NARAYANA ENGINEERING COLLEGE::NELLORE

AUTONOMOUS

B.Tech-Mechanical Engineering

Course Structure

&

SYLLABUS

(2020-21 academic year)

(NECR B.Tech 20)

(w.e.f AY: 2020-21)

NARAYANA

ENGINEERING COLLEGE

(AUTONOMOUS)

NARAYANA ENGINEERING COLLEGE::NELLORE

AUTONOMOUS

INSTITUTE VISION & MISSION

VISION

- To be one of the nation's premier Institutions for Technical and Management Education and a key contributor for Technological and Socio-economic Development of the Nation.

MISSION

- To produce technically competent Engineers and Managers by maintaining high academic standards, world class infrastructure and core instructions.
- To enhance innovative skills and multi disciplinary approach of students through well experienced faculty and industry interactions.
- To inculcate global perspective and attitude of students to face real world challenges by developing leadership qualities, lifelong learning abilities and ethical values.

DEPARTMENT OF MECHANICAL ENGINEERING

DEPARTMENT VISION & MISSION

VISION OF THE DEPARTMENT

To produce Quality Mechanical Engineers having sound technical knowledge, who would serve effectively as a responsible technocrat to the demanding needs of society.

MISSION OF THE DEPARTMENT

1) To provide Quality education through effective teaching and learning methodologies for enhancing student's technical knowledge in diversified areas of Mechanical Engineering.

2) To provide opportunities for students to address the existing problems for enhancing their problem solving abilities and leadership qualities.

3) To incorporate Inter-Disciplinary areas of Engineering through training for building a good technical foundation.

PEOs, POs, PSOs

POs

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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

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

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

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

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

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

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

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

PEOs

PEO 1: Apply knowledge in emerging areas of Mechanical Engineering to handle the realistic problems.

PEO 2: Relate engineering issues to broader social and human context, in which their engineering contributions will be utilized.

PEO 3: Graduates will exhibit managerial skills and social responsibility in their profession and adapt to current trends.

PSOs

PSO_1: Domain Specific Knowledge: Apply the relevant techniques to plan, analyze and design Mechanical Structures.

PSO_2: Product Development: Design and deployment of principles to create a new technology for the success of business.

NARAYANA ENGINEERING COLLEGE::NELLORE

AUTONOMOUS

DEPARTMENT OF MECHANICAL ENGINEERING

Course Structure for B.Tech ME w.e. f AY: 2021-22

SEMESTER I

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total marks
20MA1001	BS	Algebra & Calculus	3	1	0	4	4	40	60	100
20CH1003	BS	Chemistry for Mechanical Engineering	3	0	0	3	3	40	60	100
20ES1001	ES	Problem Solving & Programming	3	0	0	3	3	40	60	100
20EN1001	HS	English	2	0	0	2	2	40	60	100
20CH1503	BS	Chemistry for Mechanical Engineering Lab	0	0	3	3	1.5	40	60	100
20ES1503	ES	Engineering Drawing	0	1	4	5	3	40	60	100
20ES1506	ES	Problem Solving & Programming Lab	0	0	3	3	1.5	40	60	100
20EN1501	HS	English Language Lab	0	0	3	3	1.5	40	60	100
20MC8001	MC	Mandatory course I	Induction Program							
		Counselling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester					20 Points		
		Total	**11**	**2**	**16**	**29**	**19.5**	**320**	**480**	**800**

SEMESTER II

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	T otal		Int. Marks	Ext. Marks	Total marks
20PH1003	**BS**	Physics for Mechanical Engineering	3	0	0	3	3	40	60	100
20MA1003	**BS**	Vector calculus, Complex variables &Transforms	3	1	0	4	4	40	60	100
20ES1008	**ES**	Material Science	3	0	0	3	3	40	60	100
20ES1010	**ES**	Principles of Electrical & Electronics Engineering	3	0	0	3	3	40	60	100
20PH1503	**BS**	Physics for Mechanical Engineering Lab	0	0	3	3	1.5	40	60	100
20ES1505	**ES**	Engineering & IT Workshop Lab	0	0	4	4	2	40	60	100
20EN1502	**HS**	Oral Communications Skills Lab	0	0	2	2	1	40	60	100
20ES1511	**ES**	Material Science Lab	0	0	2	2	1	40	60	100
20ES1513	**ES**	Principles of Electrical& Electronics Engineering Lab	0	0	2	2	1	40	60	100
20MC8002-12	**MC**	Mandatory course II	2	0	0	2	0			
		Counselling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester					20 Points		
		Total	**14**	**1**	**16**	**31**	**19.5**	**360**	**540**	**900**

SEMESTER III

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20MA1006	BS	Probability, Statistics &Numerical methods	3	0	0	3	3	40	60	**100**
20ES1006	ES	Engineering Mechanics	2	1	0	3	3	40	60	**100**
20ES1015	ES	Thermodynamics	3	0	0	3	3	40	60	**100**
20ME2001	PC	Fluid Mechanics & Hydraulic Machines	3	0	0	3	3	40	60	**100**
20ME2002	PC	Manufacturing Processes	3	0	0	3	3	40	60	**100**
20ES1514	ES	Computer Aided Draftingand Modeling Lab	0	0	3	3	1.5	40	60	**100**
20ME2501	PC	Fluid Mechanics & Hydraulic Machines Lab	0	0	3	3	1.5	40	60	**100**
20ME2502	PC	Manufacturing Processes Lab	0	0	3	3	1.5	40	60	**100**
20CD6001	SC	Career competency Development I	0	0	2	2	1	40	60	100
20CC6001	**SC**	Value added course/Certificate courseI	0	0	0	0	1	40	60	100
		Counselling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester					20 Points		
		Total	**14**	**1**	**14**	**29**	**21.5**	**400**	**600**	**1000**

SEMESTER IV

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20ME2003	PC	Kinematics of Machinery	3	0	0	3	3	40	60	100
20ME2004	PC	Mechanics of Materials	2	1	0	3	3	40	60	100
20ME2005	PC	Metal Forming Processes	3	0	0	3	3	40	60	100
20ME2006	PC	Thermal Engineering	3	0	0	3	3	40	60	100
	OE	Open Elective I	3	0	0	3	3	40	60	100
20ME2503	PC	Computer Aided Machine Drawing	0	0	3	3	1.5	40	60	100
20ME2504	PC	IC Engines Lab	0	0	3	3	1.5	40	60	100
20ME2505	PC	Mechanics of Materials Lab	0	0	3	3	1.5	40	60	100
20CD6002	SC	Career competency Development II	0	0	2	2	1	40	60	100
20CC6002	SC	Value added course/Certificate course II	0	0	0	0	1	40	60	100
20MC8002-12	**MC**	Mandatory course III	2	0	0	2	0			
		Counselling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester					20 Points		
		Total	**16**	**1**	**14**	**31**	**21.5**	**400**	**600**	**1000**

SEMESTER V

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20ME2007	PC	Design of Machine Elements	3	0	0	3	3	40	60	100
20ME2008	PC	Metal Cutting & Machine Tools	3	0	0	3	3	40	60	100
20ME2009	PC	Thermal Power Systems	3	0	0	3	3	40	60	100
	OE	Open Elective II	3	0	0	3	3	40	60	100
20ME4001-6	PE	Professional Elective I	3	0	0	3	3	40	60	100
20ME2506	PC	Design Thinking & Product Innovation Lab	0	0	3	3	1.5	40	60	100
20ME2507	PC	Metal Cutting & Machine Tools Lab	0	0	3	3	1.5	40	60	100
20CD6003	SC	Career competency Development III	0	0	2	2	1	40	60	100
20CC6003	SC	Value added course/Certificate courseIII	0	0	0	0	1	40	60	100
20ME7501	PR	Internship I/on job training/Com Ser Project	0	0	0	0	1.5	00	100	100
		Counselling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester					20 Points		
		Total	**15**	**0**	**11**	**26**	**21.5**	**360**	**640**	**1000**

SEMESTER VI

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20ME2010	PC	Computer Integrated Manufacturing	3	0	0	3	3	40	60	100
20ME2011	PC	Dynamics of Machinery	3	0	0	3	3	40	60	100
20ME2012	PC	Heat and Mass Transfer	2	0	0	2	2	40	60	100
	OE	Open Elective III	3	0	0	3	3	40	60	100
20ME4007-12	PE	Professional Elective II	3	0	0	3	3	40	60	100
20ME4013-18	PE	Professional elective III	3	0	0	3	3	40	60	100
20ME2508	PC	CAD/CAM Lab	0	0	3	3	1.5	40	60	100
20ME2509	PC	Heat Transfer Lab	0	0	2	2	1	40	60	100
20CD6004	SC	Career competency Development IV	0	0	2	2	1	40	60	100
20CC6004	**SC**	Value added course/Certificate course IV	0	0	0	0	1	40	60	100
20MC8002-12	**MC**	Mandatory course IV	2	0	0	2	0			
		Counselling/ Mentoring	0	0	1	1	0	--	--	--
		Sports/ Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester						20 Points	
		Total	**19**	**0**	**10**	**29**	**21.5**	**400**	**600**	**1000**

SEMESTER VII

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20HS5001 -8	HS	Humanities and Social Science Elective	2	0	0	2	2	40	60	100
20ME2013	PC	Design of Transmission Systems	3	0	0	3	3	40	60	100
20ME2014	PC	Metrology & Instrumentation	3	0	0	3	3	40	60	100
	OE	Open Elective IV	3	0	0	3	3	40	60	100
20ME4019-24	PE	Professional elective IV	3	0	0	3	3	40	60	100
20ME4025-30	PE	Professional elective V	3	0	0	3	3	40	60	100
20ES1517	ES	Software Tools Lab	0	0	2	2	1	40	60	100
20ME2510	PC	Metrology & Instrumentation Lab	0	0	3	3	1.5	40	60	100
20CD6005	SC	Career competency Development V	0	0	2	2	1	40	60	100
20CC6501	SC	Skill development Training	0	0	2	2	1	40	60	100
20ME7502	PR	Internship II/on job training/Com Ser Project	0	0	0	0	1.5	00	100	100
		Counselling/Mentoring	0	0	1	1	0	--	--	--
		Sports/Hobby Clubs/Activities	0	0	2	2	0	--	--	--
		Activity Point Programme	During the Semester						20 Points	
		Total	**17**	**0**	**12**	**29**	**23**	**400**	**700**	**1100**

SEMESTER VIII

Subject Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
20ME7503	PR	Project work, seminar and internship	0	0	0	0	12	60	140	200
		Activity Point Programme	During the Semester					20 points		
			0	0	0	0	12	60	140	200

Open Electives (OE) offered by ME Department

S. No	Course Code	Subject
1	20ME3001	Engineering Optimization
2	20ME3002	Mechatronics
3	20ME3003	Industrial Engineering and Management
4	20ME3004	Automobile Engineering
5	20ME3005	Basics of Mechanical Engineering
6	20ME3006	Automation &Robotics
7	20ME3007	Engineering materials
8	20ME3008	Total Quality Management
9	20ME3009	Industrial Safety and Hazard Management

PROFESSIONAL ELECTIVE (PE)

The Professional Elective Courses (PE) are shown in different tracks/groups: The students will have options
of selecting the electives from the different tracks/groups depending on the specialization one wishes to acquire.

ELECTIVE TRACK/ GROUP	Professional Elective-1	Professional Elective-2	Professional Elective-3	Professional Elective-4	Professional Elective-5
Design Engineering	Product Design & Development (20ME4001)	Design Of Rotating Elements (20ME4007)	Finite Element Methods (20ME4013)	Computational Fluid Dynamics (20ME4019)	Geometric dimensioning an tolerancing (20ME4025)
Thermal Engineering	Gas turbines and Jet Propulsion (20ME4002)	Power plant Engineering (20ME4008)	Refrigeration & AirConditioning (20ME4014)	Hydraulic & matics Systems 20ME4020)	Automobile Engineering (20ME4026)
Production Engineering	Fundamentals of Additive Manufacturing (20ME4003)	Modern Manufacturing Methods (20ME4009)	Automation In Manufacturing (20ME4015)	Surface Engineering (20ME4021)	Manufacturing & Inspection Of Gears (20ME4027)
Industrial Engineering	Management Science (20ME4004)	Engineering Optimization (20ME4010)	Industrial Engineering (20ME4016)	Production & Operation Management (20ME4022)	Industrial Management (20ME4028)
CAD/CAM	Flexible Manufacturing Systems (20ME4005)	Mechatronics (20ME4011)	Intelligent Manufacturing Systems (20ME4017)	Automation &Robotics (20ME4023)	Computer Aided Process Planning (20ME4029)
Materials Engineering	Principles of Metal Extraction & Refining (20ME4006)	Metallurgy (20ME4012)	Composite Materials (20ME4018)	Nano materials (20ME4024)	Smart Materials (20ME4030)

HONORS

S. NO.	COURSE NAME	COURSE CODE	CREDITS
	POOL 1		
1	Industrial Tribology	20MEH001	4
2	Non-Destructive Testing	20MEH002	4
3	Supply Chain Management	20MEH003	4
4	Reverse Engineering and Rapid Prototyping	20MEH004	4
	POOL 2		
1	Robotics: Modelling, Analysis and Control	20MEH005	4
2	Mechanical Handling Systems	20MEH006	4
3	Theory and Design of Control Systems	20MEH007	4
4	Smart Materials for Mechatronic Applications	20MEH008	4
	POOL 3		
1	Automobile Engine Design	20MEH009	4
2	Automotive Transmission	20MEH010	4
3	Autotronics& Safety	20MEH011	4
4	Alternative Energy Sources for Automobiles	20MEH012	4
	POOL 4		
1	Advanced Thermodynamics	20MEH013	4
2	Advanced IC Engines	20MEH014	4
3	Jet Propulsion and rocket Engineering	20MEH015	4
4	Computational Fluid Dynamics	20MEH016	4

MINORS

S. NO	SUBJECT	COURSE CODE	CREDITS
1	Engineering Mechanics	**20MEM001**	4
2	Thermal Engineering	**20MEM002**	4
3	Production Technology	**20MEM003**	4
4	Fundamentals of Engineering Design	**20MEM004**	4
5	Production Planning and control	**20MEM005**	4
6	Materials Technology	**20MEM006**	4
7	CAD/CAM	**20MEM007**	4
8	Renewable Energy Sources	**20MEM008**	4

HUMANITIES AND SOCIAL SCIENCES (HS)

SEMESTER	SUBJECT	COURSE CODE	CREDITS
I SEM	English	20EN1001	2
	English Language Lab	20EN1501	1.5
IV SEM	Oral Communications Skills Lab	20EN1502	1
VII Sem	Humanities and Social Science Elective		2
	TOTAL		**6.5**

BASIC SCIENCES (BS)

SEMESTER	SUBJECT	COURSE CODE	CREDITS
I SEM	Algebra & Calculus	20MA1001	4
	Chemistry for mechanical engineering	20CH1003	3
	Chemistry for mechanical engineering lab	20CH1503	1.5
II SEM	Vector calculus, Complex variables &Transforms	20MA1003	4
	Physics for Mechanical Engineering	20PH1003	3
	Physics for Mechanical Engineering Lab	20PH1503	1.5
III SEM	Probability, Statistics & Numerical methods	20MA1006	3
	TOTAL		**20**

ENGINEERING SCIENCES (ES)

SEMESTER	SUBJECT	COURSE CODE	CREDITS
I SEM	Problem Solving & Programming	20ES1001	3
	Engineering Drawing	20ES1503	3
	Problem Solving & Programming Lab	20ES1506	1.5
II SEM	Material Science & Engineering	20ES1008	3
	Principles of Electrical &Electronics Engineering	20ES1010	3
	Engineering Workshop	20ES1505	1.5
	IT Workshop		1.5
	Material Science & Engineering Lab	20ES1505	1
	Principles of Electrical and Electronics & Engineering Lab	20ES1513	1
III SEM	Engineering Mechanics	20ES1006	3
	Thermodynamics	20ES1015	3
	Computer Aided Drafting and Modelling Lab	20ES1514	1.5
VII SEM	Software Tools Lab	20ES1517	1
		TOTAL	**27**

PROFESSIONAL CORE (PC)

SEMESTER	SUBJECT	COURSE CODE	CREDITS
III	Manufacturing Processes	**20ME2002**	2
	Fluid Mechanics & Hydraulic Machines	**20ME2001**	3
	Manufacturing Processes Lab	**20ME2502**	1.5
	Fluid Mechanics & Hydraulic Machines Lab	**20ME2501**	1.5
		(2+2)	8
IV	Thermal Engineering	**20ME2006**	3
	Kinematics of Machinery	**20ME2003**	3
	Mechanics of Solids	**20ME2004**	3
	Metal Forming Processes	**20ME2005**	2
	Thermal Engineering Lab	**20ME2504**	1.5
	Computer Aided Machine Drawing Lab	**20ME2503**	1.5
	Mechanics of Solids Lab	**20ME2505**	1.5
		(4+3)	(15.5)
V	Thermal Power Systems	**20ME2009**	3
	Design of Machine Elements	**20ME2007**	3
	Machine Tools	**20ME2008**	2
	Design Thinking & Product Innovation Lab	**20ME2506**	1.5
	Machine Tools Lab	**20ME2507**	1.5
		(3+2)	**11**
VI	Dynamics of Machinery	**20ME2012**	3
	Heat Transfer	**20ME2013**	2
	Computer Integrated Manufacturing	**20ME2010**	3
	Heat Transfer Lab	**20ME2509**	1
	CAD/CAM Lab	**20ME2508**	1.5
		(3+2)	10.5
VII	Design of Transmission Systems	**20ME2011**	3
	Metrology & Measurements	**20ME2014**	3
	Metrology & Measurements Lab	**20ME2510**	1.5
		(1+1)	7.5
	TOTAL	**52.5**	

PROFESSIONAL ELECTIVES (PE)

SEMESTER	SUBJECT	COURSE CODE	CREDITS
V Sem	Professional Elective I	20ME4001-06	3
VI Sem	Professional Elective II	20 ME 4007-12	3
	Professional Elective III	20 ME 4013-18	3
VII Sem	Professional Elective IV	20 ME 4019-24	3
	Professional Elective V	20 ME 4025-30	3
	TOTAL		**15**

OPEN ELECTIVES (OE)

SEMESTER	SUBJECT	CREDITS
IV Sem	Open Elective I	3
V Sem	Open Elective II	3
VI Sem	Open Elective III	3
VII Sem	Open Elective IV	3
	TOTAL	**12**

SKILL ORIENTED COURSE(SC)

SEMESTER	SUBJECT	COURSE CODE	CREDITS
III Sem	Career Competency Development I	20CD6001	1
	Value Added Course/Certificate Course I	20CC6001	1
	Industry Oriented Course I		1
IV Sem	Career Competency Development II	20CD6002	1
	Value Added Course/Certificate Course II	20CC6002	1
V Sem	Career Competency Development III	20CD6003	1
	Value Added Course/Certificate Course III	20CC6003	1
	Industry Oriented Course II		1
VI Sem	Career Competency Development IV	20CD6004	1
	Value Added Course/Certificate Course IV	20CC6004	1
VII Sem	Career Competency Development V	20CD6005	1
	Skill Development Training	20CC6501	1
	TOTAL		**12**

PROJECT (PR)

SEMESTER	SUBJECT	COURSE CODE	CREDITS
V Sem	Internship I/on job training/Com Ser Project	20ME7501	1.5
VII Sem	Internship II/on job training/Com Ser Project	20ME7502	1.5
VIII Sem	Project work, seminar and internship	20ME7503	12
		TOTAL	15

S. NO	CAT	CREDITS PER SEMESTER								CREDITS	AICTE
		I	II	III	IV	V	VI	VII	VIII		
1	HS	3.5			1			2		6.5	12
2	BS	8.5	8.5	3						20	25
3	ES	7.5	11	7.5				1		27	24
4	PC			8	15.5	11	10.5	7.5		52.5	48
5	PE					3	6	6		15	18
6	OE				3	3	3	3		12	18
7	SC			3	2	3	2	2		12	15
8	PR					1.5		1.5	12	15	--
	MC	No Credits									NC
TOTAL		19.5	19.5	21.5	21.5	21.5	21.5	23	12	160	160

NARAYANA ENGINEERING COLLEGE: NELLORE								
20MA1001	**Algebra &Calculus (CSE, ECE, EEE, CE, ME)**							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I	3	1	0	69	4	40	60	100

Pre-requisite: Intermediate Mathematics

Course Objectives:

1. To familiarize the students with the theory of matrices and quadratic forms
2. To analyze first order ordinary differential equations.
3. To enlighten the learners in the concepts of higher order differential equation an its applications
4. To explain the series expansions using mean value theorems and the concepts of multivariable differential calculus.
5. To summarize the procedure to solve the partial differential equations.
6. To explain the student with mathematical tools needed in evaluating multiple integrals and its applications.

Course Outcomes: After successful completion of the course, the student will be able to		**Blooms taxonomy Level**
CO 1	**Solve** the system of Linear Equations	**(BTL-3)**
CO 2	**Solve** first order differential equations utilizing the standard techniques for separable, exact, linear, homogeneous, or Bernoulli cases.	**(BTL-3)**
CO 3	**Obtain** the complete solution of a higher order differential equations	**(BTL-2)**
CO 4	**Make use of** the Taylor's and Maclaurin's Series and Maxima, Minima for the given function	**(BTL-3)**
CO 5	**Apply** a range of techniques for solutions of first order Linear and non linear Partial Differential Equations (PDE)	**(BTL-3)**
CO 6	**Apply** the techniques of Multiple integrals for the Area of the region bounded by curves and volume	**(BTL-3)**

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2												
CO2	3	3	1											
CO3	3	3	1											
CO4	3	2												
CO5	3	3	1											
CO6	3	2												

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	**Matrices**	**Hours: 16 (12L+4T)**

Introduction to matrices, Definition of Rank ,Definition of Echelon form , Problems, Solving System of Non-Homogeneous equations- Definition, Conditions for Consistency, Problems, Solving System of Homogeneous equations- Definition, Problems, Eigen values & Eigen Vectors- Definition, Problems

,properties of Eigen values & Eigen Vectors(Without proof), Cayley – Hamilton Theorem - Statement(Without proof),finding inverse and power of a matrix by Cayley-Hamilton Theorem, Diagonalization of a Matrix-Definition, similarity of a matrix ,modal matrix, spectral matrix,powers of a matrix, problems on Diagonalization of a matrix, Quadratic Forms- Definition, Finding Matrix from Q.F, Index, signature, rank and nature of the quadratic forms, Reduction of Q.F. into a canonical form by linear transformation , Reduction of Q.F. into a canonical form by orthogonal transformation.

At the end of the Module 1, students will be able to:

1. Solve the system of homogenous and non-homogenous linear equations.(BTL-3)
2. Obtain the Eigen values and Eigen vectors of a matrix.(BTL-2)
3. Identify special properties of matrix and for using this information to study the nature of the linear equations. (BTL-3)
4. Find the inverse and powers of a square matrix.(BTL-1)
5. Obtain the diagonalization form of the matrix.(BTL-2)
6. Apply the techniques of matrices in various engineering problems. (BTL-3)

MODULE -2	**First Order Ordinary Differential Equations**	**Hours: 9 (7L+2T)**

Exact Differential equation - Definition, condition for exactness, problems, Non - Exact Differential equations- Integrating factor , Method1:Integrating factor by inspection, problems, Method2:Finding Integrating factor , problems, Method3:Finding Integrating factor , problems, Method4:Finding Integrating factor , problems, Method5:Finding Integrating factor , problems, Linear differential Equation- Definition,Working rule to find general solution, problems, Bernoulli's differential Equation- Definition, Working rule to find general solution, problems, Applications of Differential equation of First order: Newton's law of Cooling-Explanation of the concept, problems, Law of natural growth and Decay- Explanation of the concept, problems and Simple Electric Circuits-Explanation of the concept, problems.

At the end of the Module 2, students will be able to:

1. Identify the first order ordinary differential equations. (BTL-3)
2. Solve the first order ordinary differential equations. (BTL-3)
3. Apply the techniques of first order ordinary differential equations in Newton's law of cooling, Natural growth & Decay problems. (BTL-3)
4. Make Use of the first order ordinary differential equation techniques in simple electric circuits.
   (BTL-3)

MODULE-3	**Higher Order Ordinary Differential Equations**	**Hours: 11 (8L+3T)**

Non-Homogenous Linear Differential equation of second and higher order with constant coefficients-Definition, complete solution, operator D, rules for finding Complimentary function, problems, inverse operator, General method for finding Particular Integral**.**

Non-homogeneous Linear Differential Equations of Second & Higher order with Constant coefficients with RHS term of the typee^{ax},sinax ,cosax, Polynomial in X,$e^{ax}v(x)$, X.V(x)-Explanation of the concept& problems, Method of variation of parameters- Explanation of the concept& problems, Euler- Cauchy equation- Definition, problems ,Legendre's Linear equation- Definition, problems. Applications to

Higher order Differential Equations - L-C-R circuits, problems.

At the end of the Module 3, students will be able to:

1. Identify the higher order ordinary differential equations. (BTL-3)
2. Solve the linear differential equations with constant coefficients by appropriate methods (BTL-3)
3. Solve the linear differential equations with variable coefficients by appropriate methods (BTL-3)
4. Make Use of the higher order ordinary differential equations techniques in electrical circuits. and in various engineering problems. (BTL-3)

MODULE-4	**Mean value theorems & Multivariable Calculus**	**Hours: 9 (7L+2T)**

Taylor's and Maclaurin's theorems with remainders-Statements (without proof), problems on Taylor's series , problems on Maclaurin's series, Jacobean-Definition, Properties , problems ,Functional dependence-Definition , problems ,Maxima & Minima of function of two variables - Rules , Maxima & Minima of function of two variables without constraint- problems ,Maxima & Minima of function of two variables with constraint- problems, Lagrange's Method of Undetermined multipliers, problems.

At the end of the Module 4, students will be able to:

1. Demonstrate the given function as a series of Taylor's and maclurin's with remainders.(BTL-2)
2. Illustrate series expansions of functions using mean value theorems. (BTL-2)
3. Apply Jacobean concept to deal with problems in change of variables.(BTL-3)
4. Obtain the maxima and minimum values of the function for two variables.(BTL-2)
5. Apply the mean value theorems to check the continuity of the function in the given interval (BTL-3)

MODULE-5	Partial Differential Equations	**Hours: 12 (9L+3T)**

Definition ,Formation of PDE by the Method of Elimination of arbitrary constants, problems ,Method of Elimination of arbitrary functions, problems, Method of Separation of Variables-Explanation of the concept& problems, First order linear partial differential equations-Definition, Solutions of first order linear PDE-Working rule of Lagrange's Method, problems ,First order non-linear partial differential equations- Definition, Solutions of first order non-linear partial differential equations-Standard form-I, problems , Standard form-II, problems ,Standard form-III, problems, Standard form-IV, problems.

At the end of the Module 5, students will be able to:

1. Identify the basic properties of partial differential equations. (BTL-3)
2. Outline partial differential equations. (BTL-2)

3. Solve the applications of PDE by using the method of separation of variables (BTL-3)
4. Apply the PDE techniques in various engineering fields. (BTL-3)

MODULE-6	Multiple Integrals	Hours: 12 (9L+3T)

Double Integrals- Introduction, Evaluation in Cartesian coordinates, problems, Evaluation in Polar coordinates, change of variables – Problems on Cartesian to Polar, Change of Order of Integration-Problems , Area enclosed by plane curves - Problems, Triple integrals- Introduction, Evaluation of Triple Integrals, Volume by Triple Integrals – Problems, Change of variables between Cartesian, cylindrical and spherical polar coordinates- Problems.

At the end of the Module 6, students will be able to:

1. Obtain double integrals in Cartesian and polar co-ordinates. (BTL-2)
2. Obtain the area bounded by a region using double integration techniques.(BTL-2)
3. Solve triple integrals.(BTL-3)
4. Obtain volumes by using triple integrals.(BTL-2)
4. Make Use of multiple integral techniques in engineering problems.(BTL-3)

Total hours:	69 hours (52L+17T)

Content beyond syllabus:

1. Orthogonal Trajectories.
2. Deflection of Beams .
3. Simultaneous Linear equations with constant coefficients
4. Taylor's series for function of two variables.
5. Homogeneous Linear Partial differential equations with constant coefficients.
6. Calculation of mass, centre of gravity, moment of inertia

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	**Matrices**	CO1	**https://youtu.be/P2pL5VThrzQ**
2	**First Order Ordinary Differential Equations**	CO2	**https://youtu.be/P7gVp333B6M**
3	**Higher Order Ordinary Differential Equations**	CO3	**https://youtu.be/btOCUmJkrrg**
4	**Mean value theorems & Multivariable Calculus:**	CO4	**https://youtu.be/bJPuy0QZ-tE** **https://youtu.be/0apMXhWG_W8** **https://youtu.be/aqfSOOiO2kI**
5	**Partial DifferentialEquations**	CO5	https://youtu.be/kZ7Oa7iMiCs
6	**Multiple Integrals**	CO6	https://youtu.be/mIeeVrv447s

Text Book(s):

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017
3. N. Bali, M. Goyal, C. Watkins, Advanced Engineering Mathematics, Infinity Science Press.

Reference Book(s):

1.R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.

2.George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013.

3.B. V. Ramana, Higher Engineering Mathematics, Mc Graw Hill Education

4.H. k Das, Er. Rajnish Verma, Higher Engineering Mathematics, S. Chand.

Online Resources/ Web Resources:

1 http://www.macs.hw.ac.uk/~simonm/linalg.pdf

2.http://www.e-booksdirectory.com/details.php?ebook=7400re

3 http://www.efunda.com/math/math_home/math.cfm

4.http://www.ocw.mit.edu/resources/#Mathematics

5 .http://www.sosmath.com/

6.http://www.mathworld.wolfram.com/

NARAYANA ENGINEERING COLLEGE:NELLORE								
20CH1003	CHEMISTRY FOR MECHANICAL ENGINEERING							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I	3	0	0	48	3	40	60	100

Pre-requisite: Nil

Course Objectives:

1. The main objective of the course is to impart knowledge on the fundamental concepts of chemistry involved in application of several important engineering materials that are used in the industry/day-to-day life.
2. To include the importance of water in industrial usage, significance of corrosion control to protect the structures, polymers and their controlled usage
3. To acquire knowledge of engineering materials and about fuels ,batteries, surface chemistry and lubricants

Course Outcomes: After successful completion of the course, the student will be able to:		BL
CO 1	**Select** and employ suitable water treatment technologies for domestic and industrial applications	1
CO 2	**Apply** the knowledge of electrochemistry to improve the efficiency of batteries	3
CO 3	**Illustrate** various corrosion situations and implement suitable corrosion control measures.	2
CO 4	**Explain** the preparation, properties, and applications of thermoplastics & thermosetting, elastomers & conducting polymers.	2
CO 5	**Explain** calorific values, octane number, refining of petroleum and cracking of oils	2
CO 6	**Select** lubricants for various mechines.and demonstrate the preparation of colloids	1

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1				2	1					1		
CO2	3	2				1						1		
CO3	3	1				1	2					1		
CO4	2	1				1	2					1		
CO5	1	1				1	1					1		
CO6	2	1										1		

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1

WATER TECHNOLOGY **8hrs**

Definition of hard and soft water, Sources of water and classification of impurities, Hardness and its types, Units of hardness, Determination of hardness of water by EDTA method. problems on hardness, Boiler problems – Scale and Sludge formation in boiler, Priming & Foaming,. Internal treatment methods. Water softening processes –Zeolite process, Ion- exchange process. Brackish water treatment- Electrodialysis, Reverse osmosis.

At the end of the Module 1, students will be able to:

1.List the differences between temporary and permanent hardness of water .(L1)
2.Explain the principles of reverse osmosis and electro dialysis. (L2)
3.Compare quality of drinking water with BIS and WHO standards. (L2)
4.Illustrate problems associated with hard water - scale and sludge**.** (L2)
5.Eexplain the working principles of different Industrial water treatment processes.(L2)

MODULE -2

ELECTRO CHEMISTRY AND ITS APPLICATIONS 9 hrs

Electrode potential, EMF of an electrochemical cell, Nernst equation electrode potential, concept of conductivity, conductivity cell, conductometric titrations (acid-base titrations),**Batteries**-classification Ni- cd cell, lithium ion cell, lead-acid storage cell, fuel cells-hydrogen oxygen fuel cell, methanol – oxygen fuel cell.

At the end of the Module 2, students will be able to:

1. **Apply** Nernst equation for calculating electrode and cell potentials.(L3)
2. **Compare** different batteries and their applications.(L2)
3. **Describe** the theory of construction of battery and fuel cells.(L2)
4. **solve** problems based on cell potential (L3)
5. **Explain** the theory of conductometric titrations.(L2)

MODULE-3

CORROSION AND ITS CONTROL 7hrs

Corrosion - mechanism of chemical, electrochemical corrosion - Pilling Bed worth rule – Types of Electrochemical corrosion - galvanic corrosion - differential aeration corrosion factors influencing corrosion. Corrosion control: Cathodic protection - sacrificial anodic method - Protective coatings: surface preparation for metallic coatings –metal spraying, metal cladding ,hot dipping electro plating (copper plating) and electro less plating (Nickel plating) .

At the end of the Module 3, students will be able to:

1. **Apply** Pilling Bedworth rule for corrosion and corrosion prevention.(L3)
2. **Categorize** the reasons for corrosion and study some methods of corrosion.(L2)
3. **Apply** Pilling Bedworth rule for corrosion and corrosion prevention (L3)
4. **Demonstrate** the corrosion prevention methods and factors affecting corrosion (L2)
5. **Explain** various types of corrosion.(L2)

MODULE-4

INDUSTRIAL POLYMERS - 9 **hrs**

Basic concepts of polymers, mechanisms polymerization –addition, condensation, co polymerization, Classification of plastics: Thermoplastics, thermosetting plastics: Industrial polymers Preparation, properties and applications of PVC ,Teflon ,Nylons, Bakelite and. Moulding of plastics into articles : Compression, Injection, transfer and extrusion methods.

At the end of the Module 4, students will be able to:

1 I**dentify** different types of polymers .(L2)
2. **Distinguish** between thermoplastic and thermo setting resins .(L2)
3. **Explain** the preparation, properties and applications of some plastic materials.(L2)
4.**Describe** the polymerisation reactions.(L2)
5. **Demonstrate** the moulding of plastics.(L2)

MODULE-5

FUEL CHEMISTRY **8 hrs**

Fuels – Types of fuels, characteristics of good fuel, ,units Analysis of coal,-proximate and ultimate , Liquid Fuels refining of petroleum, synthetic petrol fischer- tropch and Bergius process ,calorific value,HCV&NCV fuels for IC engines, knocking and anti-knock agents, Octane and Cetane values, cracking of oils; alternative fuels- propane, methanol and ethanol, bio fuels.

At the end of the Module 5, students will be able to:

1.Select suitable fuels for IC engines .(L1)
2.Explain calorific values, octane number, refining of petroleum and cracking of oils .(L2)
3. **Differentiate** petroleum, petrol, synthetic petrol and have knowledge how they are produced **.** .(L2)
4. **Define** various types of coal.(L1)
5.**Explain** various types of alternative fuels.(L2)

MODULE-6

SURFACE CHEMISTRY AND LUBRICANTS **7 hrs**

Surface chemistry-Introduction to surface chemistry ,colloids, micelle formation, synthesis of colloids (any two methods with examples),applications of colloids.

Lubricants-Definition, functions of lubricants, mechanism of lubrication, classification of lubricants, properties of lubricants – viscosity and viscosity index , flash and fire points, cloud and pour points, Aniline points, neutralization number and mechanical strength.

At the end of the Module 6, students will be able to:

1. **Explain** the synthesis of colloids with examples.(L2)
2. **Illustrate** the functions and properties of lubricants.(L2)
3.**Explain** the mechanism of lubrication. .(L2)
4.**Identify** the application of colloids .(L3)
5.**Select** the suitable lubricant for various engines.(L3)

Total hours:	**48 hours**

Content beyond syllabus:

1. Boiler troubles –boiler corrosion and caustic embrittlement.
2. Vulcanization and compounding of rubber

Self-Study:

Contents to promote self-Learning:

SNO	**Topic**	**CO**	**Reference**
1	Hardness of water	CO1	https://nptel.ac.in/content/storage2/courses/105104102/hard

			ness.htm
2	Conductometric titrations	CO2	https://www.youtube.com/watch?v=grWh8Rtb2LM
3	Galvanic corrosion	CO3	https://www.youtube.com/watch?v=2s-sOiJJv88
4	plastics	CO4	https://www.youtube.com/watch?v=FATc12opDCA
5	Refining of petroleum	CO5	https://www.youtube.com/watch?v=INqhbIl8r4Q
6	lubrication	CO6	https://www.youtube.com/watch?v=cTw0S4R6p08

Text Book(s):

1. P. C. Jain & Monika Jain, *Engineering Chemistry*, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 16th edition, 2013.
2. K. N. Jayaveera, G. V. Subba Reddy and C. Ramachandriah, *Engineering Chemistry*, Mc.Graw Hill Publishers, New Delhi.
3. Text Book of Engineering chemistry by y.Bharathi kumari and jyotsna.cherikuri ,VGS publications

Reference Book(s):

1. Text book of engineering chemistry by shashi chawla.
2. Text book of engineering chemistry by A.jayashree,Willey publications, New Delhi
3. Advanced polymer chemistry by M.chanda.

Online Resources:

1. https://www.cgaspirants.com/2017/08/engineering-chemistry-by-jain-jain.html

2 .https://www.scribd.com/doc/278434466/Shashi-Chawla-Engineering-Chemistry-PDF

3. https://www.mdpi.com/books/pdfview/book/240

Web Resources:

1. https://nptel.ac.in/courses/105/106/105106119/
2. https://youtu.be/KHh_IX1G6uA
3. https://www.youtube.com/watch?v=MfbxR9ZDs0s&feature=youtu.be
4. https://nptel.ac.in/courses/113/104/113104082/
5. https://nptel.ac.in/courses/113/105/113105028/

NARAYANA ENGINEERING COLLEGE:NELLORE								
20ES1001	**PROBLEM SOLVING AND PROGRAMMING**							R20
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I	3	0	0	48	3	40	60	100

Pre-requisite: Mathematics Knowledge, Analytical and Logical skills

Course Objectives:

1. To understand various steps in Program development.
2. To understand the basic concepts in C Programming Language.
3. To learn how to write modular and readable C Programs.
4. To learn the syntax and semantics of a C Programming language.
5. To learn structured programming approach for problem solving.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Identify methods to solve a problem through computer programming. (BL - 3)
CO 2	Understand the use of basic elements of C language. (BL - 2)
CO 3	Understand the difference and the usage of various control statement. (BL - 2)
CO 4	Apply the modular approach for solving the problems. (BL - 3)
CO 5	Apply the Arrays and Pointers for solving problems. (BL - 3)
CO 6	Explain User-Defined Data Types and Files. (BL - 2)

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3											1	
CO2	1	2	1										1	
CO3	1	2	1		2								2	2
CO4	2	2	3	2	1							2	3	2
CO5	3	3	2	2								1	2	
CO6	2	2	2	2								1	2	

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	**FUNDAMENTALS OF COMPUTERS AND PROGRAMMING**	**8h**

Fundamentals of computers: History of Computers, Generations of Computer, The Computer System - The Input-Process-Output Concept, Components of Computer System, Operating System - Introduction, Objectives, Functions.

Introduction to Programming, Algorithms and Flowcharts: Programs and Programming, Programming languages, Compiler, Interpreter, Structured Programming Concept, Algorithms, Flowcharts, How to Develop a Program.

Fundamental Algorithms: Exchanging the values of Two Variables, Counting, Summation of a setof numbers, Factorial computation, Generation of the FibonacciSequence, Reversing the digits of an integer.

At the end of the Module 1, students will be able to:

1. Illustrate the working of a Computer. (BL - 2)
2. Solve problems using language independent notations. (BL - 3)

3. Understand the compilers and interpreters. (BL - 2)
4. Understand Structured Programming. (BL - 2)
5. Develop algorithms and flowcharts for problems.(BL - 3)

MODULE -2	BASIC ELEMENTS OF C	7 h

Basics of C: Introduction**,** Character Set, Structure of a C Program, A Simple C Program, Variables, Data Types and Sizes, Declaration, How does The Computer Store Data in Memory, Identifiers, Keywords, Constants, Assignment, and Initialization.

Operators and Expressions: Arithmetic Operators, RelationalOperators, LogicalOperators, BitwiseOperators, Conditional Operator, Comma operator, sizeof operator, Expressions, L values and R values, Expression Evaluation- Precedence and Associativity, Type Conversion.

At the end of the Module 2, students will be able to:

1. Understand the basic structure of a program in C. (BL - 2)
2. Understand tokens in C language.(BL - 2)
3. Illustrate the working of expressions.(BL - 2)
4. Understand the precedence and Associativity rules of operators. (BL - 2)
5. Understand the rules of type conversion. (BL - 2)

MODULE-3	DATA INPUT / OUTPUT AND CONTROL STATEMENTS	8 h

Input and Output: Basic Screen and Keyboard I/O in C, Formatted Input and Output, Unformatted Input and Output Functions

Control Statements: Selection Statements - if, Nested if, if-else, Nested if-else, else-if ladder, switch Looping Statements - while, do-while, for, Nested loops, Unconditional Statements - goto, break, continue, return.

At the end of the Module 3, students will be able to:

1. Explain the Formatted and Unformatted I/O functions. (BL - 2)
2. Understand Selection Statements. (BL - 2)
3. Understand Looping Statements. (BL - 2)
4. Explain Unconditional Statements. (BL - 2)

MODULE-4	FUNCTIONS AND PROGRAM STRUCTURE	8 h

Functions: Introduction, Using Functions, Passing Arguments to a Function, Working with Function, Scope and Extent, Recursion, The C Preprocessor.

Program Structure: Storage classes, Automatic variables, External variables, Static variables, Register variables, Multifile programs.

At the end of the Module 4, students will be able to:

1. Understand the basic concept of functions. (BL - 2)
2. Understand concept of Recursion and Preprocessor. (BL - 2)
3. Explain storage specifiers. (BL - 2)

MODULE-5	ARRAYS AND POINTERS	9 h

Arrays and Strings: Introduction, One-Dimensional Array, Multidimensional Arrays, Passing Arrays to Function, Strings - Declaration, Initialization, Printing Strings, String Input, Character Manipulation, String Manipulation, Arrays of Strings.

Pointers: Fundamentals, Pointer Declarations, Operations on pointers, Passing Pointers to a Function, Pointers and Arrays, Arrays of Pointers, Pointer to Pointer, Pointer to Functions, Command line arguments, Dynamic Memory Management.

