- Remote monitoring- RMON1 andRMON2.

Contact Periods:

Lecture: 45 Periods Tutorial : 0 Periods Practical: 0 Periods Total: 45 Periods

Reference Books

1. Larry L. Peterson, Bruce S. Davie, **"Computer Networks a Systems approach"**, Fifth edition, Elsevier, 2011.
2. Priscilla Oppenheimer, **"Top-down Network Design: A Systems Analysis Approach to Enterprise Network Design"**, 3rd Edition, Cisco Press, 2010.
3. James D. McCabe, Morgan Kaufmann, **"Network Analysis, Architecture, and Design"**, Third Edition, Elsevier, 2007.
4. William Stallings, **"SNMP, SNMPv2, SNMPv3, and RMON 1 and 2,"** Third Edition, Pearson Education, 2012

5 Mani Subramanian, **"Network Management Principles and practice"**, Pearson Education, 2010.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: *Explain the architecture and applications of Computer Networks.* ***[Familiarity]***

CO2: *Analyze the performance of MAC protocols.* ***[Assessment]***

CO3: *Configure switches and Routers.* ***[Assessment]***

CO4: *Design algorithms to ensure congestion control and QOS.* ***[Usage]***

CO5: *Appreciate the performance of End-to-End protocols and data transmission techniques.* ***[Assessment]***

CO6: *Use SNMP and RMON.* ***[Usage]***

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	**H**	**M**	**M**	**M**	**M**	**M**			**M**		**M**
CO2	**H**	**H**	**M**	**H**	**M**	**H**			**M**		**M**
CO3	**H**	**H**	**M**	**H**	**M**	**H**			**M**		**M**
CO4	**H**	**H**	**H**	**M**	**H**	**M**			**M**		**M**
CO5	**H**	**H**	**M**	**H**	**M**	**H**	**L**		**M**		**M**
CO6	**H**	**H**	**H**	**M**	**H**	**M**	**L**		**M**		**M**

L-LOW M-MEDIUM H-HIGH

18CSOE33 BIG DATA ANALYTICS
(Common to All Branches)

Category : OE

L	T	P	C
3	0	0	3

PREREQUISITES: Nil

COURSE OBJECTIVES

Upon completion of this course, the students will be familiar with:

- *Statistical methods*
- *Bayesian, Support Vector and Kernel Methods*
- *Time Series Analysis and Rule Induction*
- *Neural networks and Fuzzy Logic*
- *Visualization Techniques*

UNIT I STATISTICAL CONCEPTS AND METHODS L(9)

Statistical Concepts: Probability, Sampling and Sampling Distributions, Statistical Inference, Prediction and Prediction Errors–Resampling- Statistical Method: Linear Models, Regression Modeling, Multivariate Analysis.

UNIT II BAYESIAN METHODS AND SUPPORT VECTOR AND KERNEL METHODS L(9)

Bayesian Methods: Bayesian Paradigm, modeling, inference and networks – Support Vector and Kernel Methods: Kernel Perceptron, Overfitting and Generalization Bounds, Support Vector Machines, Kernel PCA and CCA.

UNIT III TIME SERIES ANALYSIS AND RULE INDUCTION L(9)

Analysis of time series: linear systems analysis, nonlinear dynamics, Delay Coordinate Embedding - Rule induction: Propositional Rule Learning, Rule Learning as search, Evaluating quality of rules, Propositional rule induction, First order rules-ILP systems.

UNIT IV NEURAL NETWORKS AND FUZZY LOGIC L(9)

Neural networks: learning and generalization, competitive learning, principal component analysis and neural networks; Fuzzy logic: extracting fuzzy models from data, fuzzy decision trees.

UNIT V STOCHASTIC SEARCH METHODS AND VISUALIZATION L(9)

Stochastic Search Methods: Stochastic Search by Simulated Annealing, Adaptive Search by Evolution- Evolution Strategies- Genetic Algorithms & Programming- Visualization : Classification of Visual Data Analysis Techniques, Data Type to be Visualized, Visualization Techniques, Interaction Techniques and Specific Visual Data Analysis Techniques.

