NARAYANA ENGINEERING COLLEGE::GUDUR

AUTONOMOUS

DEPARTMENT OF MECHANICAL ENGINEERING

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

SEMESTER I

Course Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total marks
21MA1001	BS	Algebra and Calculus	3	1	0	4	4	40	60	100
21CH1003	BS	Chemistry for Mechanical Engineering	3	0	0	3	3	40	60	100
21ES1001	ES	Problem Solving and Programming	3	0	0	3	3	40	60	100
21EN1001	HS	English	2	0	0	2	2	40	60	100
21CH1503	BS	Chemistry for Mechanical Engineering Lab	0	0	3	3	1.5	40	60	100
21ES1504	ES	Engineering Drawing	0	1	4	5	3	40	60	100
21ES1501	ES	Problem Solving and Programming Lab	0	0	3	3	1.5	40	60	100
21EN1501	HS	English Language Lab	0	0	3	3	1.5	40	60	100
21MC8001	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

Course Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total marks
21PH1003	BS	Physics for Mechanical Engineering	3	0	0	3	3	40	60	100
21MA1003	BS	Vector calculus, Complex variablesand Transforms	3	1	0	4	4	40	60	100
21ES1006	ES	Material Science and Engineering	3	0	0	3	3	40	60	100
21ES1004	ES	Basics of Electrical and Electronics Engineering	3	0	0	3	3	40	60	100
21PH1503	BS	Physics for Mechanical Engineering Lab	0	0	3	3	1.5	40	60	100
21ES1510	ES	Engineering Workshop	0	0	3	3	1.5	40	60	100
21ES1511	ES	IT Workshop	0	0	3	3	1.5	40	60	100
21ES1509	ES	Material Science and Engineering Lab	0	0	2	2	1	40	60	100
21EN1502	HS	Communications Skills Lab	0	0	2	2	1	40	60	100
21MC8002-13	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

Course Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
21MA1006	BS	Probability, Statistics and Numerical methods	3	0	0	3	3	40	60	100
21ES1008	ES	Engineering Mechanics	3	1	0	4	4	40	60	100
21ES1011	ES	Thermodynamics	3	0	0	3	3	40	60	100
21EN1002	HS	Universal Human Values	3	0	0	3	3	40	60	100
21ME2001	PC	Fluid Mechanics and Hydraulic Machines	3	0	0	3	3	40	60	100
21ME2002	PC	Manufacturing Processes	2	0	0	2	2	40	60	100
21ES1515	ES	Computer Aided Drafting and Modeling Lab	0	0	3	3	1.5	40	60	100
21ME2501	PC	Fluid Mechanics and Hydraulic Machines Lab	0	0	3	3	1.5	40	60	100
21ME2502	PC	Manufacturing Processes Lab	0	0	3	3	1.5	40	60	100
21CD6001	SC	Career Competency Development I	0	0	2	2	1	40	60	100
21CC6001	SC	Value Added Course/ Certificate Course I	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					25 Points		
		Total	**17**	**1**	**14**	**32**	**24.5**	**440**	**660**	**1100**

SEMESTER IV

Course Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
21ME2003	PC	Kinematics of Machinery	3	0	0	3	3	40	60	100
21ME2004	**PC**	Mechanics of Solids	3	0	0	3	3	40	60	100
21ME2005	**PC**	Metal Forming Processes	3	0	0	3	3	40	60	100
21ME2006	**PC**	Thermal Engineering	3	0	0	3	3	40	60	100
	OE	Open Elective I	3	0	0	3	3	40	60	100
21ME2503	**PC**	Computer Aided Machine Drawing	0	0	3	3	1.5	40	60	100
21ME2504	**PC**	Thermal Engineering Lab	0	0	3	3	1.5	40	60	100
21ME2505	**PC**	Mechanics of Solids Lab	0	0	3	3	1.5	40	60	100
21IC6001	**SC**	Industry Oriented Course I	0	0	0	0	1	100	--	100
21CD6002	**SC**	Career Competency Development II	0	0	2	2	1	40	60	100
21MC8002-13	**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	**17**	**0**	**14**	**31**	**21.5**	**460**	**540**	**1000**

SEMESTER V

Course Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
21ME2007	PC	Design of Machine Elements	3	0	0	3	3	40	60	100
21ME2008	PC	Machine Tools	2	0	0	2	2	40	60	100
21ME2009	PC	Thermal Power Systems	3	0	0	3	3	40	60	100
21ME4001-06	PE	Professional Elective I	3	0	0	3	3	40	60	100
	OE	Open elective II	3	0	0	3	3	40	60	100
21ME2506	PC	CAD and Simulation Lab	0	0	2	2	1	40	60	100
21ME2507	PC	Design Thinking and Product Innovation Lab	0	0	3	3	1.5	40	60	100
21ME2508	PC	Machine Tools Lab	0	0	3	3	1.5	40	60	100
21CD6003	SC	Career Competency Development III	0	0	2	2	1	40	60	100
21CC6002	SC	Value Added Course/ Certificate Course II	0	0	0	0	1	40	60	100
21ME7501	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					25 Points		
		Total	**14**	**0**	**13**	**27**	**21.5**	**400**	**700**	**1100**

SEMESTER VI

Course Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
21ME2010	PC	Computer Integrated Manufacturing	3	0	0	3	3	40	60	100
21ME2011	PC	Design of Transmission Systems	3	0	0	3	3	40	60	100
21ME2012	PC	Dynamics of Machinery	3	0	0	3	3	40	60	100
21ME2013	PC	Heat Transfer	2	0	0	2	2	40	60	100
21ME4007-12	PE	Professional Elective II	3	0	0	3	3	40	60	100
	OE	Open Elective III	3	0	0	3	3	40	60	100
21ME2509	PC	Computer Aided Manufacturing Lab	0	0	3	3	1.5	40	60	100
21ME2510	PC	Heat Transfer Lab	0	0	2	2	1	40	60	100
21IC6002	SC	Industry Oriented Course II	0	0	0	0	1	100	--	100
21CD6004	SC	Career Competency Development IV	0	0	2	2	1	40	60	100
21MC8002-13	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						25 Points	
		Total	**19**	**0**	**10**	**29**	**21.5**	**460**	**540**	**1000**

SEMESTER VII

Course Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
21HS5001-05	HS	Humanities and Social Science Elective	2	0	0	2	2	40	60	100
21ME2014	PC	Metrology and Measurements	3	0	0	3	3	40	60	100
21ME4013-18	PE	Professional Elective III	3	0	0	3	3	40	60	100
21ME4019-24	PE	Professional Elective IV	3	0	0	3	3	40	60	100
21ME4025-30	PE	Professional Elective V	3	0	0	3	3	40	60	100
	OE	Open Elective IV	3	0	0	3	3	40	60	100
21ME2511	PC	Software Tools Lab	0	0	2	2	1	40	60	100
21ME2512	PC	Metrology and Measurements Lab	0	0	3	3	1.5	40	60	100
21CD6005	SC	Career Competency Development V	0	0	2	2	1	40	60	100
21CC6501	SC	Skill Development Training	0	0	2	2	1	40	60	100
21ME7502	**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

Course Code	Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
21ME7503	PR	Project work, seminar and internship	0	0	0	0	12	60	140	200
			0	**0**	**0**	**0**	**12**	**60**	**140**	**200**

Open Electives (OE) offered by ME Department

S. No	Course Code	Subject
1	21ME3001	Engineering Optimization
2	21ME3002	Introduction to Mechatronics
3	21ME3003	Industrial Engineering and Management
4	21ME3004	Automobile Engineering
5	21ME3005	Basics of Mechanical Engineering
6	21ME3006	Automation and Robotics
7	21ME3007	Engineering materials
8	21ME3008	Total Quality Management
9	21ME3009	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 Material Handling Equipment (20ME4007)	Finite Element Methods (20ME4013)	Computational Fluid Dynamics (20ME4019)	Geometric dimensioning an tolerancing (20ME4025)
Thermal Engineering	Gas turbines andJet Propulsion (20ME4002)	Power plant Engineering (20ME4008)	Refrigeration & AirConditioning (20ME4014)	Hydraulic & pneumatics 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)