At the end of the Module 5, students will be able to:

1. Understand the concept of Arrays. (BL - 2)
2. Understand the concept of pointers. (BL - 2)
3. Explain Dynamic Memory Management. (BL -2)

MODULE-6	USER-DEFINED DATA TYPES AND FILES	8 h
Structures and Unions: Basics of Structures, Nesting of Structures, Arrays of Structures, Structures and Pointers, Structures and Functions, Self-ReferentialStructures, Unions, Bit-fields, Enumerations, typedef. **Files:** Introduction, Using Files in C, Working with Text Files, Random Accesses to Files of Records.		
At the end of the Module 6, students will be able to: 1. Explain user defined data types. (BL - 2) 2. Understand the concept of Self-ReferentialStructures. (BL - 2) 3. Understand the working of files. (BL - 2)		
	Total hours:	**48 Hours**

Content Beyond Syllabus:

1. Analysis of Algorithms
2. Binary Files
3. Variable Length Argument Lists

Self-Study:

Contents to promote self-Learning:

S. No	Module	Reference
1	Fundamentals of Computers and Programming	https://nptel.ac.in/courses/106/106/106106127/ [Lec1] https://nptel.ac.in/courses/106/105/106105214/ [Week 1 - Lec 1 To 2] https://nptel.ac.in/courses/106/105/106105171/ [Week 1 - Lec 1 To 4]
2	Basic Elements of C	https://nptel.ac.in/courses/106/105/106105171/ [Week 1 - Lec5] https://nptel.ac.in/courses/106/105/106105171/ [Week 2 - Lecture 7 To 10] https://nptel.ac.in/courses/106/105/106105171/ [Week 3 - Lec 11 To 14] https://nptel.ac.in/courses/106/106/106106127/ [Lec2] https://nptel.ac.in/courses/106/106/106106127/ [Lec3] https://nptel.ac.in/courses/106/106/106106127/ [Lec4]
3	Data Input / Output and Control Statements	https://nptel.ac.in/courses/106/106/106106127/ [Lec5] https://nptel.ac.in/courses/106/105/106105171/ [Week 3 - Lec15] https://nptel.ac.in/courses/106/105/106105171/ Week 4 - Lec 16 To 20] [Week 5 - Lec 21 To 25] https://nptel.ac.in/courses/106/106/106106127/ [Lec 6 &7]
4	Functions and Program Structure	https://nptel.ac.in/courses/106/105/106105171/ [Week 7 - Lec35] [Week 8 - Lecture 36 To 40] https://nptel.ac.in/courses/106/105/106105171/ [Week 11 - Lec 53 To 54] https://nptel.ac.in/courses/106/106/106106127/ [Lec 20 To 27]

5	Arrays and Pointers	https://nptel.ac.in/courses/106/105/106105171/ [Week 6 - Lec 26 To 30][Week 7 - Lec 32 To 34,48] [Week 12 - Lec 58, 59, 61] https://nptel.ac.in/courses/106/106/106106127/ [Lec 9 To 19]
6	User-Defined Data Types and Files	https://nptel.ac.in/courses/106/105/106105171/ [Week 11 - Lec 55, 56, 57, 60] https://nptel.ac.in/courses/106/106/106106127/ [Lec 36, 37, 38] https://nptel.ac.in/courses/106/106/106106127/ [Lec60]

Text Book(s):

1. Pradip Dey, and Manas Ghosh, "Programming in C", 2018, Oxford University Press.
2. Byron Gottfried, Schaum's Outline of Programming with C, 4th Edition, 2018, McGraw-Hill

Reference Books :

1. Brian W. Kernighan, and Dennis M. Ritchie, "The C Programming Language", 2nd Edition, Pearson.
2. Ajay Mittal, Programming in C: A Practical Approach , 3/e, Pearson Publication
3. SCHILDT and HERBERT, C: The Complete Reference,4th Edition, McGraw Hill, 2020
4. SOMASHEKARA, M. T., GURU, D. S., MANJUNATHA, K. S., Problem Solving with C,2nd Edition, PHI Learning, 2018
5. Paul Deitel, Deitel& Harvey Deitel, C How to Program,6th Edition, Pearson Education
6. Jeri R. Hanly, Elliot B. Koffman, Ashok Kamthane and A.Ananda Rao, Programming in C and Data Structures, 1st Edition, Pearson Education, 2010.
7. H.Cheng, C for Engineers and Scientists, Mc.Graw-Hill International Edition Education / PHI, 2009
8. Yashavant P. Kanetkar, Let us C, 16th Edition, BBP Publications, Delhi, 2017.
9. R.G. Dromey, "How to Solve it by Computer". Pearson,2014.
10. Anita Goel, Computer Fundamentals, Pearson Publication,2010.

Online Resources / Web Resources:

1. https://nptel.ac.in/courses/106/105/106105171/
2. https://nptel.ac.in/courses/106/106/106106127/
3. https://www.youtube.com/playlist?list=PLVlQHNRLflP8IGz6OXwlV_lgHgc72aXlh
4. https://www.youtube.com/watch?v=8PopR3x-VMY
5. https://www.youtube.com/watch?v=vl794HKeXug
6. https://books.goalkicker.com/CBook/
7. https://www.tutorialspoint.com/cprogramming/index.htm
8. https://www.programiz.com/c-programming
9. https://www.javatpoint.com/c-programming-language-tutorial
10. https://www.edureka.co/blog/c-programming-tutorial/
11. https://data-flair.training/blogs/c-tutorial/
12. https://www.programmingsimplified.com/c-program-examples
13. https://www.w3schools.in/category/c-tutorial/
14. C Programming Notes for Professionals book : https://books.goalkicker.com/CBook/

NARAYANA ENGINEERING COLLEGE :: NELLORE								
20EN1001	ENGLISH							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I	2	0	0	32	2	40	60	100
Pre-requisite: Knowledge of fundamentals of English Language & Grammar								

Module	Module 1	Module 1	Module 1	Module 1	Module 1	Module 1	Total
No. of Hours	05	05	06	05	05	06	32

Course Objectives:

1. To enhance the linguistic and communicative competence.
2. To improve the Language proficiency of students in English with an emphasis on Vocabulary, Reading and Writing skills.
3. To provide knowledge of grammatical structures & rules and encourage their appropriate use.
4. To expose the students to Reading skills and apply the skill & strategies of a successful reader
5. To acquaint the students with effective strategies of paragraphs, note making, text editing, review writing and formal correspondence such as letter writing, e mail, and memos.
6. To aid the students acquire appropriate and adequate knowledge on writing Technical Reports.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Acquire in depth knowledge on formulating appropriate sentences with grammatical accuracy and vocabulary building. **(B.L:2)**
CO 2	Understand the factors that influence in use of grammar and learn to use sentences unambiguously. **(B.L:2)**
CO 3	Impart effective strategies for professional written communication using devices of coherence & cohesion with adequate support & detail. **(B.L:3)**
CO 4	Provide knowledge of use of phrases & clauses and improve effective writing Note making & Paraphrasing. **(B.L:2)**
CO 5	Understanding the grammar rules for synthesis of sentences and use prewriting strategies to plan to write dialogues, reviews and edit the text effectively. **(B.L:2)**
CO 6	Master the skills and sub skills of reading and use strategies for reading effectively and provide knowledge on the structure and format of technical writing. **(B.L:3)**

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	**1**									**2**		**2**		
CO2	**1**									**2**		**2**		
CO3	**1**									**3**		**2**		
CO4	**1**									**2**		**3**		
CO5	**1**									**3**		**3**		
CO6	**1**									**3**		**3**		
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
Module – I		**Hours :06**

Grammar : Parts of speech: Noun (Countables & Uncountables, Singulars & Plurals, Kinds of Nouns), Pronoun, Verb, Adverb, Adjective - Kinds of Sentences & Sentence Structures – Question forms – Word order in Sentence

Vocabulary Building : Concept of word formation – Synonyms & Antonyms – Homonyms & Homophones – Prefixes & suffixes – Commonly confused Words – One word substitutes – Idioms & Phrasal Verbs

At the end of the Module 1, students will be able to:

- Acquire in depth knowledge on basic grammar concepts.
- Understand the meaning of suffixes & Prefixes, idioms and phrasal verbs.
- Learn meaning and usage of Vocabulary.

Module – II		**Hours :08**

Grammar : Subject Verb agreement – Pronoun-antecedent agreement – Verbs: auxiliary verbs (Primary & Modal)- Tenses

Writing : Principles of writing: clarity, simplicity, brevity, single focus, organization of thoughts - Sentence Structure – Joining the sentences - sequencing the ideas - introduction and conclusion – Punctuation.

At the end of the Module II, students will be able to:

- Learn to use sentences clearly.
- Understand the usage of grammar.
- Learn the importance of use of Auxiliary verbs.

Module – III		**Hours :10**

Grammar : Direct & Indirect Speech – Active and Passive Voice – Comparison of Adjectives – Articles – Prepositions

Writing : Paragraph Writing - Phrases & Clauses – Conditionals - Business letters and Emails and Memos - Structure/ template of common business letters and emails: inquiry/ complaint/ placing an order

At the end of the Module III, students will be able to:

- Understand and learn the nuance of writing business letters, e-mails, memos and effective paragraphs
- Learn to use devices of coherence & cohesion with adequate support & detail
- Learn the use of prepositions and active & passive voice in engineering and scientific contexts.

Module – IV		**Hours :10**

Grammar : Phrasal Verb – Cause and effect – Verb noun Collocations & adjective-noun collocations – correcting common errors in grammar and usage - Misplaced modifiers, idiomatic expressions
Writing : Note Making- organizing techniques: providing a suitable title, headings and sub headings; methods of sequencing - Paraphrasing -techniques of paraphrasing: Replacement of words and phrases, change of sentence structures.

At the end of the Module IV, students will be able to:

- Understand the usage of phrases and clauses in sentences
- Learn grammatical rules to encourage their appropriate use in writing
- Learn to write effective note making and paraphrase

Module – V		**Hours :08**

Grammar : Question formation (Wh- questions, Yes or No questions, Tag questions)-If Clauses— Simple, Compound, Complex Sentences - Correcting common errors in grammar and usage
Writing : Editing short texts - Dialogue writing - Writing Definitions (short and long) – compare and contrast paragraphs- Writing of Reviews : Book / Play / Movie - focus on appropriate vocabulary and structure - language items like special vocabulary and idioms used

At the end of the Module V, students will be able to:

- Acquire the knowledge of applying the grammatical rules for synthesis of sentences
- Learn to write dialogues for various contexts
- Learn to edit the text and writing reviews

Module – VI		**Hours :06**

Reading Skills : Types of reading: Skimming, Scanning, Intensive & Extensive Reading - Effective Reading-Tips
Reading Comprehension
Scramble Sentences
Complete the passage using contextual clues
Identifying Main Ideas using Scanning Technique
Identifying Specific Ideas using Skimming Technique
Writing : Describing – Report Writing: definition - purpose – types – structure - formal and informal reports - stages in developing report- proposal, progress and final reports –examples

At the end of the Module VI, students will be able to:

- Master the skills and sub skills of reading
- Learn the structure and format of technical reports
- Learn to write description of things, process, places and persons

Content beyond syllabus:

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Vocabulary for Aptitude & Recruitment Tests | Campus Jobs	CO1	**https://youtu.be/uzvZa2qEuWo**
2	Tips to Improve Verbal and Written Communication Skills	CO2	**https://youtu.be/6Y3NY0ERBxY**
3	How to write professional emails in English	CO3	**https://youtu.be/3Tu1jN65slw**
4	Introduction to Collocation	CO4	**https://youtu.be/-ouWOpo2Uh8**
5	**Error Spotting Questions in Campus Recruitment Tests**	CO5	https://youtu.be/Rz6-qjNrzCU
6	Reading Skills: How To Skim, Scan and Read for Detail Effectively	CO6	https://youtu.be/SRHNKzXxu6o

Text Books:

- *Green, David Contemporary English Grammar –Structures and Composition, MacMillan India, 2014*
- *Raymond Murphy's English Grammar with CD, Murphy, Cambridge University Press,2012*
- *Michael Swan, (2017) Practical English Usage (Practical English Usage), 4th edition, UK:Oxford University Press.*
- *Ashraf, M Rizvi. Effective Technical Communication. Tata McGraw-Hill, 2006.*

Reference Books

- *English Conversation Practice –Grant Taylor, Tata McGraw Hill, 2009.*
- *Hewings, Martin. Cambridge Academic English (B2). CUP, 2012*
- *Meenakshi Raman and Sangeeta Sharma, Professional Communication, Second Edition, Oxford University Press, India, 2017*
- *Michael McCarthy, Felicity O'Dell, (2015) English Vocabulary in Use Advanced (South Asian Edition), UK: Cambridge University Press*
- *Spoken English, R.K. Bansal & JB Harrison, Orient Longman,2013, 4Th edition.*

WEB RESOURCES:

- *Grammar/Listening/Writing 1-language.com*
- *http://www.5minuteenglish.com/*
- *https://www.englishpractice.com/*

Grammar/Vocabulary

- *English Language Learning Online*
- *http://www.bbc.co.uk/learningenglish/*
- *http://www.better-english.com/*
- *http://www.nonstopenglish.com/*
- *https://www.vocabulary.com/*
- *BBC Vocabulary Games*
- *Free Rice Vocabulary Game*

Reading

- *https://www.usingenglish.com/comprehension/*
- *https://www.englishclub.com/reading/short-stories.htm*
- *https://www.english-online.at/*

Listening

- *https://learningenglish.voanews.com/z/3613*
- *http://www.englishmedialab.com/listening.html*

Speaking

- *https://www.talkenglish.com/*
- *BBC Learning English – Pronunciation tips*
- *Merriam-Webster – Perfect pronunciation Exercises*

All Skills

- *https://www.englishclub.com/*
- *http://www.world-english.org/*
- *http://learnenglish.britishcouncil.org/*

Online Dictionaries

- *Cambridge dictionary online : https://dictionary.cambridge.org/*
- *MacMillan dictionary : https://www.macmillandictionary.com/*
- *Oxford learner's dictionaries : https://www.oxfordlearnersdictionaries.com/*

NARAYANA ENGINEERING COLLEGE:NELLORE								
20CH1503	CHEMISTRY FOR MECHANICAL ENGINEERING LAB							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I	0	0	3	48	1.5	40	60	100

Pre-requisite: Nil

Course Objectives:

1.To provide the learners hands-on-training on the practical applications of the concepts learnt in the theoretical sessions on water treatment, electrochemistry, lubricants, using simple chemical methods.

2.The course will also train the learner to observe good lab practices, record readings and graphically represent the results, as well as analyze and interpret the influence of reaction conditions on the results.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Analyze quality parameters of water samples from different sources
CO 2	Perform quantitative analysis using instrumental methods .
CO 3	utilize the fundamental laboratory techniques for analyses such as titrations, separation/purification/ and Spectroscopy
CO 4	To be able to analyze and gain experimental skill.

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3											1		
CO2	3											1		
CO3	3											1		
CO4	3											1		

1: Low, 2-Medium, 3- High

COURSE CONTENT	CO
Task-1 : Determination of Hardness of a water sample	
Objective **1.** Determine the total hardness (total calcium and magnesium ion concentration). 2. Learn how to titrate with EDTA solution. 3.Determine permanent hardness and the temporary hardness	CO1
Task-2 : Estimation of DO	
Objective: 1.To Determine the level of dissolved oxygen in a sample of water using Winkler's method. 2. Analyze the effects of various factors on the level of dissolved oxygen in a water sample (e.g., salt content, temperature, degree of mixing, and the presence of reducing compounds).	CO 1
Task-3- Determination of chloride content of water	
Objective: define precipitation titrations, 1. state and explain the principle of precipitation titrations with reference to the determination	CO 1

of silver ions in an aqueous solution, 2. explain different basis of end point determination in the argentometric titrations, 3. prepare a standard solution of sodium chloride and use it for the standradisation of silver nitrate, 4. Titrate the given solution of chloride ions with silver nitrate by using Mohr's and Fajan's methods and Determine chloride ion concentration in a water sample.	
Task-4: pH metric titration of (i) strong acid vs. strong base, (ii) weak acid vs. strong base	
Objective: 1. To perform a potentiometric titration of an acidic solution of known molarity. 2. To graph the volume of base added vs the pH and to determine the equivalence point 3. To calculate the molarity of the basic solution	CO 1
Task-5: Determination of cell constant and conductance of solutions	
Objective: 1. To determine conductivity of the given water sample. by using conductivity meter 2. To understand the specific conductance.	CO 1
Task-6 : Potentiometry - determination of redox potentials and emfs	
Objective: 1. Determine the concentration of an unknown iron(II) solution. By using potentiometer 2. Discuss how the potential changes with relative concentration of oxidised/reduced from, 3. perform a redox titration of ammonium iron (II) sulphate using potassium dichromate as oxidizing agent, 4. determine the equivalence point of the redox titration by plotting titration curve using potential change values and amount of oxidizing agent added during titration,	CO 1
Task-7 : Preparation of a polymer	
Objective: To prepare phenol formaldehyde resin. (Bakelite) 1. Understand the differences between linear and cross linked polymers. 2. Compare and contrast the recycling properties of linear and cross linked polymers. 3. Compare the combustion properties of various types of material. 4. Define the following terms: polymer, monomer, repeat unit, cross linking, biopolymer	CO 1
Task-8: Determination of percentage of Iron in Cement sample by colorimeter	
Objective: 1.To provides practical knowledge of instrumental for developing experimental skill in building colorimetric estimation of iron in cement. 2.understand beers –lamberts law principle	CO 2
Task-9: Estimation of Calcium in port land Cement	
Objective: 1.To estimate calcium cement by EDTA method. 2. To understand the strength of the port land cement.	CO 2
Task-10 : Determination of Strength of an acid in Pb-Acid battery	
Objective: 1.To determine the half –reactions involved in spontaneous oxidation –reduction reactions. 2. Explain the function of the lead storage and dry cell batteries …electrolysis involving two lead strips immersed in sulfuric acid.	CO 3

Additional Experiments:	
Task-11: Adsorption of acetic acid by charcoal	
Objective **;1**cite applications of adsorption, 2.differentiate between adsorption and absorption, 3. Define physisorption and chemisorptions, describe adsorption isotherms, and study adsorption isotherms for adsorption of oxalic acid on activated charcoal.	CO 1
Task-12: Determination of Viscosity of lubricating oil by Red Viscometer	
Objective:1.Measuring viscocity of fluids. 2.Describe a fluid as having "high "or "low" viscosity	CO 4
Virtual Labs: 1. http://vlab.amrita.edu/?sub=2&brch=190&sim=338&cnt=1 2. http://vlab.amrita.edu/?sub=2&brch=190&sim=339&cnt=1 3. http://vlab.amrita.edu/?sub=2&brch=190&sim=606&cnt=1	

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Estimation of hardness of water	CO 1	https://www.youtube.com/watch?v=Sa0WfA9UGG0
2	Potentiometric redox titration	CO 1	https://www.youtube.com/watch?v=wVJ8WQax0rQ
3	Preparation of polymer	CO 4	https://www.youtube.com/watch?v=PSSK5VGcC_0

Text Book(s):

1. A Textbook of Quantitative Analysis, Arthur J. Vogel.
2. Jaya Shree Anireddy, Textbook of Engineering Chemistry, Wiley Precise Textbook Series, 20
3. Chemistry in Engineering and Technology, Volume W, Tata McGraw Hill Publishing Company

Reference Book(s):

1. S.K. Bhasin and Sudha Rani, "Laboratory Manual on Engineering Chemistry", Dhanpat Rai Publishing Company, New Delhi, 2nd edition.
2. Sunitha Rattan, "Experiments in Applied Chemistry", S.K. Kataria & Sons, New Delhi, 2nd edition.

Web References:

1. https://nptel.ac.in/courses/122101001/23
2. https://nptel.ac.in/courses/104103071/39

NARAYANAENGINEERINGCOLLEGE:NELLORE								
20ES1503	ENGINEERINGDRAWING							R2020
Semester	Hours /Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I	0	1	4	80	3	40	60	100

Pre-Requisite : Basic Mathematics(Geometry)

Course Objectives:

1. To impart skills on using drawing instruments
2. To explore various Scales in Engineering practice
3. To convey exact in formation of any physical object on drawing sheet.
4. To Construct Engineering Curves by using general methods
5. To impart skills of drawing instruments and their use to convey exact and complete information of any object.
6. To gain knowledge for conversion of isometric views in to orthographic views.

Course Outcomes :At the end of the course, student will be able to:

CO1	Define the qualities of precision and accuracy in engineering drawing.(BL-1)
CO2	Draw engineering curves with different methods(BL-3).
CO3	Develop the orthographic projection of points,lines,planesandsolids.(BL-3)
CO4	Construct Projections of solids and development of surfaces.(BL-3)
CO5	Construct the development of surfaces.(BL-3)
CO6	Construct Isometric and Perspective views(BL-3).

COURSECONTENT

TASK–1	**Introduction & Conic sections**	14Hours

Introduction to Engineering Drawing :Principles of Engineering Drawing and their significance-various instruments used, drawing sheet sizes and title block, lettering, BIS conventions, types of lines and dimensioning methods. Geometrical constructions: simple constructions, construction of Pentagon, Hexagon by general method only.

Conic Sections: Types of conics: Ellipse, Parabola and Hyperbola (Eccentricity method only),. Cycloid, Epicycloids and Hypocycloid, Involute

Scales: Reduced and Enlarged scales, Representative fraction, Scales: plain, diagonal only.

AttheendoftheTask1,studentswillbeableto:

1. Understand of Geometrical Constructions.(BL-3).
2. Understand principles of engineering scales(BL-3).
3. Draw Conical and Cycloidal curves by using general method.(BL-3).

TASK-2	**Orthographic Projections**	13Hours

Objectives and Principle of projection: Methods of projections, Comparison between first angle and third angle projection.

Projections of points: Projection of points placed in different quadrants,

Projection of straight lines: Fundamental concepts, Line parallel, perpendicular and inclined to one and two reference planes placed in first quadrant only,

Projections of planes: Projection of planes (Triangle, Square, Pentagon, Circle) parallel, perpendicular and inclined to one and two reference planes placed in first quadrant only

At the end of theTask2,students will be able to:

1. Understand Orthographic Projections.(BL-2).
2. Draw Projection of lines inclined to one and two reference planes.(BL-3).
3. Construct Projection of planes inclined to one and two reference planes.(BL-3).

TASK-3	Projections of Solids	15Hours

Types of solids; Polyhedral, Solids of revolution, Projections of regular solids (Prisms, Pyramids, Cylinder and Cone), with its axis perpendicular to one plane and parallel to another plane, Axis inclined to one plane and parallel to other plane.

AttheendoftheTask3,studentswillbeableto:

1. Understand Projections of Solids.(BL-2).
2. Draw projections of Prisms, Pyramids, Cylinders and Cone.(BL-3).

TASK-4	Sections of Solids and Development of Surfaces	14Hours

Sections of Solids: Types of sectional views of solids, cutting planes, Sections of Prism, Pyramids, Cylinder and Cone

Development of surfaces: Development of Surfaces of right regular Solids-Prism, Cylinder, Pyramid, Cone

At the end of the Task 4, students will be able to:

1. Understand Sections of Solids in simple positions.(BL-2)
2. Draw development of Simple right regular Solids.(BL-3).

TASK-5	Isometric and Orthographic Projections	12Hours

Isometric Projections: Principles, Isometric scale, Isometric views, Conventions, Isometric views of lines, planes, simple solids (Cube, Cylinder, Cone), Conversion of Isometric views into Orthographic views.

At the end of the Task 5,students will be able to:

1. Understand the isometric projections (BL-2)
2. Draw development of Simple right regular Solids.(BL-3).

TASK-6	Perspective Projections	12Hours

Perspective Projections: Perspective views of Line, Planes(square, circular, pentagon) and Simple solids (Square prism, Triangular pyramid, Cone)by using Visual Ray Method only

At the end of the Task6, students will be able to:

1.DrawPerspectiveviewsofplanes (BL-3).

2.DrawPerspectiveviewsofsimplesolids(BL-3)

Total hours:	80hours

Content beyond syllabus:
1.Interpenetration of Surfaces.

Self-Study:
Contents to promote self-Learning:

SNO	Topic	Reference
1	Introduction to Basic Engineering Scales	https://mrcet.com/downloads/hs/Engineering%20Graphics%20Manual%20final.pdf
2	Engineering curves	www.nptel.ac.in/courses/112104019/
3	Orthographic Projections	www.nptel.ac.in/courses/112104019/
4	Projections of Solids	www.nptel.ac.in/courses/105104148/
5	Isometric and Orthographic Projections	https://www.youtube.com/watch?v=iXgCzZFrYlg

Text Book(s):

1. Bhatt N.D."Elementary Engineering Drawing", Charotar Publishers,2014.
2. Shah and Rana, Engineering Drawing, 2/e,Pearson Education,2009
3. K.L.Narayana & P.Kannaiah, Engineering Drawing, 3/e,Scitech Publishers, Chennai, 2012.
4. Engineering Drawing by DrAVSSridhar Kumar, Dr Krishnaiah, TP VaraPrasad., Spectrum education, Suntechno Publications,2019

Reference Book(s):

1. Engineering Drawing and Graphic Technology-International Edition,ThomasE.French,CharlesJ.Vierck,RobertJ.Foster,McGraw-Hill,2014
2. K.Venugopal "Engineering Drawing and Graphics", New Age International (P)Ltd.,New Delhi,2010

NARAYANA ENGINEERING COLLEGE::NELLORE								
20ES1506	PROBLEM SOLVING AND PROGRAMMING LAB							R20
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I	0	0	3	48	1.5	40	60	100
Pre-requisite: Mathematics Knowledge, Analytical & Logical Skills								

Course Objectives:

1. To work with the compound data types
2. To explore dynamic memory allocation concepts
3. To able to design the flowchart and algorithm for real world problems
4. To able to write C programs for real world problems using simple and compound datatypes
5. To employee good programming style, standards and practices during program development

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Translate algorithms into programs (In C language) (BL - 2)
CO 2	Code and debug programs in C program language using various constructs.(BL-3)
CO 3	Solve the problems and implement algorithms in C. (BL - 3)
CO 4	Make use of different data types to handle the real time data (BL - 3)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	2											1	
CO2	2	2	2										2	1
CO3	2	2	3	1	2								2	2
CO4	2	2	3	1	1								2	2

1: Low, 2-Medium, 3- High

COURSE CONTENT	CO
TASK-1 (3H)	
1. Practice DOS and LINUX Commands necessary for execution of C Programs. 2. Study of the Editors, Integrated development environments, and Compilers in chosen platform. 3. Write, Edit, Debug, Compile and Execute Sample C programs to understand the programming environment.	CO 1
TASK-2 (6H)	
1. Practice programs: Finding the sum of three numbers, exchange of two numbers, largest of two numbers, to find the size of data types, Programs on precedence and associativity of operators, sample programs on various library functions.	CO 1
TASK-3 (6H)	
1. Write a C program to calculate the factorial of a given number 2. Fibonacci sequence is defined as follows: the first and second terms in the sequence are 0 & 1. Subsequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first n terms of the sequence. 3. Write a program to find the roots of a Quadratic equation.	CO1
TASK-4 (6H)	
1. Write a program to generate the series of prime numbers in the given range. 2. Write a program to reverse the digits of a number.	CO 2

3. Write a C program to find the sum of individual digits of a positive integer.	
TASK-5 (3H)	
1. Write a program to check for number palindrome. 2. Write a program to find the maximum of a set of numbers. 3. Write a C program to find the GCD (greatest common divisor) of two given integers	CO 2
TASK-6 (3H)	
1. Write a program to find the sum of positive and negative numbers in a given set ofnumbers. 2. Write C code to reverse the elements of the array. For example, [1,2,3,4,5] shouldbecome[5,4,3,2,1] 3. Write a C program to find factorial of a given integer number using recursion	CO 3
TASK-7 (6H)	
1. Write a C program that use pointers to find Addition of Two Matrices 2. Write a C program that use functions to find Multiplication of Two Matrices	CO 3
TASK-8 (3H)	
1. Write a program to accept a line of characters and print the number of Vowels,Consonants, blank spaces, digits and special characters. 2. Write a C program to check whether a given string is a palindrome or not, withoutusing any built-in functions.	CO 3
TASK-9 (6H)	
1. Illustrate the use of auto, static, register and external variables. 2. Write a program to read and print student information using structures 3. Write a C program to define a union and structure both having exactly the same numbers using the size of operators print the size of structure variables as well as unionvariable	CO 4
TASK-10 (6H)	
1. Write a program to split a "file" into two files, say file1 and file2. Write lines into the 'file' from standard input. Read the contents from 'file' and write odd numberedlines into file1 and even numbered lines into file2. 2. Write a program to merge two files.	CO 4

Additional Experiments:	
TASK-1	
1. Programs on bitwise operators. 2. Programs on bit fields.	CO4
TASK-2	
1. Write a program to read a set of strings and sort them in alphabetical order. 2. Programs on implementation of structures using files.	CO 4

Virtual Labs:
1. Problem Solving Lab (IIIT HYDERABAD) : http://ps-iiith.vlabs.ac.in/
List of Experiments

1. Numerical Representation 2. Beauty of Numbers 3. More on Numbers 4. Factorials 5. String Operations	6. Recursion 7. Advanced Arithmetic 8. Searching and Sorting 9. Permutatio n10.Sequences
2. Computer Programming Lab (IIIT HYDERABAD) : http://cse02-iiith.vlabs.ac.in/	
List of Experiments	
1. Numerical Approximation 2. Functions 3. Advanced Control Flow 4. Arrays 5. Structures	6. Basic Control Flow 7. Pointers 8. Recursion 9. Expression Evaluation

Text Book(s):

1. "How to Solve it by Computer", R.G. Dromey, 2014, Pearson.
2. Programming in C and Data Structures, J.R.Hanly, Ashok N. Kamthane and A.Ananda Rao, Pearson Education, 1st Edition, 2010.

Reference Book(s):

1. "The C Programming Language", Brian W. Kernighan, Dennis M. Ritchie, 2nd Edition, Pearson.
2. "Let us C", Yeswant Kanetkar, BPB publications
3. "Pointers in C", Yeswant Kanetkar, BPB publications, 16th Edition, 2017
4. Computer Science, A Structured Programming Approach Using C by Behrouz A. Forouzan& Richard F. Gilberg, 3rd Edition, Cengage Learning
5. C Programming A Problem-Solving Approach, Behrouz A. Forouzan & E.V. Prasad, F. Gilberg, 3rd Edition, Cengage Learning
6. Programming with C RemaTheraja, Oxford, 2018
7. Programming in C, 3rd Edition, 2015, Ashok N. Kamthane, Pearson Education
8. Programming in C, 3/e : A Practical Approach by Ajay Mittal, Pearson Publication
9. Problem Solving with C by SOMASHEKARA, M. T., GURU, D. S., MANJUNATHA, K.S., PHI Learning, 2nd Edition, 2018
10. C Programming with problem solving, J.A. Jones & K. Harrow, Dreamtech Press, 2001
11. Byron Gottfried, Schaum's Outline of Programming with C, 4th Edition, 2018, McGraw-Hill

Web Resources:

1. https://www.includehelp.com/c-programs/advacnce-c-examples.aspx
2. https://www.programiz.com/c-programming/examples
3. https://www.javatpoint.com/c-programs
4. https://www.w3resource.com/c-programming-exercises/
5. https://www.sanfoundry.com/simple-c-programs/
6. https://www.includehelp.com/c-programming-examples-solved-c-programs.aspx
7. http://www.c4learn.com/c-programs/tag/c-programs-typical-programs

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EN1501	**ENGLISH LANGUAGE LAB**							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I	0	0	3	48	1.5	40	60	100

Pre-requisite: Basic English Grammar

Course Objectives:

1. To expose the students to develop knowledge and awareness of English phonetics be able to read and produce phonemic transcriptions
2. To sensitize the students to the nuances of English speech sounds, word accent, intonation and rhythm
3. To develop strategies appropriately to improve one's ability to listen and Use listening skills to create more effective, less confrontational, more productive professional and personal communication
4. To demonstrate his/her ability to write error free written communication
5. To distinguish main ideas from specific details and make use of contextual clues to infer meanings of unfamiliar words from context
6. To provide a structured methodology for participants to prepare and deliver an effective, high impact presentation that meets the objectives and brings results

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Understand how speech sounds are used to create meaning. Apply their knowledge of English phonetics and phonology to improve their own pronunciation.
CO 2	Recognize and use pitch patterns to signal complete and incomplete thought groups and Speak confidently and intelligibly within groups and before an audience.
CO 3	Discuss and respond to content of a lecture or listening passage orally and/or in writing and make inferences and predictions about spoken discourse
CO 4	Produce coherent and unified paragraphs with adequate support and detail and can write a paragraph with a topic sentence, support, and concluding sentence
CO 5	To help the students to cultivate the habit of reading passages for competitive exams such as GRE, TOEFL, GMAT etc.
CO 6	Learn, practice and acquire the skills necessary to deliver effective, presentation with clarity and enable them to prepare resume with cover letter.

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	1									3		2		
CO2	1									2		3		
CO3	1									3		3		
CO4	1									2		3		
CO5	1									3		3		
CO6	1									3		3		
1: Low, 2-Medium, 3- High														

COURSE CONTENT	
Module - 1	8 hrs
Introduction to Phonetics : Introduction to Sounds of Speech – Vowels – Consonants - Listening with a focus on pronunciation Reading Newspaper – Highlighting Vowels and Consonants	**CO1**
Module – 2	8 hrs
Syllabification: Word Stress, Rules of word stress Practice on Intonation and Stress	**CO2**
Module – 3	8 hrs
Listening Skills : Types of Listening Skills Active listening and anticipating the speaker Listening for Specific & General Details Listening Comprehension	**CO3**
Module – 4	8 hrs
Defining & Describing: Objects, Places and Events Video Speech Writing Review Writing (Books / Movies / Products..etc.,)	**CO4**
Module – 5	8 hrs
Reading Comprehension Everyday English – Grammar, Vocabulary, LSRW Skills, Summarizing and Note making Vocabulary Building	**CO5**
Module – 6	8 hrs
JAM Role Play Giving and Asking Directions Information Transfer	**CO6**

Reference Books:

- *A Textbook of English Phonetics for Indian Students 2nd Ed T. Balasubramanian.(Macmillian),2012*
- *Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.*
- *English Pronunciation in Use. Intermediate & Advanced, Hancock, M. 2009. CUP*
- *Rizvi, Ashraf. M., Effective Technical Communication, Mc Graw Hill, New Delhi. 2005*
- *Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practice, Oxford University Press, New Delhi. 2011.*

Web Resources:

- *Grammar/Listening/Writing 1-language.com*
- *http://www.5minuteenglish.com/*
- *https://www.englishpractice.com/*

Grammar/Vocabulary

- *English Language Learning Online*
- *http://www.bbc.co.uk/learningenglish/*
- *http://www.better-english.com/*
- *http://www.nonstopenglish.com/*
- *https://www.vocabulary.com/*
- *BBC Vocabulary Games*
- *Free Rice Vocabulary Game*

Reading

- *https://www.usingenglish.com/comprehension/*
- *https://www.englishclub.com/reading/short-stories.htm*
- *https://www.english-online.at/*

Listening

- *https://learningenglish.voanews.com/z/3613*
- *http://www.englishmedialab.com/listening.html*

Speaking

- *https://www.talkenglish.com/*
- *BBC Learning English – Pronunciation tips*
- *Merriam-Webster – Perfect pronunciation Exercises*

All Skills

- *https://www.englishclub.com/*
- *http://www.world-english.org/*
- *http://learnenglish.britishcouncil.org/*

Online Dictionaries

- *Cambridge dictionary online : https://dictionary.cambridge.org/*
- *MacMillan dictionary : https://www.macmillandictionary.com/*
- *Oxford learner's dictionaries : https://www.oxfordlearnersdictionaries.com/*

NARAYANA ENGINEERING COLLEGE:NELLORE								
20PH1003	PHYSICS FOR MECHANICAL ENGINEERING							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II	3	0	0	48	3	40	60	100

Pre-requisite: Fundamental concepts of Physics

Course Objectives:

1. To gain knowledge on different types of oscillations and ultrasonics.
2. To provide knowledge on the phenomenon of heat transfer so as to understand a wide variety of practical engineering problems
3. To identify the importance of the optical phenomenon i.e. interference and diffraction related to its Engineering applications.
4. To impart knowledge in basic concepts of LASERs along with its Engineering applications
5. To Understand the nature and characteristics of modern engineering materials.
6. Familiarize types of sensors for various engineering applications

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Acquire knowledge on mechanical and sound waves in the perspective of engineering applications
CO 2	classify different modes of heat transfer and explain heat conduction in a bad conductor and compound media.
CO 3	Explain optical phenomenon i.e. interference, diffraction using Huygen's wave theory.
CO 4	Realize importance of LASERs in Engineering and Medical applications.
CO 5	Demonstrate the knowledge on characteristics and applications of modern engineering materials.
CO 6	Identify the sensors for various engineering applications

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2				1						2		
CO2	3	2										2		
CO3	3	2	1									2		
CO4	3	2				1						2		
CO5	3	3	1			1						2		
CO6	3	2	2			2						2		

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1

OSCILLATIONS & ULTRASONICS (8 hrs)

OSCILLATIONS: Mechanical simple harmonic oscillator (compound pendulum),derivation of an expression for time period; electrical simple harmonic oscillator(L.C CIRCUIT), derivation of an expression for time period; Damped harmonic oscillator-derivation of an expression for angular frequency of damped oscillations, discussion of weak damping, heavy damping, and critical damping condtions; forced

mechanical oscillator- derivation of expression for amplitude and mechanical impedance in steady state; driven LCR circuit- derivation of an expression for current and electrical impedance in steady state, Resonance-amplitude resonance, velocity resonance, sharpness of resonance, quality factor.

ULTRASONICS: Introduction, Properties of ultrasonic waves; Production of ultrasonic waves by Piezoelectric method; Detection of ultrasonic waves, Applications in non-destructive testing.

At the end of the Module 1, students will be able to:

1. analyze Mechanical and electrical simple harmonic oscillator (L4).
2. analyze damped harmonic oscillator (L4).
3. explain production of ultrasonic waves by piezo-electric method (L2)
4. describe non-destructive testing of materials by ultrasonic waves(L2) .

MODULE -2

WAVE OPTICS **(9 hrs)**

Interference-Principle of Superposition, Interference of light, Conditions for sustained Interference ,derivation of conditions for constructive and destructive interference of reflected light from a thin film, Newton's Rings-experimental arrangement, Determination of Wavelength; Engineering applications of Interference

Diffraction-distinction between interference and diffraction, differences between Fresnel & Fraunhoffer diffractions, Fraunhoffer Diffraction at single slit(derivation, energy distribution curve) , Fraunhoffer Diffraction at a Double slit (derivation, energy distribution curve),Theory of Diffraction Grating - Determination of Wavelength; Engineering applications of diffraction.

At the end of the Module 2, students will be able to:

1. explain the need of coherent sources and the conditions for sustained interference (L2)
2. describe the theory of interference of reflected light from a thin film (L2)
3. explain the theory of Fraunhoffer Diffraction of light at single and multiple slits (L2)
4. identify engineering applications of interference and diffraction (L3)
5. analyze the differences between interference and diffraction (L4)

MODULE-3

LASERS & OPTICAL FIBERS (7h)

Lasers: Spontaneous & stimulated emission of radiation - Population inversion - Pumping methods – Properties of lasers (monochromaticity, coherence, directionality, brightness) – Types of lasers: Nd- YAG Laser, He–Ne Laser, Semiconductor laser; Applications

Introduction to Optical Fibers-Total Internal Reflection-Critical angle of propagation-Acceptance angle-Numerical Aperture-Classification of fibers based on Refractive index profile-advantages of optical fibres.

At the end of the Module 3, students will be able to:

1. describe Spontaneous & stimulated emission of radiation (L2)
2. Understand the basic concepts of LASER light Sources (L2)
3. describe the construction and working of different types of Lasers (L2)
4. identify the applications of lasers in various fields (L3)

MODULE-4

SENSORS **(8 hrs)**

Sensors:(qualitative description only): Different types of sensors and applications; Strain and Pressure sensors- Piezoelectric, magnetostrictive sensors, Fibre optic methods of pressure sensing; Temperature sensors - bimetallic strip, pyroelectric detectors, Hall-effect sensor, smoke and fire detectors.

At the end of the Module 4, students will be able to:

1. identify different types of sensors and applications (L3)
2. explain working of Strain and Pressure sensors (L2)
3. describe working of Fibre optic pressure and Temperature sensors (L2)
4. explain working of Hall-effect sensor, smoke and fire detectors (L2)

MODULE-5

THERMAL PHYSICS **(8 hrs)**

Introduction, modes of heat transfer (conduction, convection and radiation), coefficient of thermal conductivity, rectilinear flow of heat along a uniform bar, thermal conductivity of bad conductor (Lee's disc method), heat conduction through compound media (materials in series and parallel).

At the end of the Module 5, students will be able to:

1. Explain different modes of heat transfer (L2)
2. describe Lee's disc method for finding coefficient of thermal conductivity of a bad conductor (L2)
3. explain rectilinear flow of heat along a uniform bar (L2)
4. Explain heat conduction in compound media (L2).

MODULE-6

MODERN ENGINEERING MATERIALS **(8 hrs)**

Metallic glasses - Introduction, preparation of metallic glasses by RF sputtering technique, properties (structural, thermodynamic, mechanical, electrical, chemical and optical), applications of metallic glasses. Shape memory alloys (SMA) – Introduction, shape memory effect and its types, characteristics of SMA, properties of NiTi alloy, applications of SMA. Composites - Introduction, types and applications.

At the end of the Module 6, students will be able to:

1. understand the preparation metallic glasses RF sputtering technique (L2)
2. explain properties and applications of metallic glasses (L2)
3. realize the characteristic, applications of shape memory alloys (L2)
4. explain applications of composites (L2).

Total hours:	**48 hrs**

Content beyond syllabus:

1.polarization of light

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	OSCILLATIONS & ULTRASONICS	CO1	https://youtu.be/gnD8Se92hfk?list=PL30D1917C52D9F9B9 https://youtu.be/hhJj36mQbaw?t=892
2	WAVE OPTICS	CO2	https://youtu.be/n65gZGwiZtk
3	LASERS	CO3	https://youtu.be/eoOM0Gx6GJc https://youtu.be/RyY4PEpV2RQ
4	SENSORS	CO4	https://youtu.be/wpAA3qeOYiI

	5	THERMAL PHYSICS	CO5	https://youtu.be/5TcPGx82Hnk
	6	MODERN ENGINEERING MATERIALS	CO6	https://youtu.be/ync30eHVD8s

Text Book(s):

1. 1. M. N. Avadhanulu, P.G. Kshirsagar & TVS Arun Murthy" AText book of Engineering Physics"- S. Chand Publications, 11th Edition 2019.
2. B.K. Pandey and S. Chaturvedi, Engineering Physics, Cengage Learning, 2012.
3. . H.J. Pain, "The physics of vibrations and waves", Wiley, 2006.