Contact Periods:

Lecture: 45 Periods Tutorial : 0 Periods Practical: 0 Periods Total: 45 Periods

REFERENCE BOOKS

1 *Michael Berthold, David J. Hand,* ***"Intelligent Data Analysis-An Introduction"****, Second Edition, Springer, 2007.*

2 *Bill Franks,* ***"Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with advanced analystics"****, John Wiley & sons, 2012.*

3 *Jimmy Lin and Chris Dyer,* ***"Data Intensive Text Processing using Map Reduce"****, Morgan and Claypool Publishers, 2010.*

4 *Tom White,* ***"Hadoop: The Definitive Guide"****, O`Reilly Publishers, 2012*

5 *David Loshin, "****Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph****", Morgan Kaufmann, 2013.*

6 *Paul Zikopoulos, Chris Eaton, "****Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data****", McGraw-Hill Education, 2011.*

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

CO1: *Explain the statistical concepts and methods.* ***[Familiarity]***

CO2: *Use Bayesian, support vector and kernel Methods.* ***[Usage]***

CO3: *Perform Time series analysis.* ***[Usage]***

CO4: *Use Rule induction.* ***[Usage]***

CO5: *Apply Neural network and Fuzzy logic.* ***[Usage]***

CO6: *Use Stochastic search methods.* ***[Usage]***

CO7: *Explain Visualization Techniques.* ***[Familiarity]***

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	M	M	M	M			M		M
CO2	H	H	H	M	H	M			M		M
CO3	H	H	H	M	H	M	L		M	L	M
CO4	H	H	H	M	H	M			M		M
CO5	H	H	H	M	H	M			M		M
CO6	H	H	H	M	H	M	L		M		M
CO7	H	M	M	M	M	M			M	L	M

L-LOW M-MEDIUM H-HIGH

18MFACZ1 - ENGLISH FOR RESEARCH PAPER WRITING
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Writing quality research papers in English*

UNIT I **L(6)**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II **L(6)**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism

UNIT III **L(6)**

Sections of a Paper, Abstracts, Introduction, Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV **L(6)**

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.

UNIT V **L(6)**

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, useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Contact Periods:

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1 ***Goldbort R (2006) Writing for Science, Yale University Press*** *(available on GoogleBooks).*

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's book .*

4 ***Adrian Wallwork , English for Writing Research Papers****, Springer New York Dordrecht Heidelberg London, 2011.*

COURSE OUTCOMES:

Upon completion of this course the students will be able to,

CO1: *Utilize writing skills to write best quality research paper and provide better readability.*

CO2: *Describe each section of a paper with clarity.*

CO3: *Review the papers efficiently.*

CO4: *Utilize the key skills to write title, abstract, introduction and literature review of the paper.*

CO5: *Write the methods, results, Discussion and Conclusion using the required skills and useful phrases.*

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	H	L	L	M			H			
CO2	H	H	L	L	M			H			
CO3	H	H	L	L	M			H			
CO4	H	H	L	L	M			H			
CO5	H	H	L	L	M			H			

L-Low, M-Moderate (Medium), H-High

18MFACZ2 - DISASTER MANAGEMENT
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Key concepts in disaster risk reduction.*
- *Types of disasters and hazards.*
- *Disaster prone areas in India.*
- *Strengths and weaknesses of disaster management approaches.*
- *Risk assessment methods.*

UNIT I INTRODUCTION L(6)

Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

UNIT IIREPERCUSSIONS OF DISASTERS AND HAZARDS L(6)

Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III DISASTER PRONE AREAS IN INDIA L(6)

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT L(6)

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

UNIT V RISK ASSESSMENT L(6)

Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co- Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

Contact Periods:

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1 *R. Nishith, Singh AK, "**Disaster Management in India: Perspectives, issues and strategies**" New Royal book Company.*

2 *Sahni, Pardeep Et.Al. (Eds.)," **Disaster Mitigation Experiences And Reflections**", Prentice Hall Of India. New Delhi.*

3 *Goel S. L. , "**Disaster Administration And Management Text And Case Studies**" ,Deep &Deep Publication Pvt. Ltd., New Delhi.*

4 *Jagbir Singh,* ***"Disaster Management: Future Challenges and Opportunities",*** *I.K. International Publishing House Pvt. Ltd. , New Delhi, 2007.*

COURSE OUTCOMES:

Upon completion of this course the students will be able to,

CO1: *Differentiate hazard and disaster and types of disasters.*

CO2: *Identify the causes and types of manmade and natural disaster.*

CO3: *Describe the disaster prone areas in India.*

CO4: *To predict and, where possible, prevent disasters, mitigate their impact on vulnerable populations, and respond to and effectively cope with their consequences*

CO5: *Provide survival strategies based on risk assessment.*

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	M		M	M	L		H		M		M
CO2	M		M	M	L		H		M		M
CO3	M		M	H	L		H		M		M
CO4	M		M	M	L		H		M		M
CO5	M		M	H	L		H		M		M

L-Low, M-Moderate (Medium), H-High

18MFACZ3 - VALUE EDUCATION
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Value of education and self- development*
- *Requirements of good values in students*
- *Importance of character*

UNIT I - ETHICS AND SELF-DEVELOPMENT **L(6)**

Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements.

UNIT II - PERSONALITY AND BEHAVIOR DEVELOPMENT **L(6)**

Soul and Scientific attitude .Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness.Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance.