LIST OF HONOR SUBJECTS

S. NO.	COURSE NAME	Course Code	CREDITS
1	Alternate fuels and Emissions Control in Automotive	21MEH001	4
2	Robotics and Applications in Manufacturing	21MEH002	4
3	Product Marketing	21MEH003	4
4	Additive Manufacturing	21MEH004	4
5.	Mechanics of Composite Materials	21MEH005	4

LIST OF MINOR SUBJECTS

S. NO	SUBJECT	Course Code	CREDITS
1	Thermodynamics	21MEM001	3
2	Manufacturing Processes	21MEM002	3
3	Material Science and Engineering	21MEM003	3
4	Design of Machine Element	21MEM004	3

Humanities and Social Science Elective

S. NO	SUBJECT	Course Course Code	CREDITS
1	Managerial Economics & Financial Analysis	21HS5001	3
2	Management Science	21HS5002	3
3	E-Business	21HS5003	3
4	Organizational Behavior	21HS5004	3
5	Enterprise Resource Planning	21HS5005	3

HUMANITIES AND SOCIAL SCIENCES (HS)

SEMESTER	SUBJECT	Course Code	CREDITS
I	English	21EN1001	2
	English Language Lab	21EN1501	1.5
II	Oral Communications Skills Lab	21EN1502	1
IV	Universal Human Values	21EN1002	3
VII	Humanities and Social Science Elective	21HS5001-08	2
	TOTAL		**9.5**

BASIC SCIENCES (BS)

SEMESTER	SUBJECT	Course Code	CREDITS
I	Algebra and Calculus	21MA1001	4
	Chemistry for Mechanical Engineering	21CH1003	3
	Chemistry for Mechanical Engineering lab	21CH1503	1.5
II	Vector Calculus, Complex Variables and Transforms	21MA1003	4
	Physics for Mechanical Engineering	21PH1003	3
	Physics for Mechanical Engineering Lab	21PH1503	1.5
III	Probability, Statistics and Numerical methods	21MA1006	3
	TOTAL		20

ENGINEERING SCIENCES (ES)

SEMESTER	SUBJECT	Course Code	CREDITS
I	Problem Solving and Programming	21ES1001	3
	Engineering Drawing Lab	21ES1504	3
	Problem Solving and Programming Lab	21ES1501	1.5
II	Material Science and Engineering	21ES1006	3
	Basics of Electrical and Electronics Engineering	21ES1004	3
	Engineering Workshop	21ES1510	1.5
	IT Workshop	21ES1511	1.5
	Material Science and Engineering Lab	21ES1509	1
III	Engineering Mechanics	21ES1008	4
	Thermodynamics	21ES1011	3
	Computer Aided Drafting and Modelling Lab	21ES1515	1.5
VII	Software Tools Lab	21ES1516	1
	TOTAL		27

PROFESSIONAL CORE (PC)

SEMESTER	Course Code	SUBJECT	CREDITS
III	21ME2001	Manufacturing Processes	2
	21ME2002	Fluid Mechanics and Hydraulic Machines	3
	21ME2502	Manufacturing Processes Lab	1.5
	21ME2501	Fluid Mechanics and Hydraulic Machines Lab	1.5
IV	**21ME2003**	Kinematics of Machinery	3
	21ME2004	Mechanics of Solids	3
	21ME2005	Metal Forming Processes	3
	21ME2006	Thermal Engineering	3
	21ME2503	Computer Aided Machine Drawing Lab	1.5
	21ME2504	Thermal Engineering Lab	1.5
	21ME2505	Mechanics of Solids Lab	1.5
V	21ME2007	Design of Machine Elements	3
	21ME2008	Machine Tools	3
	21ME2009	Thermal Power Systems	2
	21ME2506	CAD and Simulation Lab	1
	21ME2507	Design Thinking and Product Innovation Lab	1.5
	21ME2508	Machine Tools Lab	1.5
VI	21ME2010	Computer Integrated Manufacturing	3
	21ME2011	Design of Transmission Systems	3
	21ME2012	Dynamics of Machinery	3
	21ME2013	Heat Transfer	2
	21ME2509	Computer Aided Manufacturing Lab	1.5
	21ME2510	Heat Transfer Lab	1
VII	21ME2014	Metrology and Measurements	3
	21ME2512	Metrology and Measurements Lab	1.5
		TOTAL	54.5

PROFESSIONAL ELECTIVES (PE)

SEMESTER	SUBJECT	Course Code	CREDITS
V Sem	Professional Elective I	21ME4001-06	3
VI Sem	Professional Elective II	21ME4007-12	3
VII Sem	Professional Elective III	21ME4013-18	3
	Professional Elective IV	21ME4019-24	3
	Professional Elective V	21ME4025-30	3
	TOTAL		**15**

OPEN ELECTIVES (OE)

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

SKILL ORIENTED COURSE (SC)

SEMESTER	SUBJECT		CREDITS
III Sem	Career Competency Development I	21CD6001	1
	Value Added Course/Certificate Course I	21CC6001	1
IV Sem	Industry Oriented Course I	21IC6001	1
	Career Competency Development II	21CD6002	1
V Sem	Career Competency Development III	21CD6003	1
	Value Added Course/Certificate Course II	21CC6002	1
VI Sem	Industry Oriented Course II	21IC6002	1
	Career Competency Development IV	21CD6004	1
VII Sem	Career Competency Development V	21CD6005	1
	Skill Development Training	21CC6501	1
	TOTAL		**10**

PROJECT (PR)

SEMESTER	SUBJECT	Course Code	CREDITS
V Sem	Internship I/on job training/Com Ser Project	21ME7501	1.5
VII Sem	Internship II/on job training/Com Ser Project	21ME7502	1.5
VIII Sem	Project work, seminar and internship	21ME7503	12
	TOTAL		**15**

CREDITS PER SEMESTER

S. NO	CAT	CREDITS PER SEMESTER								CREDITS
		I	II	III	IV	V	VI	VII	VIII	
1	**HS**	3.5	1	3				2		**9.5**
2	**BS**	8.5	8.5	3						**20**
3	**ES**	7.5	10	8.5				1		**27**
4	**PC**			8	16.5	12	13.5	4.5		**54.5**
5	**PE**					3	3	9		**15**
6	**OE**				3	3	3	3		**12**
7	**SC**			2	2	2	2	2		**10**
8	**PR**					1.5		1.5	12	**15**
	MC	**No Credits**								
	TOTAL	**19.5**	**19.5**	**24.5**	**21.5**	**21.5**	**21.5**	**23**	**12**	**163**

SEMESTER III

Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max.Marks		
		L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
BS	Probability, Statistics and Numericalmethods	3	0	0	3	3	40	60	100
ES	Engineering Mechanics	3	1	0	4	4	40	60	100
ES	Thermodynamics	3	0	0	3	3	40	60	100
HS	Universal Human Values	3	0	0	3	3	40	60	100
PC	Fluid Mechanics and Hydraulic Machines	3	0	0	3	3	40	60	100
PC	Manufacturing Processes	2	0	0	2	2	40	60	100
ES	Computer Aided Drafting and Modeling Lab	0	0	3	3	1.5	40	60	100
PC	Fluid Mechanics and Hydraulic Machines Lab	0	0	3	3	1.5	40	60	100
PC	Manufacturing Processes Lab	0	0	3	3	1.5	40	60	100
SC	Career competency Development I	0	0	2	2	1	40	60	100
SC	Value added course/Certificate course I	0	0	0	0	1	40	60	100
	Counseling/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	1	14	32	24.5	440	660	1100

NARAYANA ENGINEERING COLLEGE: GUDUR								
21ES1008	ENGINEERING MECHANICS							R2021
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
III	2	1	0	48	3	40	60	100

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: GUDUR								
21ES1011	THERMODYNAMICS							R2021
Semester	Hours / Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
III	3	0	0	48	3	40	60	100

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.
3. Yonus A Cengel and Michael A Boles, Thermodynamics: An Engineering Approach, McGraw Hill, 2002.
4. Principles of engineering thermodynamics by morani 8THedition, SI version.

Reference Book(s):

1. Thermal engineering by R.K Rajput 6thedition.
2. R. K. Rajput (2010), A text book of Engineering Thermodynamics, Fourth Edition, Laxmi Publications, New Delhi, India.
3. Engineering thermodynamics by RK Rajput,5TH edition, Laxmi Publications, New Delhi, India.
4. Engineering thermodynamics, work and heat transfer by Gordon rogers 4TH edition, person educationindia2002.