Reference Book(s):

1. . G. Main, "Vibrations and waves in physics", Cambridge University Press, 1993.
2. Shatendra Sharma, Jyotsna Sharma, " Engineering Physics", Pearson Education,2018
2 N. Subrahmanyam, BrijLal, *A Textbook of Optics*, S. Chand, New Delhi, 2015
3. O. Svelto, "Principles of Lasers", Springer Science & Business Media, 2010.
5. Ajoy Ghatak, *Optics*, 5th Edition, McGraw Hill, 2012

Online Resources:

1. http://www.peaceone.net/basic/Feynman/
2. http://physicsdatabase.com/free-physics-books/
3. http://www.damtp.cam.ac.uk/user/tong/statphys/sp.pdf
4. http://www.freebookcentre.net/Physics/Solid-State-Physics-Books.html

Web Resources:

1. http://link.springer.com/book
2. http://www.thphys.physics.ox.ac.uk
3. http://www.sciencedirect.com/science
4. http://www.e-booksdirectory.com

NARAYANA ENGINEERING COLLEGE: NELLORE								
20MA1003	VECTOR CALCULUS, COMPLEX VARIABLES & TRANSFORMS (VC-CV&TS)							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II	3	0	0	48	3	40	60	100

Pre-requisite: Intermediate Mathematics

Course Objectives:

1. To illustrate the physical interpretation of gradient, divergence and curl.
2. To apply the basic concepts of vector integration and their applications.
3. To acquire the knowledge on the calculus of functions of complex variables.
4. To understand the concepts of Laplace transforms and its properties.
5. To apply the concepts of Laplace, transform to solve the ordinary differential equations.
6. To understand the concepts of Fourier series and Fourier transforms and itsproperties.

Course Outcomes: After successful completion of the course, the student will able to:

CO 1	Utilize different operators such as gradient, curl and divergence find the function BL-3
CO 2	Evaluate area and volumes by fundamental theorems of vector integration BL-5
CO 3	Apply the complex functions, Cauchy's integral Theorem to find the integral values BL-3
CO 4	Solve the differential equation by using Laplace transforms and its techniques BL-3
CO 5	Apply the Inverse Laplace transforms techniques to covert into time Domaine BL-3
CO 6	Find the Fourier Series and Fourier Transform for the given functions BL-2

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	**3**	**2**	**2**										**PSO1**	**PSO 2**
CO2	**3**	**2**	**2**										3	
CO3	**3**	**3**	**1**										3	
CO4	**3**	**3**	**2**										2	
CO5	**3**	**3**	**2**										3	2
CO6	**3**	**3**	**2**										2	2

1- Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	**Vector Differentiation**	**8 H**
Introduction to vector differentiation, Definition of Scalar and Vector point functions, Definition of Vector differential operator, Gradient of a Scalar point function- Definition of Gradient of a scalar point function and properties (without proof), Definition of Directional Derivative, Definition of level surface, Different Problems, Divergence of a Vector point function- Definition, Definition of Solenoidal vector and problems, Curl of a vector point function- Definition of Curl, definition of Irrotational vector, Problems, Laplacian operator- Definition and related problems, Vector Identities-Statements(without proof)		
At the end of the Module 1, students will be able to: 1. Apply del to scalar and vector point function BL-3 2. Understand the concepts of Vector Differentiation BL-2 3. Illustrate the physical interpretation of gradient, divergence and curl. BL-2 4. Calculate directional derivatives and gradients BL-1 5. Apply Vector Differentiation concepts in fluid mechanics problems BL-3		
MODULE -2	**Vector Integration**	**8 H**
Introduction to vector integration, Line Integrals-Explanation, Work done by a Force- Explanation, problems, Surface Integral-Explanation and formula for surface integrals (without proof), Problems, Volume integral- Explanation and formula for volume integral (without proof), Problems, Green's Theorem-Statement (without proof), Problems, Gauss divergence Theorem-Statement (without proof), Problems, Stake's-Theorem-Statement (without proof), Problems.		
At the end of the Module 2, students will be able to: 1. Find the work done in moving a particle along the path over a force field BL-1 2. Evaluate the rate of fluid flow along and across curves BL-5 3. Apply Green's, Stokes and Divergence theorem in evaluation of double and triple integrals BL-3 4. Use the Gauss divergence theorem to give a physical interpretation of the divergence ofa Vector field. BL-3 5. Evaluate the line integrals along simple closed curves on the Plane by Green's TheoremBL-5 6. Apply Stokes' theorem to give a physical interpretation of the curl of a vector field.BL-3		
MODULE-3	**Complex Variable**	**Hours: (11L+4T)**

complex variables- differentiation: introduction to complex variables, functions of complex variable- definition, limit and continuity of a complex function, derivative of f(z)-definition, problems, analytic function & harmonic functions- definitions, problems, cauchy-riemann equations in cartesian coordinates-statement (without proof), problems ,cauchy-riemann equations in polar coordinates-statement (without proof), problems , conjugate harmonic functions- definition, problems, milne thomson method- working rule, problems, applications to flow problem- problems. complex variables- integration: introduction to complex integration, line integration-definition, problems, cauchy's integral theorem- statement(without proof), problems, cauchy's integral formula- statement (without proof), problems, zeros of analytic functions, singularities, poles. residues- definition, explanation. cauchy's residue theorem- statement (without proof), problems. evaluation of integrals of

the type: (a) improper real integrals $\int f(x)dx$ (b) $\int f(\cos\theta,\sin\theta)d\theta$.

At the end of the Module 3, students will be able to:

1. Understand the functions of complex variable and its properties. BL-2
2. Find derivatives of complex functions. BL-1
3. Understand the analyticity of complex functions. BL-2
4. Understand the concept of differentiability, limit, continuity of complex functions andbe able to calculate limits of standard complex functions BL-2
5. Apply Cauchy's integral theorem and Cauchy's integral formula in engineering problems. BL-3
6. Understand singularities of complex functions. BL-2

MODULE-4	Laplace Transforms	8 H

Introduction to Laplace Transforms, Definition of Laplace Transforms, Sufficient conditions for the existence of the L.T of a function, Laplace Transforms of standard Functions. First Translation (or) First Shifting theorem, Problems. Second Translation (or)Second Shifting theorem, Problems. Change of scale property, Problems. L.T. of derivatives, Problems. L.T. of integrals, Problems. Multiplication by 't', Problems. L.T. of Division by 't', Problems. Evaluation of integrals by L.T. L.T. of some special functions- Unit Step Function or Heaviside's Unit Function- Definition, problems. Unit Impulse Function or Dirac Delta function- Definition, problems. Laplace Transform of Periodic Functions- Statement (without proof), Problems.

At the end of the Module 4, students will be able to:

1. Understand the concepts of Laplace transforms and convert into time to frequencydemine BL-2
2. Apply Laplace transform techniques to solve Ordinary differential equations BL-3
3. Understand and recall the properties of the Heaviside (unit step) function and its applications BL-2
4. Solve the application of Dirac Delta function by using its properties BL-3

MODULE-5	Inverse Laplace Transforms	8 H

Definition of Inverse Laplace Transforms, Inverse Laplace Transforms of standard Functions (without proof), Problems. Use of Partial Fractions to find Inverse Laplace Transform- problems. First Translation (or) First Shifting theorem- Statement (without proof), problems. Second Translation (or) Second Shifting theorem Statement (without proof), Problems. Change of scale property- Statement (without proof), problems. Inverse
L.T of derivatives- Statement (without proof), problems. Inverse L.T to finite integrals- Statement (without proof), problems. Multiplication by Powers of 's'-Statement (without proof), Problems. Division by 's'-Statement (without proof), problems. Convolution theorem-statement (without proof), problems, Applications to Ordinary Differential Equations-Working method Explanation, problems

At the end of the Module 5, students will be able to:

1. Understand the concepts of inverse Laplace Transforms and convert into frequency totime domine BL-2
2. Solve the wave functions by inverse Laplace transforms BL-3
3. Apply the Convolution Theorem to obtain inverse Laplace transforms BL-3
4. solve the higher order differential equations in limiting case condition by invers Laplace transforms BL-3

MODULE-6	**Fourier Series and Fourier Transforms**	**8 H**

Fourier Series: Introduction to Fourier Series, Periodic function-definition, properties(without proof), Euler's formulae(without proof), Dirichlet's conditions, Fourier series in $[0,2\pi]$-formula (without proof), Problems, Fourier series in $[-\pi, \pi]$- formula(withoutproof), Problems, Fourier series for even and odd functions in $[-\pi, \pi]$- formula(without proof), Problems, Half -Range Fourier sine series in$(0, \pi)$- Formula(without proof), Problems, Half -Range Fourier cosine Series in$(0, \pi)$- Formula (without derivation), Problems. Fourier Transforms: Introduction to Fourier Transforms, Fourier integral theorem Statement (without proof),Fourier sine and cosine integrals formula(without proof) , problems, Fourier Transform formula &Inverse Fourier Transform formula (without proof), Properties of Fourier Transforms (without proof), problems, Fourier Sine Transform formula & Inverse Fourier Sine Transform formula (without proof), problems, Fourier Cosine Transform formula &Inverse Fourier cosine Transform formula(without proof),problems.

At the end of the Module 6, students will be able to:

1. Find the Fourier series expansion of the given function. BL-1
2. Apply Fourier series and its properties of various engineering problems. BL-3
3. Find the periodic solutions to the differential equation by using Fourier series. BL-1
4. Understand the properties of periodic functions, represent it as a Fourier BL-2
5. Apply the concepts of Fourier transforms to Find impulse BL-3
6. Make use of the Fourier transforms and its inverse in practical applications of electronics engineering. BL-3

Total hours	**48 H**

Complex Fourier series

1. Complex Fourier series
2. Parseval's Identity for Fourier Transforms

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Vector Differentiation	CO1	https://youtu.be/a19x_YG0oLg
2	vector integration	CO2	https://youtu.be/pfCwRLK29h4https://youtu.be/KHiw9Vs-aLM
3	Laplace transforms	CO3	https://youtu.be/luJMl37-nsohttps://youtu.be/EDVJotmT584
4	Inverse Laplace transforms	CO4	https://youtu.be/9NqdBXNyJPkhttps://youtu.be/0ZlThUd-yyw
5	Fourier series	CO5	https://youtu.be/4cSZDHxyBf4
6	Fourier transforms	CO6	https://youtu.be/GtXmS5YH7XM

Text Book(s):

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers.
2. N.P. Bali and Manish Goyal, "A Text Book of Engineering Mathematics", Laxmi Publication.
3. Ramana B.V., "Higher Engineering Mathematics", McGraw Hill Publishers

Reference Book(s):

1. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley.
2. Veerarajan T., "Engineering Mathematics" , Tata McGraw-Hill.
3. Dr. M Anita, "Engineering Mathematics-I", Everest Publishing House, Pune.

Online Resources/ Web References:

1. http://keralatechnologicaluniversity.blogspot.in/2015/06/erwin-kreyszig-advanced-engineering - mathematics-ktuebook-download.html
2. http://www.faadooengineers.com/threads/13449-Engineering-Maths-II-eBooks .
3. http://www.efunda.com/math/math_home/math.cfm
4. http://www.ocw.mit.edu/resources/#Mathematics
5. http://www.sosmath.com/
6. http://www.mathworld.wolfram.com /

NARAYANA ENGINEERING COLLEGE:: NELLORE								
20ES1008	**MATERIAL SCIENCE**							R2020
Semester	H / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II	3	0	0	48	3	40	60	100

Pre-Requisite : To have basic knowledge in Engineering mathematics and Engineering Chemistry.

Course Objectives:

1. To study structure of metals and types of solids.
2. To understand about equilibrium diagrams and properties of steel and iron.
3. To learn about heat treatment of steel.
4. To study about properties and structures of ceramic materials.
5. To study about properties and structures of composite materials.

Course Outcomes: After successful completion of the course

CO1	Learn about bonds, crystallization of metals and determination of grain sizes of metals and alloys and constitution of alloys. (BL-1)
CO2	Understand about construction of equilibrium diagrams and to study about phase diagrams. (BL-2)
CO3	Understand properties and structures of various ferrous and non-ferrous metals and alloys. (BL-2)
CO4	Know and apply the concepts of heat treatment of alloys.(BL-3)
CO5	Learn about various ceramic materials. (BL-1)
CO6	Learn about various composite materials. (BL-1)

CO-PO Mapping

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	1													
CO2	2													
CO3	2													
CO4	3													3
CO5	1					1	1						1	1
CO6	1					1	1						1	1

1:Low,2-Medium,3-High

COURSE CONTENT

MODULE – 1	**Structure of Metals**	**8 H**

Bonds in Solids – Metallic bond - crystallization of metals, grain and grain boundaries, effect of grain boundaries on the properties of metal / alloys – determination of grain size.

Constitution of Alloys : Necessity of alloying, types of solid solutions,

At the end of theModule1,students will be able to:

1. Acquire knowledge about various bonds in solids. (BL-3)
2. learn about grains and determination of grain sizes. (BL-2)
3. understand the concepts of constitution of alloys. (BL-2)

.

MODULE -2	**Equilibrium of Diagrams**	**8 H**

Experimental methods of construction of equilibrium diagrams, Isomorphism alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys.

At the end of theModule2, students will be able to:

1. Learn about construction of equilibrium diagrams. (BL-2)
2. Understand eutectic and eutectoid systems. (BL-2)
3. Learn about phaserule and to study important binary phase diagrams. (BL-2)

MODULE-3	Metals & Alloys	8 H

Cast Irons and Steels : Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheriodal graphite cast iron, Alloy cast irons. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.

Non-ferrous Metals and Alloys:

Structure and properties of copper and its alloys, Aluminium and its alloys, Titanium andits alloys.

At the end of theModule3, students will be able to:

1. Understand the structure and properties of cast iron.(BL-2).
2. Understand the structure and properties of steels. (BL-2)
3. Learn about structure and properties of Nonferrous metals and alloys. (BL-2).

MODULE-4	Heat treatment of Alloys	8 H

Effect of alloying elements on Iron – Iron carbon system, Annealing, normalizing, Hardening, TTT diagrams, tempering , Hardenability, surface - hardening methods, Age hardening treatment,.

Atthe endof theModule4, students will be able to:

1. Understand about effect of alloying elements on iron. (BL-2)
2. Learn and understand about hardenability and hardening methods...(BL-2)
3. Know the concepts of cryogenic treatment of alloys. (BL-2)

MODULE-5	Ceramic &Plastic Materials	8 H

Ceramic materials: Crystalline ceramics, glasses, cermets, abrasive materials, -definition, properties and application

Plastics: Thermo set plastics & Thermo plastics- applications

Atthe endof theModule5,studentswillbeableto:

1. Learn about crystalline ceramic materials..(BL-2)
2. Learn about crystalline abrasive materials..(BL-2).
3. Understand the properties of above materials.(BL-2).

MODULE-6	Composite Materials	8 H

Composite Materials: Classification of composites, various methods of component fracture of composites, particle – reinforced materials, fiber reinforced materials, metal ceramic mixtures.

At the end of theModule6, students will be able to:

1. Know about classification of composites. (BL-2)
2. Understand about component manufacture of composites. (BL-2)
3. Learn about reinforced materials.(BL-2)

Total :	**48 h**

Content beyond syllabus:

1. **Nano Materials**
2. **Biomaterials**
3. **Polymers**

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Effect of grain boundaries on the properties of metal	CO1	https://en.wikipedia.org/wiki/Grain_boundary
2	Construction of equilibrium diagrams	CO2	https://www.sciencedirect.com/topics/engineering/equilibrium-phase-diagram
3	Classification of steels	CO3	https://mme.iitm.ac.in/vsarma/mm5025/SS.pdf
4	Cryogenic treatment	CO4	https://www5.kau.se/sites/default/files/Document/subpage/
5	Crystalline ceramics	CO5	https://www3.nd.edu/~amoukasi/CBE40361/Lecture_Ceramics_2014.pdf
6	Classification of composites	CO6	https://www.researchgate.net/figure/Classification-of-composite-materials-a-Based-on-matrix-materials-and-b-based-on_fig1_280921582

Text Book(s):

1. Introduction to Physical Metallurgy / Sidney H.Avener. 2017
2. A Text of Essential of Materials science and engineering/ DonaldR.Askeland/Thomson.2013
.3.Material Science and Metallurgy/ Dr.V.D.Kodgire,2011

Reference Book(s):

1. Science of Engineering Materials / B.K.Agarwal,2017.
2. Engineering materials and metallurgy/R. K. Rajput/S.Chand,2015.
3. Engineering Materials and Their Applications – R. A Flinn and P K Trojan / Jaico Books 1995.

OnlineResources:

1. https://libguides.cam.ac.uk/materialsscience
2. https://www.sdsmt.edu/Academics/Library/Resources/SubjectGuide/?guide=Materials%20and%20Metallurgical%20Engineering
3. https://libguides.wpi.edu/c.php?g=355327&p=4998512

WebResources:

1. https://www.youtube.com/watch?v=lW4GX3W18ds
1. https://www.youtube.com/watch?v=S96zHUSxZc0
2. https://www.youtube.com/watch?v=IkYimZBzguw

NARAYANAENGINEERINGCOLLEGE:NELLORE								
20ES1003	**PRINCIPLES OF ELECTRICAL AND ELECTRONICS ENGINEERING**							R2020
Semester	Hours /Week			Total **hrs**	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II	3	0	0	48	3	40	60	100

Pre-requisite: Fundamental concepts of Electrical Circuits Analysis and Electro Magnetic Fields. Basic Knowledge on Semiconductor materials.

Course Objectives:

1. Able to understand the performance of Electrical circuit elements.
2. To understand the Principle of Operation of electrical machines.
3. Able to Explain Typical AC Power Supply scheme.
4. To provide comprehensive idea about working principle, operation and applications of PN Diode.
5. To provide comprehensive idea about working principle, operation and applications of BJT
6. To provide comprehensive idea about working principle, operation and applications of MOSFET.

Course Outcomes: After successful completion of the course, the student will be able to:

CO1	Understand DC and AC electrical circuit analysis.(BL-2)
CO2	Demonstrate working principles of transformers and electrical machines.(BL-2)
CO3	Understand the generation, Transmission and distribution of Electrical Power.(BL-2)
CO4	Understand the operation, characteristics of PN junction diode. (BL-02)
CO5	Understand the operation, characteristics of BJT. (BL-02)
CO6	Explain the concept of MOSFET and applications of MOSFET.(BL-02)

CO-POMapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	2	1										2	3
CO2	1	2	2										2	3
CO3	2	3	2										3	3
CO4	1	2	1									1	1	
CO5	1	2	1									1	1	1
CO6	1		1									1	1	

1:Low,2-Medium,3-High

COURSECONTENT

MODULE–1	**DC & AC Circuits**	**08Hours**

Electrical circuit elements (R- L and C) - Kirchhoff laws- Series and parallel connection ofresistanceswithDCexcitation.SuperpositionTheorem-Representationofsinusoidalwaveforms-peak andrmsvalues-phasorrepresentation-realpower-reactivepower–apparent.

At the end of theModule1,students will be able to:

1. Understand the Basic Electrical circuit elements.(BL-2)
2. Able to understand the parallel connection of resistances.(BL-2)
3. Demonstrate on real power, reactive power and apparent power.(BL-2)

MODULE-2	**DC &AC Machines**	**08Hours**

Principle and operation of DC Generator-EMF equations- principle and operation of DC Motor–Performance Characteristics of DC Motor-Speed control of DC Motor–Principle and operation of Single Phase Transformer -OC and SC test on transformer-principle and operation of Induction Motor.

At the end of the Module2,students will be able to:

1. Explain principle and operation of DC Generator & Motor.(BL-2)
2. Understand the principle and operation of DC Motor.(BL-2)
3. Explain operation of transformer and induction motor.(BL-2)

MODULE-3	Basics of Power Systems	08Hours

Layout & operation of Hydro, Thermal, Nuclear Stations - Solar & wind generating stations – Typical AC Power Supply scheme – Elements of Transmission line–Types of Distribution systems :Primary & Secondary distribution systems.

At the end of the Module3,students will be able to:

1. Understand the working of Electrical power generating stations.(BL-2)
2. List the varies Elements of Transmission line.(BL-1)
3. Explain Types of Distribution systems.(BL-2)

MODULE-4	DIODE APPLICATIONS	08Hours

Operation of PN junction diode, Volt-Ampere Characteristics, Diode Resistance, Diode as a Rectifier,Halfwaverectifier,Fullwaverectifier,Rectifierparameters,RectifierswithFilters.

1. Describe operation and characteristics of Diode.(BL-02)
2. Study various Biasing techniques of diode.(BL-02)
3. Explain the construction and operation of rectifiers.(BL-02)

MODULE-5	BIPOLARJUNCTIONTRANSISTOR	08Hours

BipolarJunctionTransistor(BJT)–TypesofTransistors,OperationofNPNandPNPTransistors,Input-OutputCharacteristicsofBJT-CB,CEandCCConfigurations,Relationbetween IC, IB and IE, Transistor.

1. Describe operation and characteristics of transistors.(BL-02)
2. Study various configurations of Transistor.(BL-02)
3. Understand the Analog and digital applications of Transistor.(BL-02)

MODULE-6	METAL–OXIDE–SEMICONDUCTOR FIELD-EFFECTTRANSISTOR	09Hours

Introduction to MOSFET, Construction of depletion mode and enhancement mode of NMOS and PMOS, Drain characteristics of MOSFET, Transfer Characteristics of MOSFET, MOSFET as Switch, CMOS Inverter and it's Characteristics.

11. Explain the construction and operation of enhancement mode NMOS.(BL-02)
12. Study the characteristics of MOSFET.(BL-02)
13. Explain various applications of MOSFET.(BL-02)

Total hours:	48hours

Content beyond syllabus:

1. OCC characteristics of DCgenerator
2. BJT & FET Biasing.

Self-Study:

Contentstopromoteself-Learning:

SNO	Module	Reference
1	**DC & AC Circuits**	https://nptel.ac.in/courses/117/106/117106108/
2	**DC &AC Machines**	https://nptel.ac.in/content/storage2/MP4/108102145/mod02lec03.mp4 https://nptel.ac.in/courses/108/102/108102146/
3	**Basics of Power Systems**	https://nptel.ac.in/content/storage2/courses/105105110/pdf/m5l01.pdf https://onlinecourses.nptel.ac.in/noc18_ee15/unit?u

			nit=5&lesson=9
	4	**Diode Applications**	https://www.youtube.com/watch?v=IMoJUqDlSQs&t=12s
	5	**BJT**	https://www.youtube.com/watch?v=zbwqk69VcQM
	6	**MOSFET**	https://www.youtube.com/watch?v=g30xTHas3aU

Text Book(s):

1. D.P.Kothari and I.J.Nagrath-"Basic Electrical Engineering"-Tata Mc GrawHill-2010.
2. Basic Electrical and Electronics Engineering,M.S.Sukhija,T.K.Nagsarkar, Oxford University.
3. V.K.Mehta &Rohit Mehta,"Principles of Electronics"–S.Chand–2018.
4.Basic Electrical and Electronics Engineering,S.KBhattacharya,Pearson Education,2012.

Reference Book(s):

1. L.S.Bobrow-"Fundamentals of Electrical Engineering"-OxfordUniversityPress-2011.
2. E.Hughes- "Electrical and Electronics Technology"-Pearson-2010.
3. J.Millman, C.Halkias,"Electronic Devices and Circuits", TataMc-GrawHill, 4thEdition,2010.4.David A.Bell, "Electronic Devices and Circuits", Fifth Edition, Oxford University Press, 2009.5.Salivahanan,Kumar,Vallavaraj,"ElectronicDevicesandCircuits",TataMc-GrawHill,Second Edition.

Online Resources /Web References:

1.https://nptel.ac.in/courses/108/105/108105159/
2.https://nptel.ac.in/courses/108/105/108105066/
3.https://nptel.ac.in/courses/108/105/108105066/
4.https://youtu.be/L28F1Oenyds
5. https://www.youtube.com/watch?v=0C4uxtS-tlQ
6. https://www.youtube.com/watch?v=0RSl-QJ5-4A
7. http://www.mathtutordvd.com/products/Engineering-Circuit-Analysis-Volume-1.cfm
8. https://www.researchgate.net/publication/329252017_Analysis_Study_In_Principles_Of_Operation_Of_Dc_Machine
9. https://www.engineering.com/
10. https://www.electrical4u.com/p-n-junction-diode/
11. https://nptel.ac.in/content/storage2/courses/117101106/downloads/L23.PDF

NARAYANA ENGINEERING COLLEGE:NELLORE								
20PH1503	**ENGINEERING PHYSICS LAB-1(MECHANICAL ENGINEERING)**							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
ii	0	0	2	36	1	40	60	100

Pre-requisite: Nil

Course Objectives:

To provide student to learn about some important experimental techniques in physics with knowledge in theoretical aspects so that they can excel in that particular field. To prepare students for performing requirement analysis and design of variety of applications.

To enable the students to understand the concepts of interference and diffraction , their applications and role of optical fibre parameters in communication.

To educate students to recognize the applications of laser in finding the wavelength, slit width and its role in diffraction studies

To make the students to identify the importance of sensors

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	learn important concepts of physics through involvement in the experiments by applying theoretical knowledge.
CO 2	understand the concepts of interference and diffraction , their applications and role of optical fiber parameters in communication.
CO 3	recognize the applications of laser in finding the wavelength, slit width and its role in diffraction studies
CO 4	identify the importance of sensors

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	1										2		
CO2	2	1				1						2		
CO3	2	1				1						2		
CO4	2	1										2		

1: Low, 2-Medium, 3- High

COURSE CONTENT	**CO**
Task 1 - Determination of spring constant of springs using Coupled Oscillator	
objective:To study normal modes of oscillation of two coupled pendulums and to measure the normal mode frequencies as well as spring constant. Two identical compound pendulums are coupled by means of a spring. Normal mode oscillations are excited and their frequencies are measured.	CO 1
Task - 2 Determination of the rigidity modulus of the material of a given wire using Torsional Pendulum	
objective: To determine the rigidity modulus of the material of a given wire using Torsional Pendulum A torsion pendulum consist of a disk-like mass suspended from thin rod. When the mass is	CO 1

twisted about the axis of the wire , the wire exerts a torque on the mass, tending to rotate it back to its original position. If twisted and released, the mass will oscillate back and forth to its original position executing a simple harmonic motion. This experiment can be used to assess the shear elastic behavior of a given material .	
Task -3 . Determination of thermal conductivity of a bad conductor (Lee's disc method).	
objectives: 1.To know about different modes of heat transfer, via conduction, convection and radiation 2.To find the coefficient of thermal conductivity of a bad conductor by Lee's method. Thermal conductivity (k), is the property of a material that indicates its ability to conduct heat. Conduction will take place only if there exists a temperature gradient in a solid (or stationary fluid) medium. Conductive heat flow occurs in direction of the decreasing temperature. This transfer will continue until thermal equilibrium is reached. The rate at which the heat is transferred is dependent upon the magnitude of the temperature gradient, and the specific thermal characteristics of the material. Thermal conductivity is quantified in the units of W/mK,	CO 1
TASK -4 . Measurement of radius of curvature of a lens by Newton's rings method.	
Objective:To determine the wavelength of sodium light by Newton's Ring method The key idea behind Newtons ring experiment is the thin film formation between a plane-convex lens and a glass plate. Due to this thin film of air a path difference occurs in the waves which reflect from the lower surface of the lens and the top surface of the glass plate. As a result of it, they superimpose and develop the interference pattern.	CO 2
TASK -5 To determine the numerical aperture and acceptance angle of a given optical fiber	
Objective: To determine the numerical aperture and acceptance angle of a given optical fiber. In optical fibres light travel by multiple total internal reflections. Numerical aperture represents light gathering powerof optical fibre. Acceptance angle represents maximum limiting angle at one end of optical fibre for the liglht ray to travel by multiple total internal reflections through the core region of thefibre. 1. Optical fibers may be used for accurate sensing of physical parameters and fields like pressure, temperature and liquid level. 2. For military applications like fiber optic hydrophones for submarine and underwater sea application and gyroscopes for applications in ships, missiles and aircrafts.	CO 2
TASK-6 Determination of wavelength by plane diffraction grating normal incidence method	
Objectives: 1.To understand the types of diffraction 2.To familiarize with the principle of diffraction in plane transmission grating 3. To know the procedure for standardization of the grating 4.To determine the wavelengths of prominent spectral lines of mercury spectrum. An arrangement, which is equivalents in its action to a large number of parallel slits of same width separated by equal opaque spaces is called diffraction grating. It is constructed by ruling fine equidistant parallel lines on an optically plane glass plate with the help of a sharp diamond point.	CO 2
TASK -7 Dispersive power of a diffraction grating	
objective: To determine Dispersive power of a diffraction grating When white light passes through a grating, different wavelengths undergo different angles of	CO 2

diffraction. Hence white light split up into different colours and diffraction spectra of different orders will be produced. The angular dispersion or dispersive power of a grating is defined as the rate of change of angle of diffraction with the change of wavelength in a particular order of the spectrum.	
TASK -8 Determination of wavelength of LASER light using diffraction grating.	
Objectives :1. To demonstrate diffraction nature of lasers 2. To determine the wavelength of the given Laser source.	CO 3
TASK -9 . Laser: Diffraction at a single slit	
Objective:Determination of width of a given single slit using laser diffraction method Laser beam has high monochromaticity,coherence and directionality. Hence it forms a clear diffraction pattern and we can measure width of a single slit accurately.	CO 3
TASK -10 Laser: Diffraction at a double slit	
Objective:Determination of width of a given double slit using laser diffraction method. With this experiment we can demonstrate diffraction nature of lasers and can measure width of a double slit accurately.	CO3
Additional Experiments:	
TASK -11 Determination of temperature change using Strain Guage sensor	
Objective: Determination of temperature change using Strain Guage sensor	CO 4
TASK -12: Determination of pressure variations using Strain Guage sensor.	
Objective: Determination of pressure variations using Strain Guage sensor.	CO4
Virtual lab: 1) Laser beam divergence and spot size https://vlab.amrita.edu/?sub=1&brch=189&sim=342&cnt=1 2. Michelson's Interferometer- Wavelength of laser beam https://vlab.amrita.edu/?sub=1&brch=189&sim=1106&cnt=1 3. Melde's String Apparatus https://vlab.amrita.edu/?sub=1&brch=201&sim=882&cnt=1	

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Newton rings		**https://youtu.be/PU-SeNfIRcs**
2	Diffraction grating experiment - Wavelength of mercury spectrum		**https://youtu.be/N0lxwqANsd4**
3	Experiment - Laser Grating- Determination of Wavelength of Given Laser Source		**https://youtu.be/764Fr0mnOrQ**

Text Book(s):

1. C. L. Arora, “Practical Physics”, S. Chand & Co., New Delhi, 3rd Edition, 2012.
2. Vijay Kumar, Dr. T. Radhakrishna, “Practical Physics for Engineering Students”, S M Enterprises, 2nd Edition, 2014.

Reference Book(s):

1. S. Balasubramanian, M.N. Srinivasan “A Text book of Practical Physics”- S Chand Publishers, 2017.
2. C.H. Bernard and C.D. Epp, John Wiley and Sons, "Laboratory Experiments in College Physics" Inc., New York, 1995.
3. Dr.Ruby Das, C.S.Robinson, Rajesh Kumar and Prasanth Kumar “A text book of Engineering Physics Practical”, 1st edition, Sahu University Science Press, 2010.
4. Jayaraman, “Engineering Physics Laboratory Manual”, 1st edition, Pearson Education, 2014.

Web Resources:

1. https://www.scribd.com/doc/143091652/ENGINEERING-PHYSICS-LAB.
2. https://www3.nd.edu/~wzech/LabManual_0907c.pdf.
3. https://www.morebooks.de/store/gb/book/engineering-physics-lab-manual/isbn/978-3-330-34402.

NARAYANA ENGINEERING COLLEGE:NELLORE								
20ES1505	ENGINEERING & ITWORK SHOP							R2020
PART – A ENGINEERING WORK SHOP								
Semester	Hours / Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II	0	0	4	64	2	40	60	100

Pre-requisite: Basic mathematics.

Course Objectives:

1. To know basic workshop processes and adopt safety practices while working with various tools and equipment.
2. To identify, select and use various marking, measuring, holding, striking and cutting tools & equipment.
3. To know about the internal parts of a computer, assembling a computer from the parts, preparing a computer for use by installing the operating system
4. To gain knowledge about the usage of tools like Word processors, Spreadsheets, Presentations.
5. To learn about Networking of computers and use Internet facility for Browsing and Searching

Course Outcomes: After successful completion of the course, student will be able to:

CO1	Understand the safety aspects in using the tools and equipment.(BL-2)
CO2	Apply tools for making models in respective trades of engineering workshop.(BL-3)
CO3	Apply basic electrical engineering knowledge to makes house wiring circuits and check their functionality.(BL-3)
CO4	Understand to disassemble and assemble a Personal Computer and prepare the Computer ready to use(BL-2)
CO5	Apply knowledge to Interconnect two or more computers for information sharing. (BL-3)

COURSE CONTENT (TRADES FOR PRACTICE)

Trade -1 Carpentry (6 H)

Familiarity with different types of woods and tools used in wood working and make following joints from out of 300x40x25mms of wood stock.

a) Half–Lap joint.

b) Mortise and Ten on joint

Trade-2 Fitting (6 H)

Familiarity with different types of tools used in fitting and do the fitting exercises out of 80 x 50 x 5 mm M.S. stock.

a) V-fit b) Dovetail fit

Trade - 3 Sheet Metal Work (6 H)

Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from out of 22 or 20 guage G.I. sheet.

a) Tapered tray b) Conical funnel

Trade - 4 Electrical House Wiring (6 H)
Familiarities with different types of basic electrical circuits and make the following electrical connections. a) Two lamps in series b) Two way switch c) Tube light d) Two lamps in parallel with 3 pin plug and switches
Trade 5 – Welding(8H)
Familiarity with different types of tools used in welding and do the following welding exercises. 1. Single V butt joint 2.Lap joint

Text Book(s):

1. Hajra Choudhury S.K., Hajra Choudhury A.K., Nirjar Roy S.K. "Elements of WorkshopTechnology"Vol-I2008&Vol-II2010MediaPromoters&Publishers Pvt.Limited,Mumbai.
2. KalpakjianS.and StevenS.Schmid,"Manufacturing Engineering and Technology" 4th Edition, Pearson Education IndiaEdition,2002.
3. P. Kannaiah&K. L. Narayana "Workshop manual" 2nd Ed., Scitech publications Pvt.Ltd.,Hyderabad,2008.

Reference Book(s):

1. Gowri P., Hariharan and Suresh Babu A., "Manufacturing Technology-I", Pearson Education2008.

WebResources:

1. https://www.muet.edu.pk/sites/default/files/images/users/41/Workshop%20Intro.pdf
2. http://ecoursesonline.iasri.res.in/mod/page/view.php?id=98826

PART-B IT WORKSHOP LAB

Course Objectives:

1. To provide technical training on Productivity tools like Word processors, Spreadsheets, Presentations.
2. To make the students know about the internal parts of a computer, assembling, installing the operating system.
3. To teach connecting two or more computers.

Course Outcomes: After successful completion of the course, student will be able to:

CO 1	Understand functionalities of a computer and operating system. (BL-2)
CO 2	Practice Word processors, Presentation and Spreadsheet tool. (BL-2)
CO 3	Connect computer using wired and wireless connections. (BL-2)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1													
CO2	1													
CO3	1													

1: Low, 2-Medium, 3- High

COURSE CONTENT	CO
Task-1 Learn about Computer (4H)	
Identify the internal parts of a computer and its peripherals. Represent the same in the form of diagrams including Block diagram of a computer. Write specifications for each part of a computer including peripherals and specification of Desktop computer. Submit it in the form of a report.	CO 1
Task -2 Assembling a Computer (4H)	
Disassemble and assemble the PC back to working condition. Troubleshoot the computer and identify working and non-working parts. Identify the problem correctly by various methods available (eg: beeps). Record the process of assembling and trouble-shooting a computer.	CO 1
Task-3 Install Operating system (2H)	CO 1
Install Linux, any other operating system (including proprietary software) and make the system dual boot or multi boot. Record the entire installation process.	
TASK-4 Operating system features (2H)	CO 1
Record various features that are supported by the operating system(s) installed. Submit a report on it. Access CD/DVD drives, write CD/DVDs, access pen drives, print files, etc. Install new application software and record the installation process.	
TASK-5 Word Processor (6H)	CO 2
Create documents using the word processor tool. Tasks to be performed are inserting and deleting the characters, words and lines, Alignment of the lines, Inserting header and Footer, changing the font, changing the colour, including images and tables in the word file, making page setup, copy and paste block of text, images, tables, linking the images which are present in other directory, formatting paragraphs, spell checking, etc. Prepare project cover pages, content sheet and chapter pages at the end of the task using the features studied. Submit a report of the word processor considered. Create documents using the word processor tool. Mail Merge in word processor for creating appointment orders for 10 employee records in excel.	
TASK-6 Spreadsheet (4H)	CO 2
To create, open, save the spreadsheet and format them as per the requirement. Some of the tasks to be practiced are Managing the worksheet environment, creating cell data, inserting and deleting cell data, format cells, adjust the cell size, applying formulas and functions, preparing charts, sorting cells, working with pivot tables and charts. Submit a report of the Spreadsheet application considered.	
TASK-7 Presentations (6H)	CO 2
To create, open, save and run the presentations, Select the style for slides, format the slides with different fonts, colors, create charts and tables, insert and delete text, graphics and animations, bulleting and numbering, hyperlink, set the time for slide show, Record slide show. Submit a report of the Presentation tool considered.	
TASK-8 Wired network & Wireless network (4H)	CO 3
Select a LAN cable, Identify the wires in the cable, Define the purpose of each	

wire, Study the RJ45 connecter, Use crimping tool to fix the cable to the connecter, Test the cable using LAN tester, Connect two or more computers using cross and straight cables, Configure the computers, share the data between the computers.	

Additional Experiments:	
TASK -1 IoT	CO 3
Raspberry Pi Study the architecture of Raspberry pi, configure software, Install SD card, Connect the cables, Install Raspbian (or any other) operating system, Configure Wi-Fi, remotely connect to your Raspberry Pi.	
TASK -2 OUTLOOK, MACROS	CO 3
Practice the following tasks and submit report A. Configure outlook and access mails. B. Create Macros in word and spreadsheet tools	

Text Book(s):

1. B.Govindarajulu, "IBM PC and Clones Hardware Trouble shooting and Maintenance",2nd edition, Tata McGraw-Hill, 2002
2. "MOS study guide for word, Excel, Powerpoint& Outlook Exams", Joan Lambert, Joyce Cox, PHI.
3. "Introduction to Information Technology", ITL Education Solutions limited, Pearson Education.

Reference Book(s):

1. Rusen, "Networking your computers and devices", PHI
2. Bigelows, "Trouble shooting, Maintaining & Repairing PCs", TMH.

On-line/Web Resources:

https://turbofuture.com/computers/Dissassembling-and-Assembling-the-computer-system
https://www.instructables.com/id/Disassemble-a-Computer/
https://www.windowscentral.com/how-do-clean-installation-windows-10
https://www.tutorialspoint.com/ms_excel_online_training/index.asp
https://www.raspberrypi.org

NARAYANA ENGINEERING COLLEGE: NELLORE								
20ES1511	**Material Science Lab**							R2020
Semester	Hours / Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II	0	0	2	32	1	40	60	100

Pre-requisite: To have basic knowledge in Engineering Chemistry.

Course Objectives:

1. To Prepare metallographic sample.
2. To impart knowledge on metallographic techniques for studying the microstructures of alloys.
3. To perform heat treatment of various steels
4. TogainknowledgeonCrystalstructureandmicrostructuresofuntreatedsteels.

Course Outcomes: After successful completion of the course, the student will be able to

CO1	Describe the relation between microstructure and properties of ferrous alloys. (BL-2)
CO2	Understand various crystal structures (BL-1)
CO3	Study thermosetting of ferrous and nonferrous alloys (BL-1)
CO4	Determine the strength and magnetic defects of materials. (BL-3)

CO-POMapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2													
CO2	2	2	1	1								1		
CO3	2		1	1								1		
CO4	2		2	1								1		

1:Low,2-Medium,3-High

COURSE CONTENT

Task-1

Study of general procedure for specimen preparation and Metallurgical Microscope.

Task -2

Preparation and study of the Micro Structure of pure metals like Iron, Cu and Al.

Task -3

Preparation and study of the Microstructure of Mild steels.

Task -4

Preparation and study of the Microstructure of low carbon steel.

Task -5

Preparation and study of the Microstructure of high carbon steels.

TASK-6

Study of microstructures of Cast Iron.

TASK-7

Study of microstructures of Nonferrous alloys.

TASK-8

Study of microstructures of Heat-treated steels.

TASK-9

Metallographic study and analysis of Brass

TASK-10

Metallographic study and analysis of Bronze.

TASK-11

Hardenability of steel by Jominy End Quench Test.

TASK-12

Find out the hardness of various treated and untreated steels.

TASK-13

Study of crystal structure of BCC, FCC and HCP crystals.

TASK -14

Demonstration of microstructure characteristic by Image Analyzer.