UNIT III - VALUES IN HUMAN LIFE **L(6)**

Importance of cultivation of values, Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature ,Discipline

UNIT IV - VALUES IN SOCIETY **L(6)**

True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

UNIT V - POSITIVE VALUES **L(6)**

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence , Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

Contact Periods:

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

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

2 *Dr. Yogesh Kumar Singh, "**Value Education**", A.P.H Publishing Corporation,New Delhi*

3 *R.P Shukla, "**Value Education and Human Rights**", Sarup and Sons, NewDelhi.*

4 *https://nptel.ac.in/courses/109104068/36*

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: Understand the values and work ethics

CO2: Enhance personality and behaviour development

CO3: Apply the values in human life.

CO4: Gain Knowledge of values in society.

CO5. Learn the importance of positive values in human life.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	H	M	M	H		H				H	
CO2	H	M	M	H		H				M	
CO3	H	M	M	H		H				M	
CO4	H	M	M	H		H				M	
CO5	H	M	M	H		H				M	

L-Low, M-Moderate (Medium), H-High

18MFACZ4 - CONSTITUTION OF INDIA
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Indian constitution*
- *Constitutional rights & duties*
- *Organs of governance*
- *Local administration*
- *Roles and functions of Election commission*

UNIT I - INDIAN CONSTITUTION **L(6)**

History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working) - Philosophy of the Indian Constitution: Preamble Salient Features

UNIT II - CONSTITUTIONAL RIGHTS & DUTIES **L(6)**

Contours of Constitutional Rights & Duties: Fundamental Rights , Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT III - ORGANS OF GOVERNANCE **L(6)**

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT IV - LOCAL ADMINISTRATION **L(6)**

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT V - ELECTION COMMISSION **L(6)**

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Contact Periods:
LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1 *The Constitution of India, 1950 (Bare Act), Government Publication.*
2 *Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.*
3 *M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.*
4 *D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.*

COURSE OUTCOMES

At the end of the course, students will be able to

CO1: *Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.*

CO2: *Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.*

CO3: *Understand the various organs of Indian governance.*

CO4: *Familiarize with the various levels of local administration.*

CO5: *Gain knowledge on election commission of India.*

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1				**H**		**L**	**H**			**H**	**M**
CO2				**H**		**L**	**H**			**H**	**M**
CO3				**H**		**L**	**H**			**H**	**M**
CO4				**H**		**L**	**H**			**H**	**M**
CO5				**H**		**L**	**H**			**H**	**M**

L-Low, M-Moderate (Medium), H-High

18MFACZ5 - PEDAGOGY STUDIES
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Understanding of various theories of learning, prevailing pedagogical practices and design of curriculum in engineering studies.*
- *Application of knowledge in modification of curriculum, its assessment and introduction of innovation in teaching methodology.*

UNIT I - INTRODUCTION **L(6)**

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.

UNIT II - PEDAGOGICAL PRACTICES **L(6)**

Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education. Evidence on the effectiveness of pedagogical practices Methodology for the in depth stage: quality assessment of included studies.

UNIT III - PEDAGOGICAL APPROACHES **L(6)**

How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teacher's attitudes and beliefs and Pedagogic strategies.

UNIT IV - PROFESSIONAL DEVELOPMENT **L(6)**

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

UNIT V - CURRICULUM AND ASSESSMENT **L(6)**

Research gaps and future directions Research design Contexts Pedagogy Teacher education Curriculum and assessment Dissemination and research impact.

Contact Periods:

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

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.*
7 *www.pratham.org/images/resource%20working%20paper%202.pdf.*

COURSE OUTCOMES:

Upon completion of this course the students will be able to,

CO1: *Explain the concept of curriculum, formal and informal education systems and teacher education.*

CO2: *Explain the present pedagogical practices and the changes occurring in pedagogical approaches.*

CO3: *Understand the relation between teacher and community, support from various levels of teachers to students and limitation in resources and size of the class.*

CO4: *Perform research in design a problem in pedagogy and curriculum development.*

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1				H		H	M			H	L
CO2				H		H	M			H	M
CO3				H		H	M			H	M
CO4				H		H	H			H	M

L-Low, M-Moderate (Medium), H-High

18MFACZ6 - STRESS MANAGEMENT BY YOGA
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Eight parts of yoga*
- *Techniques to achieve overall health of body and mind*
- *Breathing techniques and its effects*

UNIT I **L(6)**

Definitions of Eight parts of yog. (Ashtanga).

UNIT II **L(6)**

Yam and Niyam.-Do`s and Don't's in life.

UNIT III **L(6)**

Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

UNIT IV **L(6)**

Asan and Pranayam : Various yog poses and their benefits for mind & body.