NARAYANA ENGINEERING COLLEGE::GUDUR								
21ME2002	MANUFACTURING PROCESSES							R2021
Semester	Hours / Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
III	3	0	0	48	3	40	60	100

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

3. Production Technology by R.K. Jain and S.C. Gupta, Khanna Publishers, 17th edition,2012
4. Ian Gibson, Davin Rosen, Brent Stucker "Additive Manufacturing Technologies, Springer, 2ndEd,2014.
5. Welding and Welding Technology, Richard Little McGraw Hill Education,2017
6. Manufacturing Science by Amitabh Ghosh ,east-west press pvt. Ltd. Second Edition

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. Principles of Metal Castings, Rosenthal, Tata Mc Graw Hill ,2ndEdition,2001
6. Workshop Technology–B.S.RaghuVamshi–Vol I.

NARAYANA ENGINEERING COLLEGE:GUDUR								
21ME2001	**Fluid Mechanics and Hydraulic Machines**							R2021
Semester	Hrs / Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
III	3	0	0	48	3	40	60	100

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 : I**ntroduction 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. 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., NewDelhi,2019.

3.Dr D S Kumar, "Fluid Mechanics and Fluid Power Engineering" S K Katariua&Sons,2014.

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:GUDUR								
21ES1515	COMPUTER AIDED DRAFTING AND MODELLING LAB							R2021
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

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,, steppedblock, 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. Ibrahim Zeid, “CAD / CAM - Theory and Practice 2E”, Tata Mcgraw-Hill, NewDelhi,2010.

2. P. Radhakrishnan, S. Subramanyan, V. Raju “CAD/CAM/CIM”, New Age International,2015.

3. M.M.M. Sarcar, K. Mallikarjuna Rao, K. Lalit Narayan “computer aided design and manufacturing”, prentice hall of India,2008.

Reference Book(s):

1. Mikell.P.Groover, “CAD/CAM: Computer-Aided Design and Manufacturing”, Prenticehall of India Pvt. Ltd.,NewDelhi.2008

2. Chriss McMahon and Jimmie Browne, “CAD/CAM”, Addision Wesley, New York,2000.

3. Tien-chienchang, Richard A wysk, Hsu-pin wang, “Computer-Aided Manufacturing", PearsonEdition,2009.

NARAYANA ENGINEERING COLLEGE::NELLORE								
21ME2502	**Manufacturing process Lab**							R2021
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

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 A charkan. N., Machine Tool Design Vol. 1 to 4, MIR Publication. 3 HMT, Production Technology, Tata McGraw Hill.

Reference Book(s):

1 .Hajra Choudary, Elements of workshop technology, Vol I & II, Media Publishers,

2 .Malkin Stephen, Grinding Technology: Theory and Applications of Machining with Abrasives,Industrial press,2008

3 .PoulDeGarmo, J.T.Black,R.A.Kosher, Materials and Processes in Manufacturing, Prentice Hall of India Pvt.Ltd.,1997.

NARAYANA ENGINEERING COLLEGE:GUDUR								
21ME2501	**Fluid Mechanics and Hydraulic Machines Lab**							R2021
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

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 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.

SEMESTER IV

Category	Course Title	Contact Periods per week				Credits	Scheme of Examination Max.Marks		
		L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
PC	Kinematics of Machinery	3	0	0	3	3	40	60	100
PC	Mechanics of Solids	3	0	0	3	3	40	60	100
PC	Metal Forming Processes	3	0	0	3	3	40	60	100
PC	Thermal Engineering	3	0	0	3	3	40	60	100
OE	Open Elective I	3	0	0	3	3	40	60	100
PC	Computer Aided Machine Drawing	0	0	3	3	1.5	40	60	100
PC	Thermal Engineering Lab	0	0	3	3	1.5	40	60	100
PC	Mechanics of Solids Lab	0	0	3	3	1.5	40	60	100
SC	Career competency Development II	0	0	2	2	1	40	60	100
SC	Industry oriented Course I	0	0	0	0	1	100	--	100
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	18	0	14	32	21.5	460	540	1000

NARAYANA ENGINEERING COLLEGE:GUDUR								
21ME2003	KINEMATICS OF MACHINERY							R2021
Semester	Hours / Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
IV	3	0	0	48	3	40	60	100

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

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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:GUDUR								
21ME2004	MECHANICS OF SOLIDS							R2021
Semester	Hours / Week			Total hrs	Credits	Max Marks		
	L	T	P		L	T	P	
IV	2	1	0	48	3	40	60	100

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 LearningPublishers.

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:GUDUR								
21ME2005	**METAL FORMING PROCESSES**							R2021
Semester	Hours / Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
IV	3	0	0	48	3	40	60	100

COURSE CONTENT		
MODULE – 1	**INTRODUCTION TO METAL FORMING**	**10 Hrs**
Stress, strain, Two-dimensional stress analysis, and three-dimensional stress analysis, the relation between engineering stress and true stress, the relation between engineering strain and true strain, yield criteria, yield locus, theory of plasticity, Hot working, cold working, strain hardening, recovery, recrystallization, and grainGrowth		
MODULE -2	**ROLLING & FORGING**	**9Hrs**
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 the strip,disc and power requirements, applications		
MODULE-3	**EXTRUSION PROCESSES**	**10Hrs**
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 the degree of drawing, Drawing force, power, and number of stages-defects in products, Numerical problems on drawing		
MODULE-4	**WIRE DRAWING & SHEET METAL WORKING**	**9Hrs**
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 requirements in sheet metal operations, defects in sheet metal products		
MODULE-5	**PROCESSING OF PLASTICS**	**10Hrs**
Processing of plastics, injection and blow molding, calendaring, thermos forming, compression molding,transfer molding, and joining of plastics. Rapid manufacturing: - Introduction – concepts of rapid manufacturing, information flow forrapid prototyping, classification of the rapid prototyping process, stereolithographic process, 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:GUDUR								
21ME2006	THERMAL ENGINEERING							R2021
Semester	Hours / Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
IV	3	0	0	48	3	40	60	100

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.

NARAYANAENGINEERINGCOLLEGE:NELLORE								
21ME2503	**Computer Aided Machine Drawing Lab**							R2021
Semester	Hours /Week			Total hrs	Credit	MaxMarks		
	L	T	P		C	CIE	SEE	TOTAL
IV	0	1	2	48	2	40	60	100

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

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NARAYANA ENGINEERING COLLEGE:GUDUR								
21ME2504	THERMAL ENGINEERING LAB							R2021
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

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:GUDUR								
21ME2505	**Mechanics of Solids Lab**							**R2021**
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

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 http://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.

List of B.Tech R21 III &IV Year Subjects, and Labs

V -SEMESTER

S.No	BOS Subjects of Department of Mechanical Engineering	Sem/Branch	Category
1.	Design of Machine Elements	V SEM	PC
2.	Machine Tools	V SEM	PC
3.	Thermal Power Systems	V SEM	PC
4.	CAD & Simulation Lab	V SEM	PC
5.	Design Thinking &Product Innovation Lab	V SEM	PC
6.	Machine Tools Lab	V SEM	PC

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	DESIGN OF MACHINE ELEMENTS						NECR BTECH (R21)	
Semester	Hours/ Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
V	3	0	0	48	3	40	60	100

COURSE CONTENT

MODULE- I	DESIGN FOR STATIC & DYNAMIC LOADS	10 Hrs

Mechanical Engineering Design: Design process, design considerations, codes and standards of designation of materials, selection of materials. Design for Static Loads: Modes of failure, design of components subjected to axial, bending, torsional and impact loads. Theories of failure for static loads. Design for Dynamic Loads: Endurance limit, fatigue strength under axial, bending and torsion, stress concentration, notch sensitivity. Types of fluctuating loads, fatigue design for infinite life. Fatigue theories of failure.Soderberg, Goodman and modified Goodman criterion for fatigue failure. Fatigue design under combined stresses.

MODULE-II	DESIGN OF BOLTED JOINTS & WELDED JOINTS	9 Hrs

Design of Bolted Joints: Threaded fastners, preload of bolts, various stresses induced in the bolts. Torquerequirement for bolt tightening, eccentrically loaded bolted joints, gasketed joints.
Welded Joints: Strength of lap and butt welds, eccentrically loaded welded joints. Joints subjected to ending and torsion.