VirtualLabs:

1http://mrmsmtbs-iitk.vlabs.ac.in/

2.http://mrmsmtbs-iitk.vlabs.ac.in/home%20page.html

Self-Study:

Contents to promote self-Learning

SNO	Topic	CO	Reference
1	Preparation and Study of Mild steel	CO1	https://www.youtube.com/watch?v=YpCiPwZINqs
2	Study structure of BCC crystals.	CO2	https://www.youtube.com/watch?v=_h-Xv9nsJLc
3	Metallographic Study and analysis of Brass.	CO3	https://www.youtube.com/watch?v=IPjM4UGumT4
4	Hardenability of Steel by Jominy End Quench Test.	CO4	https://www.youtube.com/watch?v=qjsZVivfzcg

Text Book(s):

1. Introduction to Physical Metallurgy / Sidney H.Avener. 2017
2. A Text of Essential of Materials science and engineering/ DonaldR.Askeland/Thomson.2013
3. Material Science and Metallurgy/ Dr.V.D.Kodgire,2011

Reference Book(s):

1. Science of Engineering Materials/Agarwal
2. Engineering materials and metallurgy/R. K.Rajput/S.Chand.
3. Engineering Materials and Ther Applications – R. A Flinn and P K Trojan /JaicoBooks

NARAYANA ENGINEERING COLLEGE:NELLORE								
20ES1508	**Principles Of Electrical And Electronics Engineering Lab**							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
I	0	0	3	48	1.5	40	60	100

Pre-requisite: Network Analysis

Course Objectives:

1. To design electrical circuits
2. To analyze a given network by using mesh & Nodal analysis
3. To measure three phase Active and Reactive power.
4. To understand the locus diagrams.
5. To Conduct Experiment on semiconductor devices.
6. To verify amplification of Transistor, FET & MOSFET.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Verify electrical circuits. (BL-2)
CO 2	Experimentally determine self-inductance, mutual inductance and coefficient of coupling Practically. (BL-2)
CO 3	Describe construction, working and characteristics of diodes, transistors and operational amplifiers (BL-03)
CO 4	Demonstrate how electronic devices are used for applications such as rectification, switching and amplification (BL-01)

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1		2	2		2								2	2
CO2		2	2	3									2	2
CO3		2	2	2									3	2
CO4		1	1	3									3	2

1: Low, 2-Medium, 3- High

COURSE CONTENT	**CO**
Task 1 - Verification of Kirchhoff laws.	
Objectives: a) To Verify the KCL b) To Verify the KVL	CO 1
TASK-2 Determination of Self, Mutual Inductances and Coefficient of Coupling	
Objective: To determine the self and mutual inductances and coefficient of coupling for two inductive coils.	
Task-3 verification of RL ,RC& RLC series circuits	
Objectives: To Verify the Resistance, inductance & Capacitance effects in series Ac circuits	CO 1
TASK-4 Locus Diagrams of RL and RC Series Circuits	
Objective: To Plot the current locus diagrams for RL and RC circuits.	CO 2

TASK-5 Series Resonance	
Objective: To determine resonant frequency, band width and Q-factor for series RLC circuits	CO 2
TASK-6 Parallel Resonance	
Objective: To determine resonant frequency, band width and Q-factor for parallel RLC circuits	CO 2
PART-B: Electronics Laboratory	
Task 7 - characteristics of Semi-conductor diode	
Objective: Objectives: Draw and study the characteristics of Semi-conductor diode	CO 3
Task 8-characteristics of Zener Diode	
Objectives: Draw and study the characteristics of Zener Diode	CO 3
Task 9-characteristics of Transistor in Common Emitter configuration	
Objective: Objectives: Draw and study the input and output characteristics of Transistor in Common Emitter configuration.	CO 3
Task 10-Characteristics of Transistor in Common Collector configuration	
Objective: Draw and study the input and output characteristics of Transistor in Common collector configuration.	CO 4
Task 11- Study of Rectifiers	
Objectives: Construct half wave and full wave rectifier circuits. Find ripple factor and plot their output waveforms with and without filters.	CO 4
Task 12-Characteristics of MOSFET	
Objective: Draw and study the Drain and Transfer characteristics of Transistor in Common Emitter configuration	CO 4

Additional Experiments:	
TASK-13 Simulation of DC Circuits	
Objective: To simulate a simple DC circuits using PSpice	CO 2
TASK-14 DC Transient Response	
Objective: To simulate a simple DC circuits using PSpice	CO 2
TASK-15 LC Tuned Oscillators	
Objective: Conduct Experiment on LC-Tuned Oscillators Using PSPICE.	CO4

TASK-15 Class A Amplifier	
Conduct Experiment on Class A amplifier using PSPICE	CO4
Virtual Labs: 1. Speed Control of DC Motor By Varying The Armature And Field Resistances. 2. Conduct OC and SC Test on Single Phase Transformer. 3. Conduct Brake test on 3-phase induction motor.	

4. PSPICE Virtual Lab: **https://vlabs.iitkgp.ernet.in/be/#**	

Text Book(s):

1. Simulation of Power Electronics Circuit, M B Patil, V Ramanarayan and V T Ranganat, Alpha Science International Ltd., 2009.
2. Basic Electrical and Electronics Engineering, M.S.Sukhija, T.K.Nagsarkar, Oxford University

Reference Book(s):

1. A Sudhakar, Shyammohan S Palli, "Circuits & Networks", Tata McGraw- Hill, 4th Edition, 2010.
2. WillamHayt.jr, Jack E.kemmerly,StevenM.Durbin, "Engineering Circuit analysis" Tata McGraw- Hill, 8th Edition2012
3 A Chakrabarthy, "Electric Circuits", Dhanpat Rai & Sons, 6th Edition, 2010.
4 Rudra Pratap, "Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers", Oxford University Press, 1 st Edition, 1999.
5. David A.Bell, "Electronic Devices and Circuits", Fifth Edition, Oxford University Press, 2009.
6.. Salivahanan, Kumar, Vallavaraj, "Electronic Devices and Circuits", Tata Mc-Graw Hill, Second Edition.

Web Resources:

1. **https://www.ee.iitkgp.ac.in/**
2. **http://www.vlab.co.in/lab_ready_for_use.php**
3. **http://vlab.amrita.edu/?sub=1&brch=75**
4. **https://www.electronicsforu.com/tag/on-semiconductor**
5. **https://www.electrical4u.com/difference-amplifier/**

NARAYANA ENGINEERING COLLEGE:NELLORE								
20EN1502	**ORAL COMMUNICATION SKILLS LAB**							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
II	0	0	2	32	1	40	60	100

Pre-requisite:Nil

Course Objectives:

1. Understand the role of communication in personal & professional success and developawareness of appropriate communicationstrategies.
2. Understand and learn to distinguish informal speech from formal speech through role playsand can handle a concern or complaint, with empathy andunderstanding.
3. Improves speaking ability in English both in terms of fluency andcomprehensibility.
4. Understand the essential points in preparing an oralpresentation
5. To improve the mass communication and provide an opportunity to exercise their rights toexpress them effectively
6. To equip students with knowledge and techniques to effectively tackle the interviewprocess

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	To develop knowledge, skills, and judgment around human communication that facilitates their ability to work collaboratively with others.
CO 2	Use listening skills to create more effective, less confrontational, more productive professional & personal relationships and understand techniques required for excellent telephone etiquette.
CO 3	Develop their public speaking abilities to speak both formally and informally.
CO 4	Learn the skills necessary to deliver effective presentation with clarity and impact.
CO 5	Understand the nuances of English language and skills required for effective participation in group activities.
CO 6	Learn to face different types of interviews with confidence and understand the procedure& preparation required for attending an interview.

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	1									3		2		
CO2	1									2		3		
CO3	1									3		2		
CO4	1									3		3		
CO5	1									3		2		
CO6	1									2		3		
1: Low, 2-Medium, 3- High														

COURSE CONTENT	**CO**
Module - 1	
Ice - Breaking Activity – Introducing Oneself and Others – Greetings – Taking Leave - Introduction to Communication Skills – Verbal & Non Verbal Communication - Barriers to effective communication - Kinesics - Proxemics – Chronemics - Haptics- Paralanguage.	**CO1**
Module - 2	
Situational Dialogues and Role play – Expressions in various Situations - Greetings – Apologies – Requests – Giving directions -Social and Professional etiquettes – TelephoneEtiquettes	**CO2**
Module - 3	
Just a Minute (JAM) - Asking for Information and Giving Directions–Description (Oral): Pictures, Photographs, Products, and Process	**CO3**
Module – 4	
Presentation Skills – Oral presentations (individual and group) through Seminars / PPTs - Fluency & accuracy in speech – Improving self- expression– Tonal variations – Listener oriented speaking - Developing persuasive speakingskills.	**CO4**
Module - 5	
Debate : concepts, types, do's and don'ts - intensive practice- Group Discussion and Group Discussion : Dynamics of group discussion,intervention, summarizing, modulationofvoice, body language, relevance, fluency and organization of ideas and rubrics for evaluation.	**CO5**
Module - 6	
Interview Skills: Concept and process, pre-interview planning, opening strategies,answering strategies, interview through Tele - Conference & video - conference and Mock Interviews.	**CO6**

Reference Book(s):

- *Rizvi,Ashraf.M.,EffectiveTechnicalCommunication,McGrawHill,NewDelhi.2005*
- *Raman, Meenakshi &Sangeetha Sharma. Technical Communication: Principles and Practice, Oxford University Press, New Delhi.2011.*
- *Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition,2018.*
- *English for Technical Communication for Engineering Students, Aysha Vishwamohan, Tata McGraw-Hill2009*
- *CommunicationSkillsbyLeenaSen,PHILearningPvtLtd.,NewDelhi,2009*

Web Resources:

- *Grammar/Listening/Writing1-language.com*
- *http://www.5minuteenglish.com/*
- *https://www.englishpractice.com/Grammar/Vocabulary*
- *English Language LearningOnline*
- *http://www.bbc.co.uk/learningenglish/*
- *http://www.better-english.com/*
- *http://www.nonstopenglish.com/*
- *https://www.vocabulary.com/*
- *BBC Vocabulary Games*
- *Free Rice Vocabulary GameReading*
- *https://www.usingenglish.com/comprehension/*
- *https://www.englishclub.com/reading/short-stories.htm*
- *https://www.english-online.at/ Listening*
- *https://learningenglish.voanews.com/z/3613*
- *http://www.englishmedialab.com/listening.htmlSpeaking*
- *https://www.talkenglish.com/*
- *BBC Learning English – Pronunciationtips*
- *Merriam-Webster – Perfect pronunciation Exercises AllSkills*
- *https://www.englishclub.com/*
- *http://www.world-english.org/*
- *http://learnenglish.britishcouncil.org*

/Online Dictionaries

- *Cambridge dictionary online :https://dictionary.cambridge.org/*
- *MacMillan dictionary :https://www.macmillandictionary.com/*
- *Oxford learner's dictionaries :https://www.oxfordlearnersdictionaries.com/*

NARAYANA ENGINEERING COLLEGE::NELLORE

AUTONOMOUS

DEPARTMENT OF MECHANICAL ENGINEERING

List of R20 III & IV Sem Subjects

S.No	BoS Subjects from The Department of ME	Sem/Branch	Category
1.	Engineering Mechanics	III Sem ME	ES
2.	Thermodynamics	III Sem ME	ES
3.	Manufacturing Processes	III Sem ME	PC
4.	Fluid Mechanics &Hydraulic Machines	III Sem ME	PC
5.	Computer Aided Drafting and Modeling Lab	III Sem ME	ES
6.	Manufacturing Process Lab	III Sem ME	PC
7.	Fluid Mechanics & Hydraulic Machines Lab	III Sem ME	PC
8.	Thermal Engineering	IV Sem ME	PC
9.	Kinematics of Machinery	IV Sem ME	PC
10.	Mechanics of Materials	IV Sem ME	PC
11.	Metal Forming Processes	IV Sem ME	PC
12.	IC Engines Lab	IV Sem ME	PC
13.	Mechanics of Materials Lab	IV Sem ME	PC
14.	Computer Aided Machine Drawing	IV Sem ME	PC

NARAYANA ENGINEERING COLLEGE: NELLORE								
	ENGINEERING MECHANICS							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
III	2	1	0	48	3	40	60	100

Pre-requisite: Differentiation and integration topics in mathematics.

Course Objectives:

1. To learn the fundamentals of mechanics concept of force and its types.
2. To learn the effect of friction on equilibrium.
3. To develop knowledge in analyzing different types of trusses.
4. To gain proficiency in understanding the concept center of gravity & moment of inertia.
5. To learn kinematics, kinetics of particle and rigid body, related principles.

CO1	Compute the resultant of system of forces in plane and space acting on bodies. (BL-3)
CO2	Solve the mechanics problems associated with friction forces. (BL-3)
CO3	Determine the support-reactions and analyze the internal forces of the members of various trusses and frames. (BL-4)
CO4	Calculate the location of centroid of composite areas. (BL-4)
CO5	Solve problems related to kinetics. (BL-3)

***CO*-PO Mapping**

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS 2
CO1	2	1	1										1	
CO2	2	2	2										1	
CO3	2	2	2											
CO4	2	2	2										2	
CO5	2	2	2										1	

1:Low,2-Medium,3-High

COURSE CONTENT

MODULE – 1	System of Forces	10 H

Composition and resolution of forces, parallelogram law, principle of transmissibility, types of force systems - concurrent and concurrent coplanar forces, resultant of coplanar force systems couple, moment of a force Varignon's theorem, concept of free body diagrams, concept of equilibrium of coplanar force systems.

MODULE -2	Friction	09 H

Definition of Friction and its applications, angle of friction, angle of repose, coefficient of friction. Types of Friction, laws of static friction, Description and application of friction on blocks on horizontal and inclined planes.

MODULE-3	Analysis of Trusses	09 H

Introduction to plane trusses, analysis of plane trusses by method of Joints, method of sections & tension coefficient method.

MODULE-4	Centroid & Moment of Inertia	10H
Definition of Centroid & Centre of Gravity, Axes of Symmetry, Location of Centroid of Rectangle, Triangle, Semicircle, Quadrant and sector of a circle by method of integration. Numerical problems on Centroid of Composite sections. Concept of Moment of inertia, perpendicular axis theorem, parallel axis theorem, and moment of inertia of Rectangular, Circular, Semicircular, Quadrant of a circle Triangular sections by method of integration. Numerical Problems on moment of inertia of composite section.		
MODULE-5	**Kinematics & Kinetics**	**10 H**
Rectilinear and Curvilinear motion, Velocity, Acceleration, Motion of a projectile, Relative motion. Kinetics of rectilinear motion, Newton's laws of motion, D'Alembert's principle, Work-energy method, Impulse-momentum equation, Kinetics of circular motion, Rotation.		
	Total hours:	**48 h**

Text Book(s):

1. S S.Bhavikatti, "Engineering Mechanics", 4th edition, New Age International,2008.

2. R.K. Bansal, "A text book of Engineering Mechanics", LaxmiPublications,2010

3. Irving Shames, GKM Rao, "Engineering Mechanics: Statics and Dynamics", 4thedition, Pearson, 2009.

Reference Book(s):

1. BasudebBhattacharya.,"EngineeringMechanics",2ndedition,OxfordUniversityPress (India),2015.
2. K L Kumar, Veenu Kumar, "Engineering Mechanics", 4th edition, Tata McGrawHill,2010.
3. Engineering Mechanics, R.S.Khurmi, S.Chand, 2012.
4. Engineering Mechanics Statics and Dynamics by Ferdinand Singer,2011

NARAYANA ENGINEERING COLLEGE:NELLORE								
	THERMODYNAMICS							R2020
Semester	Hours / Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
III	3	0	0	48	3	40	60	100

Pre-requisite : Engineering physics, Mathematics

Course Objectives:

1. To learn the fundamental concepts of thermodynamics and related definitions
2. To understand the concept of law of conservation of energy for a process or cycle andto create awareness of principle of working of various thermodynamic systems to learntheir practical applications.
3. To describe the principle of entropy, availability, irreversibility and combustion thermodynamics.
4. To study the behavior of pure substance, ideal and real gases during various thermodynamic processes and to study change in various properties.
5. To Prepare students to apply principle of thermodynamics to solve numerical and designproblems of various thermodynamic processes and systems to provide useful solutions**.**

Course Outcomes: At the end of the course, student will be able to:	
CO 1	Understand the concepts of system, control volume, thermodynamic properties, thermal equilibrium, work and heat. (BL-2)
CO 2	Apply the laws of thermodynamics for different workstations.(BL-3)
CO 3	Analyze the performance of steam power cycles .(BL-4)
CO 4	Measure the properties of pure substances and gas mixtures.(BL-3)
CO 5	Analyze air standard cycles applied in prime movers. (BL-4)

CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	1	1	-	-	-	-	-	-	-	-	-	1	2	-
CO2	2	2	1	-	-	-		-	-	-	-	1	2	-
CO3	2	2	1	1	1				-	-	-		1	-
CO4	-	2	-	-	-	-	-	-	2	-	-	-	2	-
CO5	2	2	1	1	1				-	-	-	2	1	2
	1: Low, 2-Medium, 3- High													

COURSE CONTENT

MODULE – 1	**FUNDAMENTAL CONCEPTS**	09 Hours

Fundamental Concepts and Definitions: Microscopic and Macroscopic approaches, Concept of continuum and control volume, Systems of Thermodynamics, State, Property, Process, Homogeneous and Heterogeneous systems, Thermodynamic equilibrium, Quasi – static Process, Zeroth Law of Thermodynamics, Temperature Measurement .

Work And Heat Transfer: Thermodynamic Definition of Work and Heat, Different forms of Work and Work transfer and Heat and Heat Transfer, Path Function and Point Function.

MODULE -2	**FIRST LAW OF THERMODYNAMICS**	10 Hours

First Law of Thermodynamics: First law applied to a closed system undergoing a cyclic process and a change of state, Concept of Energy and its forms – Internal Energy and Enthalpy, Perpetual Motion Machine of First Kind (PMM1), First Law Limitations.

Systems of flow : First law applied to a control volume, Steady flow process and its mass and energy balance, Steady flow energy equation on unit mass and time basis, Application of SFEE for devices like boiler, turbine, compressor, heat exchanger, nozzle, diffuser and throttling device.

MODULE-3	SECOND LAW OF THERMODYNAMICS	10Hours

Second Law of Thermodynamics: Definition of a heat engine and energy reservoir, thermal efficiency of heat engine, Refrigerator and heat pump and their coefficient of performances, Kelvin-Planck and Clausius Statements ofthe Second Law and their equivalence, Carnot Cycle and Reversible Heat Engine, Carnot theorems and corollaries, Absolute Thermodynamic Temperature Scale, PMMI and PMM II, Reversible process, Irreversible process, Causes of Irreversibility,

Entropy : Concept of Entropy, Clausius theorem, Clausius inequality, Entropy changes in an irreversible and reversible process, Principle of increase of entropy with its application, Absolute entropy.

MODULE-4	PURE SUBSTANCES	09 Hours

PURE SUBSTANCE: Behavior of pure substance (steam) explained through T-v, P-T, P-v, P-h & T-s diagrams Triple point and critical point, Quality or Dryness Fraction, Wetness Fraction, Steam Tables, Mollier Chart Measurement of dryness fraction using throttling and separating- throttling calorimeters and also from steam tables Steam processes; expressions for the change in internal energy, enthalpy, work, heat, entropy in various Processes.

MODULE – 5	IDEAL GASES AND GAS POWER CYCLES	10 Hours

Ideal Gas and Real Gas: Ideal gas, relation among the specific heats, internal energy, enthalpy. Analysis of isochoric, isobaric, isothermal, isentropic, isenthalpic processes, representation of the above processes on P-v, T- s planes. Determination of work, heat, entropy and enthalpy changes during the above processes, problems Characteristic gas equations of a real gas, law of corresponding states, compressibility factor, problems.

MODELLING OF BASIC ENERGY CONVERSION CYCLES:

Air standard cycle assumptions, Overview of reciprocating engines, Air standard cycles for reciprocating engines – Otto, Diesel &dual, Derivation for efficiency and Mean effective pressure (MEP) and Problems.

Total hours:	**48 hours**

Text Book(s):

1. P.K.Nag, Engineering Thermodynamics, TMH, New Delhi,2013
2. G.J.Vanwylen and R.E.Sonntag, Fundamentals of Classical Thermodynamics, Wiley Eastern, NewDelhi,2008.

Reference Book(s):

1. R. K. Rajput (2010), A text book of Engineering Thermodynamics, Fourth Edition, Laxmi Publications, New Delhi, India.
2. Engineering thermodynamics by RK Rajput,5TH edition, Laxmi Publications, New Delhi, India.
3. Engineering thermodynamics, work and heat transfer by Gordon rogers 4TH edition, person educationindia2002.
4. Yonus A Cengel and Michael A Boles, Thermodynamics: An Engineering Approach, McGrawHill, 2002.
5. Principles of engineering thermodynamics by morani 8THedition, SI version.

NARAYANA ENGINEERING COLLEGE::NELLORE							
	MANUFACTURING PROCESSES						R2020
Semester	Hours / Week			Total hrs	Credits	Max Marks	
	L	T	P		C	CIE	SEE	TOTAL
III	3	0	0	48	3	40	60	100

Pre-requisite:

Knowledge in strength of materials

Knowledge in engineering materials

Basic knowledge in mathematical calculations

Preliminary Knowledge about various Mechanical Manufacturing methods

Course Objectives:

1. To give an exposure to different techniques of casting and moulds required
2. To learn the Working principle of different special casting processes and gating system 3.To give an understanding of welding metallurgy and weldability and to introduce variousmetal joining techniques
4. To Classify the working of different types of GAS welding processes and GAS welding defects
5. To study the concepts of surface treatment process and manufacturing methods of ceramics andpowder metallurgy.

Course Outcomes: After successful completion of the course, the student will be able to:	
CO 1	introduce the basic concepts of casting, pattern preparation and gating system [BL-2]
CO 2	Demonstrate different special casting processes and melting systems[BL-2]
CO 3	Classify working of various welding processes,weld joint and their characteristics[BL-2]
CO 4	Apply the principles of various gas welding and cutting processes[BL-3]
CO 5	Outline the manufacturing methods of ceramics and powder metallurgy[BL-2]

CO-PO Mapping

CO	PO												PSO	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1											1	
CO2	1	1	2										2	
CO3	1	1	2										2	
CO4	1	1	2		1							1	3	
CO5	1	1		1	2							1	1	2
1:Low,2-Medium,3-High														

COURSE CONTENT

MODULE – 1	**CASTING PROCESSES**	10 h

Introduction : Importance and selection of manufacturing processes.

Casting Processes: Introduction to casting process, process steps; Sand Casting – Sand Molds - Typesof Molding Sands and Testing; pattern: types, materials and allowance; Cores: Types of cores, core prints, principles and design of gating system;

Solidification of casting: Concept, solidification of pure metal and alloy.

MODULE -2	**SPECIAL CASTING PROCESSES**	9h

Special casting processes: Process Mechanics, characteristics, parameters and applications of Shellcasting, investment casting, die casting, centrifugal casting;
RISERS – Types, function and design, casting design considerations, Design of feeding systems i.e.,sprue, runner, gate and riser, moulding flasks ; casting defects and remedies
METHODS OF MELTING: Crucible melting and cupola operation, steel making processes

MODULE-3	**METAL JOINING PROCESSES - WELDING**	10h

WELDING : Classification of welding processes ;types of welds and welded joints and V-I characteristics, design of welded joints, ARC welding, Forge welding, resistance welding, Thermit welding and Plasma (Air and water) welding submerged arc welding, Laser welding, applications, advantages and disadvantages of the above processes, other fabrication processes.
Heat affected zones in welding; Arc Welding defects: causes and remedies.

MODULE-4	**GAS WELDING**	10h

Gas Welding: – Flame Characteristics-Equipment, fluxes and filler rods-Ultrasonic Welding – Friction Welding-Resistance Spot Welding-Resistance Seam Welding – Stud Welding – PercussionWelding - Brazing:- Filler Metals, Methods - Soldering:- Techniques, Types of Solders and Fluxes ;TIG& MIG welding

CUTTING OF METALS: Oxy – Acetylene Gas cutting, water plasma. Cutting of ferrous, non-ferrous metals soldering and brazing and adhesive bonding : Types and their applications, gas welding defects– causes and remedies–destructive and nondestructive testing of welds

MODULE-5	**SURFACE ENGINEERING & POWDERMETALLURGY**	9 h

SURFACE ENGINEERING: Surface treatment processes and their characteristics and applications.
(a) Overlay coatings (b) Diffusion coatings (c) Thermal or mechanical modification of surfaces. **Ceramics**: Classification of ceramic materials, ceramic powder preparation; Processing of ceramic parts:Pressing, casting, sintering; Secondary processing of ceramics: Coatings, finishing.
Powder Metallurgy: Principle, manufacture of powders, steps involved.

Total hours	48 hours

Text Book(s):

1. Rao P.N.," Manufacturing Technology–Volume I", 5thedition, McGraw-Hill Education, 2018.
2. Kalpak Jains and SchmidS.R.,"Manufacturing Engineering andTechnology",7th edition, Pearson,2018

Reference Book(s):

1. Manufacturing Technology, R.K. Rajput, Laxmi Publications
2. Production Technology by R.K.Jainand S.C.Gupta,KhannaPublishers,17 th qedition,2012
3. Production Technology, K.L Narayana, I.K. International Pub, 3rdEdition,2013
4. Manufacturing Process Vol. I, H.S.ShahPearson,2013,
5. Welding and Welding Technology, Richard Little McGraw Hill Education,2017

NARAYANA ENGINEERING COLLEGE:NELLORE								
	Fluid Mechanics and Hydraulic Machines							R2020
Semester	Hrs / Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
III	3	0	0	48	3	40	60	100

Pre-Requisite: To have basic knowledge in Mechanics, Mathematics and Integral and Differential Calculus.

Course Objectives:

1. To study the Properties of Fluids.
2. To acquire fundamental knowledge in flow through pipes.
3. To learn various concepts in impact of jet on vanes
4. To understand the various types of hydraulic turbines
5. To analyze the flow in Hydraulic Pumps.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Apply the concepts of fluid statics, fluid kinematics and fluid dynamics in solving the problems of fluid flows (BL-3)
CO 2	Become conversant with concepts of flow through pipes, pitot tube, venturi meter, orifice meter, flow nozzle and turbine meter and able to describe them.(BL-1)
CO 3	Illustrate the concepts of fluid jets on stationary and moving flat, inclined and curved vanes and also hydro power stations (BL-2)
CO 4	Make use of the various concepts of water turbines for calculating the efficiencies and unit and specific quantities (BL-3)
CO 5	Demonstrate the knowledge of working principles of centrifugal pumps (BL-2)

CO-POMapping

CO	PO											
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**
CO1	3	1	-	-	-	-	-	-	-	1	-	2
CO2	2	2	1	-	-	1	-	-	-	-	-	1
CO3	2	2	2	1	-	-	-	-	-	-	-	1
CO4	1	2	2	2	-	-	-	-	-	-	-	2
CO5	1	2	2	2	-	-	-	-	-	-	-	2

1:Low,2-Medium,3-High

COURSE CONTENT

MODULE – 1	**PROPERTIES OF FLUIDS**	**10 Hrs**

Definition of fluid, Dimensions and units, physical properties of fluids–density. specific weight, specific gravity, surface tension– vapor pressure and their influence on fluid motion–Newton's Law Of Viscosity,

Fluid Statics-Atmospheric, Gauge and Vacuum pressure–measurement of pressure–Piezometer, manometers-simple, U-tube manometers, U-tube differential manometers.

Fluid Kinematics : stream line, path line and streak lines and steam tube, classification of flows- steady & unsteady, uniform, non-uniform, laminar, turbulent, rotational and irrotational flows-equation of continuity for one dimensional flow.

MODULE -2	FLUID DYNAMICS	9 Hrs

Fluid Dynamics: surface and body forces – Euler's and Bernoulli's equations for flowing stream line, momentum equation and its application on force on pipe bend

Flow Through Pipes: Reynolds's Number, Darcy Weisbach equation–Minor losses in pipes–pipes in series and pipes in parallel. Measurement of flow: Pitot Tube, Venturi Meter - horizontal position only and Orifice Meter.

MODULE-3	IMPACT OF JET ON VANES	10 Hrs

Dimensional Analysis- dimensional homogeneity- methods of dimensional analysis-Rayleigh's method-Buckingham theorem.

Impact Of Jet : Introduction to Hydrodynamic Thrust of jet on fixed and moving surfaces (flat and curved), series of flat vanes and series of radial curved vanes -velocity diagrams, work done and efficiency

MODULE-4	HYDRAULIC TURBINES	10 Hrs

Classification of turbines, Impulse and Reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies(theory & derivations), hydraulic design-draft tube-theory- functions and efficiency.

MODULE-5	CENTRIFUGAL PUMPS	9 Hrs

Introduction, Classification -components and working of centrifugal pumps, - work done – manometric head, losses, efficiencies–specific speed–pumps in series and parallel–performance characteristic curves and NPSH.

Total Hrs:	48 Hrs

Text Book(s):

1. Fluid Mechanics and Hydraulic Machines by Modi &Seth, Standard book house

2. A Text of Fluid Mechanics and Hydraulic Machines by Dr.R.K.Bansal – Laxmi Publications (P) Ltd., New Delhi, 2019.

Reference Book(s):

1. Fluid mechanics and fluid machines by Rajput, S.Chand & Co.
2. Mechanics of Fluids by Potter, Wiggert, Ramadan, M.M.M.SARCAR, Cengage Publishers.
3. Principles of Fluid Mechanics and Fluid Machines by M.Narayana Pillai, Universities Press.
4. Dr D S Kumar, "Fluid Mechanics and Fluid Power Engineering" S K Katariua&Sons,2014.

1.

NARAYANA ENGINEERING COLLEGE: NELLORE								
	Computer Aided Drafting and Modeling Lab							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
III	0	0	3	48	1.5	40	60	100

Pre-requisite: To have basic knowledge in Computers and Engineering Drawing.

Course Objectives:

1. To study the basics of CAD software
2. To develop skills to create 2D models.
3. To develop skills to create 3D models.
4. To study the basics of obtaining 2D Multi view drawings from 3D models.

Course Outcomes: After successful completion of the course, the student will be able to:	
CO 1	Study basic of CAD software and study basic concept of product design (BL-1)
CO 2	Use the software package for drafting and modelling and explain representation of curves for real time applications. (BL-2)
CO 3	Construct 2D models of Engineering Components (BL-3)
CO 4	construct 3D models of Engineering Components (BL-3)

CO-POMapping

CO	**PO**												**P**
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PS**
CO1													
CO2	2									2			
CO3	3		3		2					2		2	
CO4	3		3		2					2		2	

1: Low, 2-Medium, 3-High

COURSE CONTENT

Task -1 Introduction to AutoCAD commands

Study capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.

Task -2
. Draw Title Block with necessary text and projection symbol
Task -3
Draw the methods of Dimensioning
TASK-4
Draw front view and top view of pentagon & hexagon by using 2D modeling
TASK-5
Draw front view and top view of simple solids like prism, pyramid, cylinder, cone by using 2D modeling
TASK-6
Draw front view, top view and side view of objects from the given pictorial views (eg. V-block,, stepped block, pulley, Simple stool,).
TASK-7
Draw sectional views of prism, pyramid, , etc,
TASK-8
Draw isometric projection of simple objects. cylinder, cone and sphere
TASK-9
Creation of 3-D models of simple objects like journal bearing and spiral steps
TASK-10
Draw a layout of Engineering workshop.

Text Book(s):

1. Mikell.P.Groover, "CAD/CAM: Computer-Aided Design and Manufacturing", Prentice hall of India Pvt. Ltd.,NewDelhi.2008
2. Ibrahim Zeid, "CAD / CAM - Theory and Practice 2E", Tata McGraw-Hill, NewDelhi,2010.

Reference Book(s):

1. Chriss McMahon and Jimmie Browne, "CAD/CAM", Addision Wesley, New York,2000.
2. Tien-chienchang, Richard A wysk, Hsu-pin wang, "Computer-Aided Manufacturing", PearsonEdition,2009.
3. P. Radhakrishnan, S. Subramanyan, V. Raju "CAD/CAM/CIM", New Age International,2015.
4. M.M.M. Sarcar, K. Mallikarjuna Rao, K. Lalit Narayan "computer aided design and manufacturing", prentice hall of India,2008.

NARAYANA ENGINEERING COLLEGE::NELLORE								
	Manufacturing process Lab							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
III	0	0	3	48	1.5	40	60	100

Pre-requisite:

Knowledge in strength of materials

Knowledge in engineering materials

Course Objectives:

1. To acquire practical knowledge on Metal Casting and Welding,
2. To Study and practice arc and gas welding technologies.
3. To Gain knowledge on the properties, testing and applications of Steel, Cast Iron and Brass
4. To acquire practical knowledge on Press Working and unconventional machining Processes.
5. To Make the students practice on machine tools so that they can identify, manipulate and control various process parameters during machining processes in machine tool shop.

Course Outcomes: After successful completion of the course, the student will be able to:	
CO 1	understand the importance of safety in metal casting technology[BL-2]
CO 2	Apply Hands on experience on welding machine to perform welding and cutting operations[BL-3]
CO 3	Demonstrate Press Working operations on jobs[BL-2]
CO 4	select the proper tools to work on a machine for the type of part required[BL-4]
CO 5	Fabricate different types of components using various manufacturing techniques. [BL-3

CO-PO Mapping

CO	PO												P
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS
CO1	1	1										1	1
CO2	1	1										1	1
CO3												1	1
CO4	1	1										1	1
CO5	1	1										1	2
1: Low, 2-Medium, 3-High													

COURSE CONTENT
Task 1
Pattern Design and making on lathe machine
Task 2
Sand Properties Testing – Exercise for Strength and Permeability
Task -3
Gating Design and pouring time and solidification time calculations
TASK -4
Molding, Melting and Casting for ferrous/ non ferrous materials
TASK -5
Arc Welding: Lap & Butt Joint of M.S. plates -5mm
TASK-6
Brazing on copper pipes- 6mm pipe
TASK -7
Spot Welding on M.S PLATE- 2mm size
TASK -8
Tig Welding : Lap & Butt Joint of M.S. plates -5mm
TASK -9
Hydraulic Press: Deep drawing Press Tool: Blanking and Piercing operation with Simple dies
TASK -10
Additive manufacturing-3D printing
ADDITIONAL EXPERIMENTS
TASK-11
Design the mould for making chalk pieces
TASK-12
Design the small components by using 3D Printing
Text Book(s): 1 .W. A. J. Chapman, Workshop Technology Part I, ELBS & Edward Arnold Publishers. 2 Hajra Choudary, Elements of workshop technology, Vol I & II, Media Publishers
Reference Book(s): 1. .Malkin Stephen, Grinding Technology: Theory and Applications of Machining with Abrasives, Industrial press,2008. 2. Poul DeGarmo, J.T.Black,R.A.Kosher, Materials and Processes in Manufacturing, Prentice Hall of India Pvt.Ltd.,1997. HMT, Production Technology, Tata McGraw Hill.

NARAYANA ENGINEERING COLLEGE:NELLORE								
	Fluid Mechanics and Hydraulic Machines Lab							R2020
Semester	Hours / Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
III	0	0	3	48	1.5	40	60	100

Pre-requisite: To have basic knowledge in Mechanics, Mathematics and Integral and Differential Calculus.

Course Objectives:

1. To study the frictional losses of fluid flow in pipes of different diameters.
2. To acquire fundamental knowledge of Bernoulli's principle.
3. To analyze the flow in Hydraulic Machines such as Turbines and pumps

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Familiar with Calibration of discharge measuring devices such as Venturi meter and Orifice meter.(BL-3)
CO 2	Familiarize with measuring minor loss (sudden contraction) and major loss (Frictional factor) of a given pipe.(BL-3)
CO 3	Apply the Bernoulli's Theorem (BL-3)
CO 4	Gain practical experience in handling various hydraulic machines (BL-3)

COURSE CONTENT

Task 1 – Calibration of Venturi Meter

Calibrate the coefficient of Discharge of a Venturi Meter.

Task -2 Calibration of Orifice Meter

Calibrate the coefficient of Discharge of an Orifice Meter.

TASK-3 External Mouth Piece

Calibrate the coefficient of Discharge of external mouth piece.

TASK-4 Rectangular Notch

Calibrate the coefficient of Discharge of Rectangular Notch.

TASK-5 Minor Losses

Find the loss of head due to sudden contraction.

TASK-6 Major Losses

Find the friction factor of pipes having different diameters and same material.

TASK-7 Verification of Bernoulli's Theorem.

Prove that the total energy remains constant by using Bernoulli's tube withdifferent cross section.
TASK -8 Impact of jet on vanes
Measure the co efficient of impact of jet on flat and curved vanes.
TASK-9 Pelton wheel turbine
Conduct performance test on Pelton Wheel and find it's efficiency.
TASK-10 Single stage centrifugal pump.
Calculate the efficiency of a single stage centrifugal pump with constant speed.
ADDITIONAL EXPERIMENTS
TASK-11 Multi stage centrifugal pump.
Calculate the efficiency of a Multi stage centrifugal pump with constant speed.
TASK-12 Reciprocating pump.
Calculate the efficiency of a Reciprocating pump with constant speed.
VirtualLabs: **1http://eerc03-iiith.vlabs.ac.in/** **2.http://fmc-nitk.vlabs.ac.in/fluid-machinery/**
Text Book(s): **1.** Hydraulic and Fluid Mechanics including Hydraulic Machines by Modi &Seth, Standard book house 2.A Text of Fluid Mechanics and Hydraulic Machines by Dr.R.K.Bansal – Laxmi Publications (P) Ltd.,New Delhi.
Reference Book(s): 1. Fluid mechanics and fluid machines by Rajput, S.Chand & Co. 2. Mechanics of Fluids by Potter, Wiggert, Ramadan, M.M.M.SARCAR, Cengage Publishers. **3.** Principles of Fluid Mechanics and Fluid Machines by M.Narayana Pillai, Universities Press.

NARAYANA ENGINEERING COLLEGE:NELLORE								
	THERMAL ENGINEERING							R2020
Semester	Hours / Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
IV	3	0	0	48	3	40	60	100

Pre-requisite: Basic knowledge of engineering thermodynamics

Course Objectives:

1. To make students familiar with the design and operating characteristics of modern internal combustion engines.
2. To discuss about the various working systems in IC engines.
3. To describe the combustion mechanisms in IC engines.
4. To examine the IC engines performance by various testing procedures
5. To understand the different types of Compressors.

Course Outcomes: At the end of the course, student will be able to:

CO 1	Understand the working principle of IC engine.(BL-2)
CO 2	Explain about various working systems in IC engines.(BL-2)
CO 3	Describe the combustion processes of engines and identify the combustionchamber – requirements.(BL-2)
CO 4	Evaluate the performance of IC engine.(BL-4)
CO 5	Summarize about the types and working principles of compressors.(BL-2)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1											1	
CO2	3												2	
CO3	2	1	1										1	
CO4	2	1	1										1	
CO5	2	1		1									1	

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	INTRODUCTION TO IC ENGINES	09 Hours

IC ENGINES: Classification, Various parts and their uses, Materials of parts, Working principles of two stroke and four stroke engines and SI and CI engines, Valve and Port Timing Diagrams, Scavenging of IC Engines.

MODULE -2	VARIOUS SYSTEMS OF IC ENGINES	10 Hours

FUEL SUPPLY SYSTEM (IN SI ENGINES) : Line diagram of fuel supply, Fuel pumps – Mechanical and Electrical, Air cleaners , Fuel filters, Simple Carburettor – its working principle and types, Carburettor defects.

COOLING SYSTEM (IN SI ENGINES) : Methods – Air cooling, water cooling and liquid cooling, Types of water cooling – Thermosyphon system and Pump Circulation system, Radiator and Thermostat. Pressure sealed cooling, Anti freeze solutions.

LUBRICATION SYSTEM (IN SI ENGINES) : Dry sump and Wet sump systems. Crankcase ventilation, Oil pumps – Gear pump and Plunger pump, Oil filters – Bypass system and Full flow system.

IGNITION SYSTEM (IN SI ENGINES) : Requirements of ignition system, Types – Battery Ignition, Magneto Ignition and Electronic Ignition, Working principles of all the ignition systems, Spark Advance and

Retard Mechanisms.

MODULE -3	COMBUSTION IN IC ENGINES	10 Hours

COMBUSTION IN SI ENGINES: Combustion in SI Engines Normal Combustion and abnormal combustion, Importance of flame speed and effect of engine variables, Type of Abnormal combustion, pre-ignition and knocking (explanation of) Fuel requirements and fuel rating, anti-knock additives, combustion chamber – requirements, types.

COMBUSTION IN CI ENGINES: Four stages of combustion, Delay period and its importance, Effect of engine variables, Diesel Knock, Need for air movement, open and divided combustion chambers and nozzles used – fuel requirements and fuel rating.

MODULE-4	TESTING AND PERFORMANCE OF IC ENGINES	09 Hours

TESTING AND PERFORMANCE OF IC ENGINES: Parameters of performance, measurement o cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power, Determination o frictional losses and indicated power, Performance test, Heat balance sheet.

MODULE-5	COMPRESSORS	10 Hours

RECIPROCATING COMPRESSORS: Classification of compressors, Principle of operation o reciprocating compressors, work required, Isothermal efficiency volumetric efficiency and effect of clearance multistage compression, under cooling, saving of work, minimum work condition for multi-stagecompression.

CENTRIFUGAL COMPRESSORS: Mechanical details, principle of operation, velocity and pressure variation, impeller blade shape-losses, slip factor, power input factor, pressure coefficient and adiabatic coefficient, velocity diagrams, power required.

Total hours:	**48 Hours**

Text Book(s):

1. R.S. Khurmi and J.K. Gupta, A Textbook of Thermal Engineering, (2011), 3rd Edition, S. Chand & Company Ltd., New Delhi
2. R. K. Rajput (2011), Thermal Engineering, 18th edition, Lakshmi Publications, New Delhi,India.
3. Dr. Kirpal Singh, Automobile Engineering (Volume II), 6th Edition, Standard Publisher, New Delhi.
4. V. Ganesan (2011), I.C. Engines, 3rd edition, Tata McGraw-Hill, New Delhi,India.

Reference Book(s):

1. Mathur, Sharma (2008), IC Engines, 3rd edition, Dhanpat Rai & Sons, New Delhi,India.

2. B.JohnHeywood (2011), internalcombustionenginefundamentals,2ndedition, TataMcGraw-Hill, NewDelhi.

3. Pulkrabek (2008), Engineering fundamentals of IC Engines, 2nd edition, Pearson Education.

NARAYANA ENGINEERING COLLEGE:NELLORE								
	KINEMATICS OF MACHINERY							R2020
Semester	Hours / Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
IV	3	0	0	48	3	40	60	100

Pre-requisite: Basics in Engineering Mathematics, Physics & Engineering Mechanics

Course Objectives:

1. To understand the basic principles of kinematics and the related terminology of machines.
2. To learn the principle of steering mechanisms and its types.
3. To analyse a mechanism for displacement, velocity and acceleration of links in a machine.
4. To gain proficiency in understanding the terminology of gears.
5. To acquire knowledge in cam profile drawing for various followers.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Identify different types of mechanisms and inversions of different kinematic chains.(BL-3)
CO 2	Identify and enumerate different mechanisms with basic understanding of motion andmachine. (BL-3)
CO 3	Draw velocity and acceleration diagrams for different mechanisms. (BL-4)
CO 4	Apply the knowledge of gears to Calculate pitch, module, number of teeth, path of contact for meshing gears. (BL-3)
CO 5	Draw displacement diagrams and cam profile diagram for followers executing differenttypes of motions and various configurations of followers. (BL-5)

CO-PO Mapping

CO	PO												
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	P
CO1	2	2	2		1							1	
CO2	1	1	1		1							1	
CO3	3	2	2										
CO4	1	1	1		1							1	
CO5	1	1	1		1							1	
1:Low,2-Medium,3-High													

COURSE CONTENT		
MODULE – 1	**Introduction**	**10 Hrs**

Definitions of link or element, kinematic pairs, degrees of freedom, Grubler's criterion (without derivation), kinematic chain, mechanism, structure, mobility of mechanism, inversion, machine, kinematic chains and inversions. Inversions of four bar chain, single slider crank chain and double slider crank chain, Quick return motion mechanisms – drag link mechanism.