UNIT V **L(6)**

Regularization of breathing techniques and its effects-Types of pranayam.

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

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*

3 *Pandit Shambu Nath, "Speaking of Stress Management Through Yoga and Meditation",New Dawn Press,New Delhi.*

4 *K.N Udupa,"Stress and its management by Yoga", Motilal Banarsidass Publ,New Delhi.*

COURSE OUTCOMES*:*

Upon completion of this course, the students will be able to:

CO1: *understand the basics of Yoga.*

CO2: *Identify Do's and Dont's in life.*

CO3: *Follow ethical and moral guidelines given by Yamas and Niyamas in life.*

CO4: *Develop healthy mind in a healthy body thus improving social health by Asan and Pranayam*

CO5: *Use breathing techniques to live a stress free life*

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1				**H**		**M**	**H**			**H**	
CO2				**H**		**M**	**H**			**H**	**L**
CO3				**H**		**M**	**H**			**H**	
CO4				**H**		**M**	**H**			**H**	
CO5				**H**		**M**	**H**			**H**	

L-Low, M-Moderate (Medium), H-High

18MFACZ7 - PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Techniques to achieve the highest goal happily*
- *How to become a person with stable mind, pleasing personality and determination*
- *Awakening wisdom in students*

UNIT I **L(6)**

Neetisatakam-Holistic development of personality-Verses- 19,20,21,22 (wisdom)-Verses-29,31,32 (pride & heroism)-Verses- 26,28,63,65 (virtue)

UNIT II **L(6)**

Verses- 52,53,59 (dont's)-Verses- 71,73,75,78 (do's). - Approach to day to day work and duties.-Shrimad Bhagwad Geeta - Chapter 2-Verses 41, 47,48,

UNIT III **L(6)**

Shrimad Bhagwad Geeta -Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,-Chapter 18-Verses 45, 46, 48.

UNIT IV **L(6)**

Statements of basic knowledge.-Shrimad Bhagwad Geeta: -Chapter2-Verses 56, 62, 68 -Chapter 12 -Verses 13, 14, 15, 16,17, 18-Personality of Role model.

UNIT V **L(6)**

Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39-Chapter18 – Verses 37,38,63

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1. "***Srimad Bhagavad Gita****" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata*
2. ***Bhartrihari's Three Satakam (Niti-sringar-vairagya)*** *by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.*
3. *"**Bhagavad Gita: The Song of God**", Swami Mukundananda, Jagadguru Kripaluji Yog, USA*
4. *"**Bhagavad-Gita As It Is**", A.C. Bhaktivedanta Swami Prabhupada,, Bhaktivedanta Book Trust Publications*

COURSE OUTCOMES :

On completion of this course, students will be able to

CO1: *Understand the Holistic development*

CO2: *Understand the day to day to day work and duties*

CO3: *Understand mankind to peace and prosperity*

CO4:*Become versatile personality.*

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1							**H**	**M**	**L**		**H**
CO2							**H**		**M**		**H**
CO3							**H**		**M**		**H**
CO4							**H**	**M**	**M**		**H**

L-Low, M-Moderate (Medium), H-High

18MFACZ8 - SANSKRIT FOR TECHNICAL KNOWLEDGE
(Common to all Branches)

Category : AC

L	T	P	C
2	0	0	0

PREREQUISITES: Nil

COURSE OBJECTIVES:

Upon completion of this course, the students will be familiar with:

- *Alphabets and tense of the language.*
- *Sentence formation*
- *The Technical information in Sanskrit Literature*

UNIT I **L(6)**

Alphabets in Sanskrit, Past/Present/Future Tense

UNIT II **L(6)**

Simple Sentences - Order, Introduction of roots

UNIT III **L(6)**

Technical information about Sanskrit Literature

UNIT IV **L(6)**

Technical concepts of Engineering-Electrical, Mechanical

UNIT V **L(6)**

Technical concepts of Engineering-Architecture, Mathematics

LECTURE: 30 PERIODS TUTORIAL: 0 PERIODS PRACTICAL: 0 PERIODS TOTAL: 30 PERIODS

REFERENCE BOOKS:

1. *"* **"Abhyaspustakam"** *– Dr.Vishwas, Samskrita-Bharti Publication, New Delhi*
2. **"Teach Yourself Sanskrit"** *Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication*
3. **"India's Glorious Scientific Tradition"** *Suresh Soni, Ocean books (P) Ltd., New Delhi.*

COURSE OUTCOMES:

Upon completion of this course the students will be able to,

CO1: Read and write sentences

CO2: Explore the huge knowledge from ancient literature

CO3: Use technical concepts to develop logic in mathematics and engineering.

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1								M	L		H
CO2	L								M		H
CO3		L	H	H					H	M	H

L-Low, M-Moderate (Medium), H-High