MODULE-III	DESIGN OF SHAFTS & COUPLINGS	10 Hrs

Power Transmission Shafts: Design of shafts subjected to bending, torsion and axial loading. Shafts subjectedto fluctuating loads using shock factors. Couplings: Design of flange and bushed pin couplings, universal coupling.

MODULE-IV	DESIGN OF BEARINGS	10Hrs

Design of Sliding Contact Bearings: Lubrication modes, bearing modulus, McKee's equations, design of journal bearing. Bearing Failures. Design of Rolling Contact Bearings: Static and dynamic load capacity, Stribeck's Equation, equivalent bearing load, load-life relationships, load factor, selection of bearings from manufacturer's catalogue.

MODULE-V	DESIGN OF GEARS	9Hrs

Design of Gears: Spur gears, beam strength, Lewis equation, design for dynamic and wear loads, design of helical gears

	Total Hours	48 Hrs

TEXT BOOK

1. J.E. Shigley, “Mechanical Engineering Design”, 2nd edition, Tata McGraw Hill, 1986.
2. V.B.Bhandari, “Design of Machine Elements”, 3rd edition, Tata McGraw Hill, 2010.

REFERENCES:

1. R.L. Norton, “Machine Design an Integrated approach”, 2nd edition, Pearson Education, 2004.
2. R.K. Jain, “Machine Design:, Khanna Publications, 1978.
3. M.F.Spotts and T.E.Shoup, “Design of Machine Elements”, 3rd edition, Prentice Hall (Pearson Education), 2013.

NARAYANA ENGINEERING COLLEGE:GUDUR								
	MACHINE TOOLS						NECR BTECH R21	
Semester	Hours/ Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
V	3	0	0	48	3	40	60	100

COURSE CONTENT

MODULE- I	**THEORY OF METAL CUTTING**	10 Hrs

Theory of Metal Cutting: Introduction, Basic elements of machining, Nomenclature of single point cutting tool, Tool Geometry, Mechanics of chip formation, Types of chips. Determination of shear angle and chip thickness ratio, stress and strain in the chip, velocity relations, Merchant's theory of orthogonal cutting forces,related simple problems.

Tool wear, Tool life and Tool life criteria, cutting fluids- types and required characteristics. Cutting Tool Materials. Requirements of Tool materials and types,

MODULE-II	**LATHE MACHINES**	9 Hrs

Lathe: Constructional details, specifications, classification of lathes. Lathe accessories - various work holding devices Lathe Mechanisms: Spindle speed Mechanisms in Belt driven and All Geared Head stock lathe, Apron and Half-nut mechanisms. Lathe operations including taper turning and thread cutting and related problems.

MODULE-III	**DRILLING , SHAPING AND PLANING**	10 Hrs

Drilling Machines: Types and specifications, spindle feed mechanism, drilling operations, drilling time. Constructional details, Shaping Machines, types of shapers ,Constructional details Planing:, Constructional details, types planers, specifications, Quick Return Mechanism in shapers and planers, automatic feed mechanisms shapers and planers.

MODULE-IV	**MILLING MACHINES**	9Hrs

Milling Machines: Working Principle, Size and Specification, Up and Down Milling, Types of milling machines, Description and working of Universal Milling machine. Milling operations, Milling cutters,Indexing methods and Indexing Head, related simple problems

MODULE-V	**GRINDING MACHINES**	10Hrs

Grinding Machines: Types of grinding machines: constructional details , cylindrical, center less and surface grinding machines. Tool and cutter grinding machines. Wheel materials, Selection and specification of grinding wheels, Truing and Dressing of grinding wheels, Surface Finishing Operations: Honing and Lapping operations

Total Hours	48 Hrs

TEXT BOOK

1. Workshop Technology Vol. II by Hazra Chowdary 2008
2. Production Engineering by P.C. Sharma, S.Chand & Co. 1999

REFERENCES:

1. Materials and Processes in Manufacturing by E.Paul De Garmo, J.T.Black and Ronald A.Kohser.2019
2. Manufacturing Technology by P.N.Rao, TMH. 2017
3. Manufacturing Science by Ghosh & MallickEd,2014.

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	THERMAL POWER SYSTEMS							NECR BTECH R21
Semester	Hours/ Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
V	3	0	0	48	3	40	60	100

COURSE CONTENT

MODULE-1	STEAM POWER PLANT & BOILERS	09Hours

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 – Height of chimney for given draught and discharge.

MODULE-2	STEAM NOZZLES & CONDENSERS	10Hours

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

MODULE-3	STEAM TURBINES	10Hours

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, thermodynamic analysis of a stage – Degree of reaction

– Velocity diagram – Parson's reaction turbine – Condition for maximum efficiency.

MODULE-4	GAS TURBINES & JET PROPULSION	09Hours

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, Propulsiveefficiency.

MODULE-5	REFRIGERATION & AIR CONDITIONING	10Hours

Refrigeration: Bell-Coleman cycle - Vapor compression cycle, sub cooling and super heating-Vapor absorption cycle,properties of common refrigerants.

Air Conditioning: Principles of Psychrometry Psychometric properties, psychometric processes, summer and winter airconditioning systems.

Totalhours:	48hours

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 EngineeringbyR. Yadav 5TH edition,LaxmiPublications,NewDelhi,India.2020
3. Applied Thermodynamics, work and heat-transfer by Gordonrogers4TH edition, personeducation india2002.

NARAYANA ENGINEERING COLLEGE:GUDUR								
	Design Thinking & Product Innovation Lab							NECR BTECH R21
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
V	0	0	3	48	1.5	40	60	100

COURSE CONTENT

Task 1 - [4hrs]

Design A Device For conversion of linear motion to rotary motion and vice versa,

Task 2 – [4 hrs]

Design a device for the measurement of Temperature/ and pressure

Task -3- [4hrs]

Design a device for the measurement of Humidity

TASK -4 [4 hrs]

Design a device for Water Level Indicator

TASK -5 [4 Hrs]

Design of simple pneumatic and hydraulic circuits using basic components

TASK-6 [4 hrs]

Design a hydraulic circuit by using Flow Control Valves for simple application

TASK -7 [4 Hrs]

Design Automatic Car Wiper/ safety issues in Automobiles

TASK -8 [4 Hrs]

Design and Simulation of a Smart Lighting system with IOT technology

TASK -9 [4 hrs]

Design and manufacture any two domestic utility products with any material Use of Power Tools

TASK -10 [4 hrs]

Reversing engineering methods, identifying the bad features in a product

ADDITIONAL EXPERIMENTS

TASK -11 [4 hrs]

Design and manufacturing of any mechanical component by using 3D printing technology.

TASK -12 [4 hrs]

Importance of ergonomics in product development, environmental considerations in design, safety considerations in design -Design of electrical vehicles, unmanned vehicles

Text Book(s):

1. Philip Kosky, Robert T. Balmer, William D. Keat, George Wise, "Exploring Engineering: An Introduction to Engineering and Design", 4th edition, Elsevier, 2016.
2. David Ralzman, "History of Modern Design", 2nd edition, Laurence King Publishing Ltd., 2010
3. An AVA Book, "Design Thinking", AVA Publishing, 2010

Reference Book(s):

1. G. Pahl, W.Beitz, J. Feldhusen, KH Grote, "Engineering Design: A Systematic Approach", 3rd edition, Springer, 2007.
2. Tom Kelley, Jonathan Littman, "Ten Faces in Innovation", Currency Books, 2006.

NARAYANAENGINEERINGCOLLEGE::GUDUR								
	MACHINE TOOLS LAB							NECR BTECH R21
Semester	Hours /Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
V	0	0	3	48	1.5	40	60	100

COURSECONTENT
Task1 [4Hrs]
Step turning and taper turning on lathe machine
Task2 [4Hrs]
Drilling operation using lathe machine
Task-3 [6Hrs]
Boring and Internal threading on lathe machine,
TASK-4 [4Hrs]
Knurling and Thread Cutting on lathe machine
TASK-5 [6Hrs]
Key way on shafts by using shaping machines
TASK-6 [6Hrs]
Key-way on shafts using milling machine
TASK-7 [4Hrs]
Gear Hobbing using milling machine
TASK-8 [4Hrs]
At least one model on surface grinder or tool and cutter grinder.
TASK-9 [4Hrs]
Spur Gear cutting by using Milling Machine
TASK-10 [4Hrs]
Drilling operations by using drilling machine
ADDITIONAL EXPERIMENTS **[2Hrs]** TASK-11 Tapping operations by using drilling machineTASK 12- At least one model on cylindrical grinder

Text Book(s):

1 W. A.J.Chapman, Workshop Technology Part I, ELBS & Edward Arnold Publishers.
2 A charkan.N.Machine ToolDesignVol.1to4,MIRPublication.
3 HMT,ProductionTechnology,TataMcGrawHill.