MODULE -2	**Mechanisms with LowerPairs**	**9 Hrs**

straight line motion mechanisms – Peaucellier'smechanism and Robert's mechanism, intermittent motion mechanisms – Geneva mechanism and ratchetand pawl mechanism, pantograph.
Steering Mechanism: Condition for perfect steering, Steering gear mechanisms, Davis and Ackermann–Hooke's Joint.

MODULE-3	Velocity and Acceleration of Mechanisms	10 Hrs

Determination of velocity and acceleration of a point/link in simple mechanisms by relative velocity method (graphical) – Coriolis component of acceleration. Instantaneous centre – Centrodes – Kennedy's theorem – To determine linear velocity and angular velocity of links of simple mechanisms by instantaneous center method.

Klein's Construction for velocity and acceleration of slider crank mechanism.

MODULE-4	Gears & Gear Trains	10 Hrs

Classification of Gears – Gear terminology –Law of gearing –Velocity of sliding – Length of path o contact, Arc of contact – Contact ratio – Interference in Involute gears, Methods of avoiding interference – Minimum number of teeth to avoid interference on pinion meshing with gear and on pinion meshing with rack. Characteristics of involutes action, Comparison of Involute and Cycloidal teeth profiles. Numerical problems.
Velocity ratio & Train value, Types of gear trains– Simple, Compound, Reverted & Epicyclic gear trains. Algebraic/Tabular method of finding Train value of Epicyclic gear trains, Bevel gear Differential of an automobile

MODULE-5	CAMS	9 Hrs

.
Types of cams, types of followers, displacement, velocity and acceleration time curves for cam profiles, disc cam with reciprocating follower having knife-edge, roller and flat faced follower, disc cam with oscillating roller follower. Follower motions including, SHM, uniform velocity, uniform acceleration and retardation and Cycloidal motion

Total hours:	48 hours

Text Book(s):

1. Thomas Bevan, Theory of Machines, CBS Publishers, 2009.
2. S.S. Rattan, Theory of Machines, Tata McGraw Hill Publishers, 3rd Edition, 2009.
3. Kinematics & Theory of Machines, Sadhu Singh, Pearson

Reference Book(s):

1. J.E.Shigley, Theory of Machines, Tata McGraw Hill Publishers, New Delhi, 3rd Edition, 2005.
2.C.S. Sharma and Kamlesh Purohit, Theory of Mechanisms and Machines, PHI Learning Pvt. Limited,2006
3. Amitabh Ghosh and A.K. Mallik, Theory of Machines, East West Publications, 3rd Edition, 2009.

NARAYANA ENGINEERING COLLEGE:NELLORE								
	MECHANICS OF MATERIALS							R2020
Semester	Hours / Week			Total hrs	Credits	Max Marks		
	L	T	P		L	T	P	
IV	2	1	0	48	3	40	60	100

Pre-requisite: Course on Engineering Mechanics.

Course Objectives:

1. To learn the concepts of stress, strain and its relation.
2. To acquire knowledge in bending moment diagrams of beams .
3. To calculate slope and deflection for various types of beams.
4. To Analyze the shear stresses in beams of different cross sections,
5. To determine the deflection in helical springs.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Explain the fundamentals of Stress and Elastic Constants.(BL-2)
CO 2	Illustrate shear force and bending moment diagrams.(BL-2)
CO 3	Explain the methods for calculating the stress in the beams with different sections.(BL-2)
CO 4	Find the shear strength of solid and hallow shafts.(BL-1)
CO 5	Classify different stresses and strains for the thin and thick cylinders (BL-2)

CO-POMapping

CO	PO												P
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1
CO1	3	2	2			2						2	
CO2	3	3	2			2				3		2	
CO3	2	1	2			2				3		2	
CO4	3	2	2			2				3		2	
CO5	3	2	2			2				3		2	
1:Low,2-Medium,3-High													

COURSE CONTENT

MODULE – 1	SIMPLE STRESSES AND STRAINS	08 hours

Types of Stresses, Strains, Hooke's law, Stress–Strain diagram for various materials, Working Stress, Factor of safety, Lateral strain, Poisson's ratio, Volumetric strain, relation between three elastic module, Bars of Varying section, Composite bars, Temperature stresses, Strain energy.

MODULE -2	SHEAR FORCE AND BENDING MOMENT	10 hours

Concept of shear force and bending moment, S.F and B.M. diagrams for cantilever, Simply supported, Over hanging beams subjected to Point loads, Uniformly distributed loads, Uniformly varying loads and combinationof these loads, Point of contra flexure.

MODULE-3	BENDING STRESS AND SHEAR STRESS	10 hours

Theory of simple bending, Bending equation, Determination of flexural stresses for simple cases, Section modulus.

Shear stress formula, Shear stress distribution across various beams & sections - Rectangular, Circular, Triangular, I, T sections

MODULE-4	TORSION AND DEFLECTION OF BEAMS	10 hours

Theory of pure torsion, Torsion Equation, transmission of power in solid and hollow circular shafts, comparison o strengths of solid and hollow shafts, shafts in series and parallel, combined bending and torsion. Relationship between curvature, slope and deflection, Slope and deflection of cantilever and simply supported beams by Double Integration method and Macaulay's method.		
MODULE-5	**PRESSURE VESSELS AND COMPLEX STRESSES**	10 hours
Thin seamless cylindrical shells, Derivation of formula for longitudinal and circumferential stresses, Volumetric strain, Thin spherical shells, Thick cylinders under internal and external pressure. Complex Stresses - Stresses on an inclined plane under different uniaxial and biaxial stress conditions – Principal planes and principal stresses - Mohr's circle		
	Total hours:	**48 hours**

Text Book(s):

1. F.P. Beer, E.R. Johnston, Jr&John.T. DeWolf, "Mechanics of Materials", 7th edition, Tata McGraw-Hill,2016.
2. SS Rattan, Strength of materials, 3rd edition, Tata McGraw-Hill,2016.
3. Strength of Materials by R.K. Bansal, Laxmi Publishers, 5thEdition,2012.
4. Mechanics of Materials, Andrews Pytel,J aan Kiusallaas & M.M.M.Sarcar (Second Edition),Cengage Learning Publishers.

Reference Book(s):

1. Timoshenko, "Strength of Materials Part-I&II", 3rd edition, CBS Publishers,2004.
2. Popov, "Mechanics of Solids", 2nd edition, New Pearson Education,2015
3. R.K.Rajput, *Strength of materials*, S.Chand Publications, Revised Edition,2006.
4. Strength of Materials by M.Chakraborti, S.K.Kataria &Sons, 2ndEdition,2011.

NARAYANA ENGINEERING COLLEGE:NELLORE								
	METAL FORMING PROCESSES							R2020
Semester	Hours / Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
IV	3	0	0	48	3	40	60	100

Pre-requisite:

Knowledge of strength of materials is essential

Basics concepts of mechanical components and manufacturing processKnowledge in engineering materials

Basic knowledge in mathematical calculations

Course Objectives:

The objective of this course is to

1. Introduce the concepts of one, two and three dimensional stress analysis, theory of plasticity, strain hardening, hot and cold working process.
2. Create awareness among the students on various types of rolling mills, forgings.
3. .Create awareness among the students on extrusions, wire drawing processes.
4. Understand the concepts of sheet metal operations.
5. Understand the concepts on plastic manufacturing processes and rapid manufacturing process and its applications.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Understand the basic concept on one, two and three dimensional stress analysis, theory of plasticity, strain hardening, hot and cold working process [BL-2]
CO 2	Define different rolling and forging processes and their defects [BL-1]
CO 3	Familiarize the fundamentals of extrusion process and their industrial applications[BL-2]
CO 4	Identify various press working processes, their advantages and disadvantages. [BL-3]
CO 5	Explain the concept of plastic manufacturing process, [BL-2]

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	2	2		1							1	2	2
CO2	1	1	1		1							1	2	1
CO3	3	2	2										2	1
CO4	1	1	1		1							1	2	1
CO5	1	1	1		1							1	2	2
1:Low,2-Medium,3-High														

COURSE CONTENT

MODULE – 1	INTRODUCTION TO METAL FORMING	10 h

Stress, strain, Two dimensional stress analysis and three dimensional stress analysis, relation between engineering stress and true stress, relation between engineering strain and true strain ,yield criteria, yield locus, theory of plasticity, Hot working, cold working, strain hardening, recovery, recrystallisation and grainGrowth

MODULE -2	ROLLING & FORGING	9h

Introduction to bulk and sheet metal forming, Economics of bulk forming

ROLLING : principles and theory of rolling, Process description of Rolling. Forces in rolling and power requirements, applications and, limitations, defects in rolled products – Numerical problems on Rolling. FORGING PROCESSES: Principles of forging – Process description of Forging -Types Forging – Smith forging, Drop Forging – Roll forging –: Rotary forging – forging defects, Forces in forging of strip, disc and power requirements, applications

MODULE-3	EXTRUSION PROCESSES AND WIRE DERAWING	10h

EXTRUSION PROCESSES: Basic extrusion process and its characteristics. Mechanics of hot and cold extrusion - Forward extrusion and backward extrusion – Impact extrusion Hydrostatic extrusion, forces in extrusion of cylindrical and non-cylindrical components – characteristics and defects in extruded parts.

WIRE DRAWING: Process Mechanics and its characteristics, determination of degree of drawing, drawingforce, power, and number of stages-defects in products, Numerical problems on drawing

MODULE-4	SHEET METAL WORKING	9h

Sheet Metal Working – Economical Considerations - Stamping, forming and other cold working processes: Blanking and piercing – Bending and forming – Drawing and its types – Cup drawing and Tube drawing – coining – Hot and cold spinning. Force and power requirement in sheet metal operations, defects in sheet metal products

MODULE-5	PROCESSING OF PLASTICS	10h

Processing of plastics, injection and blow moulding, calendaring, thermos forming, compression moulding,transfer moulding, joining of plastics.

Rapid manufacturing: - Introduction – concepts of rapid manufacturing, information flow forrapid prototyping, classification of rapid prototyping process, sterer holography fused deposition modeling, selective laser sintering

Total hours:	48 hours

Text Book(s):

1. Manufacturing Technology, Schmid and kalpak Jain, Pearson Education,2016
2. Production Technology by R.K. Jain and S.C. Gupta, Khanna Publishers, 17th edition,2012
3. Manufacturing technology Vol I by P.N. Rao, Tata McGraw Hill, 4th edition,2013

Reference Book(s):

1. Manufacturing Technology, R.K. Rajput, Laxmi Pub
2. Rapid Prototyping Principles and Applications, Rafiq Noorani, WielyPub

NARAYANA ENGINEERING COLLEGE:NELLORE								
	IC ENGINES LAB							R2020
Semester	Hours / Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
IV	0	0	3	48	1.5	40	60	100

Pre-requisite: BASICS IN THERMODYNAMICS

Course Objectives:

1. To enable the students understand the principles, working and performance of IC engines.
2. To introduce students to the working of compressors, steam nozzles
3. To understand principle of various refrigeration and air-conditioning systems.
4. To teach students the principles of waste heat recovery and thermal storage systems.

Course Outcomes: After successful completion of the course, the student will be able to:

CO1	Conduct constant speed and variable speed tests on IC engines and interpret their performance.(BL-3)
CO2	Determine the valve timing diagram of SI engine& CI engine. (BL-3)
CO3	Estimate energy distribution by conducting heat balance test on IC engines(BL-5) Apply the concept of Morse test on SI engine.(multi cylinder)
CO4	Experiment on IC engine load variations with Air fuel ratio. (BL-3)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	3	1									1	1	1
CO2	2	1	1									1		1
CO3	1	2	1									1		2
CO4	1	1	1						3	2		2	1	1
1:Low,2-Medium,3-High														

COURSE CONTENT

Task 1

Performance test on Spark Ignition engine and Compression Ignition using the alternate fuels.

Task-2

Valve Timing Diagram of an 4 stroke diesel engine .

Task-3

Port Timing Diagram of an 2-Stroke Petrol engine.

TASK-4

Performance Test on a 4 -Stroke Diesel Engines.

TASK-5

Performance Test on 2-Stroke Petrol engine.

TASK-6 Evaluation of Engine friction by conducting Morse test on 4-Stroke Multi cylinderEngine.
TASK-7 Retardation and motoring test on 4- stroke engine.
TASK-8 Heat Balance of an I.C. Engine.
TASK-9 /Fuel Ratio and Volumetric Efficiency of an I.C. Engines.
TASK-10 Performance Test on Variable Compression Ratio Engines for CI Engines.
Additional Experiments
TASK -11 Performance Test on Reciprocating Air – Compressor Unit.
TASK -12 Study of Boilers.
Text Book(s): 1. Vasandani V.P. and Kumar, D.S., Treatise on Heat Engineering, Chand & Co Publishers, New Delhi,2011. 2.Ganesan, V., Gas Turbines 3rd Edition, Tata McGraw Hill Book Company, New Delhi,2010. 3. Internal Combustion Engines / V. Ganesan- TMH, 4thEdition,2012 4. Thermal Engineering / Rajput / Lakshmi Publications, 9thEdition,2013
Reference Book(s): 1.I.C. Engines fundamentals, Heywood, McGraw-Hill, 1st Edition,2011 2. IC Engines – Mathur & Sharma – DhanpathRai&Sons,,2010 3. Engineering fundamentals of IC Engines – Pulkrabek, Pearson, PHI, 2ndEdition,2009 4. Thermal Engineering, Rudra moorthy – TMH, 10thEdition,2010

NARAYANA ENGINEERING COLLEGE:NELLORE

	Mechanics of Materials Lab							**R2020**
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
IV	0	0	3	48	1.5	40	60	100

Pre-requisite: Should possess basic knowledge in Engineering drawing, Standards, Dimensioning and preparation of neat drawings and to understand symbols used in engineering drawings.

Course Objectives:

1. To conduct uni-axial tension test on Steel, Aluminium, Copper and Brass.
2. To perform compression test on spring and wood.
3. To determine elastic constants of materials using flexural and torsion tests.
4. To find hardness of given metals.
5. To acquire knowledge on mechanical properties of materials such as various Elastic Moduli

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Understand the stress-strain behaviour of different materials.(BL-2)
CO 2	Explain the hardness of different materials.(BL-2)
CO 3	Identify the difference between compression and tension testing.(BL-3)
CO 4	Find the Young's modulus of the material by conducting deflection test(BL-1)
CO 5	Identify the toughness of a specimen using Impact testing machine (BL-3)

COURSE CONTENT

Task 1 Tension on U.T.M.

Study the stress – strain relations of (a) Mild Steel b) Cast iron and (c) Tor Steel be conducting tension test on U.T.M

Task 2 Compression test on U.T.M.

Study the stress – strain relations of (a) Mild Steel b) Cast iron and (c) Tor Steel be conducting compression test on U.T.M

Task -3 Compressive and Shear strength.

Find the compressive and shear strength of wood and shear strength of GI sheet by conducting relevant tests.

TASK -4 Brinnell's and Vicker's hardness.

Find the Brinnell's and Vicker's hardness numbers of (a) Steel (b) Brass (c) Aluminium (d) Copper.

TASK -5 Modulus of rigidity.

Determine the Modulus of rigidity (a) Solid shaft (b) Hollow shaft made of steel and aluminium.

TASK-6 Compression and Tensile tests.

Find the spring index and modulus of rigidity of the material of a spring by conducting compression and tensile tests.

TASK -7 Deflection test.

Determine the Young's modulus of the material by conducting deflection test on a simply supported, and continuous beams.

TASK -8 Deflection test.

Determine the Young's modulus of the material by conducting deflection test on propped cantilever beam

TASK -9 Impact strength .

Find impact strength of a given material by conducting a Charpy test

TASK -10 Impact strength.
Find impact strength of a given material by conducting a Izod test

Additional Experiments:
TASK -11 Deflection.
Determine the deflection in leaf spring with a single leaf and multiple leafs.
TASK -12 Bending Test
Determine the bending stress by conducting Bending test on 1. Mild steel 2. Wood
VirtualLabs htt p://sm-nitk.vlabs.ac.in/

Text Book(s):

1. F.P.Beer,E.R.Johnston,Jr&John.T.DeWolf,"Mechanics ofMaterials",7thedition,TataMcGraw-Hill,2016.
2. SS Rattan, Strength of materials, 3rd edition, Tata McGraw-Hill,2016.
3. Strength of Materials by R.K. Bansal , Laxmi Publishers, 5thEdition,2012.
4. Mechanics of Materials, Andrews Pytel,JaanKiusallaas&M.M.M.Sarcar (SecondEdition),Cengage Learning Publishers.

Reference Book(s):

1. Timoshenko, "Strength of Materials Part-I& II", 3rd edition, CBS Publishers,2004.
2. Popov, "Mechanics of Solids", 2nd edition, New Pearson Education,2015
3. R.K.Rajput, *Strength of materials*, S.Chand Publications, Revised Edition,2006.
4. Strength of Materials by M.Chakraborti, S.K.Kataria& Sons, 2ndEdition,2011.

NARAYANAENGINEERINGCOLLEGE:NELLORE								
	Computer Aided Machine Drawing Lab							R2020
Semester	Hours /Week			Total hrs	Credit	MaxMarks		
	L	T	P		C	CIE	SEE	TOTAL
IV	0	1	2	48	2	40	60	100

Pre-requisite: Should possess basic knowledge in Engineering drawing, Standards, Dimensioning and preparation of neat drawings and to understand symbols used in engineering drawings.

Course Objectives:

1. To introduce students to the basics and standards of engineering drawing related to machines and components.
2. To teach students technical skills regarding assembly, production and part drawings.
3. To help students gain knowledge about standard CAD packages on modelling and
   i. drafting.
4. 4. To Communicate about the assemble and part drawings through the computer aided drawings.5.To familiarize students with various limits, fits and tolerances.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Define various standards, specifications, dimensioning methods followed while preparing Engineering drawings. (BL-1)
CO 2	Understand and practice to represent symbols for Foundation bolts and keys in drawings.(BL-2)
CO 3	Develop, assemble and sketch assembled views of mechanical systems. (BL-3)
CO 4	Develop suitable drawing views to represent part drawings of different machine parts in CAD software. (BL-3)
CO 5	Design machine components and assembly using CAD software. (BL-3)

CO-PO Mapping

CO	PO												PS
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1
CO1	1	1										1	1
CO2	1	1										1	1
CO3												1	1
CO4	1	1										1	1
CO5	1	1										1	2

1: Low, 2-Medium, 3-High

COURSE CONTENT

PART -A The following contents are to be done by any 2D software package

Task 1

1. Conventional representation of materials.
2. Conventional representation of machine components.

Task 2 Conventional representation

1. Conventional representation of dimensioning on the drawings.
2. Conventional representation sectional views.

Task -3 Detachable joints
Drawing of thread profiles, hexagonal and square-headed bolts and nuts, bolted joint with washer and locknut, stud joint, screw joint and foundation bolts.
PART B **The following contents are to be done by any 2D software package**
TASK -4 Riveted joints
Drawing of rivet, lap joint, butt joint with single strap, single riveted , double riveted double strap joints.,
TASK -5 Welded joints
Lap joint and T joint with fillet, butt joint with conventions
TASK-6 Keys & Couplings
Taper key, sunk taper key, round key, saddle key, feather key, woodruff key. Shaft coupling, bushed pin-type flange coupling, universal coupling, Oldhams' coupling
PART-C The following contents are to be done by any 3D software package:
TASK -7 Assembly drawings
Lathe tool post, , tail stock, machine vice, gate valve
TASK -8 Assembly drawings
screw jack, plumber block, clamping device, Geneva cam, universal coupling, connecting rod, eccentric.

Additional Experiments:
TASK -9 Manufacturing drawing
Representation of limits, fits and tolerances for mating parts. Use any four parts of above assembly drawings and prepare manufacturing drawing with dimensional and geometric tolerances.

Text Book(s):

1.K.L. Narayana, P. Kannaiah, "A text book on Engineering Drawing", SciTech Publications, 2014
2. N.D.Bhatt, "Machine Drawing", Charotar, 50th edition, 2014.
3"Software tools/packages", Auto CAD, Solid works or equalent.
4.Machine Drawing With AutoCAD, GoutamPohit, GoutamGhosh, Pearson Publications

Reference Book(s):

1. CecilJensen, JayHelsel and Donald D.Voisinet, "Computer Aided Engineering Drawing", TataMcGraw-Hill, NY,2000.
2. James Barclay, Brain Griffiths, "Engineering Drawing for Manufacture", Kogan PageScience,2003.
3. K.L. Narayana, "Production Drawing", NewAge International Publishers, 3rdedition,2014
4.P I Varghese and K C John, Machine Drawing, VIP Publishers,2011

NARAYANA ENGINEERING COLLEGE:NELLORE								
	Design of Transmission Systems							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VI	3	0	0	48	3	40	60	100

Course Objectives:

1. To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
2. To understand the standard procedure available for Design of Transmission of Mechanical elements
3. To learn to use standard data and catalogues

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Design for the different types of belt drives (BTL-4)
CO 2	Design for the spur gear and analysis of speed ratios (BTL-4)
CO 3	Design of bevel, worm and helical gears (BTL-4)
CO 4	Design of different gear boxes (BTL-4)
CO 5	Design of cams and analysis of profiles (BTL-4)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1			3		1									
CO2		2	3		1									
CO3			3		1									
CO4			3		1									
CO5		2	3		1									

1: Low, 2-Medium, 3- High

COURSE CONTENT		
UNIT - I	**DESIGN OF FLEXIBLE ELEMENTS**	**10 Hours**
Design of Flat belts and pulleys — Selection of V belts and pulleys — Selection of hoisting wire ropes and pulleys — Design of Transmission chains and Sprockets		
At the end of the UNIT-1, students will be able to: 1. Getting knowledge about the belt and belt drives 2. To understand the power transmission.		
UNIT - II	**SPUR GEARS AND PARALLEL AXIS HELICAL GEARS**	**9 Hours**
Speed ratios and number of teeth-Force analysis -Tooth stresses — Dynamic effects — Fatigue strength — Factor of safety — Gear materials — Design of straight tooth spur & helical gears based on strength and wear considerations — Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces for helical gears.		
At the end of the UNIT-II, students will be able to: 1. To analysis the force on the teeth 2. To study the pressure on gears		
UNIT - III	**BEVEL, WORM AND CROSS HELICAL GEARS**	**10 Hours**
Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demerits- terminology. Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears.		
At the end of the UNIT-III, students will be able to: 1. Explain construction of bevel gear 2. Classification gears and terminology of the gear 3. estimating the gear size		
UNIT - IV	**GEAR BOXES**	**10 Hours**

Geometric progression — Standard step ratio — Ray diagram, kinematics layout -Design of sliding mesh gear box — Design of multi speed gear box for machine tool applications — Constant mesh gear box — Speed reducer unit. — Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications.

At the end of the UNIT-IV, students will be able to:

1. To learn about the gear box operation
2. To learn about gear changing and gear operations
3. To convert torque converters

UNIT - V	**CLUTCHES AND BRAKES**	**9 Hours**

Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches- Electromagnetic clutches. Band and Block brakes — external shoe brakes — Internal expanding shoe brake.

At the end of the Module 5, students will be able to:

1. To design the cam for automobile
2. To learn about the clutches operations
3. To study the break operations

Total hours:	**48 hours**

Content beyond syllabus:

1. **To learn about advanced braking system**

Self-Study:

Contents to promote self-Learning:

SNO	**Topic**	**CO**	**Reference**
1	Design for the different types of belt drives	CO1	**https://www.slideshare.net/2461998/types-of-belt-drives**
2	Design for the spur gear and analysis of speed ratios	CO2	**https://www.slideshare.net/YashShah328/spur-gear-and-design-of-spur-gear**
3	Design of bevel, worm and helical gears	CO3	**https://egyankosh.ac.in/bitstream/123456789/31615/1/Unit-11.pdf**
4	Design of different gear boxes	CO4	**https://www.lnjpitchapra.in/wp-content/uploads/2020/05/file_5eafbf547618e.pdf**

	5	Design of cams and analysis of profiles	CO5	https://www.youtube.com/watch?v=g3kdVRQ-dKk

TEXT BOOK . Bhandari V, "Design of Machine Elements", 3rd Edition, Tata McGraw-Hill Book Co, 2010.
2. Joseph Shigley, Charles Mischke, Richard Budynas and Keith Nisbett "Mechanical Engineering Design", 8th Edition, Tata McGraw-Hill, 2008.

REFERENCES:
1. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
2. Gitin Maitra, L. Prasad "Hand book of Mechanical Design", 2nd Edition, Tata McGraw-Hill, 2001.
3. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000.
4. C.S.Sharma, Kamlesh Purohit, "Design of Machine Elements", Prentice Hall of India, Pvt. Ltd., 2003

Online Resources:
https://easyengineering.net/me6601-design-of-transmission-systems/

Web Resources:
https://www.youtube.com/watch?v=AAJyUk4wHfI
https://www.youtube.com/watch?v=dBHOMtGquuo
https://www.youtube.com/watch?v=FDyo3u2WOlM

NARAYANA ENGINEERING COLLEGE:NELLORE								
	Thermal Power Systems							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
V	3	0	0	48	3	40	60	100

Pre-Requisite: Thermal Power Systems

Course Objectives:

1. To understand working steam power plant
2. To explain the functions of steam nozzle
3. To draw velocity diagram of steam turbine
4. To understand working of jet propulsion
5 To define the basics of refrigeration and air conditioning system

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Interpret the layout of various steam power plant and boilers operation. (BTL-5)
CO 2	Understand the stagnation properties.(BTL-2)
CO 3	Solve the problems on turbine velocity diagram. (BTL-6)
CO 4	Explain the working of gas turbines. (BTL-2)
CO 5	Analyze the working of vapor compression refrigeration cycle. (BTL-4)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	2										3	
CO2	3	3	2										3	
CO3	2	3	2										3	
CO4	3	2	2										3	
CO5	3	2	2										3	

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	**STEAM POWER PLANT & BOILERS**	**9 Hours**
Steam Power Plant: Rankine cycle -Thermodynamic analysis, Concept of mean temperature of heat addition, Methods to improve cycle performance – Regeneration & Reheating. Boilers: Classification – Working principles LP & H.P. boilers – Mountings and accessories – Working principles – Boiler horse power, Equivalent evaporation, Efficiency– Draught, Classification .		
At the end of the Module 1, students will be able to: 1. Explain the concept of mean temperature of heat addition 2. Interpret the steam power plant and boiler operation 3. List out the boiler mountings and accessories		
MODULE -2	**STEAM NOZZLES & CONDENSERS**	**10 Hours**
Steam Nozzles: Stagnation Properties – Function of a nozzle – Applications and types – Flow through nozzles – Thermodynamic analysis - Condition for maximum discharge, Critical pressure ratio, Super saturated flow– Degree of super saturation and degree of under cooling - Wilson line. Steam Condensers: Requirements of steam condensing plant – Classification of condensers – Working principle of different types – Vacuum efficiency and condenser efficiency		
At the end of the Module 2, students will be able to: 1. Explain the condition for maximum discharge 2. Define the Critical pressure ratio 3. Classify different types of condensers		
MODULE-3	**STEAM TURBINES**	**10 Hours**
Impulse Turbines: Classification, Impulse Turbine, Mechanical details – Velocity diagram – Effect of friction – Power developed, axial thrust, Blade or diagram efficiency– De-laval turbine-Methods to reduce rotor speed – Velocity and Pressure compounding – Combined velocity diagram for Impulse turbine. Reaction Turbines: Mechanical details – Principle of operation		
At the end of the Module 3, students will be able to: 1. Explain the working impulse turbine 2. Solve the problems on velocity diagram		
MODULE-4	**GAS TURBINES & JET PROPULSION**	**9 Hours**

Gas Turbines: Simple gas turbine plant –Essential components – Parameters of performance – Actual cycle – Regeneration, Inter cooling and reheating – Closed and Semi-closed cycles. Jet Propulsion: Classification of jet propulsive engines – Working principles with schematic diagrams and T-s diagram - Turbo jet engines Rockets: Application – Working principle – Classification – Propellant type – Thrust, Propulsive efficiency.

At the end of the Module 4, students will be able to:

1. Explain the working principle of Simple gas turbine plant
2. Differentiate between closed and semi closed cycles

MODULE-5	**REFRIGERATION & AIR CONDITIONING**	**10 Hours**

Refrigeration: Bell-Coleman cycle - Vapor compression cycle, sub cooling and super heating- Vapor absorption cycle, properties of common refrigerants. Air Conditioning: Principles of Psychometric Psychometric properties, psychometric processes, summer and winter air conditioning systems.

At the end of the Module 5, students will be able to:

1. Gain knowledge on Refrigeration
2. Explain the working of vapour compression cycle

Total hours: 48 hours

Content beyond syllabus:

1. Latest advancement in steam power plant

Self-Study:

Contents to promote self-Learning:

SNO	**Topic**	**CO**	**Reference**
1	Steam Power Plant: Rankine cycle	CO1	https://energyeducation.ca/encyclopedia/Rankine_cycle
2	Steam Nozzles: Stagnation	CO2	https://nitsri.ac.in/Department/Mechanical%20Engineering/MEC_404_Steam_Nozzle_Lecture_Notes_Part_II.pdf
3	Impulse Turbines:	CO3	https://www.energy.gov/eere/water/types-hydropower-

		Classification		turbines#:~:text=The%20two%20main%20types%20of,Pelton%20and%20cross%2Dflow%20turbines.
	4	Gas Turbines: Simple gas turbine plant	CO4	https://netl.doe.gov/sites/default/files/gas-turbine-handbook/1-1.pdf
	5	Refrigeration: Bell-Coleman cycle	CO5	https://www.mecholic.com/2017/12/bell-coleman-refrigeration-cycle.html

Text Book(s):

1. R. K. Rajput (2010), A text book of Thermal Engineering, Fourth Edition, Laxmi Publications,. New Delhi, India.
2. Thermal Engineering by R S Khurmi & GK Guptha6thedition.2006
3. Principles of Applied Thermodynamicsbymorani8THedition,SIversion.2015

Reference Book(s):

1. Yonus A Cengel and Michael A Boles, Applied Thermodynamics: An Engineering Approach, McGrawHill, 2002.
2. Thermal Engineering byR. Yadav 5 THedition,LaxmiPublications,NewDelhi,India.2020
3. Applied Thermodynamics, work and heat-transfer by Gordonrogers4THedition,personeducation india2002.

Web Resources:

1. https://www.youtube.com/watch?v=SPg7hOxFItI
2. https://www.youtube.com/watch?v=m3-2NogJZQk

NARAYANA ENGINEERING COLLEGE:NELLORE								
	Dynamics of Machinery							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VI	3	0	0	48	3	40	60	100

Course Objectives:

1. Explain the importance of friction and apply for brakes and dynamometers
2. Analyze the turning moment diagrams and discuss the applications of flywheel
3. Familiarizes the concept of gyroscope and its applications for aero plane, motor cycle and motor cars
4. Uses of governors and its applications
5. Explain the need of balancing of rotating and reciprocating masses

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Understand the effect of reactive gyroscopic couple on the stability of vehicles (BTL-2)
CO 2	Understand the use of governors (BTL-2)
CO 3	Identify and correct the unbalances of rotating body (BTL-4)
CO 4	Reduce the magnitude of vibration (BTL -4)
CO 5	Explain isolate vibration of dynamic systems (BTL-4)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1			3		2									
CO2			3		2									
CO3			3		2									
CO4			3		2									
CO5			3		2									

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE- I	**PRECESSION , TURNING MOMENT DIAGRAMS AND FLYWHEELS**	**10 Hours**
PRECESSION: Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aeroplanes and ships. TURNING MOMENT DIAGRAMS AND FLY WHEELS: Turning moment diagrams for steam engine, IC Engine and multi cylinder engine. Crank effort - coefficient of Fluctuation of energy, coefficient of Fluctuation of speed – Fly wheels and their design, Fly wheels for Punching machines.		
At the end of the MODULE -1, students will be able to: 1. To understand the precession and turning moment diagrams		
MODULE - II	**GOVERNORS**	**9 Hours**
GOVERNORS: Watt, Porter and Proell governors. Spring loaded governors – Hartnell and Hartung governors with auxiliary springs. Sensitiveness, isochronism and hunting. Effort and power of a governor.		
At the end of the MODULE -II, students will be able to: 1. To find the different types of governors and uses		
MODULE- III	**BALANCING OF ROTATING & RECIPROCATING MASSES**	**10 Hours**
BALANCING: Balancing of rotating masses - single and multiple – single and different planes. BALANCING OF RECIPROCATING MASSES: Primary and Secondary balancing of reciprocating masses. Analytical and graphical methods. Unbalanced forces and couples -Vengine, multi cylinder inline and radial engines for primary and secondary balancing		
At the end of the MODULE -III, students will be able to: 1. Study the balancing of masses		
MODULE - IV	**VIBRATION**	**10 Hours**
Free and forced vibration of single degree of freedom system, Role of damping, whirling of shafts and critical speeds. Simple problems on free, forced and damped vibrations.		
At the end of the MODULE-IV, students will be able to: 1. To learn the vibration effect		
MODULE - V	**VIBRATION ISOLATION & TRANSMISSIBILITY**	**9 Hours**
Vibration Isolation & Transmissibility. Transverse vibrations of beams with concentrated and distributed loads. Dunkerly's method, Raleigh's method. Torsional vibrations - two and three rotor systems		

At the end of the MODULE V, students will be able to: 1. To study the vibration in working conditions	
Total hours:	**48 hours**

TEXT BOOK

1. S.S. Rattan, “Theory of Machines”, MGH Publishers,3rd Edition,2013.
2. R.L. Norton, “Kinematics and Dynamics of Machinery”, Tata McGraw Hill.2009

REFERENCES:

1. Thomas bevan, “Theory of machines”, Pearson, 3rd edition,2012.
2. Shigley et.al. “Theory of machines and mechanisms” of Oxford international student edition. 2011
3. R.S Khurmi, “Theory of machines”, S.Chand publications , 14TH 2020

Web Resources:

https://www.youtube.com/watch?v=0UhDnbsTuU8
https://www.youtube.com/watch?v=9r630K5HmJc&list=PLSGws_74K01_pG3R7rgtDtrDZBjcTgPdR

NARAYANA ENGINEERING COLLEGE: NELLORE								
	HEAT TRANSFER							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
OE	3	0	0	48	3	40	60	100

Course Objectives:

1. To impart the basic laws of conduction, convection and radiation heat transfer and their applications
2. To familiarize the convective heat transfer concepts
3. To explain basics of radiation heat transfer
4. To explain basics of radiation heat transfer and to make conversant with the heat transfer analysis related to thermal systems like heat exchangers, evaporator, and condenser.
5. To understand the phenomenon of boiling and condensation to familiarize the mass transfer process

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Apply the conduction, convection and radiation mode of heat transfer through various applications
CO 2	Evaluate heat transfer for forced and free convection applications
CO 3	Explain the radiation heat transfer problems.
CO 4	Calculate the parameters of heat exchangers, condensers and evaporator using LMTDand NTU Methods for various applications.
CO 5	Apply principles of heat and mass transfer to basic thermal engineering systems

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	1												2
CO2	2		2									1		
CO3	1	2	1											
CO4	2	1	1		2				2				1	1
CO5	2			1	2							1		
1: Low, 2-Medium, 3- High														

NARAYANA ENGINEERING COLLEGE: NELLORE								
	HEAT AND MASS TRANSFER							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
V	3	0	0	48	3	40	60	100

COURSE CONTENT

MODULE – 1	INTRODUCTION Basic Modes of Heat Transfer and Conduction Heat transfer	11 H

Introduction: Basic modes of heat transfer- rate equations- generalized heat conduction equation - steady state heat conduction solution for plain and composite slabs - cylinders - critical thickness of insulation- heat conduction through fins of uniform cross section- fin effectiveness and efficiency.

MODULE -2	Convection Heat Transfer	11 H

Convection: Basic concepts of convection–heat transfer coefficients - types of convection – forced convection and free convection. Forced convection in external flow–concepts of hydrodynamic and thermal boundary layers- use of empirical correlations for flow over plates and cylinders. Fluid friction – heat transfer analogy approximate solution to laminar boundary layer equation for external flow. Internal flow – Use of empirical relations for convective heat transfer in horizontal pipe flow.

MODULE-3	Radiation Heat Transfer	8 H

Radiation: Radiation heat transfer – thermal radiation – laws of radiation - Black and Gray bodies – shape factor-radiation exchange between surfaces - Radiation shields - Greenhouse effect.

MODULE-4	Heat Exchangers, Boiling and Condensation	12 H

Heat Exchangers: Types of heat exchangers- parallel flow- counter flow- cross flow heat exchangers- overall heat transfer coefficient- LMTD and NTU methods- fouling in heat exchangers.

MODULE-5	Mass Transfer	06 H

Mass Transfer: Conservation laws and constitutive equations - Fick's law of diffusion, isothermal equi-mass - Equimolal diffusion- - diffusion of gases and liquids- mass transfer coefficient.

Total hours:	48H

Text Book(s):

1. P.K. Nag, “Heat Transfer”, 3rd edition, Tata McGraw-Hill, 2011.

2. S.P. Sukhatme, “A Textbook of Heat Transfer”, Universities Press, TMH publications 2005

Reference Book(s):

1. J.P.Holman, “Heat Transfer”, 9th edition, Tata McGraw-Hill,2008.

2. Cengel. A.Yunus, “Heat Transfer”, A Practical Approach, 4th edition, Tata McGrawHill, 2007.

3. Lienhard and Lienhard, “A Heat and Mass Transfer”, Cambridge Press, 2011.

4. C.P. Kothandaraman and S. Subramanyan, “Heat and Mass Transfer databook”, New Age Publications, 2014

	NARAYANA ENGINEERING COLLEGE:NELLORE							
	COMPUTER INTEGRATED MANUFACTURING							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

Course Objectives:

1. To understand the basic concepts of CAD/CAM in CIM environment.
2. To develop an understanding of the underlying knowledge and related methods of Computer Aided Process Planning.
3. To understand the different methods to improve application of Group Technology in manufacturing.
4. To understand the use of FMS in CIM environment.
5. To understand the use of robotics in manufacturing environment.

Course Outcomes :After successful completion of the course, the student will be able to:

CO1	Apply the concepts of CAD/ CAM systems in CIM.(BL-3)
CO2	Examine the integration of computer in process & production planning.(BL-1)
CO3	Extend the concept of GT to improve efficiency in manufacturing..(BL-2)
CO4	Apply the concept of AGV'S in FMS to improve material handling.(BL-3)
CO5	Identify the application of robotic technology in CIM environment.(BL-2)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	2	1	1	-	-	-	-	-	-	-	2	2
CO2	3	3	1	1	-	-	-	-	-	-	-	-	2	2
CO3	2	2	-	-	-	-	-	-	-	-	-	-	1	1
CO4	2	2	2	2	2	-	-	-	-	-	-	-	2	2
CO5	1	1	2	2	2	-	-	-	-	-	-	-	2	2

1:Low,2-Medium,3-High

COURSE CONTENT

MODULE – 1	INTRODUCTION	9h

Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control – Concurrent Engineering- CIM concepts – Computerised elements of CIM system –Types of production — Manufacturing Control — Basic Elements of an Automated system – Levels of Automation – Lean Production and Just-In-Time Production.

MODULE -2	COMPUTERISED PROCESS PLANNING	10h

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control

MODULE-3	CELLULAR MANUFACTURING	9h

Group Technology(GT), Part Families – Parts Classification and coding ,Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method – Arranging Machines in a GT cell – Hollier Method

MODULE-4	FLEXIBLE MANUFACTURING SYSTEM (FMS)	10h
Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control—. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.		
MODULE-5	**INDUSTRIAL ROBOTICS**	10h
Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming		
	Total hours:	**48 hours**

Text Book(s):

1. Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2008.
2. Radhakrishnan P, Subramanyan S.and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2000.

Reference Book(s):

1. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", Prentice Hall India, 2003.
2. Gideon Halevi and Roland Weill, "Principles of Process Planning – A Logical Approach" Chapman & Hall, London, 1995.
3. Rao. P, N Tewari &T.K. Kundra, "Computer Aided Manufacturing", Tata McGraw Hill Publishing Company, 2000.

NARAYANA ENGINEERING COLLEGE: NELLORE								
	Smart Materials							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
OE	3	0	0	48	3	40	60	100

Course Objectives:

1. To study various types of smart materials used in engineering application.
2. To study various properties i.e. optical, electric, dielectric etc. of smart materials.
3. To study different synthesis techniques of smart materials.
4. To study different characterization techniques of smart materials.
5. To study devices based on smart materials such as sensors, actuators etc.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Understand various smart material kinds applied to engineering. (BTL-2)
CO 2	Demonstrate the various optical, electric, dielectric, etc. properties of intelligent materials. (BTL-2)
CO 3	Classify different smart material manufacturing methods. (BTL-4)
CO 4	Explain various methods for characterizing smart materials. (BTL-2)
CO 5	Develop products made of smart materials, as sensors, actuators, etc. (BTL-3)

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2													1
CO2		1										1		1
CO3				1										
CO4	1	2											1	1
CO5				2								1		
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	**INTRODUCTION**	**9 Hours**

Historical account of the discovery and development of smart materials, Two phases: Austenite and Martensite, Temperature induced phase changes, Shape memory effect, Pseudoelasticity, One-way shape memory effect, Two-way shape memory effect		
MODULE -2	**PROPERTIES OF SMART MATERIALS**	**9 Hours**
Physical principles of optical, Electrical, Dielectric, Piezoelectric, Ferroelectric, Pyroelectric and Magnetic properties of smart materials		
MODULE-3	**SYNTHESIS OF SMART MATERIALS**	**10 Hours**
Solid state reaction technique, Chemical route: Chemical vapour deposition, Sol-gel technique, Hydrothermal method, Co-precipitation. Green synthesis, Mechanical alloying and Thin film deposition techniques: Chemical etching, Sol-gel, spray pyrolysis		
MODULE-4	**CHARACTERIZATION TECHNIQUES**	**10 Hours**
X-ray diffraction, Raman spectroscopy (RS), Fourier-transform infrared reflection (FTIR), UV-Visible spectroscopy, Scanning electron microscopy (SEM), Transmission electron microscopy, Atomic force microscopy (AFM) and Differential Scanning Calorimetry (DSC).		
MODULE-5	**MATERIALS AND DEVICES**	**10 Hours**
Characteristics of shape memory alloys, Magnetostrictive, Optoelectronic, Piezoelectric, Metamaterials, Electro-rheological and Magneto-rheological materials and Composite materials. Devices based on smart materials: Sensors & Actuators, MEMS and intelligent devices, Future scope of the smart materials.		
	Total hours:	**48 hours**

Text Book(s):

1. Encyclopaedia of Smart Materials- Mel Schwartz, John Wiley & Sons, Inc.2002
2. Smart Materials and Structures - M. V. Gandhi and B.S. Thompson, Champman and Hall, 1992

Reference Book(s):

1. Smart Materials and Technologies- M. Addington and D. L. Schodek, , Elsevier, 2005.
2. Characterization and Application of smart Materials -R. Rai, Synthesis, , Nova Science, 2011.
3. Electro ceramics: Materials, Properties, Applications -A.J. Moulson and J.M. Herbert, 2 nd Edn., John Wiley & Sons, 2003.