Reference Book(s):

1 .Hajra Choudary, Elements of workshop technology, Vol I&II, Media Publishers,2008

2.MalkinStephen, Grinding Technology: Theory and Applications of Machining with Abrasives,Industrialpress,2008

3..PoulDeGarmo, J.T.Black, R.A.Kosher, Materials and Processes in Manufacturing, Prentice Hall of IndiaPvt.Ltd.,1997.

VI - SEMESTER

S.No	BOS Subjects of Department of Mechanical Engineering	Sem/Branch	Category
1.	Computer IntegratedManufacturing	VISEM	PC
2.	Dynamics of Machinery	VI SEM	PC
3.	Heat Transfer	VI SEM	PC
4.	Computer Aided Manufacturing Lab	VI SEM	PC
5.	Heat Transfer Lab	VI SEM	PC

	NARAYANA ENGINEERING COLLEGE: GUDUR							
	COMPUTER INTEGRATED MANUFACTURING					NECR BTECH R21		
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 – 1	INTRODUCTION TO CAD/CAM	10h

Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing control – Concurrent Engineering- CIM concepts – Computerized elements of CIM system –Types of production – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Basic Elements of an Automated system – Levels of Automation.

MODULE -2	COMPUTER AIDED PROCESS PLANNING	10h

Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – benefits of CAPP -Production Planning and Control Systems -Master Production Schedule – Material Requirement planning - inputs to MRP system, working of MRP, outputs and benefits - introduction to Capacity Planning -Control Systems-Shop Floor Control.

MODULE-3	COMPUTER NUMERICAL CONTROL	9h

Introduction to CNC, components of CNC, CNC programming- manual part programming, G Codes, M Codes, N Codes, programming of simple components in turning, drilling and milling systems, programming with canned cycles. Cutter radius compensations.

MODULE-4	CELLULAR MANUFACTURING & FLEXIBLE MANUFACTURING SYSTEM (FMS)	10h

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 – Arranging Machines in a GT cell –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--.Introduction to Automated Storage and Retrieval Systems

MODULE-5	INDUSTRIAL ROBOTICS	9h

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 – Robot Accuracy and Repeatability

Total hours:	**48 hours**

Text Book(s):

1.Mikell.P.Groover "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hallof 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:

1.Principles of Process Planning – A Logical Approach" Chapman &Hall, London, 1995

NARAYANA ENGINEERING COLLEGE:GUDUR								
	DYNAMICS OF MACHINERY						NECR BTECH R21	
Semester	Hours/ Week			Totalhrs	Credits	MaxMarks		
	L	T	P		C	CIE	SEE	TOTAL
VI	3	0	0	48	3	40	60	100

COURSE CONTENT

MODULE- I	**PRECESSION , TURNING MOMENT DIAGRAMS AND FLYWHEELS**	10 Hrs

PRECESSION: Gyroscopes, effect of precession motion on the stability of moving vehicles such as motor car, motor cycle, aero planes 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.

MODULE-II	**GOVERNORS**	9 Hrs

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.

MODULE-III	**BALANCING OF ROTATING & RECIPROCATING MASSES**	10 Hrs

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 radialengines for primary and secondary balancing

MODULE-IV	**VIBRATIONS**	10Hrs

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.

MODULE-V	**VIBRATION ISOLATION & TRANSMISSIBILITY**	9Hrs

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.

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

NARAYANA ENGINEERING COLLEGE:GUDUR								
	HEAT TRANSFER						NECR BTECHR21	
Semester	Hours/ Week			Totalhrs	Credit	MaxMarks		
	L	T	P		C	CIE	SEE	TOTAL
V I	3	0	0	48	3	40	60	100

COURSECONTENT

MODULE–1	**BASIC MODES OF HEAT TRANSFER AND CONDUCTION HEAT TRANSFER**	**10 H**

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. Unsteady State Heat Transfer Conduction- Transient heaconduction- lumped system analysis and use of Heisler charts.

MODULE-2	**CONVECTION HEAT TRANSFER**	**10H**

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 empirica 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**	**09H**

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

MODULE-4	**HEAT EXCHANGERS, BOILING AND CONDENSATION**	**10 H**

Types of heat exchangers- parallel flow- counter flow- cross flow heat exchangers- overall heat transfer coefficient-LMTD and NTU methods- fouling in heat exchangers. Boiling and Condensation: Different regimes of boiling- nucleate, transition and film boiling – condensation - film wise and drop wise condensation.

MODULE-5	**MASS TRANSFER**	**09H**

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:GUDUR								
	Computer Aided Manufacturing Lab							NECR BTECH R21
Semester	Hours/ Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VI	0	0	3	48	1.5	40	60	100
COURSECONTENT								
TASK-1 [4 Hrs]								
Write a program for translation, scaling, and rotation.								
TASK-2 [4 Hrs]								
Write program for generating spline Bezier and B-spline.								
TASK-3 [3Hrs]								
Write a program for sweep surfaces and surface of revolution.								
TASK-4 [3 Hrs]								
Create wireframe, surface, and solid models.								
TASK-5 [3Hrs]								
Introduction to CNC Machines and G-Code, M-Code								
TASK-6 [4 Hrs].								
CNC part programming for operations like turning, step turning, taper turning, threading								
TASK-7 [4 Hrs]								
CNC program for plane milling, drilling operations								
TASK-8 [4 Hrs]								
Generation of CNC part programming with CAM packages for a given 3D models								
TASK-9 [4 Hrs]								
Development of APT programming for 2D objects								
TASK-10 [4 Hrs]								
Programming for Robot pick and place and continuous path.								
ADDITIONAL EXPERIMENTS								
TASK-11 [4 Hrs]								
Write the manual part program to the given dimensions and execute in CNC Milling for linear and circular interpolation								
TASK-12 [4Hrs]								
Write the manual part program to the given dimensions and execute in CNC Milling for drilling								

TextBook(s):

1. Mikell.P.Groover "Automation, Production Systems, and Computer Integrated Manufacturing", Prentice Hall of India, 2008.

2. Radhakrishnan P, Subramanian 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 HallIndia, 2003.
2. Rao. P, N Tewari &T.K. Kundra, "Computer Aided Manufacturing", Tata McGrawHill Publishing Company, 2000.

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	HEAT TRANSFER LAB							NECR BTECH R21
Semester	Hours/Week			Totalhrs	Credit	MaxMarks		
	L	T	P		C	CIE	SEE	TOTAL
VI	0	0	3	48	1.5	40	60	100

COURSECONTENT
TASK-1 [4 Hrs]
Determine the overall heat transfer coefficient across the width of composite wall
TASK-2 [4 Hrs]
Determine the thermal conductivity of a metal rod.
TASK-3 [4 Hrs]
Determine the thermal conductivity of insulating powder material through concentric sphere apparatus
TASK-4 [4 Hrs]
Determine the thermal conductivity of insulating material through lagged pipe apparatus
TASK-5 [4 Hrs]
Determine the efficiency of a pin fin in natural and forced convection.
TASK-6 [4 Hrs]
Determine the heat transfer coefficient for a vertical cylinder in natural convection
TASK-7 [4 Hrs]
Determine the heat transfer coefficient in forced convection of air in a horizontal tube
TASK-8 [4 Hrs]
Determine the heat transfer coefficients on film and drop wise condensation apparatus.
TASK-9 [4 Hrs]
Determine the effectiveness of a parallel and counter flow heat exchanger.
TASK-10 [4 Hrs]
Study the pool boiling phenomenon and different regimes of pool boiling.
Additional Experiments
TASK-11 [2 Hrs]
Experiment on pool boiling
TASK-12[2 Hrs]
Determine the emissivity of the test plate surface
TASK-13[2 Hrs]
Experiment on Stefan-Boltzmann apparatus
TASK-14 [2 Hrs]
Determine the heat transfer rate coefficient in fluidized bed apparatus

TextBook(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

ReferenceBook(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. Subrahmanyam, “Heat and Mass Transfer databook”, New Age Publications, 2014

VII - SEMESTER

S.No	BOS Subjects of Departmentof Mechanical Engineering	Sem/Branch	Category
1.	Design of Transmission Systems	VII SEM	PC
2.	Metrology & Measurements	VII SEM	PC
3.	Metrology & Measurements Lab	VII SEM	PC
4.	Software Tools Lab	VII SEM	PC

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	DESIGN OF TRANSMISSION SYSTEMS							NECR BTECH R21
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	DESIGN OF FLEXIBLE ELEMENTS	10 Hrs

Design of Flat belts and pulleys — Selection of V belts and pulleys — Selection of hoisting wire ropes andpulleys — Design of Transmission chains and Sprockets

MODULE-II	SPUR GEARS AND HELICAL GEARS	9 Hrs

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

MODULE-III	BEVEL AND WORM GEARS	10 Hrs

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.