Web Resources:

1. https://nptel.ac.in/courses/112104173/

2. www.iop.org/EJ/article/0964-1726/5/3/002/sm6301.ps.gz

MOOCs:

1. https://nptel.ac.in/courses/112104173/
2. https://nptel.ac.in/courses/112104251/

NARAYANA ENGINEERING COLLEGE: NELLORE								
	AUTOMATION IN MANUFACTURING							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
OE	3	0	0	48	3	40	60	100

COURSE OBJECTIVES:

1. To understand the principles of automation.
2. To understand and outline the system configurations used in automated production.
3. To recognize and articulate the foundational assumption of the transfer mechanism, types of transfer mechanism that may be used for work part transfer
4. To understand principle of FMS and group technology.
5. To understand importance of inspection.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	understand to know what is automation, types of automation, components of automation, strategies and levels of automation.(BTL-1)
CO 2	understand to know basic elements of automated systems.(BTL-2)
CO 3	understand the components of manufacturing systems.(BTL-2)
CO 4	understand the group technology and flexible manufacturing systems .(BTL-2)
CO 5	understand importance of inspection .(BTL-3)

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3		3											2
CO2	3				3							1		
CO3	3			1										
CO4	3	1							2				1	1
CO5	3			2								1		
1: Low, 2-Medium, 3- High														

NARAYANA ENGINEERING COLLEGE::NELLORE								
	AUTOMATION IN MANUFACTURING							R2020
Semester	Hours / Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100

COURSE CONTENT

MODULE- I	INTRODUCTION	10 Hrs

Production System Facilities, Manufacturing Support systems, Automation in Production systems, Automation principles & Strategies Manufacturing Operations, Product/Production Relationship, Production concepts .

MODULE- II	INDUSTRIAL CONTROL SYSTEM	9 Hrs

Basic Elements of an Automated System, Advanced Automation Functions & Levels of Automation, Continuous versus Discrete control, Computer Process control, Forms of Computer Process Control.

MODULE- III	AUTOMATED MANUFACTURING SYSTEMS	10 Hrs

Components of a Manufacturing systems, Classification of Manufacturing Systems, overview of Classification Scheme, Single Station Manned Workstations and Single Station Automated Cells.

MODULE- IV	GROUP TECHNOLOGY & FLEXIBLE MANUFACTURING SYSTEMS	9 Hrs

Part Families, Parts Classification and coding, Production Flow Analysis, Cellular Manufacturing, Flexible Manufacturing Systems: What is an FMS, FMS Components, FMS Applications & Benefits, and FMS Planning & Implementation Issues.

MODULE- V	INSPECTION TECHNOLOGIES	10 Hrs

Automated Inspection, Coordinate Measuring Machines Construction, operation & Programming, Software, Application & Benefits, Flexible Inspection System, Inspection Probes on Machine Tools, Machine Vision, Optical Inspection Techniques & Non-contact Non-optical Inspection Technologies

Total Hours	48 Hrs

TEXT BOOKS :

1. Automation, Production Systems and Computer Integrated Manufacturing: M.P. Groover./PE/PHI 2016
2. Computer Control of Manufacturing Systems: Yoram Koren 2019

REFERENCES:

1. CAD/CAM/CIM, (2 nd Edition),by Radha krishnan and Subramanian, New Age Publications, 2007
2. CAD / CAM/ CIM by Radhakrishnan.2008
3. Automation by W. Buekingham.1968

NARAYANA ENGINEERING COLLEGE:NELLORE								
	AUTOMATION & ROBOTICS							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100

Pre-Requisite: CAD/CAM

Course Objectives:

1. To Understand robot configuration, structures, basic components, workspace and generations of robots.
2. To Get acquainted with performing spatial transformations and solve kinematics of the robot
3. To Get knowledge and analysis skills associated with trajectory planning
4. To Learn about various sensors, actuators, robot programming
5. To Understand the present &future applications of a robot

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Demonstrate knowledge of industrial robots, characteristics, end effectors and actuators. (BTL-3)
CO 2	Apply spatial transformation to obtain forward and inverse kinematics (BTL-3)
CO 3	Solve robot dynamics problems, generate joint trajectory for path planning (BTL-3)
CO 4	Describe working principle of various sensors and program different operations (BTL-2)
CO 5	Apply the applications of robots in industry. (BTL-3)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1			3					2						
CO2			3					2						
CO3			3					2						
CO4			3					2						
CO5			3					2						

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	AUTOMATION	**10 Hours**

Introduction: Automation in production system, need, types, Principles and Strategies of automation, levels of automation, basic elements of an automated system, hardware components for automation and process control, mechanical feeders, hoppers, orienters, high speed automatic insertion devices.

At the end of the Module 1, students will be able:

1. To study the principle the different strategies of automation
2. To learn the different levels in automation
3. To study the automated flow lines

MODULE -2	ASSEMBLY LINE BALANCING AND AUTOMATED MANUFACTURING SYSTEM	**9 hours**

Assembly Line Balancing: Assembly process and systems assembly line, line balancing algorithms, ways of improving line balance, flexible assembly lines.

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Automated Manufacturing Systems: Components, classification and overview of manufacturing systems, manufacturing cells, GT and cellular manufacturing, FMS and its planning and implementation.

At the end of the Module 2, students will be able :

1. To learn the assembly line balancing
2. To study the material handling identification
3. To study the automated system

MODULE-3	ROBOTICS	**10 Hours**

Introduction: Brief history of robots, classification of robot, functional line diagram, degrees of freedom. Elements of robot - types and its functions, factors to be considered in the design of grippers.

Robot Actuators And Feedback Components: Actuators, Pneumatic, Hydraulic actuators, Electric & Stepper motors, comparison. Position sensors - potentiometers, resolvers, encoders - velocity sensors, Tactile sensors, Proximity sensors

At the end of the Module 3, students will be able :

1. To study the classification of robot
2. To learn the actuators and components

MODULE-4	**KINEMATICS AND DYNAMICS OF A MANIPULATOR**	**9 Hours**

Manipulator Kinematics: Homogenous transformations as applicable to translation, rotations- D-H notation, Forward and inverse kinematics.

Manipulator Dynamics: Differential transformations, Jacobians, Lagrange - Euler and Newton - Euler formations

At the end of the Module 4, students will be able:

1. **To learn the manipulator kinematics**
2. **To study the dynamics**

MODULE-5	ROBOT PROGRAMMING AND APPLICATIONS	**10 Hours**

Robot Programming: Methods of programming - requirements and features of programming languages, software packages, problems with programming languages. Motion path control- slew motion, joint integrated motion, straight line motion; avoidance of obstacles

At the end of the Module 4, students will be able:

1. To learn the Methods of programming
2. To study the problems with programming languages

Total hours:	**48 hours**

Content beyond syllabus:

1. Software related to psychometric processes

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Demonstrate knowledge of industrial robots, characteristics, end effectors and actuators.	CO1	**https://blog.robotiq.com/bid/53266/ -End-Effector-Definition-and-Examples**
2	Apply spatial transformation to obtain forward and inverse kinematics	CO2	**https://www.google.com/search?q=Ap patial+transformation+to+obtain+forw nd+inverse+kinematics&source=lnms& =vid&sa=X&ved=2ahUKEwjHreHV6bn7 XSmwGHXYdA3IQ_AUoAXoECAEQAw& 1440&bih=700&dpr=1#fpstate=ive&vl c3c89f58,vid:EzNAs2w1cS0**
3	Solve robot dynamics problems, generate joint trajectory for path	CO3	**https://blogs.mathworks.com/studen lounge/2019/11/06/robot-manipulat trajectory/**

		planning			
	4	Describe working principle of various sensors and program different operations	CO4	**https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SPR1304.pdf**	
	5	Appreciate applications of robots in industry.	CO5	https://www.jabil.com/blog/ten-popular-industrial-robot-applications.html	

TEXT BOOK

1. Mikell P.Groover, Automation, Production Systems and Computer Integrated Manufacturing- Pearson Education.5/e, 2009.
2. Mikell P. Groover and Mitchell Weiss, Roger N. Nagel, Nicholas G.Odrey, Industrial Robotics — McGraw Hill, 1986

REFERENCES:

1. S. R. Deb & Sankha Deb, Robotics Technology and Flexible Automation, Tata McGraw-Hill Education, 2009.
2. R K Mittal and I J Nagrath, Robotics and control, Illustrated Edition, Tata McGraw Hill India 2003.
3. Saeed B. Niku, Introduction to Robotics – Analysis, System, Applications, 2/e, John Wiley & Sons, 2010.
4. Richard D. Klafter, Thomas Robotic Engineering an integrated approach, PHI publications 1988

Online Resources:

1. https://www.youtube.com/watch?v=TxqPAPg4nb4

Web Resources:

2. https://www.youtube.com/watch?v=TxqPAPg4nb4
3. https://www.youtube.com/watch?v=PjsZGn4B6cw
4. https://www.youtube.com/watch?v=mZ-OLcvlLCU

NARAYANA ENGINEERING COLLEGE:NELLORE								
	AUTOMOBILE ENGINEERING							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100

Pre-Requisite: Basics in Thermal Engineering

Course Objectives:

1. To understand the working of automobile components
2. To illustrate the principle of ignition system
3. To gain the knowledge on steering and suspension system
4. To study construction of wheel and different brake system
5 To understand the working of Automobile Electrical system

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Illustrate the working of automobile components (BTL-2)
CO 2	Demonstrate the working of different ignition and fuel systems (BTL-2)
CO 3	Identify the principle of steering geometry and wheel alignment.(BT L3)
CO 4	Predict the possible failures in the braking systems.(BT- L5)
CO 5	Identify Modern technology and safety measures used in Automotive Vehicles. (BTL-3)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	2											3	
CO2	3	1											3	
CO3	3	1											3	
CO4	2	1											3	
CO5	2	1											3	

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	**Introduction and Engine Components**	**10 Hours**
Vehicle construction - Chassis and body - Specifications - Engine - Types - Construction - Location of engine- Cylinder arrangement - Construction details - Cylinder block - Cylinder head - Cylinder liners - Piston – piston rings - Piston pin - Connecting rod - Crankshaft – Valves. Lubrication system - Types - Oil pumps -Filters. Crankcase ventilation.		
At the end of the Module 1, students will be able to: 1. Gain the knowledge of engineering behind the construction of vehicle structure. 2. Identify lubrication system in automobile.		
MODULE -2	**Ignition and Fuel Supply Systems**	**9 Hours**
Ignition system - Coil and Magneto - Spark plug - Distributor – Electronic ignition system - Fuel system - Carburetor - Fuel pumps - Fuel injection systems - Mono point and Multi point – Unit Injector – Nozzle types - Electronic Fuel Injection system (EFI) – GDI, MPFI, DTSI.		
At the end of the Module 2, students will be able to: 1. Explain the working of Ignition system and types 2. Understand in depth of Electronic Injection system. 3. Sketch Fuel injection system		
MODULE-3	**Steering and Suspension System**	**10 Hours**
Principle of steering - Steering Geometry and wheel alignment - Steering linkages – Steering gearboxes - Power steering - front axle - Suspension system - Independent and Solid axle – coil, leaf spring and air suspensions - torsion bar - shock absorbers.		
At the end of the Module 3, students will be able to: 1. Gain the knowledge of science behind the steering system. 2. Identify the mechanisms behind the steering system. 3. Explain the working of suspension system		

MODULE-4	Wheels, Tyres and Braking System	9 Hours
Wheels and Tyres - Construction - Type and specification - Tyre wear and causes - Brakes - Needs – Classification –Drum and Disc Mechanical - Hydraulic and pneumatic - Vacuum assist – Retarders – Anti-lock Braking System(ABS).		
At the end of the Module 4, students will be able to: 1. Understand engineering fundamentals of the Braking system 2. Explain the working of Anti-lock Braking System (ABS).		
MODULE-5	**Automobile Electrical Systems and Advances in Automobile Engineering**	**10 Hours**
Battery-General electrical circuits- Active Suspension System (ASS) - Electronic Brake Distribution (EBD) – Electronic Stability Program(ESP), Traction Control System (TCS) - Global Positioning System (GPS), Hybrid vehicle, Fuel Cell.		
At the end of the Module 5, students will be able to: 1. Gain knowledge on automobile electrical systems 2. Explain the working of electronic brake system 3. Understand the principle of fuel cell working		
	Total hours:	**48 hours**

Content beyond syllabus:

1. Biodiesel

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Vehicle Structure and Engine Components	CO1	http://www.rmkec.ac.in/tmp/mech/Contents/automobileengineering.pdf
2	Ignition and Fuel Supply Systems	CO2	http://ecoursesonline.iasri.res.in/mod/resource/view.php?id=3788
3	Steering and Suspension System	CO3	https://wiregrass.libguides.com/c.php?g=1035978&p=7530246

4	Wheels, Tyres and Braking System	CO4	https://archive.nptel.ac.in/courses/107/106/107106088/
5	Automobile Electrical Systems and Advances in Automobile Engineering	CO5	https://archive.nptel.ac.in/courses/107/106/107106088/

Text Book(s):

1. Automobile Engineering - Vol.1 & Vol.2, Kirpal Singh, Standard Publishers distributor.
2. Automobile Engineering, R.K.Rajput, Lakshmi Publication.

Reference Book(s):

1. Automobile Engineering, Joseph Hidner.
2. Automobile Engineering, William Crouse, TMH, 10th edition, 2006.
3. Automobile Engineering, K.K.Ramalingam/Scitech Publication.

Web Resources:

1. https://www.youtube.com/watch?v=c3CalfdYZYw&list=PLpe3qgeJLpB2wAoaRSY9_yAeOt7u0LTNd
2. https://www.youtube.com/watch?v=PYje-4D76kc&list=PLpe3qgeJLpB2wAoaRSY9_yAeOt7u0LTNd&index=3

NARAYANA ENGINEERING COLLEGE: NELLORE								
	COMPOSITE MATERIALS							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100

Course Objectives:

1. To define composite material, classification and characteristics of composite materials.
2. To explain micro mechanical analysis of a lamina
3. To apply the knowledge of biaxial strength theories in solving the problem
4. To under the metal matrix composites materials
5. To explain the micromechanics of Failure of Unidirectional Lamina

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Define the composite material and characteristics of composite materials .(**BTL-1)**
CO 2	Explain micro mechanical analysis of a lamina and evaluation of the four elastic moduli by Rule of mixture . .(**BTL-2)**
CO 3	Solve the numerical problems on Tsai-Hill theory, Tsai, Wu theory ..(**BT-3)**
CO 4	Explain about Metal Matrix Composites and reinforcement of materials (.(**BTL-2)**
CO 5	Explain the micromechanics of Failure of Unidirectional Lamina .(**BTL-2)**

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	3										2	2	
CO2	3	3										2	2	
CO3	3	3										2	2	
CO4	3	3										2	2	
CO5	3	3										2	2	
1: Low, 2-Medium, 3- High														

NARAYANA ENGINEERING COLLEGE:NELLORE								
	COMPOSITE MATERIALS							R2020
Semester	Hours / Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100

COURSE CONTENT

MODULE- I	INTRODUCTION TO COMPOSITE MATERIALS	10 Hrs

Introduction To Composite Materials: Definition, classification and characteristics of composite Materials – fibrous composites, laminated composites, particulate composites. Applications: Automobile, Aircrafts. missiles. Space hardware, Electrical and electronics, Marine, recreational and sports equipment, future potential of composites

MODULE- II	MICRO MECHANICAL ANALYSIS OF A LAMINA	9 Hrs

Micro Mechanical Analysis of a Lamina: Micro Mechanical Analysis of a Lamina: Introduction, Evaluation of the four elastic moduli by Rule of mixture, Numerical problems. Macro Mechanics of a Lamina: Hooke's law for different types of materials, Number of elastic constants, Two - dimensional relationship of compliance and stiffness matrix. Hooke's law for two-dimensional angle lamina,

MODULE- III	BIAXIAL STRENGTH	10 Hrs

Biaxial Strength Theories Maximum stress theory, Maximum strain theory, Tsai-Hill theory, Tsai, Wu tensor theory, Numerical problems. Macro Mechanical Analysis of Laminate Introduction, code, Kirchoff hypothesis, CL T, A, B, and D matrices (Detailed derivation) ,

MODULE- IV	METAL MATRIX COMPOSITES	09 Hrs

Metal Matrix Composites: Metal Matrix Composites: Reinforcement materials, types, characteristics and selection base metals selection. Need for production MMC's and its application. Fabrication Process For MMC's: Powder metallurgy technique, liquid metallurgy technique and secondary processing, special fabrication techniques.

MODULE- V	FAILURE THEORIES	10 Hrs

Failure Theories: Micromechanics of Failure of Unidirectional Lamina, Anisotropic Strength and Failure Theories, Importance of Shear Strength, Choice of Failure Criteria, Examples.

	Total Hours	48 Hrs

TEXT BOOKS :

1 . K.K. Chawla, "Composite Materials", Springer-Verlag, New York. (1998),

2. Madhujit Mukhopadhya, "Mechanics of composite materials and structures",. Universities Press 2004.

REFERENCES:

1.B.T. Astrom "Manufacturing of Polymer Composites", Chapman & Hall. , (1997), 1. Stuart M Lee, J. Ian Gray, Miltz, "Reference Book for Composites Technology", CRC press. (1989),

2. Frank L Matthews and R D Rawlings, "Composite Materials: Engineering and Science", Taylor and Francis. (2006),

NARAYANA ENGINEERING COLLEGE: NELLORE								
	Design of Material Handling Equipment							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VI	3	0	0	48	3	40	60	100

Course Objectives:

1. To understand about material handling equipment
2. To explain the design of hoisting Equipment likes: Wire and Hemp Rope
3. To classify the different types of conveyors
4. To understand design of Bucket elevators: Loading and bucket arrangements
5. To understand the environmental and human factors in material handling

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Understand material handling equipment working principle in detail.(BTL-2)
CO 2	Explain the design of hoisting Equipment likes: Wire and Hemp Rope, Welded and roller chains.(BTL-2)
CO 3	Classify different types of Conveyors and applications of Belt Conveyors (BTL-3)
CO 4	Explain the concept of loading and bucket arrangements.(BTL-2)
CO 5	Explain about environmental and human factors in material handling.(BTL-2)

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO1	**PO2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO 2**
CO1	2	2										2	2	
CO2	2	2										2	2	
CO3	2	2										2	2	
CO4	2	2										2	2	
CO5	2	2										2	2	
1: Low, 2-Medium, 3- High														

NARAYANA ENGINEERING COLLEGE:GUDUR							
	MATERIALS HANDLING EQUIPMENT						R2020
Semester	Hours / Week			Total hrs	Credits	Max Marks	
	L	T	P		C	CIE	SEE	TOTAL
VI	3	0	0	48	3	40	60	100

COURSE CONTENT		
MODULE- I	INTRODUCTION	10Hrs
Introduction to material handling Equipment, Detail classification of MHE, Application and their selection.		
MODULE- II	**DESIGN OF HOISTS**	09Hrs
Design of hoisting Equipment likes: Wire and Hemp Rope, Welded and roller chains. Design of ropes, pulleys, Pulley systems, Sprockets and drums, Load handling attachments. Design of Hooks: forged hooks and eye hooks, Girder Design, Crane grabs, Grabbing attachments, Design of arresting gear		
MODULE- III	**DESIGN OF CONVEYORS**	9Hrs
Classification of Conveyors, Design and applications of Belt Conveyors, Apron Conveyors and Escalators Pneumatic Conveyors, Screw conveyors and vibratory conveyor		
MODULE- IV	**DESIGN OF ELEVATORS**	10Hrs
Design of Bucket elevators: Loading and bucket arrangements, Cage elevators, Shaft way, Guides, counter weights.		
MODULE- V	**SAFETY AND TRAINING**	10 Hrs
Need, Environmental and human factors in material handling, Safety Regulations		
	Total Hours	48 Hrs

TEXT BOOKS :

- 1. Material Handling Equipments by Rudenko, MIR Publishers1964
- 2.Alexandrov M., "Materials Handling Equipments", MIR Publishers, 1981

REFERENCES:

- 1. ASME, "Materials Handling Handbook", Wiley -Interscience, 1985
- 2. Spivakovsy A.O. and Dyachkov V K, "Conveying Machines", Volume I and II,
- MIRPublishers,1985
- 3. Tech P S G, "Design Data Book", Kalaikathir Achchagam, Coimbatore, 2003.

NARAYANA ENGINEERING COLLEGE:NELLORE								
	ENGINEERING OPTIMIZATION							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VI	3	0	0	48	3	40	60	100

Course Objectives:

1. To acquire knowledge on operations research modeling and essential tools for optimization
2. To develop formulation skills in transportation models and finding solutions.
3. To understand the concepts of Project Evaluation Review Technique and Critical Path Method in project management.
4. To provide a systematic procedure for determining the optimal combination of decisions.
5. To acquire knowledge on optimization techniques & important algorithmic design paradigms and methods of analysis.

Course Outcomes: After successful completion of the course ,the student will be able to:

CO1	List & understand the different operations research modeling and essential tools for optimization.(BL- 1)
CO2	Interpret the formulation skills in transportation models and finding solutions.(BL- 3)
CO3	Discuss the concepts of Project Evaluation Review Technique and Critical Path Method in project management. (BL-2)
CO4	Identify a systematic procedure for determining the optimal combination of decisions.(BL-2)
CO5	Summarize the optimization techniques & important algorithmic design paradigms and methods of analysis.(BL-2)

CO-PO Mapping.

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	2	2	2	2	-	-	-	-	-	-	1	2	-
CO2	2	1	1	1	1	-	-	-	-	-	-	1	1	-
CO3	2	1	1	1	1	-	-	-	-	-	-	1	1	-
CO4	1	1	1	1	1	-	-	-	-	-	-	1	1	-
CO5	2	1	2	1	1	-	-	-	-	-	-	1	1	-

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	LINEAR PROGRAMMING PROBLEM	10h

OR definition– Classification of Models –Types of Operations Research models, Linear Programming Problem Formulation, Graphical Method, Simplex Method, Two– Phase Simplex Method, Big-M Method, Problem of Degeneracy, conversion to primal to dual and dual simplex method

At the end of the Module 1, students will be able to:

1. Learn numerical methods of solving linear programming problems.
2. Learn about the various optimization methods to slove problems.
3. Understand the various the theory and numerical methods needed to understand and solve the mathematical problems.

MODULE -2	TRANSPORTATION PROBLEM	9h

Transportation Problem – Formulation; Different Methods of Obtaining Initial Basic Feasible Solution-North-West Corner Rule, Least Cost Method, Vogel's Approximation Method; OptimalityTesting. Unbalanced Transportation Problem, Degenerate Problem; Assignment Problem – Formulation; Optimal Solution -Travelling Salesman problem. Sequencing -Assumptions-n-jobs-2 Machines model, n-jobs-3-machines models & n jobs – m Machines models

At the end of the Module 2, students will be able to:

1. Learn how to minimize the total cost of transporting goods from the various supply origins to the different demand destinations.
2. Learn the northwest corner rule and the matrix minimum cost method.
3. Learn the sequencing of jobs.

MODULE-3	**PERT & CPM**	10h

PERT & CPM: Introduction to Project Management, Activities, Events, Predecessor Relationships, AOA Diagram, Early Start, Early Finish, Late Start & Late Finish Times, Earliest Occurrence and Latest Occurrence of the Event, Total Float, Free Float, Independent Float CPM- Deterministic Model- Critical Path, Crashing, Optimal Project Duration, Least Possible Project Duration PERT- Probabilistic Model-Various types of Activity Time Estimates, Standard Deviation and Variance of the Activities and Projects, and Probability of Completing the Project within scheduled time

At the end of the Module 3, students will be able to:

1. Construct a simple net work diagrams.
2. Analyze net works that have deterministic time.
3. Describe activity crashing "and solve simple problem.

MODULE-4	**DYNAMIC PROGRAMMING & REPLACEMENT MODELS**	10h

Dynamic Programming : Introduction – Bellman"s Principle of Optimality – Applications of Dynamic Programming- Capital Budgeting Problem – Shortest Path Problem – Solution of Linear Programming Problem by DP, cargo-loading problem, employment Smoothing

Replacement Models: Introduction –Types of Replacement Problem, Determination of Economic Life of an Asset, and Simple Probabilistic Model for Items which completely fail-Individual Replacement Model, Group Replacement Model

At the end of the Module 4, students will be able to:

1. Acquire knowledge on Bellman"s Principle of Optimality
2. Learn about the shortest path Problem.
3. Learn about the different replacement models.

MODULE-5	**OPTIMIZATION TECHNIQUES**	9h

Introduction to Optimization: Engineering application of Optimization – Statement of an Optimization problem - Optimal Problem formulation - Classification of Optimization problem. Optimum design concepts: Definition of Global and Local optima, Optimality criteria Optimization algorithms for solving unconstrained optimization problems – Gradient based method: Cauchy's steepest descent method, Newton's method, Conjugate gradient method
Heuristic Programming – Greedy Heuristic, Meta Heuristic – Tabu Search Algorithm, Simulated Annealing Algorithm, Genetic Algorithm, Application of Metaheuristics to Integer Linear Programs, Constraint Programming.

At the end of the Module 5, students will be able to:

1. Learn classical optimization techniques and numerical methods of optimization.
2. Know the basics of different evolutionary algorithms.
3. Learn how to solve unconstrained optimization problems.

Total hours: 48 hours

Text Book(s):

1. Operation Research, J.K.Sharma,MacMilan, 5th edition, 2013.
2. Engineering Application Of Optimization, Ravichandran, K.M.Ragsdell,G.V.Reklaitis2007
3. Engineering of Optimization BY SS RAO 2000

Reference Book(s):

1. Operations Research by R Panneerselvam, PHI, 2nd edition, 2012.
2. Operations Research, Wagner, PHI Publications, 2nd edition. 2003
3. Prem Kumar Gupta "Introduction to Operations Research" S.Chand, 2012
4. Operations Research S.D Sharma 5th edition, 2011

Online Resources:

https://www.sciencedirect.com/topics/computer-science/optimization-formulation

Web Resources:

1. **https://www.youtube.com/watch?v=xrGVe6gMRyk**
2. **https://www.youtube.com/watch?v=FiHRNzkMADo**
3. **https://www.youtube.com/watch?v=Tm2HhqMu5Jg**

Content beyond syllabus:

1. Waiting Lines - Poisson arrivals and exponential service

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Classification of Models in OR	CO1	**https://prinsli.com/classification-of-modelling-in-operations-research/**

	2	Travelling Salesman problem	CO2	**https://www.javatpoint.com/travelling-sales-person-problem**
	3	Deterministic Model	CO3	**https://en.wikipedia.org/wiki/Deterministic_system**
	4	Simple Probabilistic Model	CO4	**https://www.cs.toronto.edu/~rgrosse/courses/csc311_f21/readings/Probabilistic%20Models.pdf**
	5	Cauchy's steepest descent method	CO5	https://www.sciencedirect.com/topics/mathematics/steepest-descent-method

NARAYANA ENGINEERING COLLEGE:NELLORE								
	Finite Element Method							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100

Course Objectives:

The subject should enable the students to learn the principles involved in discretization in finite element approach, form stiffness matrices and force vectors for simple elements, find the various approach followed in finite element approach, use the various elements for discretization and learn about shape functions.

To learn the application of FEM to various structural problems incorporating temperature. and boundary conditions and heat transfer problems.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Solve complex problems using FEM.(BTL-6)
CO 2	Formulate isoparametric elements with different irregular boundaries (BTL-6)
CO 3	Implement solution techniques for higher order problems in practice. (BTL-3)
CO 4	Determine the thermal stresses (BTL-3)
CO 5	Apply concepts for modeling of non-linear materials and geometry (BTL-3)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1		3	3									2		
CO2			3	2								2		
CO3			3									2		
CO4			3	2								2		
CO5			3		3							2		

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE - I	**INTRODUCTION TO FINITE ELEMENT METHODS**	**10 Hours**
Introduction to finite element methods for solving field problems, applications, Stress and equilibrium, Boundary conditions, Strain-Displacement relations, Stress- strain relations for 2D and 3D Elastic problems. Potential energy and equilibrium, Rayleigh-Ritz method, Formulation of Finite Element Equations. One dimensional Problems: Finite element modelling of ID bar elements coordinates and shape functions. Requirements for Convergence and Interpolation functions, Pascal's Triangle, Assembly of global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Quadratic shape functions.		
At the end of the MODULE-1, students will be able to: 1. To learn the boundary condition 2. To study the 2D and 3D elastic problems		
MODULE - II	**1 D ANALYSIS OF TRUSSES AND BEAMS**	**10 Hours**
Analysis of trusses: Stiffness Matrix for 1D truss element, Stress Calculations and Problems with maximum of three elements. Analysis of beams: Element Stiffness Matrix and Load vector for 1 D beam element, Hermite shape functions and simple problems		
At the end of the MODULE-II, students will be able to: 1. To learn the maximum of three elements 2. To calculations different beams		
MODULE - III	**2D ANALYSIS**	**10Hours**
Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundary conditions. Estimation of load Vector, Stresses. Finite element modeling of Axi-symmetric solids subjected to axi-symmetric loading with triangular elements.		
At the end of the MODULE-III, students will be able to: 1. To study modeling of two dimensional stress analysis 2. To learn triangular elements		
MODULE - IV	**QUADRILATERAL ELEMENTS & THERMAL ANALYSIS**	**10 Hours**

Quadrilateral Elements: Isoparametric, Sub parametric and Super parametric elements, Modelling of 4 noded and 8 noded quadrilateral elements and simple problems. Numerical Integration. Steady state heat transfer analysis: One dimensional analysis of composite slab and fin

At the end of the MODULE-IV, students will be able to:

1. To identify Isoparametric, Sub parametric
   To learn One dimensional analysis of composite slab and fin

MODULE - V	**DYNAMIC ANALYSIS**	**10 Hours**

Analysis of a 1D uniform shaft subjected to torsion – Simple problems Dynamic analysis: Formulation of finite element model, element – mass matrices, evaluation of Eigen values and Eigen vectors for a bar and shaft.

At the end of the Module 5, students will be able to:

1. To study the heat transfer and fluid mechanics by using the finite element method

Total hours:	**50 hours**

Content beyond syllabus:

1. **To learn about finite element analysis in fluid machines and heat transfer**

Self-Study:

Contents to promote self-Learning:

SNO	**Topic**	**CO**	**Reference**
1	Solve complex problems using FEM.	CO1	**https://www.iist.ac.in/sites/default/files/people/IN08026/FEM.pdf**
2	Formulate isoparametric elements with different irregular boundaries.	CO2	**https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SMEA1503.pdf**
3	Implement solution techniques for higher order problems in practice.	CO3	**https://nptel.ac.in/courses/106104189**
4	Apply concepts for carrying out research	CO4	**https://en.wikipedia.org/wiki/Finite_element_method**
5	Apply concepts for modeling of non-linear materials and geometry	CO5	https://www.youtube.com/watch?v=ZljfZ70toyY

EXT BOOKS: 1. T. Chandraputla, Ashok Belegundu, Introduction to Finite Element in Engineering, Pearson Publica 4/e, 2011.

2. S.S.Rao, The Finite Element Methods in Engineering, Elsevier Butterworth - Heinemann, 2/e, 2011. 3. S.Md.Jalaludeen, Finite Element Analysis in Engineering, 2/e, Anuradha Publications, 2016.

REFERENCES: 1. J N Reddy, An introduction to the Finite Element Method, McGraw – Hill, New York, 1993.
2. R D Cook, D S Malkus and M E Plesha, Concepts and Applications of Finite Element Analysis, 3/e, John Wiley, New York, 1989.
3. K J Bathe, Finite Element Procedures in Engineering Analysis, Prentice-Hall, Englewood Cliffs, 1982.
4. G.Lakshmi Narasaiah, Finite Element Analysis, 1/e, B.S. Publications, 2008.
5. O C Zienkiewicz and R L Taylor, the Finite Element Method, 3/e. McGraw-Hill, 1989

Web Resources:

learning-modules-for-finite-element-method-on-the-world-wide-web.pdf

TNARAYANA ENGINEERING COLLEGE:NELLORE								
	FLEXIBLE MANUFACTURING SYSTEMS							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
OE	3	0	0	48	3	40	60	100

Course Objectives:

1. To Examine the basic concepts on design and modes of manufacturing systems.
2. To Discuss the scheduling and controlling methods used in manufacturing systems.
3. To the concepts of Group Technology to the development of FMS.
4. To Analyze and control the software components of FMS.
5. To Summarize the concepts of modern trends and applications of FMS.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Understand the basic concepts of design procedures and modes of manufacturing systems.(BTL-1)
CO 2	Understand the concepts of developing the manufacturing systems.(BTL-2)
CO 3	Acquire the knowledge on formulation of Group Technology and its applications.(BTL-3)
CO 4	Understand the concepts of computer controlling systems and software for flexible manufacturing systems.(BTL-4)
CO 5	Understand concepts of modern trends and applications of FMS. .(BL5)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1												2
CO2	2		2									1		
CO3	1	2	1											
CO4	2	1	1		2				2				1	1
CO5	2			1	2							1		
1: Low, 2-Medium, 3- High														

NARAYANA ENGINEERING COLLEGE: NELLORE								
	FLEXIBLE MANUFACTURING SYSTEMS							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
V	3	0	0	48	3	40	60	100

COURSE CONTENT

MODULE – 1	INTRODUCTION	10 Hours

Introduction: Definitions of manufacturing with input-output model, definition of system, basic problems concerning systems and system design procedure, modes of manufacturing – job/batch/flow and multiproduct, small batch manufacturing Flexibility and Types of Flexibility

MODULE -2	SCHEDULING AND CONTROL OF FLEXIBLE MANUFACTURING SYSTEMS	08 Hours

:Development of Manufacturing Systems – Benefits – Major Elements —Single Product, Single Batch, N – Batch Scheduling Problem – Knowledge Based Scheduling System.

MODULE-3	GROUP TECHNOLOGY	10 Hours

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

MODULE-4	COMPUTER CONTROL OF FLEXIBLE MANUFACTURING SYSTEMS:	10 Hours

Introduction – composition of FMS– hierarchy of computer control –computer control of work center and assembly lines – FMS supervisory computer control, Application of simulation – model of FMS– simulation software

MODULE-5	APPLICATIONS & FUTURE TRENDS OF FMS	10 Hours

FMS Application in Machining, Sheet Metal Fabrication, Prismatic Component Production – Aerospace Application – FMS Development Towards Factories of The Future – Artificial Intelligence and Expert Systems in FMS – Design Philosophy and Characteristics for Future.

Total hours:	48 hours

Text Book(s):

1. Jha, N.K. "Handbook of flexible manufacturing systems", Academic Press Inc., 1991
2. Raouf, A. and Ben-Daya, M., Editors, "Flexible manufacturing systems: recent development", Elsevier Science, 1995

Reference Book(s):

1. Radhakrishnan P. and Subramanyan S., “CAD/CAM/CIM”, Wiley Eastern Ltd., New Age International Ltd., 1994.

NARAYANA ENGINEERING COLLEGE:NELLORE								
	GAS TURBINES AND JET PROPULSION							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
OE	3	0	0	48	3	40	60	100

Course Objectives:

1. To Acquire knowledge about the gas turbine cycles, classification, working Principles and its efficiencies.
2. To Describe the different operating modes for gas turbines.
3. To Evaluate, enumerate, and resolve problems of jet propulsion
4. To Identify the essential principles, uses, and workings of rocket and Ram engines.
5. To Explain the functionalities of different components of Rocket Technology.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Explain the basic fundamentals of the various gas turbine operating cycles.(BTL-1)
CO 2	Discuss the various modes pertaining to gas turbines.(BTL-2)
CO 3	Identify, formulate and solve problems related to jet propulsion. (BTL-3)
CO 4	Understand the basic fundamentals, applications and operations of Ram jet and Rocket engines. (BTL-4)
CO 5	Illustrate the different components and its functions of Rocket Technology.(BTL-5)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1												2
CO2	2		2									1		
CO3	1	2	1											
CO4	2	1	1		2				2				1	1
CO5	2			1	2							1		
1: Low, 2-Medium, 3- High														

NARAYANA ENGINEERING COLLEGE: NELLORE								
	GAS TURBINES AND JET PROPULSION							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
V	3	0	0	48	3	40	60	100

COURSE CONTENT

MODULE – 1	INTRODUCTION	09 Hours

Gas Turbines; gas turbine applications, gas turbine advantages & disadvantages, energy flow & back work, deviation from ideal cycle, gas turbine with regeneration, thermal efficiency of gas turbine with & without regenerator, gas turbine engines, inter cooling & reheating, turbojet engine, turbofan engine, turboprop engine

MODULE -2	OPERATING CYCLE	10 Hours

. Simple open cycle gas turbine or air standard Brayton cycle, Actual Brayton cycle, the cycle air flow rate, the cycle work ratio, optimum pressure ratio or maximum cycle thermal efficiency, means of improving the efficiency and the specific output of simple cycle.

MODULE-3	JET PROPULSION	10 Hours

Jet propulsion: Historical sketch- reaction principle- essential features of propulsion devices- Thermal jet engines, classification of – energy flow, thrust, thrust power and propulsion efficiency- need for thermal jet engines and applications. Turboprop and turbojet – thermodynamic cycles, plant layout, essential components, and principles of operation – performance evaluation – thrust augmentation and Thrust reversal – contrasting with piston engine propeller plant.

MODULE-4	RAM JET AND ROCKET ENGINES	10 Hours

Ram jet- Thermo dynamic cycle, plant lay out, essential components – principle of operation – performance evaluation– comparison among atmospheric thermal jet engines..

Rocket Engines: Need for applications- basic principle of operation and parameters of performance – classification, solid and liquid propellant rocket engines, advantages, domains of application – propellants – comparison of propulsion systems.

MODULE – 5	ROCKET TECHNOLOGY	09 Hours

Rocket Technology: Flight mechanics, application thrust profiles, acceleration staging of rockets, need for – feed systems, injectors and expansion nozzles – rocket transfer and ablative cooling.

	Total hours:	48 hours

Text Book(s):

1. Gas Turbines , V. Ganesan TMGH 2006
2. Gas turbines , cohen , Rogers & Sarvana Muttoo , Addision Wiley & longman 2017

Reference Book(s):

1. Thermodynamics of propulsion, Hill & Paterson.2009
2. Rocket Propulsion , Sutton.2010
3. Element of Gas Turbines propulsion , Jack D Matingly, MGHJack D Matingly, MGH1996

NARAYANA ENGINEERING COLLEGE:NELLORE								
	HYDRAULIC &PNEUMATICS SYSTEMS							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100

Pre-Requisite: BASICS IN HYDRAULICS & PNEUMATICS

Course Objectives:

1. To understand various properties of fluids and basics of hydraulics
2. To define the purpose of Actuator
3. To identify the working of hydraulic circuits
4. To understand the working of compressors
5 To describe the trouble shooting and remedies in Hydraulic and Pneumatic systems

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Calculate the fluid properties and flow characteristics (BTL-3)
CO 2	Explain the working of hydraulic actuator (BTL-2)
CO 3	Calculate the flow of fluid in hydraulic circuits (BTL-3)
CO 4	Solve the problems on Pneumatic system (BTL-3)
CO 5	Illustrate different applications of hydraulic and pneumatic system (BTL-4)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1											3	
CO2	3	2											3	
CO3	3	2											3	
CO4	3	2		2									3	
CO5	3	2		2									3	

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	Fluid Power Principles and Hydraulic Pumps	10 Hours

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids – Properties of fluids and selection – Basics of Hydraulics – Pascal's Law – Principles of flow – Friction loss – Work, Power and Torque Problems, Sources of Hydraulic power : Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps – Problems.

At the end of the Module 1, students will be able to:

1. Understand the properties of fluids
2. Learn principles of fluid flow
3. Solve the problem on fluid flow

MODULE -2	Hydraulic Actuators and Control Components	9 Hours

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors – Control Components : Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories : Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols – Problems

At the end of the Module 2, students will be able to:

1. Gain knowledge on hydraulic actuators
2. Explain the construction and Operation of flow and pressure control valve
3. Solve the problems on hydraulic motors

MODULE-3	Hydraulic Circuits and Systems	10 Hours

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double- Pump,

Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

At the end of the Module 3, students will be able to:

1. Understand the working of industrial circuits
2. Describe the pressure intensifier working

MODULE-4	Pneumatic and Electro Pneumatic Systems	9 Hours
Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, Introduction to fluidics and pneumatic logic circuits.		
At the end of the Module 4, students will be able to: 1. Understand properties of air and working of Pneumatic actuators 2. Explain about Cascade method and Electro Pneumatic System		
MODULE-5	**Trouble Shooting and Applications**	**10 Hours**
Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools .		
At the end of the Module 5, students will be able to: 1. List the applications of Hydraulic and Pneumatic System 2. Explain the working of Press and Forklift		
Total hours:		**48 hours**

Content beyond syllabus:

1. Creating awareness on different elements of mini hydro power plant

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Basics of Hydraulics	CO1	https://www.grc.nasa.gov/www/k-12/WindTunnel/Activities/Pascals_principle.html
2	Hydraulic Actuators: Cylinders –	CO2	https://www.electricalvolt.com/2022/02/hydraulic-actuator-its-parts-types-working-advantages/

	3	Intensifiers, Industrial hydraulic circuits	CO3	https://www.powermotiontech.com/technologies/other-technologies/article/21884328/book-2-chapter-13-pressure-intensifier-circuits
	4	Design of Pneumatic circuit	CO4	https://www.clippard.com/cms/wiki/how-design-efficient-pneumatic-systems
	5	Trouble Shooting Hydraulic and Pneumatic systems	CO5	https://nptel.ac.in/courses/112105046

Text Book(s):

1. Hydraulic and Pneumatic Control by K Shammuga Sundaram, S. Chand & Co. Ltd., New Delhi 2006
2. Hydraulics and Hydraulic Machinery by Dr. Jagadish Lal; Metropolitan Book Company Ltd.,Delhi.1994
3. Hydraulic and Pneumatic Power and Control Design, Performance and Application byYeaple, McGraw Hill, New York.1996

Reference Book(s):

.