MODULE-IV	GEAR BOXES	10Hrs

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. Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications.

MODULE-V	CLUTCHES AND BRAKES	9Hrs

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

TEXT BOOKS:

1. 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.
3. Prabhu. T.J., "Design of Transmission Elements", Mani Offset, Chennai, 2000

REFERENCES:

1. Sundararaja Moorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
2. Gitin Maitra, L. Prasad "Handbook of Mechanical Design", 2nd Edition, Tata McGraw-Hill, 2001.
3. C.S.Sharma, Kamlesh Purohit, "Design of Machine Elements", Prentice Hall of India, Pvt. Ltd., 2003.

NARAYANA ENGINEERING COLLEGE :GUDUR								
	METROLOGY AND MEASUREMENTS						NECR BTECHR21	
Semester	Hours/ Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VII	3	0	0	48	3	40	60	100

COURSECONTENT

MODULE–1	LINEAR& ANGULAR MEASUREMENT	10 H

Introduction to Metrology; Need for high precision measurements; Terminologies in Measurement- Precision, accuracy sensitivity, calibration. Errors in Measurement, types of errors, Abbe's Principle. Basic standards of length-Line standards End standards, Wavelength standards; Various Shop floor standards.

Linear Measurement – Slip gauges, wringing, grades; Surface plate; Dial indicators; Height gauges, and Venire calipers Comparators- mechanical, electrical, optical, and pneumatic. Angular Measurement – Bevel protractor; Sine Bar, principleand use of sine bar, sine center; Angle gauges.

Sprit level; Angle Dekkor; Clinometers.

MODULE-2	LIMITS , FITS AND TOLERANCES	10H

Limits and Limit gauges – Making to suit, selective assembly, systems of limits and fits; Types of fits; Hole basis system, and Shaft basis system. Standard systems of limits and fits; Shaft and Hole system; Tolerance, allowance, and deviation (as per BIS).Simple problems on tolerance and allowance, shaft and hole system. Limit Gauges – GO and NO GO gauges; types of limit gauges.

Gauge design - Taylor's principle of gauging; Gauge tolerance, disposition of gauge tolerance, wear allowance.

Optical Measuring Instruments: - Benefits of using light waves as standards; Monochromatic light; Principle of Interference. Interference band using optical flat, application in surface measurement. Interferometers – NPL flatness interferometer, Pitter-NPL gauge interferometer.

MODULE-3	MEASUREMENT OF SURFACE TEXTURE	09H

Measurement of surface texture – Meaning of surface texture, roughness, and waviness; Analysis of surface traces, peakto valley height, R.M.S. value, Centre Line Average and Ra value, Rt, Rz, etc.

Methods of measuring surface roughness – Stylus probe, Tomlinson surface meter, Talysurf; Terms used in surface roughness measurement – assessment length, roughness width cut-off, sampling length, and evaluation length. Interference method for measuring surface roughness – using optical flat and interferometers. Autocollimator, principle and use of autocollimator.

MODULE-4	TRANSDUCERS	10 H

Introduction to Mechanical Measurement – significance of mechanical measurement; Fundamental methods of measurement; Classification of measuring instrument. Stages in generalized measuring system – Sensor-Transducer stage, Signal-Conditioning stage, Readout-Recording stage; Types of input quantities; Active and Passive transducers. Performance characteristics of measuring devices –Static characteristics –Accuracy, Precision, Repeatability,Sensitivity, Reproducibility, Drift, Resolution, Threshold, Hysteresis, and Static calibration. Dynamic characteristics- different order systems and their response-, Measuring lag, Fidelity, Dynamic error; Types of errors in measurement. Transducers – Working, Classification of transducers. Motion and Dimension measurement – LVDT
– Principle, applications, advantages and limitations.

MODULE-5	MECHANICAL MEASUREMENT	09H

Torque Measurement – Dynamometers – Mechanical, Hydraulic , and Electrical. Vibration measurement – Vibrometers and Accelerometers – Basic principles and operation. Temperature Measurement – Use of Thermal Expansion – Liquid-in-glass thermometers metallic strip pressure thermometers. Thermocouples – Principle, application laws for Thermocouples, Thermocouple materials and construction, measurement of Thermocouple EMF. Resistance Temperature Detectors (RTD); Thermistors; Pyrometers (Basic Principles).	
Total hours	**48H**

Text Book(s):

1. Anand K Bewoor, Vinay A Kulkarni, Metrology &Measurement, McGraw-Hill, 2009
2. ErnestODublin ,DhaneshN.Manik, Measurement Systems Application and Design,McGraw-Hill,2004
3. GalyerJ.F.W.,SchotboltC.R.,MetrologyforEngineers,ELBS,1990
4. Thomas G. Beckwith, John H. L., Roy D. M., Mechanical Measurements, 6/E ,PearsonPrenticeHall, 2007

ReferenceBook(s):

1. ASME,Handbookof IndustrialMetrology,1998
2. HumeK.J.,EngineeringMetrology,Macdonald &Co.Ltd.,1990
3. J.P.Holman,ExperimentalMethodsforEngineers,McGraw-Hill,2007
4. SharpK.W.B.,PracticalEngineeringMetrology, SirIsaacPitman&Sons Ltd.,1958

NARAYANA ENGINEERING COLLEGE:GUDUR								
	METROLOGY & MEASUREMENTS LAB							NECR BTECH R21
Semester	Hours/Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VII	0	0	3	48	1.5	40	60	100

COURSE CONTENT
PART-A[Metrology Lab]
TASK-1 [4 Hrs]
Measurement of lengths, heights, diameters by vernier calipers, micrometers etc
TASK-2 [4 Hrs]
Measurement of bores by internal micrometers and dial bore indicators
TASK-3 [3 Hrs]
Machine tool alignment test on the lathe.
TASK-4 [4 Hrs]
Machine tool alignment test on drilling machine
TASK-5 [4 Hrs]
Machine tool alignment test on milling machine.
PART B[Instrumentation Lab]
TASK-6 [4 Hrs]
Calibration of pressure gauge
TASK-7 [4 Hrs]
Calibration of transducer for temperature measurement.
TASK-8 [4 Hrs]
Study and calibration of LVDT transducer for displacement measurement.
TASK-9[3 Hrs]
Calibration of strain gauge.
TASK-10[3 Hrs]
Calibration of thermocouple
ADDITIONAL EXPERIMENTS
TASK-11 [4 Hrs]
Study of tool makers microscope and its applications
TASK-12 [4 Hrs]

Use of spirit level in finding the straightness of a bed and flatness of a surface
TASK-13[4 Hrs]
Calibration of capacitive transducer
TASK-14[3Hrs]
Study and calibration of a rotameter

TextBook(s):

1. AnandK Bewoor,VinayA Kulkarni,Metrology&Measurement,McGraw-Hill, 2009
2. ErnestO.Doebelin,DhaneshN.Manik,MeasurementSystemsApplicationandDesign,McGraw-Hill,2004
3. GalyerJ.F.W.,SchotboltC.R.,MetrologyforEngineers,ELBS,1990
4. Thomas G. Beckwith, John H. L., Roy D. M., Mechanical Measurements, 6/E , PearsonPrenticeHall, 2007

ReferenceBook(s):

1. 1 ASME,Handbookof IndustrialMetrology,1998
2. HumeK.J.,EngineeringMetrology,Macdonald &Co.Ltd.,1990
3. J.P.Holman,ExperimentalMethodsforEngineers,McGraw-Hill,2007
4. SharpK.W.B.,PracticalEngineeringMetrology, SirIsaacPitman&Sons Ltd.,1958

NARAYANA ENGINEERING COLLEGE:: GUDUR								
	SOFTWARE TOOLS LAB							NECR BTECHR21
Semester	Hours/Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VII	0	0	3	48	1.5	40	60	100

COURSE CONTENT

Task-1 [4 Hrs]

Analysis Of A Rectangular Plate With A Hole

Task-2 [4 Hrs]

. Analysis Of A Truss Member Under Loading

Task-3 [4 Hrs]

Static Analysis Of Beam

Task-4 [4 Hrs]

Analysis Of A Square Plate Considering Conduction.