1. Anthony Esposito, “Fluid Power with Applications”, Pearson Education 2005.
2. Majumdar S.R., “Oil Hydraulics Systems- Principles and Maintenance”, Tata McGraw- Hill, 2001.

Online Resources:

Web Resources:

1. https://www.youtube.com/watch?v=PgKsr2_-oxc
2. https://www.youtube.com/watch?v=QRcZHnuC-us

NARAYANA ENGINEERING COLLEGE:GUDUR								
	Industrial Engineering							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
OE	3	0	0	48	3	40	60	100

Course Objectives:

1. To Illustrate the fundamental concepts of management administration and organization.
2. To study the systematic method of improving the value of a product that a project produces.
3. To improve the design and condition of the workspace by using method study.
4. To know sound Inventory Management techniques by maintaining the optimal amount of inventory to meet customer demand.
5. To collect information regarding the performance of the product with established standards for the use of engineering production, purchasing and quality control etc.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Explain the core ideas in management, administration, and organization. (BTL-1)
CO 2	Evaluate the systematic approach of increasing the value of a product. (BTL-6)
CO 3	Apply method study to enhance the layout and condition of the workspace. (BTL-3)
CO 4	Evaluate the right amount of inventory on hand to satisfy consumer demand. (BTL-1)
CO 5	Defined standards for the use of engineering production, purchasing and quality control etc. (BTL-1)

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	1													1
CO2		1										1		1
CO3				2										
CO4	1	2											2	1
CO5				1								1		
CO6	2	3												
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	**INTRODUCTION**	**10 Hours**
Concepts of Management-Administration and Organization – Functions of Management – Taylor's Scientific Management, Fayol's Principles of Management, Douglas Mc-Gregor's Theory X and Y, Hertzberg's Two factor Theory of Motivation, Maslow's Hierarchy of Human needs – Organizational Structures Functional- virtual - Matrix Basic Concepts Related to Organization		
MODULE -2	**Plant location AND PLANT LAYOUT**	**10 Hours**
Plant Location : Objectives, Product Life Cycle, – Factor Considerations in Plant Location, Comparative Study of Rural and Urban Sites, Methods of Selection of Plant Layout, Objectives of Good layout, Principles, Types of Layout, Line Balancing.		
MODULE-3	**WORK STUDY**	**10 Hours**
– Definition, Objectives, Method Study – Steps Involved – Various Types of Process Charts –. Work Measurement - Definition, Time Study, Steps involved - Equipment, Different Methods of Performance Rating - Allowances, Standard Time Calculation. Work Sampling - Definition, Steps Involved,		
MODULE-4	**INVENTORY MODELS**	**9 Hours**
Deterministic models- EOQ Models – With and Without Shortages Models; Inventory Models with Price Breaks -Probabilistic Models –Discrete Variable, Continuous Variable. Inventory Control Systems		
MODULE-5	**INSPECTION & QUALITY CONTROL**	**9 Hours**
Inspection & Quality Control: Statistical Quality Control- Techniques-Variables and Attributes-Control Charts: X and R Charts; P Charts and C Charts. Acceptance Sampling Plan - Single Sampling and Double Sampling Plans- OC Curves. Introduction to TQM- Quality circles-.		
	Total hours:	**48 hours**

Text Book(s):

1. Industrial Engineering And Management By OP Khanna
2. Introduction to industrial Engineering, Bonnie Boardman ,Mays open press 2020.

References:

1. Industrial Engineering and management by Rhona, Free sage publications 2012
2. Chary S.N., Production and Operations Management, 5 th Edition, McGraw Hill Education, 2017.

NARAYANA ENGINEERING COLLEGE:NELLORE								
	INDUSTRIAL MANAGEMENT							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
OE	3	0	0	48	3	40	60	100

Course Objectives:

1. to understand the Basic management .
2. to understand strategic management.
3. to understand statistics in quality control and management.
4. to understand human resource development.
5. to understand management information systems .

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	know the concept of Basic management and Levels of management (BTL-1)
CO 2	know strategic management.(BTL-2)
CO 3	Apply the statistics in quality control and management. (BTL-2)
CO 4	understand the objectives of HRM .(BTL-2)
CO 5	understand management information systems.(BTL3)

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2		3									1		2
CO2	1				3						1	1		
CO3	2			1								1		
CO4	2	1		1					2		1		1	1
CO5	3			2								1		
1: Low, 2-Medium, 3- High														

NARAYANA ENGINEERING COLLEGE:GUDUR								
	INDUSTRIAL MANAGEMENT							R2020
Semester	Hours / Week			Totalhrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100

COURSE CONTENT

MODULE- I	**BASICS OF MANAGEMENT**	10 Hrs

Introduction, Definition of management, characteristics of management, functions of management - Planning, Organising, Staffing, Directing, Co-ordination, Controlling,Motivating, Communication, Decision Making, Principles of management – F.W.Taylor, HenryFayol, Elton Mayo, Administration and management, Nature of management, levels of management, Forms of Organization- Line , Line –staff etc

MODULE- II	**STRATEGIC MANAGEMENT**	9 Hrs

Military origins of strategy – Evolution - Concept and Characteristics of strategic management –Defining strategy – Mintzberg's 5P's of strategy – Corporate, Business and Functional Levels of strategy - Strategic Management Process. Preparing an Environmental Threat and Opportunity Profile (ETOP)

MODULE- III	**QUALITY MANAGEMENT**	10 Hrs

Definition of quality, continuous improvement definition of quality, types of quality – quality of design, conformance and performance, phases of quality management, Demings view of quality, Quality Management Assistance Tools: Ishikawa diagram – Pareto Analysis – Pokka Yoke (Mistake Proofing).quality circles, TQM, Kaizen, Five S (5S), Six sigma, ISO 9001:2000

MODULE- IV	**HUMAN RESOURCE DEVELOPMENT**	9 Hrs

Strategic importance HRM; objectives of HRM; challenges to HR professionals; role, Responsibilities and competencies of HR professionals; HR department operations; Human Resource Planning - objectives and process; human resource information system.. Talent acquisition; recruitment and selection strategies, career planning and management, , training and development.

MODULE- V	**MANAGEMENT INFORMATION SYSTEMS**	10 Hrs

Concept of data and information, characteristics of information, types of information, Definition of MIS, Need, Purpose and Objectives, Contemporary Approaches to MIS, Components of an information system, Need to study information systems,

Total Hours	48 Hrs

TEXT BOOKS:

1. P. Khanna, "Industrial Engineering and Management", Dhanpatrai publications Ltd, New Delhi. 1966
2. L.C.Jhamb , Savitri Jhamb , Industrial Management – I , Everest Publishing House .2015

REFERENCES:

1. Dinesh Seth and Subhash C. Rastogi, "Global Management Solutions", Cengage Learning, Second Edition, USA.2009
2. B. Davis and Margrethe H. Olson, "Management Information Systems", Mc-Graw-Hill International Editions.1985

NARAYANA ENGINEERING COLLEGE:NELLORE								
	INTELLIGENT MANUFACTURING SYSTEMS							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100

Course Objectives:

1. Learn computer integrated manufacturing systems.
2. Apply the principles of artificial intelligence in manufacturing system
3. Explain various process planning techniques in intelligent manufacturing
4. Describe the Group Technology based on knowledge base system
5. Demonstrate knowledge group technology in automated manufacturing

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Assess the performance of manufacturing systems
CO 2	Develop a systematic approach for design and implementation of manufacturing systems
CO 3	Suggest new procedures to improve the productivity of existing manufacturing systems
CO 4	Utilize online collaboration tools to work in complex teams
CO 5	study the group technology

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3						2							
CO2	3			2			2							
CO3	3						2							
CO4	3			2			2							
CO5	2						2							

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE-I	**COMPUTER INTEGRATED MANUFACTURING SYSTEMS**	**10 Hrs**
Computer integrated manufacturing systems – structure and functional areas of CIM system - AD, CAPP, CAM, CAQC, ASRS and advantages of CIM Manufacturing communication systems – MAP/TOP OSI model, Intelligent manufacturing – system components, system architecture and data flow,		
MODULE-II	**ARTIFICIAL INTELLIGENCE**	**9 Hrs**
Components of knowledge based systems –Machine learning – concept of artificial intelligence, conceptual learning, artificial neural networks -biological neuron, artificial neuron, types of neural networks, applications in manufacturing		
MODULE- III	**PROCESS PLANNING**	**10 Hrs**
Automated process planning – variant approach, generative approach, expert systems for process planning, feature recognition, phases of process planning Knowledge Based System for Equipment Selection (KBSES) – Manufacturing system design, equipment selection problem,		
MODULE-IV	**GROUP TECHNOLOGY**	**9 Hrs**
Group technology: models and algorithms – visual method, coding method, cluster analysis method, matrix formation – similarity coefficient method, sorting-based algorithms, bond energy algorithm,cost based method,		
MODULE-V	**KNOWLEDGE BASED GROUP TECHNOLOGY**	**10 Hrs**
Knowledge based group technology - group technology in automated manufacturing system, structure of knowledge based system for group technology (KBSGT) – data base, knowledge base, clustering algorithm		
	Total hours:	**48 hours**

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Assess the performance of manufacturing systems	CO1	**https://www.slideshare.net/HarshadaGurav/performance-measures-of-manufacturing-system**
2	Develop a systematic approach for design and implementation of manufacturing systems	CO2	**https://publications.lib.chalmers.se/records/fulltext/255133/255133.pdf**
3	Suggest new procedures to improve the productivity of existing manufacturing systems	CO3	**https://www.slideshare.net/vishalbarasara3/production-and-productivity**
4	Utilize online collaboration tools to work in complex teams	CO4	**https://www.opensym.org/os2016/proceedings-files/p601-chasanidou.pdf**
5	To study the group technology	CO5	https://www.youtube.com/watch?v=y3-5ENFtqrQ

TEXTBOOKS :

1. Andre Kusaic, " Intelligent Manufacturing Systems", PHI,1989
2. Hamid R. Parsaei and Mohammad Jamshidi, "Design and Implementation of Intelligent Manufacturing Systems", PHI, 2009

REFERENCES:

1. Mikell P. Groover, "Automation, Production Systems and Computer Integrated Manufacturing", 8th edition, PHI, 2008.
2. Yagna Narayana, "Artificial Neural Networks", PHI, 2009

Online Resources:

https://www.youtube.com/watch?v=y3-5ENFtqrQ

NARAYANA ENGINEERING COLLEGE:NELLORE								
	MANAGEMENT SCIENCE							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
V	3	0	0	48	3	40	60	100

Course Objectives:

1. To understand the concept of management and Organization designs
2. To explain principle of operations management and types of plant layout
3. To develop an understanding of the human resource management nature
4. To explain about strategy formulation and Implementation
5. Gain knowledge on Management Information System

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Explain the importance of management science and types of organization designs
CO 2	Illustrate about operations management and material management
CO 3	Summarize the human resource management operations and process
CO 4	Explain the SWOT analysis and Project management network analysis
CO 5	Define the concept of Management Information System and Materials Requirement Planning

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1		2						2					
CO2	1	2		1								1		
CO3		1	1						1					
CO4	1	1								1				
CO5												1		
CO6		2	1	1								1		

1: Low, 2-Medium, 3- High

NARAYANA ENGINEERING COLLEGE: NELLORE								
	MANAGEMENT SCIENCE							R2020
Semester	Hours / Week			Totalhrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
V	3	0	0	48	3	40	60	100

COURSE CONTENT

MODULE- I	INTRODUCTION TO MANAGEMENT	10 Hrs

Management - Concept and meaning - Nature-Functions - Management as a Science and Art and both. Schools of Management Thought - Taylor's Scientific Theory-Henry Fayol's principles - Eltan Mayo's Human relations - Systems Theory - **Organisational Designs** - Line organization - Line & Staff Organization - Functional Organization - Matrix Organization - Project Organization - Committee form of Organization

MODULE- II	OPERATIONS MANAGEMENT	9 Hrs

Principles and Types of Plant Layout - Methods of Production (Job, batch and Mass Production), **Material Management** - Objectives - Inventory-Functions - Types, Inventory Techniques - EOQ-ABC Analysis - Purchase Procedure and Stores Management - Product Life Cycle.

MODULE- III	HUMAN RESOURCES MANAGEMENT (HRM)	10 Hrs

HRM - Definition and Meaning – Nature - Managerial and Operative functions - Evolution of HRM - Job Analysis - Human Resource Planning(HRP) - Employee Recruitment-Sources of Recruitment - Employee Selection - Process and Tests in Employee Selection - Employee Training and Development - On-the- job & Off-the-job training methods -

MODULE- IV	STRATEGIC & PROJECT MANAGEMENT	9 Hrs

Definition& Meaning - Setting of Vision - Mission - Goals - Corporate Planning Process - Environmental Scanning - Steps in Strategy Formulation and Implementation - SWOT Analysis - **Project Management** - Network Analysis - Programme Evaluation and Review Technique (PERT) - Critical Path Method (CPM) Identifying Critical Path - Simple problems.

MODULE- V	CONTEMPORARY ISSUES IN MANAGEMENT	10 Hrs

The concept of Management Information System(MIS) - Materials Requirement Planning (MRP) - - Total Quality Management (TQM) - Six Sigma Concept - Enterprise Resource Planning (ERP) - Performance Management - Business Process Outsourcing (BPO) - Business Process Re-engineering and Bench Marking -

Total Hours	48 Hrs

TEXT BOOK

1. A.R Aryasri, "Management Science", TMH, 2013
2. Kumar/Rao/Chhalill 'Introduction to Management Science' Cengage, Delhi, 2012.
.

REFERENCES:

1. Koontz &Weihrich, "Essentials of Management", 6th edition, TMH, 2005.
2.. Kanishka Bedi, "Production and Operations Management", Oxford University Press, 2004.
3. Samuel C.Certo, "Modern Management", 9th edition, PHI, 2005

NARAYANA ENGINEERING COLLEGE:NELLORE								
	Manufacturing & Inspection of Gears							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100

Course Objectives:

1. To Identify methods of manufacturing external and internal spur, single and double helical, and bevel and worm gears
2. To Describe the methodology and underlying theory for basic manufacture and inspection of each.
3. To Discuss the "features" associated with each manufacturing method .
4. To determine acceptability for a specific application, and interpreting the inspection data for purposes other than simply determining accept/reject status.
5. To Specify the data required to control both the manufacturing and inspection processes on an engineering drawing.

Course Outcomes: After successful completion of the course, the student will be able :

CO 1	To develop the different types of gears (BTL-3)
CO 2	To describe the applications of helical and bevel gears (BTL-2)
CO 3	To finish the gears by hobbling (BTL-4)
CO 4	To learn the quality standards tooth thickness (BTL-2)
CO 5	To learn the production of gears with die casting (BTL-2)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3				2		2							
CO2	3			2			2							
CO3	3			2										
CO4	3			1	2		2							
CO5	3				2									

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE-I	**INTRODUCTION TO**	**10 Hrs**

	GEARS	
Types of gears, classification, gear drawings, gearboxes, application of gears, gear production methods, an overview. GEAR MATERIALS Non-metallic, ferrous and non-ferrous gears. Properties of gear materials, selection of material for typical gears and applications – blank preparation methods for different gears, size, type and material.		
MODULE-II	**PRODUCTION OF GEARS**	**9 Hrs**
Gear milling different gears, cut quality obtainable. Gear hobbing, description and operation of machine, types of gears cut, hobbing cutters, work holding methods gear shaping, disc type and rack type gear shapers, Production of straight bevel gears and spiral gears, milling, generation by straight bevel gear generator.		
MODULE-III	**HEAT TREATMENT OF GEARS**	**10 Hrs**
Through hardening, case hardening, flames hardening, induction hardening of gears, Nitriding of gears. Tuft riding of gears. Inspection of gears for hardening defects **GEAR FINISHING** Gear finishing advantages, finishing of gears by grinding, shaving, lapping, honing methods and cold rolling of gears. Description of machines, process and process parameters		
MODULE-IV	**GEAR INSPECTION**	**9 Hrs**
Types of gear errors, gear quality standards tooth thickness and base tangent length measurement, pitch errors, radial run out errors, profile errors, pitch error measurement. Composite error measurement. Computerized gear inspection centers. Reasons and remedies for gear errors		
MODULE-V	**MODERN GEAR PRODUCTION METHODS**	**10 Hrs**
Gear production by stamping, die casting, power metal process, injection and compression Moulding in plastics. Die casting, cold and hot rolling, mass production methods shear speed shaping. Gear broaching – Gleason. G-Trac Gear generation method		
	Total hours:	**48 hours**

Self-Study: Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	To develop the different types of gears	CO1	**https://www.khkgears.co.jp/kr/gear_technology/pdf/gear_guide_060817.pdf**
2	The production of helical and bevel gears	CO2	**https://www.youtube.com/watch?v=bP3PJFscij0**
3	To finishing the gears by hobbling	CO3	**https://www.youtube.com/watch?v=vGPuDHCybx4**
4	To learn the quality standards tooth thickness	CO4	**https://webstore.ansi.org/preview-pages/AGMA/preview_ANSI+AGMA+2002-B88+(R2014).pdf**
5	To learn the production of gears with die casting	CO5	https://www.youtube.com/watch?v=hYmHp_D2huM

EXT BOOKS:

TEXT BOOKS:

1. Society of Manufacturing engineers, Gear Processing and Manufacturing", 2nd 3 Edition 1984

2. Henry E.Merrit,Gear engineering ,Wheeler publishing,Allahabad,1992

REFERENCES:

1. Practical Gear design by Darle W. Dudley, McGraw-Hill book company

2. Earle Buckingham, Analytical mechanics of gears, Dover publications, New York, 1949

Web Resources:

https://www.slideshare.net/sabihakhathun/gears-manufacturing-process-inspectionfailure-and-remedies

NARAYANA ENGINEERING COLLEGE: NELLORE								
	Mechatronics							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
OE	3	0	0	48	3	40	60	100

Course Objectives:

1. To understand the significance of mechatronic systems and sensors.
2. To research different kinds of electronic devices.
3. To study importance of hydraulic and pneumatic systems.
4. To study various types of digital electronic systems.
5. To describe the various interface device kinds.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Illustrate the significance of sensors and mechatronic systems. (BTL-4)
CO 2	Understand various types' electronic devices. (BTL-2)
CO 3	Illustrate the importance of actuation systems, both hydraulic and pneumatic. (BTL-4)
CO 4	Understanding of digital electronic systems. (BTL-2)
CO 5	Illustrate the significance of multiple interfaces. (BTL-4)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1														1
CO2		1										1		1
CO3				2										
CO4	1	1											1	1
CO5				1								1		
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	**INTRODUCTION**	**10 Hours**
Mechatronics systems, elements, levels of mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor-based controllers, advantages and disadvantages of mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.		
MODULE -2	**ELECTRONIC DEVICES**	**09 Hours**
Solid state electronic devices, PN junction diode, BJT, FET, DIA and TRIAC. Analog signal conditioning, amplifiers, filtering. Introduction to MEMS & typical applications.		
MODULE-3	**HYDRAULIC AND PNEUMATIC SYSTEMS**	**10 Hours**
Hydraulic and pneumatic actuating systems, Fluid systems, Hydraulic and pneumatic systems, control valves, electro - pneumatic, hydro-pneumatic, electro-hydraulic servo systems: Mechanical actuating systems and electrical actuating systems.		
MODULE-4	**DIGITAL ELECTRONIC SYSTEMS**	**09 Hours**
Digital electronics and systems, digital logic control, micro processors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control.		
MODULE-5	**INTERFACING DEVICES**	**10 Hours**
System and interfacing and data acquisition, DAQS , SCADA, A to D and D to A conversions; Dynamic models and analogies, System response. Design of mechatronics systems & future trends.		
	Total hours:	**48 hours**

Text Book(s):

1. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran & GK Vijaya Raghavan/WILEY India Edition/2008.
2. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering/ W Bolton/ Pearson Education Press/3rd edition, 2005.

Reference Book(s):

1. Mechatronics – Electronic Control Systems in Mechanical and Electrical Engg. 4th Edition, Pearson, 2012 W. Bolton
2. Mechatronics – Principles and Application Godfrey C. Onwubolu, Wlsevier, 2006 Indian print.

NARAYANA ENGINEERING COLLEGE: NELLORE								
	METALLURGY							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VI	3	0	0	48	3	40	60	100

Course Objectives:

1. To explain the constitution of alloys and purpose of alloying metals
2. To classify the tool steels and selection of tool steels
3. To explain the modes of fracture and fatigue fractures
4. To understand the structure and properties of polymers
5. To make use of different methods of testing materials under tension, compression and shear load

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Understand about constitution of alloy and purpose of alloying, effect of alloying elements with other metals (**BTL-2**)
CO 2	Classify the tool steels and explain the method of heat treatment of tool steels (**BTL-2**)
CO 3	Explain the modes of fracture and fatigue fractures Identify (**BTL-2**)
CO 4	Define about polymers and types of polymers (**BTL-1**)
CO 5	Make use of different methods of testing materials under tension, compression and shear load **(BTL-3)**

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3										3	3	
CO2	3	3										3	3	
CO3	3	3										3	3	
CO4	3	3										3	3	
CO5	3	3										3	3	

1: Low, 2-Medium, 3- High

NARAYANA ENGINEERING COLLEGE:NELLORE								
	METALLURGY							R2020
Semester	Hours / Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VI	3	0	0	48	3	40	60	100

COURSE CONTENT

MODULE- I	CONSTITUTION OF ALLOYS & ALLOY STEELS	9 Hrs

Introduction to Constitution of alloys– classification of alloys-pure metal- purpose of alloying-effects of alloying elements upon ferrite, carbide, iron- iron carbide diagram- effects of alloying elements in tempering- nickel steels-chromium steels-nickel chromium steels-manganese steels-molybdenum steels- tungsten steels

MODULE- II	TOOL STEELS	10 Hrs

Classification of Tool Steels-Selection of Tool Steels -Shock-resisting Tool Steels-Mold Steels-Heat Treatment of Tool Steels -Tool Failures-Ceramic Tools-Faulty Tool Design-Faulty Steel-effect of residual stressesbending fractures

MODULE-III	FAILURE ANALYSIS	10 Hrs

Introduction- modes of fracture- fatigue fractures-effect of strength reducers- faulty processing-beach marks

MODULE-IV	NON-METALLIC MATERIALS	09 Hrs

Polymers – types of polymer, Properties and applications on various thermosetting and thermoplastic polymers , Engineerin Ceramics – Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON –Composites Classifications Metal Matrix and FRP – Applications of Composites

MODULE- V	MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS	10 Hrs

Mechanisms of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), hardness tests, Impact test lzod and charpy, fatigue and creep failure mechanisms.

Total Hours	48 Hrs

TEXT BOOKS :

1. Introduction to Physical Metallurgy / Sidney H.Avener. 2017
2. A Text of Essential of Materials science and engineering/ Donald R.Askeland/Thomson.2013
3. Material Science and Metallurgy/ Dr.V.D.Kodgire,2011

REFERENCES:

1. Science of Engineering Materials / B.K.Agarwal,2017.
2. Engineering materials and metallurgy/R. K. Rajput/S.Chand,2015.
3. Engineering Materials and Their Applications – R. A Flinn and P K Trojan / Jaico Books 1995.

NARAYANA ENGINEERING COLLEGE:NELLORE								
	MODERN MANUFACTURING METHODS							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
OE	3	0	0	48	3	40	60	100

Pre-Requisite: Basics on conventional manufacturing processes

Course Objectives:

1. Understand the basics of unconventional processes and Mechanical Energy Based Processes (BL2).
2. Describe the Electrical Energy Based Processes for machining different materials (BL2)..
3. Explain Chemical and Electro Chemical Energy Based Processes and their suitability to machine different materials (BL2)..
4. Describe various Thermal Energy Based Processes for machining applications (BL2).
5. Explain Ultrasonic and Abrasive jet machining process their advantages and limitations(BL2).

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Understand the advantages and limitations of unconventional machining processes
CO 2	Understand the Electrical energy based processes and its limitations
CO 3	Students can understand the use of electro chemical energy process and their applications
CO 4	Analyse the thermal energy based process and their limitations
CO 5	Understand the applications and limitations of ultrasonic and Abrasive jet machining process.

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	3	2	-	-	3	-	-	-	-	-	-	-	-
CO2	2	3	1	-	1	2	-	-	-	-	-	-	1	-
CO3	2	2	1	-	-	3	-	-	-	-	-	-	1	-
CO4	1	3	-	-	3	2	-	-	-	-	-	-	-	-
CO5	2	3	-	-	2	3	-	-	-	-	-	-	1	-
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	**Non – Traditional Machining Processes**	**10 Hours**
Non – Traditional Machining Processes: Introduction, Need, Classification and Brief Overview, Considerations in Process selection, Materials, Applications. **Mechanical Energy Based Processes:** Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultra Sonic Machining – Working Principle, Description of Equipment, Process Parameters, Metal Removal Rate, Applications, Advantages and Limitations.		
At the end of the Module 1, students will be able to: 1. Understanding of mechanical based unconventional processes (UMP). 2. It will develop the ability of select the process for particular application. .		
MODULE -2	**Electrical Energy Based Processes**	**9 Hours**
Electric Discharge Machining – Working Principles, Description of Equipment, Process Parameters, Surface Finish and MRR, Electrode / Tool, Power and Control Circuits, Tool Wear, Dielectric Fluid, Flushing, Advantages, Limitations and Applications. Wire cut EDM – Working Principle and Applications.		
At the end of the Module 2, students will be able to: 1. Understanding of electrical and chemical based unconventional processes (UMP). 2. The students will learn the principle of hybrid process and their applications.		
MODULE-3	**Chemical and Electro Chemical Energy Based Processes**	**10 Hours**
Chemical Machining and Electro Chemical Machining – Working Principle, Description of Equipment, Etchants, Maskants, Techniques of Applying Maskants, Process Parameters, Surface Finish and MRR, Electro Chemical Grinding, Electro Chemical Honing, Applications, Advantages and Limitations.		
At the end of the Module 3, students will be able to: 1. Understanding of electrical and chemical based unconventional processes (UMP). 2. The students will learn the principle of hybrid process and their applications.		
MODULE-4	**Thermal Energy Based Processes**	**10 Hours**
Laser Beam Machining and Drilling, Plasma Arc Machining, Electron Beam Machining – Working Principle, Description of Equipment, Process Parameters, Applications, Advantages and Limitations.		
At the end of the Module 4, students will be able to:		

1. Understanding of thermal based unconventional processes (UMP).
2. The students will learn the importance of high pulse energy source

MODULE-5	Ultrasonic Machining	9 Hours

ULTRASONIC MACHINING (USM): Introduction, equipment, tool materials & tool size, abrasive slurry, Effect of parameters on Material removal rate, tool wear, Accuracy, surface finish, applications, advantages & Disadvantages of USM.

ABRASIVE JET MACHINING (AJM): Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive work material, Process characteristics-Material removal rate, Nozzle wear, Accuracy & surface finish. Applications, advantages & Disadvantages of AJM. Water Jet Machining: Principle, Equipment, Operation, Application, Advantages and limitations

At the end of the Module 5, students will be able to:

1. The students will understand the use of controlled explosive and spark energy in deformation process.
2. The students will also learn about thin coating techniques.

Total hours:	48 hours

Content beyond syllabus:

1. Advanced Manufacturing process like different types of 3D printing Machines.

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	**Non – Traditional Machining Processes**	CO1	**https://archive.nptel.ac.in/courses/112/107/112107078/**
2	**Electrical Energy Based Processes**	CO2	**https://archive.nptel.ac.in/courses/112/107/112107078/**
3	**Chemical and Electro Chemical Energy Based Processes**	CO3	**https://archive.nptel.ac.in/courses/112/107/112107078/**
4	**Thermal Energy Based Processes**	CO4	**https://archive.nptel.ac.in/courses/112/107/112107078/**
5	**Ultrasonic Machining**	CO5	https://archive.nptel.ac.in/courses/112/107/112107078/

Text Book(s):

1. Jain V.K., Advanced Machining Processes, 1st Edition, Allied Publishers Pvt. Ltd., New Delhi, 2007.
2. Pandey P.C and Shan H.S., Modern Machining Processes, 1/e, McGraw Hill, New Delhi, 2007.
3. Ian Gibson, David W. Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 1/e, Springer, 2010.

Reference Book(s):

1. Chua C.K., Leong K.F. and Lim C.S., Rapid Prototyping: Principles and Applications, 2/e, World Scientific Publishers, 2003.
2. Benedict G.F., Nontraditional Manufacturing Processes, 1/e, CRC Press, 1987.
3. Mishra P.K., Nonconventional Manufacturing, 1/e, Narosa Publishing House, New Delhi, 2014.
4. McGeough J.A., Advanced Methods of Machining, 1/e, Springer, 1988

Online Resources:

1. **https://archive.nptel.ac.in/courses/112/107/112107078/**

Web Resources:

1. https://archive.nptel.ac.in/courses/112/107/112107077/

NARAYANA ENGINEERING COLLEGE:NELLORE								
	NANO MATERIALS							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100

Course Objectives:

1. To Understand the properties of Nano-materials in diverse fields.
2. To Gain knowledge about the Nanomaterials and their properties,
3. To emphasis on the physics of Nanomaterials in detail .
4. To Highlights of the virtual way of understanding the courses materials.
5. To know the application based approach.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Find the scope of nano science and technology (BTL-4)
CO 2	Design the down top approach different types of electro chemical deposition (BTL-6)
CO 3	Understand Diffraction technique, spectroscopy techniques (BTL-2)
CO 4	Study the properties of synthesis of nano materials (BTL-1)
CO 5	Understand the application of nano materials (BTL-2)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3				2									
CO2	3			2										
CO3	3			2										
CO4	3			1	2									
CO5	3				2									

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE - I	**INTRODUCTION**	**10 Hrs**

Introduction: Scope of nanoscience and nano tecnology, nanoscience in nature, classification of nanostructured materials, importance of nano materials. Synthetic Methods: Bottom-Up approach: - Sol-gel synthesis, micro emulsions or reverse micelles, co-precipitation method, solvo thermal synthesis.

At the end of the MODULE-1, students will be able to:

1. Understand the constituents of matter, nanomaterials, properties and usefulness.

MODULE - II	**TOP-DOWN APPROACH**	**9 Hours**

Top-Down approach:- Inert gas condensation, arc discharge method, aerosol synthesis, plasma arc technique, ion sputtering, laser ablation, laser pyrolysis, and chemical vapour deposition method, electrodeposition method, high energy ball milling

At the end of the MODULE-II, students will be able to:

1. Able to learn how to understand the basic behavior of Nanomaterials.

MODULE - III	**TECHNIQUES FOR CHARACTERIZATION**	**10 Hrs**

Diffraction technique, spectroscopy techniques, electron microscopy techniques for the characterization of nanomaterials, BET method for surface area analysis, dynamic light scattering for particle size determination

At the end of the MODULE-III, students will be able to:

1. Able to compete with International Student in Nanomaterial Sciences

MODULE - IV	**STUDIES OF NANO**	**9 Hrs**

Synthesis, properties and applications of the following nanomaterials, fullerenes, carbon nanotubes, core-shell nanoparticles, nano shells, self assembled monolayers, and monolayer protected metal nanoparticles, nano crystalline materials, magnetic nanoparticles and important properties in relation to nano magnetic materials,

At the end of the MODULE-IV, students will be able to:

1. Able to use the knowledge for higher study and research.

MODULE - V	**APPLICATIONS**	**10 Hours**

Engineering Applications of Nanomaterials-aviation and space, chemical industry, automotive engineering, building , consumer electronics- fuel cells, batteries , sensors
At the end of the Module 5, students will be able to: 1. Able to explore the possible physics research, their applications in society and health care unit.
Total hours: 48 hours

Content beyond syllabus:

1.

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	To find the scope of nano science and technology	CO1	**https://web.pdx.edu/~pmoeck/phy381/intro-nanotech.pdf**
2	To design the down top approach different types of electro chemical deposition	CO2	**https://www.intechopen.com/chapters/49413**
3	To understood Diffraction technique, spectroscopy techniques	CO3	**https://research-repository.griffith.edu.au/bitstream/handle/10072/34561/62679_1.pdf**
4	To study the properties of synthesis of nano materials	CO4	**https://www.youtube.com/watch?v=Z51R49OOqAA**
5	To under stood the application of nano materials	CO5	https://www.deshbandhucollege.ac.in/pdf/resources/1590038900_P(H)-VI-Nanomaterials-Unit-5.pdf

EXT BOOKS:

1. Nanomaterials- Synthesis, Properties and Applications, Edited by A.S. Edelstein and R.C. Cammarata, Institute of Physics Publishing, London, 1998 (paper back edition)

2. The Physics and Chemistry of NanoSolids by Frank J. Owens and Charles P. Poole Jr, WileyInterscience, 2008.

REFERENCES:

1. Nanochemistry: A Chemical Approach to Nanomaterials, by G.Ozin and A. Arsenault, RSC Publishing, 2005
2. Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience, Edward L. Wolf, Wiley-VCH, 2nd Reprint (2005)

Web Resources:

https://www.youtube.com/watch?v=evE08ycZfnM

NARAYANA ENGINEERING COLLEGE:NELLORE								
	POWER PLANT ENGINEERING							R2022
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
IV	3	0	0	48	3	40	60	100

Pre-requisite:BasicsinEngineeringMathematics,Physics&EngineeringMechanics

Course Objectives:

1. To understand the sources of energy, power plant economics and environmental aspects.
2. To learn about the working of the components of different power plants.
3. To understand the working principle, types, layout of diesel power plant & Gas turbines.
4. To acquire knowledge on working principle, layout, auxiliary equipments of hydro electric power plant.
5. To acquire knowledge on renewable energy sources, working principle and types of nuclear power plants, working principle and advantages and hazards.

Course Outcomes: After successful completion of the course ,the student will be able to:

CO1	List & understand the sources of energy, power plant economics and environmental aspects. (BL-1)
CO2	Explain the working of the components of different power plants. (BL-2)
CO3	Discuss the working principle, types, layout of diesel power plant & Gas turbines.(BL-2)
CO4	Explain the working principle, layout, auxiliary equipments of hydro electric power plant.(BL-2)
CO5	Interpret the renewable energy sources, working principle and types of nuclear power plants, working principle and advantages and hazards.(BL-2)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	-	-	-	-	-	-	-	-	-	-	-	2	1
CO2	1	1	-	2	-	-	-	-	-	-	-	1	-	1
CO3	1	1	-	2	-	-	-	-	-	-	-	-	-	-
CO4	1	1	-	2	-	-	-	-	-	-	-	1	1	1
CO5	1	1	2	1	-	-	-	-	-	-	-	1	1	1

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	INTRODUCTION	10 Hours

Introduction to the Sources Of Energy - Resources and Development of Power in India. Conventional and non- conventional energy sources, Power Plant Economics and Environmental Considerations: Capital Cost, Investment of Fixed Charges, Operating Costs, General Arrangement of Power Distribution, Load Curves, Load Duration Curve. Definitions of Connected Load, Maximum Demand, Demand Factor, Average Load, Load Factor, Diversity Factor - Tariff - Related Exercises. Effluents from Power Plants and Impact on Environment - Pollutants and Pollution Standards - Methods of Pollution Control. Inspection And Safety Regulations.

At the end of the Module 1, students will be able to:

1. Acquire knowledge about various sources of energy.
2. Learn about the various costs associated with power plant.
3. Understand the various environmental aspects of power plants.

MODULE -2	STEAM POWER PLANT	10 Hours

Introduction to Boilers- Modern High Pressure and Supercritical Boilers - Analysis of Power Plant Cycles - Modern Trends in Cycle Improvement - Waste Heat Recovery, Fluidized Bed Boilers., Fuel and Handling Equipments, Types of Coals, Coal Handling, Choice of Handling Equipment, Coal Storage, Ash Handling Systems. Steam Power Plant : Combustion Process : Properties of Coal - Overfeed and Under Feed Fuel Beds, Travelling Grate Stokers, Spreader Stokers, Retort Stokers, Pulverized Fuel Burning System And Its Components, Combustion Needs and Draught System, Cyclone Furnace, Design and Construction, Dust Collectors, Cooling Towers And Heat Rejection. Analysis of Pollution from Thermal Power Plants - Pollution Controls.CO2 Recorders.

At the end of the Module 2, students will be able to:

1. Understand the construction of boilers.
2. Learn about coal storage & handling equipment.
3. Understand the concepts of Design and Construction of Power Plant .

MODULE-3	**DIESEL & GAS TURBINE PLANT**	**10 Hours**

DIESEL POWER PLANT: Diesel Power Plant, Construction, Plant lay out with auxiliaries, fuel storage.

GAS TURBINE PLANT: Introduction - Classification - Construction - Layout with Auxiliaries - Principles of Working Closed and Open Cycle Gas Turbines. Advantages And Disadvantages Combined Cycle Power Plants.

At the end of the Module 3, students will be able to:

1. Acquire knowledge about Diesel power plant.
2. Learn about Plant layout & fuel storage.
3. Understand the concepts of Gas turbines.

MODULE-4	**HYDRO ELECTRIC PLANT & PROJECTS**	**08 Hours**

HYDRO ELECTRIC POWER PLANT: Water Power - Hydrological Cycle / Flow Measurement - Drainage Area Characteristics - Hydrographs - Storage and Pondage - Classification of Dams and Spill Ways.

HYDRO PROJECTS AND PLANT: Classification - Typical Layouts - Plant Auxiliaries - Plant Operation Pumped Storage Plants.

At the end of the Module 4, students will be able to:

1. Acquire knowledge about Hydro electric power plant.
2. Learn about Hydrographs.
3. Acquire knowledge on Hydro projects .

MODULE-5	**NON-CONVENTIONAL SOURCES & NUCLEAR POWER STATION**	**10 Hours**

POWER FROM NON-CONVENTIONAL SOURCES: Utilization of Solar Collectors- Working Principle, Wind Energy - Types of Turbines - HAWT & VAWT-Tidal Energy. MHD power Generation.

NUCLEAR POWER STATION: Nuclear Fuel - Nuclear Fission, Chain Reaction, Breeding and Fertile Materials - Nuclear Reactor -Reactor Operation. Types of Reactors: Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, Fast breeder Reactor, Homogeneous Reactor, Gas Cooled Reactor, Radiation Hazards and Shielding - Radioactive Waste Disposal.

At the end of the Module 5, students will be able to:

1. Acquire knowledge on non-conventional sources of energy.
2. Learn about Nuclear reactors.
3. Understand the hazards and waste disposal of radioactive substances.

Total hours:	**48 hours**

Content beyond syllabus:

1. Electrical Equipment in Power Station.

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Power plant economics and environmental aspects	CO1	**https://getmyuni.azureedge.net/assets/main/study-material/notes/mechanical_engineering_power-plant-engineering_power-plant-economics-variable-load-problem_notes.pdf**
2	Coal & ash handling in Thermal power systems	CO2	**https://instrumentationtools.com/ash-handling-system-in-thermal-power-plant/**
3	Diesel power plant	CO3	**https://www.academia.edu/42399482/Diesel_Power_Plant_Principle_Component_Layout_Applications**
4	Typical Layout of Hydroelectric Power Plant	CO4	**https://www.electricaleasy.com/2015/09/hydroelectric-power-plant-layout.html**
5	Types of Nuclear Reactors	CO5	**https://www.britannica.com/technology/nuclear-reactor/Types-of-reactors**

Text Book(s):

1. P.K. Nag, "Power Plant Engineering", 3rd edition, TMH, 2013.
2. Wakil, "Power plant technology", M.M.EI TMH Publications.

Reference Book(s):

1. Rajput, "A Text Book of Power Plant Engineering:, 4th edition, Laxmi Publications, 2012.
2. Ramalingam, "Power plant Engineering", Scietech Publishers, 2013
3. P.C. Sharma, "Power Plant Engineering", S.K. Kataria Publications, 2012.
4. Arora and S.Domakundwar, "A course in Power Plant Engineering", Dhanpat Rai & Co (p) Ltd, 2014.

NARAYANA ENGINEERING COLLEGE: NELLORE								
	Product Design and Development							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
OE	3	0	0	48	3	40	60	100

Course Objectives:

1. To understand the basic structure of Product Design, Product Development Process and Explain the techniques uses in product design and development.
2. To develop ability for analyzing the life cycle assessment and Justify physical prototype in line with design for robustness.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Interpret basic structure of Product Design , Product Development Process and Scope of Product Development. (BTL-2)
CO 2	Illustrate the techniques of Product Function, Product Teardown And Experimentation. (BTL-1)
CO 3	Apply the knowledge of Benchmarking, Establishing Engineering Specifications and Product Architecture in product. (BTL-3)
CO 4	Relate the knowledge of Brainstorming, Directed Search, Morphological Analysis and Concept Variants for concept selection and embodiment. (BTL-2)
CO 5	Analysis of Product Metrics and life cycle assessment. (BTL-4)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1													2
CO2		1										1		1
CO3				2										
CO4	2	1											2	1
CO5				2								2		
CO6	1													

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	INTRODUCTION	10 Hours
Strategic importance of Product development - integration of customer, designer, material supplier and process planner, Competitor and customer - behavior analysis. Understanding customerpromoting customer understanding-involve customer in development and managing requirements - Organization process management and improvement.		
MODULE -2	**CONCEPT GENERATION, SELECTION AND TESTING**	**09 Hours**
Plan and establish product specifications. Task - Structured approaches - clarification - search-externally and internally-Explore systematically - reflect on the solutions and processes - concept selection - methodology - benefits. Implications - Product change - variety - component standardization - product performance - manufacturability – Concept Testing Methodologies.		
MODULE-3	**PRODUCT ARCHITECTURE**	**10 Hours**
Product development management - establishing the architecture - creation - clustering - geometric layout development - Fundamental and incidental interactions - related system level design issues - secondary systems -architecture of the chunks .		
MODULE-4	**INDUSTRIAL DESIGN**	**09 Hours**
Integrate process design - Managing costs - Robust design – Modular Design-Integrated design -Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically - Need for industrial design-impact – design process - investigation of customer needs - assessing the quality of industrial design.		
MODULE-5	**DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT**	**10 Hours**
Definition - Estimation of Manufacturing cost-reducing the component costs and assembly costs – Minimize system complexity - Prototype basics - Principles of prototyping - Planning for prototypes - Economic Analysis - Understanding and representing tasks-		
	Total hours:	**48 hours**

Text Book(s):

1. Product Design and Development, Karl T.Ulrich and Steven D.Eppinger, McGraw –Hill International Edns.1999

References:

1. Concurrent Engg./Integrated Product Development. Kemnneth Crow, DRM Associates, 6/3,ViaOlivera, Palos Verdes, CA 90274(310) 377-569,Workshop Book
2. Effective Product Design and Development, Stephen Rosenthal, Business One Orwin,

Homewood, 1992,ISBN, 1-55623-603-4
3. Tool Design – Integrated Methods for successful Product Engineering, Stuart Pugh, Addison Wesley Publishing,Neyourk,NY,1991, ISBN 0-202-41639-5

NARAYANA ENGINEERING COLLEGE:NELLORE								
	PRODUCTION AND OPERATIONS MANAGEMENT							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
OE	3	0	0	48	3	40	60	100

Course Objectives:

1. To Understand the concepts of operations management and types of production systems.
2. To Acquire the knowledge of forecasting techniques
3. To Understand the importance of value engineering and plant layout
4. To Gain knowledge of Aggregate Planning and MRP
5. To Determine the exact scheduling which will be followed in production

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Illustrate the operation management and concept in product development
CO 2	Explain forecasting techniques and errors in forecasting
CO 3	Summarize the value engineering and plant layout
CO 4	Determine various aggregate planning and MRP
CO 5	Explain the different types of scheduling

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	1		1	1							1	1	1	
CO2		1		1				1						1
CO3	1		1	1	1							1	1	
CO4	1		1	1	1								1	
CO5		2	1	1				1				1	1	
CO6	1		1		1								1	

1: Low, 2-Medium, 3- High

NARAYANA ENGINEERING COLLEGE: NELLORE								
	PRODUCTION AND OPERATIONS MANAGEMENT							R2020
Semester	Hours / Week			Totalhrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100

COURSE CONTENT

MODULE- I	INTRODUCTION	10 Hrs

Introduction: Operations Management – Definition, Objectives, Types of Production System, Difference between OM & PM, Historical Development of Operations Management, Current Issues in Operation Management, Product Design – Requirements of Good Product Design, Product Development – Approaches, Concepts in Product Development, Standardization, Simplification,, Introduction to Concurrent Engineering.