Task-5 [4 Hrs]

Analysis Of A Fin Considering Conduction And Convection

Task-6 [4 Hrs]

Write A Code For Agricultural Drone By Using Python

Task-7 [4 Hrs]

Write A Code For Drone In Safety Application Using Python

Task-8 [4 Hrs]

Write A Code For Robot for medical applications By Using Python

Task-9 [4 Hrs]

Demonstration On 3d Printing Technology

Task-10 [4 Hrs]

Making Of Simple Components Using 3d Printing Machine

Additional Experiments

Task -11[4 Hrs]

Thermal Stress And Heat Transfer Analysis Of Plate.
Task -12[4 Hrs]
Model Analysis Of Beams.

TEXTBOOKS:

1. A first course in the Finite Element Method Logan, D. L Cengage Learning 6th Edition 2016
2. A Hands-On, Project-Based Introduction to Programming by Eric Matthes 2019

REFERENCE BOOKS:

1. Finite Element Method in Engineering Rao, S. S Pergaman Int. Library of Science 5th Edition2010
2. Earning Python 5/Ed (Updated For 3.3 And 2.7) By Lutz M 2013

LIST OF PROFESSIONAL ELECTIVES (NECR BTECH (R21))

ELECTIVETRACK/GROUP	Professional Elective-1	Professional Elective-2	Professional Elective-3	Professional Elective-4	Professional Elective-5
Design Engineering	Product Design &Development	Design of Material Handling Equipment	Finite Element Methods	Computational Fluid Dynamics	Geometric Dimensioning and Tolerance
Thermal Engineering	Gas turbines and Jet Propulsion	Power plant Engineering	Refrigeration & Air Conditioning	Hydraulic & Pneumatics Systems	Automobile Engineering
Production Engineering	Fundamentals of additive manufacturing	Modern Manufacturing Methods	Automation In Manufacturing	Surface Engineering	Manufacturing & Inspection Of Gears
Industrial Engineering	Management Science	Engineering Optimization	Industrial Engineering	Production & Operation Management	Industrial Management
CAD/CAM	Flexible Manufacturing Systems	Mechatronics	Intelligent Manufacturing Systems	Automation Robotics	Computer Aided Process Planning
Materials Engineering	Principles of Metal Extraction & Refining	Metallurgy	Composite Materials	Nano materials	Smart Materials

PROFESSIONAL ELECTIVE -1

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	PRODUCT DESIGN AND DEVELOPMENT							NECR BTECH (R21)
Semester	Hours/ Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
V	3	0	0	48	3	40	60	100

COURSE CONTENT

MODULE- I	INTRODUCTION	10 Hrs

Need for Integrated Product and Process Development (IPPD) -Strategic importance of Product development - integration of customer, designer, material supplier and process planner, Competitor and customer - behavior analysis. Understanding customer-promoting customer understanding-involve customer in development and managing requirements - Organization process management and improvement.

MODULE-II	CONCEPT GENERATION, SELECTION AND TESTING	9 Hrs

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-III	PRODUCT ARCHITECTURE	10 Hrs

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 - creating detailed interface specifications-Portfolio Architecture.

MODULE-IV	INDUSTRIAL DESIGN	9 Hrs

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 - conceptualization - refinement - management of the industrial design process - technology driven products - user – driven products - assessing the quality of industrial design.

MODULE-V	DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT	10 Hrs

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-baseline project planning - accelerating the project-project execution.

Total Hours	48 Hrs

TEXT BOOK

1. Product Design and Development, Karl T.Ulrich and Steven D.Eppinger, McGraw –Hill InternationalEdns.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 WesleyPublishing,Neyourk,NY,1991, ISBN 0-202-41639-5

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	GAS TURBINES AND JET PROPULSION							NECR BTECH (R21)
Semester	Hours/ Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
V	3	0	0	48	3	40	60	100

COURSECONTENT		
MODULE–1	**GAS TURBINE OPERATING CYCLE**	**09Hours**
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 thespecific output of simple cycle.		
MODULE-2	**GAS TURBINE**	**10Hours**
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-3	**JET PROPULSION**	**10Hours**
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**	**10Hours**
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**	**09Hours**
Rocket Technology: Flight mechanics, application thrust profiles, acceleration staging of rockets, need for – feedsystems, injectors and expansion nozzles – rocket transfer and ablative cooling.		
	Totalhours:	**48hours**

Text Book (s):

1. Gas Turbines , V. Ganesan TMGH 2006
2. Gas turbines , cohen , Rogers & Sarvana Muttoo , Addision Wiley & longman2017

ReferenceBook(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

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	FUNDAMENTALS OF ADDITIVE MANUFACTURING							NECR BTECH (R21)
Semester	Hours/ Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
V	3	0	0	48	3	40	60	100

COURSE CONTENT

MODULE- I	**INTRODUCTION**	10 Hrs

Introduction toAdditive Manufacturing- basic principles of additive manufacturing classification of the additive manufacturing process- benefits, the difference between additive manufacturing and CNC machining .Additive manufacturing processes, Generic additive manufacturing process steps, Computer Aided Process Planning forAdditive Manufacturing

MODULE-II	**LIQUID ADDITIVE MANUFACTURING**	9 Hrs

Liquid Additive Manufacturing- classification, VAT photopolymerization process – materials – process benefits and drawbacks, material jetting- material jetting process in fundamentals, materials for material jetting , material jettingmachines, material jetting benefits and drawbacks

MODULE-III	**SHEET ADDITIVE MANUFACTURING**	10Hrs

Sheet Additive Manufacturing, process and material selection, applications, gluing /adhesive bonding, bond- then- form processes, form-then-bond process , thermal bonding , ultrasonic additive manufacturing, applications ,drawbacks

MODULE-IV	**WIRE ADDITIVE MANUFACTURING**	9 Hrs

Wire Additive Manufacturing- principle, sub system of wire additive manufacturing process, wire arc additive manufacturing and material selection, applications, Fused deposition modelling, material selection, applications,limitations of FDM, FDM machines

MODULE-V	**POWDER ADDITIVE MANUFACTURING**	10 Hrs

Powder Additive Manufacturing, process and material selection, applications, trends and future directions, direct energy deposition (DED)process description, laser based metal deposition process, electron beam based metaldeposition process, process parameters, limitations

Total Hrs	48 Hrs

TEXT BOOKS:

1. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, IanGibson, David W Rosen, Brent Stucker, Springer, 2015, 2nd Edition.
2. 3D Printing and Additive Manufacturing: Principles & Applications, Chua Chee Kai, Leong Kah Fai, WorldScientific, 2015, 4th Edition..

REFERENCES:

1. Rapid Prototyping: Laser-based and Other Technologies, Patri K. Venuvinod and Weiyin Ma, Springer, 2004.
2. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, D.T. Pham, S.S. Dimov, Springer 2001.
3. Rapid Prototyping: Principles and Applications in Manufacturing, Rafiq Noorani, John Wiley & Sons, 2006.
4. Additive Manufacturing, Second Edition, Amit Bandyopadhyay Susmita Bose, CRC Press Taylor & FrancisGroup, 2020.
5. Additive Manufacturing: Principles, Technologies and Applications, C.P Paul, A.N Junoop, McGrawHill, 2021.

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	MANAGEMENT SCIENCE							NECR BTECH (R21)
Semester	Hours/ Week			Total hrs	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 - Social responsibilities of Management

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 - **Marketing Management** - Concept - Meaning - Nature-Functions of Marketing - 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:GUDUR								
	FLEXIBLE MANUFACTURING SYSTEMS							NECR BTECH (R21)
Semester	Hours / Week			Total hrs	Credit	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
	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, smallbatch 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 – BatchScheduling Problem – Knowledge Based Scheduling System.