MODULE- II	FORECASTING	9 Hrs

Forecasting: Introduction, Statistical Forecasting Techniques, Moving Average, Exponential Smoothing Technique, Errors in Forecasting and Evaluation of Forecasting Techniques.

MODULE- III	VALUE ENGINEERING AND PLANT LAYOUT	10 Hrs

Value Engineering and Plant Layout: Value Engineering – Objectives, Types of Values, Function and Cost, Product Life Cycle, Steps in Value Engineering, Facility Location and Layout – Factor Considerations in Plant Location, Comparative Studyof Rural and Urban Sites, Methods of Selection of Plant Layout, Objectives of Good layout, Principles, Typesof Layout, Line Balancing

MODULE- IV	AGGREGATE PLANNING AND MRP	9 Hrs

Aggregate Planning and MRP: Aggregate Planning – Definition, Different Strategies, Various Models of Aggregate Planning- Graphical Models, Master scheduling, Material Requirement Planning(MRP)-Terminology, Types of Demands, Inputs to MRP, Techniques of MRP, Benefits and Drawbacks of MRP, Manufacturing Resources Planning (MRP II), Just in Time (JIT) Philosophy, Kanban System, Pull Systems vs. Push Systems, Benefits of JIT.

MODULE- V	SCHEDULING	10 Hrs

Scheduling: Policies, Types of Scheduling, Scheduling Strategies, Scheduling and Loading Guidelines, Forward and Backward Scheduling, Grant Charts, Priority Decision Rules, Flow Shop Scheduling, Job Shop Scheduling, Line of Balance.

Total Hours	**48 Hrs**

TEXT BOOK

1. 1 Buffa E.S. and Sarin R.K., Modern Production / Operations Management, 8th Edition, Wiley IndiaPvt. Ltd., New Delhi, 2009.
2. Pannerselvam R., Production and Operations Management, 3rd Edition, PHI Learning Pvt. Ltd., NewDelhi, 2012.

REFERENCES:

1. 1. James L. Riggs, Jim Rigs, Production Systems: Planning, Analysis and Control, 4th Edition, WaveLand Press, 1992.
2. Chary S.N., Production and Operations Management, 5th Edition, McGraw Hill Education, 2017.
3. Richard B.Chase, Ravi Shankar, Robert Jacobs F., Operations and Supply Chain Management, 15th Edition, McGraw Hill Education, 2018.
4. Joseph G. Monks, Operations Management-Theory and Problems, 3rd Edition, McGraw Hill Education, 1987.
5. Steven Nahmias, Tava Lennon Olsen, Production and Operation Analysis: Strategy – Quality –Analytics – Applications, 7th Edition, Waveland Press Inc., 2015.

NARAYANA ENGINEERING COLLEGE:NELLORE								
	REFRIGERATION & AIR CONDITIONING							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100

Course Objectives:

1. To define basic of Refrigeration and need of craft Refrigeration.
2. To understand Simple Vapour Refrigeration System
3. To learn about Simple Vapour Absorption System
4. To understand the basic of Air conditioning and processes on psychometric charts.
5 To study of various Air Conditioning Equipment-operating principles

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Determine the COP of Refrigeration System and Bell-Coleman Cycle. (BTL-3)
CO 2	Analyze the vapour compression cycle and interpret the usage of refrigerants (BTL-4)
CO 3	Explain the working of vapour absorption system. (BTL-2)
CO 4	Classify the different types of psychometric processes. (BTL-4).
CO 5	Identify various types of air conditioning equipment used. (BTL-3)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	2										3	
CO2	3		2				1						3	
CO3	3	1	2										3	
CO4	3	1	2										3	
CO5	3	1	2										3	

1: Low, 2-Medium, 3- High

COURSE CONTENT		
MODULE – 1	**Introduction to Refrigeration**	**10 Hours**
Necessity and Applications, Carnot Refrigerator, First and Second Law Applied to Refrigerating Machines, Unit of Refrigeration, COP, EER, Different Refrigeration Methods. **Air Refrigeration:** Bell-Coleman Cycle, Ideal and Actual Cycles, Open and Dense Air Systems - Numerical Problems - Refrigeration Needs of Air Crafts		
At the end of the Module 1, students will be able to: 1. Gain the knowledge on working of Refrigeration system 2.Apply the basic principles of refrigeration to solve the problem 3. Identify the type of air craft refrigeration system and evaluate the variable to solve the problems		
MODULE -2	**Vapour Compression Refrigeration (VCR) System**	**9 Hours**
Vapour Compression Refrigeration (VCR) System - Basic Cycle - Working Principle and Essential Components of the Plant - COP - Representation of Cycle On T-S and P-h Charts - Expander Vs. Throttling, Effect of Sub Cooling and Super Heating - Cycle Analysis - Actual Cycle- Construction and Use of P-h Charts - Refrigerants - Desirable Properties - Classification of Refrigerants Used - Nomenclature- Lubricants - Ozone Depletion - Global Warming-		
At the end of the Module 2, students will be able to: 1. Understand the working of various parts of vapour compression refrigeration system 2. Solve the numerical problems on vapour compression refrigeration system. 3. Learn about Ozone Depletion and Global Warming		
MODULE-3	**Vapour Absorption Refrigeration (VAR) System**	**10 Hours**
Vapor Absorption Refrigeration (VAR) System-Description and Working of NH3 - Water System and Li Br-Water (Two Shell & Four Shell) System -Calculation of Max COP, Principle of Operation of Three Fluid Absorption System **STEAM JET REFRIGERATION SYSTEM:** Working Principle and Basic Components-Estimation of Motive Steam Required Principle and Operation of: (I) Thermo-Electric Refrigerator (ii) Vortex Tube or Hilsch Tube.		
At the end of the Module 3, students will be able to: 1. Explain the working of NH3- water system 2. Understand principle of operation of Three fluid absorption system 3. Illustrate the working principle of Steam Jet Refrigeration system		
MODULE-4	**Introduction to Air**	**9 Hours**

	Conditioning	
Psychrometric Properties & Processes - Characterization of Sensible and Latent Heat Loads - Need For Ventilation, Consideration of Infiltrated Air - Heat Load Concepts. Air Cooler (Evaporative Cooling) ,Window, Split, Summer , Winter, Year Round, Central Air Conditioning Systems.		
At the end of the Module 4, students will be able to: 1. Learn about different components of Air Conditioning system. 2. Define psychrometric chart and Processes 3. Understand the working of Summer, winter and Year round air conditioning systems		
MODULE-5	**Air Conditioning Equipment**	**10 Hours**
Air Conditioning Equipment - Humidifiers - Dehumidifiers - Air Filters, Fans and Blowers. Human Comfort**:** Requirements of Temperature, Humidity And Concept of Effective Temperature, Comfort Chart. Heat Pump - Heat Sources - Different Heat Pump Circuits.		
At the end of the Module 5, students will be able to: 1. Gain knowledge on Air Conditioning Equipment 2. Demonstrate the working of Fans and Blowers 3. Explain the working of Heat Pump and Heat Pump Circuits		
Total hours:		**48 hours**

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Air cycle refrigeration system	CO1	https://archive.nptel.ac.in/courses/112/105/112105129/

	2	Simple vapour refrigeration system	CO2	https://www.slideshare.net/ilovemylifesomuch/simple-vapour-compression-refrigeration-system
	3	Simple Vapour Absorption refrigeration system	CO3	https://mechcontent.com/vapour-absorption-refrigeration-system/
	4	Psychrometric Properties & Processes	CO4	https://hvac-eng.com/psychrometric-processes/
	5	Fans and Blowers	CO5	https://d13mk4zmvuctmz.cloudfront.net/assets/main/study-material/notes/mechanical_engineering_turbomachines_centrifugal-pumps-blowers-and-compressors_notes.pdf

Text Book(s):

1. Refrigeration and Air Conditioning-P.L.Ballaney, 2/e, 2012.
2. Basic Refrigeration and Air-Conditioning - P.N.Ananthanarayanan / TMH, 4/e, 2013.

Reference Book(s):

1. Refrigeration and Air Conditioning / Manohar Prasad / New Age, 2/e, 2013
2. Principles of Refrigeration - Dossat / Pearson Education, 4/e, 2007

Web Resources:

1. https://www.youtube.com/watch?v=h5wQoA15OnQ
2. https://www.youtube.com/watch?v=PjcdqAkP0UA
3. https://www.youtube.com/watch?v=GzEMdQk1QTk

NARAYANA ENGINEERING COLLEGE:NELLORE								
	Basics of Mechanical Engineering							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
OE	3	0	0	48	3	40	60	100

Pre-Requisite: Basic Mathematics and Physical Science.

Course Objectives:

1. To study working of different power plants..
2. To understand about concepts of pumps and turbines.
3. To learn about working of IC Engines.
4. To study about concepts of different types of Boilers.
5 To understand concepts of Refrigeration and Air conditioning.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Learn about Properties of gases and steam. (BTL-1)
CO 2	Understand about working of different power plants. (BTL-2)
CO 3	Understand concepts of pumps and turbines. (BTL-2)
CO 4	Learn about the concepts of IC Engines. (BTL-1)
CO 5	Learn about concepts of different types of Boilers. (BTL-1)
CO 6	Understand various refrigeration systems. (BTL-2)

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	1												2	1
CO2		1		2								1		1
CO3														
CO4	1	1											1	1
CO5			2									1		
CO6	1													
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	**Properties of Steam**	**8 Hours**

.Properties of Steam: Steam formation, Types of Steam, Enthalpy, Specific volume, Internal energy and dryness fraction of steam, use of Steam tables, steam calorimeters

At the end of the Module 1, students will be able to:

1. Acquire knowledge about various Gas laws.
2. learn about properties of steam..
3. understand the concepts of steam calorimeters and use of steam tables.

.

MODULE -2	Power Plant Engineering	8 Hours

Introduction – Energy Renewable and Non – Renewable Energy Sources – Classification of Power Plants based on Sources of Energy – Thermal Power Plant or Steam Power Plant – Hydro Electric Power Nuclear Power Plant – Diesel Power Plant – Gas Turbine Power Plant

At the end of the Module 2, students will be able to:

1. Learn about energy resources..
2. Understand concepts of various types of power plants.
3. Distinguish between Diesel and Gas turbine power plant.

MODULE-3	Pumps & Turbines	8Hours

Pumps – Classification of Pumps, Centrifugal Pump, Applications of Centrifugal Pump, Priming, Reciprocating Pumps, Single Acting Reciprocating Pump, , –Hydraulic Turbine – Classification of Hydraulic Turbines, Impulse Turbine, Reaction Turbine, Difference between Impulse and Reaction Turbine.

At the end of the Module 3, students will be able to:

1. Explain construction and operation of different pumps
2. Classify pumps based on principle of operation
3. Classify turbines based on principle of operation

MODULE-4	Design & Manufacturing	8 Hours

General considerations of design, design process. Selection of Engineering Materials - properties – Manufacturing considerations in the design.

Types of manufacturing processes -casting, arc welding & gas welding and its applications

At the end of the Module 4, students will be able to:

1. Learn about types of Heat Engines.
2. Understand classification and working of IC engines
3. Compare 2 stroke and 4 stroke, petrol and diesel engines

MODULE-5	I.C Engine	8 Hours
. . Heat Engine – Types of Heat Engine – External Combustion Engine, IC Engine (Internal Combustion), Classification of I.C. Engine, Two Stroke Petrol Engine, Four Stroke Engine, Valve Timing Diagram, Port Timing Diagram, Comparison of Two Stroke and Four Stroke Engines, Comparison of Petrol Engine and Diesel Engine, Fuel System of a Petrol Engine, Ignition Systems.		
At the end of the Module 5, students will be able to: 1. Understand classification and construction of boilers 2. Distinguish between Fire tube and Water tube Boilers.. 3. Compare boiler mountings and accessories.		
MODULE-6	**Refrigeration and Air Conditioning**	**8 Hours**
Introduction – Terminology of Refrigeration and Air Conditioning – Properties of Refrigerants – List of Commonly used Refrigerants – Types of Refrigerating System –Air Conditioning – Application of Air		
At the end of the Module 6, students will be able to: 1. Analyze the basics cycles of Refrigeration and Air Conditioning Systems 2. Outline the operation of refrigerators 3. Identify different refrigerants and applications		
Total hours:		**48 hours**

Content beyond syllabus:

1. Software related to psychometric processes

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	Properties of Gases and Gas laws.	CO1	http://ocw.sogang.ac.kr/rfile/2011/course3-phy/Chapter%2001_20111028163501.pdf
2	Hydro Electric Power Plant	CO2	https://en.wikipedia.org/wiki/Hydroelectricity
3	Centrifugal Pumps	CO3	https://en.wikipedia.org/wiki/Centrifugal_pump
4	Concepts of IC Engines	CO4	https://en.wikipedia.org/wiki/Internal_combustion_engine
5	Classification of boilers	CO5	http://www.boilers.guide/classifications/
6	Applications of Air Conditioning	CO6	https://nptel.ac.in/content/storage2/courses/112105129/pdf/RAC%20Lecture%203.pdf

Text Book(s):

1. Power Plant Engineering by PK Nag, 3rd edition McGraw Hill Publication.
2. Elements of Mechanical Engineering Fourth Edition S Trymbaka Murthy, University Press.
3. Basic Civil and Mechanical Engineering, by Prof.V.Vijayan, Prof.M.Prabhakaran and Er.R.Viashnavi, S.Chand Publication.

Reference Book(s):

1. Refrigeration and Air Conditioning by CP Arora, 3rd edition McGraw Hill Publication.
2. Internal Combustion Engines by VGanesa, 4th Edition, McGraw Hill Publication.
3. Basic Mechanical Engineering by DK Chavan and G K Pathak ,Standard Book House, 2016 edition.

Online Resources:

Web Resources:

1. https://www.youtube.com/watch?v=TxqPAPg4nb4
2. https://www.youtube.com/watch?v=PjsZGn4B6cw
3. https://www.youtube.com/watch?v=mZ-OLcvlLCU

NARAYANA ENGINEERING COLLEGE:NELLORE								
	AUTOMOBILE ENGINEERING							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
OE	3	0	0	48	3	40	60	100

Pre-requisite: Basic concepts in Thermodynamics and Internal Combustion engines

Course Objectives:

1. To learn the various components of automobile.
2. To understand the principles of transmission system.
3. To learn the concept of steering mechanism.
4. To Impart knowledge on suspension system and brakes.
5. To address the underlying concepts and methods behind automobile pollution and control.
6. To explore practically about the components present in an Automotive electrical system.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Demonstrate the knowledge on working of various components of an automobile.[BT-2]
CO 2	Identify and analyze the various systems and sub systems suitable for an automobile.[BT-2]
CO 3	Explain the probable solution in the design of steering systems..[BT-3]
CO 4	Analyze the complex issues in suspension and braking system.[BT-4]
CO 5	Apply the techniques to estimate pollution from the emissions of automobiles. [BT-3]
CO 6	Identify the components present in an Automotive electrical system.[BT-2]

CO-PO Mapping

CO	PO												PSO	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	2	1				2	3	2	3	3	2	2	2	2
CO2	3	2	2		2	2	2		3	1	2	1	2	1
CO3	1	3	1	3					1	2			1	1
CO4	3	1			1								1	1
CO5	1	1		1	3					2	1	1	2	1
CO6	1	1		3		3	1	2				1	3	1

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	**Basics of an Automobile**	8h

Classification of automobiles, Components of a four wheeler automobile, Chassis and body, Power unit, Rear wheel drive, Front wheel drive, Four wheel drive, Engine construction, Types of automobile engines, Turbo charging, Super charging, Crank case ventilation, Oil filters, Oil pumps.

At the end of the Module 1, students will be able to:

1. Identify the components of automobile. [BT-3]
2. understand the concept of automobile engine. [BT-2]
3. demonstrate the principle of oil filters. [BT-2]

MODULE -2	Transmission System	8h

Clutches- Principle- Types: Cone Clutch, Single Plate Clutch, Multi Plate Clutch, Magnetic and Centrifugal Clutches, Fluid Fly Wheel – Gear – Box Types: Sliding Mesh, Constant Mesh, Synchromesh, Epi-Cyclic, Over Drive, Torque Converter, Automatic transmission system, Propeller Shaft – Hotch – Kiss Drive, Torque Tube Drive, Universal Joint, Differential, Rear Axles.

At the end of the Module 2, students will be able to:

4. understand the principle of clutch. [BT-2]
5. differentiate the types of clutches. [BT-4]
6. explain the automatic transmission systems. [BT-2]

MODULE-3	Steering System	8h

Requirements and functions of steering system, Layout of steering system, Steering Geometry – Camber, Castor, King Pin Rake, Combined Angle Toe-In, Center Point Steering. Types Of Steering Mechanism – Ackerman Steering Mechanism, Davis Steering Mechanism, Steering Gears – Types, Steering Linkages, Power steering.

At the end of the Module 3, students will be able to:

4. Explain the terminology related to steering mechanism .[BT-3]
5. Classify the steering mechanisms .[BT-2]
6. Demonstrate the power steering.[BT-2]

MODULE-4	Suspension System	8h

Objects of Suspension Systems – Rigid Axle Suspension System, Torsion Bar, Shock Absorber, Independent Suspension System.

Braking System: Mechanical Brake System, Hydraulic Brake System, Pneumatic and Vacuum Brake Systems.

At the end of the Module 4, students will be able to:

1.Identify the types of suspension systems. [BT-2]
2.analyze the various brake systems. [BT-2]
3.Understand the principle of shock absorber. [BT-2]
.

MODULE-5	Emissions from Automobiles	8h

National and International Pollution Standards – Pollution Control–Modern Techniques in automobiles – Multipoint Fuel Injection for SI Engines – Common Rail Diesel Injection, Emissions from Alternative Energy Sources– Hydrogen, Biomass, Alcohols, LPG, CNG – Their Merits And Demerits.

At the end of the Module 5, students will be able to:

4. Explain concepts of multi fuel injection and CRDI . [BT-2]
5. Identify the emissions from alternate energy systems. [BT-2]

6. Demonstrate the modern techniques in automobiles. [BT-2]

MODULE-6	Electrical System	8h

Charging Circuit, Generator, Current – Voltage Regulator – Starting System, Bendix Drive, Mechanism of Solenoid Switch, Lighting Systems, Horn, Wiper, Fuel Gauge – Oil Pressure Gauge, Engine Temperature Indicator.

At the end of the Module 6, students will be able to:

1. understand the importance of electrical system in automobiles. [BT-2]
2. Demonstrate the working of temperature indicator. [BT-2]
3. Explain the mechanism solenoid switch. [BT-2]

Total hours: 48 hours

Term work:

1.planning to visit automobile workshops and study various transmission systems and submit Detailed Report.

2.case study on modern automobile engines and submit the report.

Content beyond syllabus:

Application of Sensors in automobiles.

Self-Study:

Contents to promote self-Learning:

S. No.	Topic	Reference
1	**Basics of an Automobile**	https://lecturenotes.in/notes/22622-note-for-autor ae-by-subrat-sahu?reading=true
2	Transmission System	https://mrcet.com/downloads/digital_notes/ME/IV e%20Engineering.pdf
3	Steering System	https://sites.google.com/site/mec4703automobilee cabinet
4	Suspension System	https://docs.google.com/viewer?a=v&pid=sites&s GRvbWFpbnxtZWM0NzAzYXV0b21vYmlsZW fGd4OjU4OTJjOGU5ODA5YTVlYjA
5	Emissions from Automobiles	https://lecturenotes.in/m/21176-automotive-polluti control?reading=true
6	Electrical System	http://fmcet.in/AUTO/AT6502_uw.pdf

Text Book(s):

1. Automobile Engineering - Vol.1 & Vol.2, Kirpal Singh, Standard Publishers distributor.
2. Automobile Engineering, R.K.Rajput, Lakshmi Publication.

Reference Book(s):

1. Automobile Engineering, Joseph Hidner.
2. Automobile Engineering, William Crouse, TMH, 10th edition, 2006.
3. Automobile Engineering, K.K.Ramalingam/Scitech Publication.

4. Automotive engines, Newton, Steeds & Garret.

Online Resources:

1.http://160592857366.free.fr/joe/ebooks/Automative%20engineering%20books/Automotive%20Engineering%20Powertrain,%20Chassis%20System%20and%20Vehicle%20Body.pdf

2.http://www.engineering108.com/pages/Automobile_Engineering/Automobile-engineering-ebooks-free-download.html

3. https://easyengineering.net/automobilebooks/

4. https://www.pdfdrive.com/automobile-engineering-books.html

Web References:

1. https://nptel.ac.in/courses/107/106/107106088/
2. https://bookauthority.org/books/best-automotive-engineering-books
3. https://www.youtube.com/watch?v=SGL2pFyNVTQ

NARAYANA ENGINEERING COLLEGE:NELLORE								
	ROBOTICS							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
OE	3	0	0	48	3	40	60	100

Pre-requisite: Basic knowledge of CAD/CAM,CNC Machines.

Course Objectives:

1. To introduce the history, constructional features and other basic information on robotics
2. To introduce to the sensors used in robotics
3. To teach robot programming of a typical robot as also the concepts of path planning and applications.
4. To learn the concepts of Robotics, kinematics of robot, principles of robot drives and controls, sensors used in robots and programming methods.

Course Outcomes: At the end of the course, student will be able to:

CO 1	Understand the knowledge about the importance of robotics in today and future and robot configuration and subsystems (BL-2)
CO 2	Explain the working of robot accessories such as sensors,grippers.(BL-3)
CO 3	Explain robot programming languages which may adopt in different applications of robot(BL-3)
CO 4	understand the applications of various types of end effectors, and sensor devices(BL-2)
CO 5	Apply the Design and implementation programming of robot systems (BL-3)
CO 6	use the techniques, skills, and modern engineering tools necessary for engineering practice. (BL-2)

CO-PO Mapping

CO	PO												PSO	
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	1	2										2	2	
CO2	2	2	2										2	
CO3	2	3											2	
CO4	2	2										1	2	
CO5	3	2	2										2	
CO6	2	2		2									2	

1: Low, 2-Medium, 3- High

COURSE CONTENT

MODULE – 1	INTRODUCTION	08 Hours

Definition of robot, necessity, advantages and disadvantages of robots, basic components of a robotic systems, robot joints, degrees of freedom, configurations of robots –cartesian, cylindrical, spherical, articulated, SCARA, work volume, specification of a robot- load carrying capacity (pay load), reach, stroke, speed of motion, speed of response, stability, repeatability, resolution and Accuracy.

At the end of the Module 1, students will be able to:

1. Understand the manufacturing, maintenance, research of nuclear power plants and many other areas(BL-2)
2. Understand the degrees of freedom.(BL-2)

1. Recall work volume, specification of a robot- load carrying capacity.(BL-2)

MODULE -2	DRIVES/ACTUATORS, GRIPPERS,SENSORS	08 Hours

Hydraulic, pneumatic and electrical. Stepper motors, brushless motors, servo motor, comparison of drives.
Types of end-effectors/grippers, mechanical grippers.
Position, velocity, force, tactile, range, proximity sensors, machine vision - elements of machine vision.

At the end of the Module 2, students will be able to:

1. Classify the robot actuators, grippers,sensors.(BL-2)
2. Explain the working of actuators, grippers,sensors .(BL-3)
3. Understand the problems in actuators, grippers,sensors.(BL-2)

MODULE-3	ROBOT CLASSIFICATION	08 Hours

Servo and non-servo controlled robots, limited sequence, Point to point, continuous and intelligent robots
TRAJECTORY PLANNING:Path vs trajectory, joint space and cartesian space schemes, basics of trajectory planning, Joint space trajectory including via points - cubic polynomials, cartesian straight-line trajectory.

At the end of the Module 3, students will be able to:

1.Know the robot classifications. .(BL-1)
2.understand basics of trajectory planning, Joint space trajectory including via points.(BL-2)
3.Explain cubic polynomials, cartesian straight-line trajectory.(BL-2)

MODULE-4	KINEMATIC ANALYSIS OF ROBOTS	08 Hours

Homogeneous transformation matrices, inverse of transverse transformation, forward and inverse kinematics of robot, DH matrix, HT of robot coordinate system, 2R and 3R robot manipulators. DYNAMICS:Introduction to robot dynamics.

At the end of the Module 4, students will be able to:

1. Understand Homogeneous transformation matrices.(BL-2)
2. Describe the kinematics of robot, DH matrix, HT of robot coordinate system.(BL-2)
3. Know 2R and 3R robot manipulators . (BL-2)

MODULE-5	ROBOT PROGRAMMING	08 Hours

Importance, types, manual setup, lead through programming, textual programming languages, commands for elementary operations - RAPID.

At the end of the Module 5, students will be able to:

7. Explain the types, manual setup of robot programming.(BL-3)
8. Understand the ROBOT programming languages. (BL-2)
9. Solve different effects in elementary operations. (BL-3)

MODULE-6	APPLICATIONS OF ROBOT	08 Hours

Robot Application in Manufacturing: Material Transfer - Material handling, loading andunloading - Process - spot and continuous arc welding & spray painting - Assembly andInspection.

At the end of the Module 6, students will be able to:

1. Know different types of Robot Application in Manufacturing .(BL-2)
2. Understand Material handling, loading andunloading - Process .(BL-2)

3. Demonstration of spot and continuous arc welding & spray painting - Assembly andInspection.(BL-1)	
Total hours:	**48 Hours**

Term work:

1. **Robotics**, design, construction, and use of machines (**robots**) to perform tasks done traditionally by human beings.
2. **Robots** are widely **used** in such industries as automobile manufacture to perform simple repetitive tasks,
3. Industries where work must be performed in environments hazardous to humans.

Content beyond syllabus:

1. **IOT BASED ROBOTICS**

Self-Study:

Contents to promote self-Learning:

SNO	Topic	Reference
1	**INTRODUCTION**	**https://nptel.ac.in/courses/112/105/112105249/**
2	**DRIVES/ACTUATORS, GRIPPERS,SENSORS**	**https://nptel.ac.in/courses/112/105/112105249/**
3	**ROBOT CLASSIFICATION**	http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv071-Page1.htm
4	**KINEMATIC ANALYSIS OF ROBOTS**	http://www.nptel.iitm.ac.in
5	**ROBOT PROGRAMMING**	https://nptel.ac.in/courses/112/101/112101099/
6	**APPLICATIONS OF ROBOT**	https://nptel.ac.in/courses/112/101/112101099/

Text Book(s):

1. Saeed B. Niku, Introduction to Robotics : Analysis, Systems, Applications, Pearson Education Inc., 2001
2. Industrial Robotics, Technology, Programming and Applications: Groover M.P., Weiss M. and Odrey N.G., McGraw Hill Higher Education, 2nd ed., 2012.
3. Robotics, Fundamental Concepts and analysis : Ashitave Ghosal, Oxford Press, 1st ed., 2006.

Reference Book(s):

1. Robotics and Control : R.K.Mittal and I J. Nagarath, McGraw Hill, 2015
2.Robotics : Fu K S, R.C. Gonazalez and C.S.G Lee, McGraw Hill, 2008
3.Introduction to Robotics, Mechanics and Control: John J.Craig, Pearson Education, 3rd ed., 2009.

Online Resources:

1. https://nptel.ac.in/courses
2. https://freevideolectures.com/university/iitm

3. https://nptel.ac.in/courses/112/101/112101099/
4. https://swayam.gov.in/nd1_noc19_me74/preview

Web Resources:

1. https://nptel.ac.in/courses/112/101/112101099/
2. https://swayam.gov.in/nd1_noc19_me74/preview
3. http://www.nptel.iitm.ac.in
4. http://www.learnerstv.com/Free-Engineering-Video-lectures-ltv071-Page1.htm

NARAYANA ENGINEERING COLLEGE:NELLORE								
	Engineering Materials							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

Pre-Requisite: No Pre requisite is required.

Course Objectives:

1. To study structure of metals and types of solids.
2. To understand about equilibrium diagrams and properties of steel and iron.
3. To learn about heat treatment of steel.
4. To study about properties and structures of ceramic & Composite materials.

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Learn about bonds, crystallization of metals and determination of grain sizes of metals and alloys and constitution of alloys. (BT-1)
CO 2	Understand about construction of equilibrium diagrams and to study about phase diagrams.(BT-2)
CO 3	Understand properties and structures of various ferrous and non-ferrous metals and alloys. (BT-2)
CO 4	Know and apply the concepts of heat treatment of alloys. (BT-3)
CO 5	Learn about common crystal structure of metals. (BT-1)
CO 6	Learn about various composite materials. (BT-1)

CO-PO Mapping														
CO	**PO**												**PSO**	
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	1	2											1	1
CO2				1								1		2
CO3													1	1
CO4	1		2		1									
CO5												2		
CO6													1	
1: Low, 2-Medium, 3- High														

COURSE CONTENT		
MODULE – 1	**Structure of Metals**	**8 Hours**

Construction and interpretation of Thermal equilibrium diagram of binary nonferrous alloys, Gibb's phase rule, Study of Eutectic, Eutectoid, Peritectic, Peritectoid and monotectic reactions. Lever rule. Iron– Iron Carbide Equilibrium diagram, Study and interpretation.
Plain Carbon Steels: types, properties and applications

Cast Irons: types, properties and applications.

At the end of the Module 1, students will be able to:

1. Acquire knowledge about various bonds in solids.
2. learn about grains and determination of grain sizes.
3. understand the concepts of constitution of alloys.

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MODULE -2	**Equilibrium of Diagrams**	**8 Hours**

Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of important binary phase diagrams of Cu-Ni-, Al-Cu, Bi-Cd, Cu-An, Cu- Sn and Fe-Fe_3C.

At the end of the Module 2, students will be able to:

7. Learn about construction of equilibrium diagrams.
8. Understand eutectic and eutectoid systems.
9. Learn about phase rule and to study important binary phase diagrams.

MODULE-3	Metals & Alloys	8 Hours

Cast Irons and Steels : Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheriodal graphite cast iron, Alloy cast irons. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.

Non-ferrous Metals and Alloys :

Structure and properties of copper and its alloys, Aluminium and its alloys, Titanium and its alloys.

At the end of the Module 3, students will be able to:

7. Understand the structure and properties of cast iron..
8. Understand the structure and properties of steels.
9. Learn about structure and properties of Non ferrous metals and alloys..

MODULE-4	Heat treatment of Alloys	8 Hours

Effect of alloying elements on Iron – Iron carbon system, Annealing, normalizing, Hardening, TTT diagrams, tempering , Hardenability, surface - hardening methods, Age hardening treatment, Cryogenic treatment of alloys.

At the end of the Module 4, students will be able to:

4. Understand about effect of alloying elements on iron.
5. Learn and understand about hardenability and hardening methods..
6. Know the concepts of cryogenic treatment of alloys.

MODULE-5	CRYSTAL STRUCTURE & ATOMIC PACKING	8 Hours

Common crystal structure of metals, Calculation of atomic packing factor for simple cubic, BCC, FCC and HCP crystal structures.
Defects in crystals, point, line, surface and volume defects. Mechanisms of plastic deformation: slip and twinning, Effect of dislocations on plastic deformation, Critical resolved shear stress, Hall– Petch equation, cold working and hot working, strain Hardening and Bauchinger effect. Recovery, Recrystallisation, Grain growth and its effect on mechanical properties of metals.

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At the end of the Module 5, students will be able to:

10. Learn about Crystal structure of Metals.
11. Learn about Defects in crystals.
12. Understand the mechanical properties of above materials. .

MODULE-6	Composite Materials	8 Hours

Fracture: Type of fracture in metals, Ductile and brittle fracture, Griffith theory of brittle fracture, modes of fracture, ductile-brittle transition.
Fatigue: Types of fatigue loading, Experimental determination of fatigue strength (RR– Moore Test),S–N Curve, Structure of fatigue fractured specimen, Effect of metallurgical variables on fatigue of metal, Low cycle fatigue, Cumulative fatigue damage, Factors to be considered for the improvement for the fatigue life.
Creep: Creep Test, Creep curve, Creep strength, Creep deformation mechanisms, difference between creep curve and stress-rupture curve.
Diffusion: Fick's laws of diffusion, Application of diffusion theory in Mechanical Engineering.

At the end of the Module 6, students will be able to:

4. Know about types of fractures in metals..
5. Understand about fatigue and fatigue strength.
6. Learn about deformation mechanisms, diffusion theory.

Total hours: 54 hours

Content beyond syllabus:

2. Nano Materials .
3. Bio Medical Materials.
4. Polymers

Self-Study:

Contents to promote self-Learning:

SNO	Topic	CO	Reference
1	effect of grain boundaries on the properties of metal	CO1	https://en.wikipedia.org/wiki/Grain_boundary
2	construction of equilibrium diagrams	CO2	https://www.sciencedirect.com/topics/engineering/equilibrium-phase-diagram
3	Classification of steels	CO3	https://mme.iitm.ac.in/vsarma/mm5025/SS.pdf
4	Cryogenic treatment of alloys	CO4	https://www5.kau.se/sites/default/files/Dokument/subpage/2010/02/48_671_684_pdf_16802.pdf
5	Crystalline ceramics	CO5	https://www3.nd.edu/~amoukasi/CBE30361/Lecture_Ceramics_2014.pdf
6	Composite Materials.	CO6	https://www.researchgate.net/figure/Classification-of-composite-materials-a-Based-on-matrix-materials-and-b-based-on_fig1_280921582

Text Book(s):

1. Introduction to Physical Metallurgy / Sidney H. Avener.
2. A Text of Essential of Materials science and engineering/ Donald R.Askeland/Thomson.
3. Dr Material Science and Metallurgy/kodgire
4. V. Raghavan, "Material Science and Engineering", 4th Edition, Prentice Hall of India Ltd., 1994.

Reference Book(s):

1. F Science of Engineering Materials / Agarwal
2. Engineering materials and metallurgy/R. K. Rajput/ S.Chand.
3. Engineering Materials and Their Applications – R. A Flinn and P K Trojan / Jaico Books
4. William F Smith, Javad Hashemi, Ravi Prakash, "Material Science and Engineering", 5th Edition, McGraw Hill Education, 2014.

Online Resources:

1. https://libguides.cam.ac.uk/materialsscience
2. https://www.sdsmt.edu/Academics/Library/Resources/SubjectGuide/?guide=Materials%20and%20Metallurgical%20Engineering
3. https://libguides.wpi.edu/c.php?g=355327&p=4998512

Web Resources:

1. https://www.youtube.com/watch?v=lW4GX3W18ds
2. https://www.youtube.com/watch?v=S96zHUSxZc0
3. https://www.youtube.com/watch?v=IkYimZBzguw

NARAYANA ENGINEERING COLLEGE:NELLORE								
	TOTAL QUALITY MANAGEMENT							R2020
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
	3	0	0	48	3	40	60	100

Pre-requisite: Basic Concept of Statistics and Fundamental Knowledge of Mathematics; Principles of Management; Understanding of different functional areas of management

Course Objectives:

1.To provide students an insight into the concept of quality, cost of quality, international quality standards.

2.To learn the principles of Total quality management, techniques for problem solving.

3.To learn about various tools of quality management used in various industrial applications.

4. To familiarize the students with principles of Quality Function Development (QFD)
5. To Impart knowledge on ISO 9000:2000 Quality System

Course Outcomes: After successful completion of the course, the student will be able to:

CO 1	Understanding the concepts and principles of TQM.[BT-2]
CO 2	Analyze various quality problems and contribute towards continuous improvement in the system .[BT-3]
CO 3	formulate quality circles to find solutions to problems in industry.[BT-6
CO 4	use Quality Function Development (QFD) technique in manufacturing and service sectors.[BT-3]
CO 5	Identify the Need of ISO 9000:2000 Quality System and its Elements .[BT-3]
CO 6	apply six sigma approach to various industrial situations.[BT-3]

COURSE CONTENT

MODULE – 1	**Basic concepts of Total Quality Management**	8h

Definition of Quality, Dimensions of Quality, Quality Planning, Quality costs - Analysis Techniques for Quality Costs, Basic concepts of Total Quality Management, Principles of TQM, Barriers to TQM Implementation. Quality standards – Need of standardization - Institutions – bodies of standardization, ISO 9000 series – ISO 14000 series

At the end of the Module 1, students will be able to:

1. understand the different phases involved in Total Quality Management.[BT-2]
2. Identify suitable Barriers to implement Total Quality Management . [BT-3]
3. Explain the tools and applications of Total Quality Management.[BT-2]

MODULE -2	**Quality measurement systems**	8h

Process management- Quality measurement systems (QMS) – developing and implementing QMS – nonconformance database- TQM tools & techniques- 7 QC tools- 7 New QC tools.

Customer satisfaction - Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention,

At the end of the Module 2, students will be able to:

1. Define the requirements of the process management. .[BT-1]
2. Identify suitable tools & techniques of TQM.[BT-3]

Evaluate the qualitative parameters for Continuous Process Improvement.[BT-5]

MODULE-3	Failure Analysis	8h

System failure analysis approach – flow chart – fault tree analysis – failure mode assessment and assignment matrix – organizing failure mode analysis – pedigree analysis. Quality circles – organization – focus team approach – statistical process control – process chart – Ishikawa diagram – preparing and using control charts.

At the end of the Module 3, students will be able to:

1. Identify the basic issues in System failure analysis approach.[BT-3]
2. Illustrate the importance of organizing failure mode analysis . .[BT-2]

Demonstrate the knowledge of Statistical process control charts in industry .[BT-2]

MODULE-4	Quality Function Development	8h

Quality Function Development (QFD) – elements of QFD – benchmarking-Types- Advantages & limitations of benchmarking – Taguchi Analysis – loss function - Taguchi design of experiments. Poka-yoke, Kaizen, Deming cycle.

Total Productive Maintenance (TPM) - Concept, Improvement Needs,

At the end of the Module 4, students will be able to:

1. Understand the elements of Quality Function Development [BT-2]
2. Explain the concept of Taguchi analysis. [BT-2]
3. Define the stages of improvements with Failure Modes and Effects Analysis (FMEA) - [BT-1]

MODULE-5	Lean Management	8h

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Lean Management, philosophy and creation of lean enterprise, JIT concepts-Kanban

System-Elements of total quality management,

At the end of the Module 5, students will be able to:

1. Explain the Need for implement of ISO 9000:2000 Quality System in industries .[BT-2]
2. Apply the test cases for the given problem using quality control techniques. [BT-3]
3. Understand the elements of Implementation of Quality System.[BT-2]

MODULE-6	TQM Approaches	8h

Value improvement elements – value improvement assault – supplier teaming. Business process reengineering & elements of Supply chain management. Six sigma approach – application of six sigma approach to various industrial situations	
Total hours:	**48 hours**

Term work:

1.planning to visit local industries and study various quality control techniques and submit Detailed Report.

2) Assignment 1. Explain TQM tools & techniques used in engineering institutions

3.case study on applications of TQM tools in engineering colleges to solve various problems

4. Assignment 2: how to implement six sigma approach to various industrial situations

Content beyond syllabus: 1.Modern organization structures 2. Software used to implement TQM

Self-Study:

Contents to promote self-Learning:

	Topic		**Reference**
	Principles of TQM		https://nptel.ac.in/courses/110/104/110104080/
	TQM tools & techniques		http://ecoursesonline.iasri.res.in/mod/page/view.php?id=5318
	organizing failure mode analysis		https://asq.org/quality-resources/fmea
	ISO 9000:2000 Quality System		https://www.iso.org/standard/29280.html
	Six sigma approach		https://study.com/academy/lesson/six-sigma-quality-control-improvement.html
	elements of Supply chain management		https://www.redlinegroup.com/insights/what-are-the-four-elements-of-supply-chain-management-91061613544

Text Book(s):

1. Besterfield D.H. et al., Total quality Management, 3rd ed., Pearson Education Asia, 2006.
2 Total Quality Management, D.R.Kiran, BS Publications, 2016
3. Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.
4. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.

Reference Book(s):

1. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012

2.Feigenbaum.A.V. "Total Quality Management, McGraw Hill, 1991.

3.Oakland.J.S. "Total Quality Management Butterworth - Hcinemann Ltd., Oxford. 1989.

4.Narayana V. and Sreenivasan, N.S. Quality Management - Concepts and Tasks, New AgeInternational 1996.

5.Zeiri. "Total Quality Management for Engineers Wood Head Publishers, 1991

Online Resources:

1. https://www.youtube.com/watch?v=yWlAOFs04go
2. https://www.youtube.com/watch?v=i-KXkLBnFEU
3. https://www.youtube.com/watch?v=gwHngq4Bw0w
4. https://www.youtube.com/watch?v=wEBPVQ7W2wg

Web References:

1https://nptel.ac.in/courses/110/104/110104080/

2.https://asq.org/quality-resources/fmea

3. https://www.iso.org/standard/29280.html

4. https://study.com/academy/lesson/six-sigma-quality-control-improvement.html