MODULE-3	GROUP TECHNOLOGY AND JUSTIFICATION OF FMS	10 Hours

Introduction – Matrix Formulation – Mathematical Programming Formulation –Graph Formulation – Knowledge Based System for Group Technology – Economic Justification Of FMS- Application of Possibility Distributions inFMS Systems Justification.

MODULE-4	COMPUTER CONTROL AND SOFTWARE FOR FLEXIBLE MANUFACTURING SYSTEMS:	10 Hours

Introduction – composition of FMS– hierarchy of computer control –computer control of work center and assemblylines – 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 – DesignPhilosophy 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.
2. Groover M.P., “Automation, Production Systems and Computer Integrated Manufacturing”, Prentice Hall of India Pvt., New Delhi, 1996.
3 Kalpakjian, “Manufacturing Engineering and Technology”, Addison-Wesley Publishing Co., 1995.
4. Taiichi Ohno, “Toyota Production System: Beyond large-scale Production”, Productivity Press (India) Pvt. Ltd. 1992

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	PRINCIPLES OF METAL EXTRACTION AND REFINING							NECR BTECH (R21)
Semester	Hours/ Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
V	3	0	0	48	3	40	60	100

COURSECONTENT

MODULE–1	**INTRODUCTION TO METAL EXTRACTION**	09Hours

Definitions: Ore, Minerals, Metals, etc. Scope of extractive metallurgy, Drying, Calcining , Sintering, Roasting, Smelting, Distillation, Firere fining Hydrometallurgy, Steps involved, Importance. Merits of pyro and hydrometallurgy. Electrometallurgy, Electro winning. Electro refining. Applications. Fundamentals of MODULEProcess,MODULEoperations.

MODULE-2	**CHEMICAL REACTION**	10Hours

Review of chemical equilibrium. The basic concept of free energy change. Requirements forpredictionand calculation of a chemical reaction. Ellingham diagram in detail for metaloxides. Activities in concentrated solution and in industrial liquid metallic solution 1wt/std.State. Henrian solution activity and activity coeff..

MODULE-3	**TYPES OF REACTIONS**	10Hours

Effect of conc: Of reacting substances on rate of a reaction. Order and mole cularity of a reaction, reaction and concentration of reactant of 1^{st}, 2^{nd}, and nth order. Determination of order and velocity constant of a reaction. Reversible reactions. The effect of temperature on rates of reactions. Arrhenius equation, Role of activation energy. Theory of absolute reactions. Rates, Applicability of reaction kinetics to metallurgical systems

MODULE-4	**EXTRACTION OF METALS**	09Hours

Extraction of metals from oxide and sulphide ores. Reduction of oxide ores by Carbon Hydrogen metal lothermic reduction (Al,Si,Mg,Ca.etc). Electrolysis at low pressure and high pressure. Conversion into halides and subsequent extraction. Reduction of sulphide ores by reduction, smelting and mattes melting.

MODULE-5	**REFINING OF METALS**	10Hours

Refining of impure metals. Introduction chemical, electrochemical and physical methods i.e. fire refining. Refining via volatile comp. Electrolysis, Distillation. Zone refining, Materials and heat balance. Flow diagram. Techniques and procedure of material balance. Techniques and methods of heat balance

Totalhours:	**48Hours**

Text Book(s):

1. Principles of Metal Refining and Recycling by by Thorvald Abel Engh (Author), Geoffrey K. Sigworth (Author), Anne Kvithyld (Author)2021
2. The Extraction and Refining of Metals By Colin Bodsworth 2021

Reference Books:

1. Principles of Extractive MetallurgyAhindra Ghosh, Hem Shanker Ray New Age International,1991

PROFESSIONAL ELECTIVE-2

NARAYANAENGINEERINGCOLLEGE:GUDUR

	Design of Material Handling Equipment						NECR BTECH (R21)
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	**MATERIALS HANDLINGEQUIPMENT**	10 Hrs
Introduction to material handling Equipment, Detail classification of MHE, Application and their selection.		
MODULE-II	**DESIGN OF HOISTS**	9 Hrs
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**	10 Hrs
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**	10 Hrs
Design of Bucket elevators: Loading and bucket arrangements, Cage elevators, Shaft way, Guides, counter weights.		
MODULE-V	**SAFETY AND TRAINING**	9 Hrs
Need, Environmental and human factors in material handling, Safety Regulations		
	Total hours	48 Hours

TEXT BOOK :

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.
4. Principles of Extractive Metallurgy,Fathi Habashi CRC Press, 1969

NARAYANA ENGINEERING COLLEGE:GUDUR								
	POWER PLANT ENGINEERING							NECR BTECH R21
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 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.

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.CO_2 Recorders

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

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 PumpedStorage Plants.

MODULE-5	NON-CONVENTIONAL SOURCES & NUCLEAR POWER STATION	10Hours

POWER FROM NON-CONVENTIONAL SOURCES: Utilization of Solar Collectors- Working Principle, WindEnergy - 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 Hazardsand Shielding - Radioactive Waste Disposal.

Total hours:	48 hours

Text Book(s):

1. P.K. Nag, "Power Plant Engineering", 3rd edition, TMH, 2013.

2. Wakil, "Power plant technology", M.M.EI TMH Publications.2011

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.

NARAYANAENGINEERINGCOLLEGE: GUDUR								
	MODERN MANUFACTURING METHODS							NECR BTECH (R21)
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	Non – Traditional Machining Processes	10 Hrs

Non – Traditional Machining Processes: Introduction, Need, Classification and Brief Overview, Considerations inProcess 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.

MODULE-II	Electrical Energy Based Processes	9 Hrs

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.

MODULE-III	Chemical and Electro Chemical Energy Based Processes	10 Hrs

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.

MODULE-IV	Thermal Energy Based Processes	10 Hrs

Laser Beam Machining and Drilling, Plasma Arc Machining, Electron Beam Machining – Working Principle,Description of Equipment, Process Parameters, Applications, Advantages and Limitations.

MODULE-V	Ultrasonic Machining	9 Hrs

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

Total Hours	48 Hrs

TEXT BOOK

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 toDirect Digital Manufacturing, 1/e, Springer, 2010.

REFERENCES:

1. Chua C.K., Leong K.F. and Lim C.S., Rapid Prototyping: Principles and Applications, 2/e, World ScientificPublishers, 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.

NARAYANA ENGINEERING COLLEGE:GUDUR								
	ENGINEERING OPTIMIZATION							NECR BTECH (R21)
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 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

MODULE -2	**TRANSPORTATION PROBLEM**	9h

Transportation Problem – Formulation; Different Methods of Obtaining Initial Basic Feasible Solution- North- West Corner Rule, Least Cost Method, Vogel'sApproximation Method;OptimalityTesting. Unbalanced Transportation Problem, Degenerate Problem; Assignment Problem – Formulation; Optimal Solution - Traveling Salesman problem. Sequencing -Assumptions-n-jobs-2 Machines model, n-jobs-3-machines models & n jobs – m Machines models

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

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

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.

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

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	MECHATRONICS							NECR BTECH (R21)
Semester	Hours/ Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VI	3	0	0	48	3	40	60	100

COURSECONTENT		
MODULE–1	**INTRODUCTION**	**10Hours**
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**	**10Hours**
System and interfacing and data acquisition, DAQS, SCADA, A to D and D to A conversions; Dynamic modelsand analogies, System response. Design of mechatronics systems & future trends.		
	Total hours:	**48 hours**

TextBook(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/ PearsonEducation 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.

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	METALLURGY						NECR BTECH (R21)	
Semester	Hours/ Week			Total hrs	Credits	Max Marks		
	L	T	P		C	CIE	SEE	TOTAL
VI	3	0	0	48	3	40	60	100

COURSECONTENT

MODULE–1	CONSTITUTION OF ALLOYS& ALLOY STEELS	09Hours

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-2	TOOL STEELS	10Hours

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 stresses- bending fractures

MODULE-3	FAILURE ANALYSIS	10Hours

Introduction- modes of fracture- fatigue fractures-effect of strength reducers- faulty processing-beach marks

MODULE-4	NON-METALLIC MATERIALS	09Hours

Polymers – types of polymer, commodity and engineering polymers – Properties and applications o various thermosetting and thermoplastic p olymers (PP, PS, PVC, PMMA, PET,PC, PA, ABS, PI PAI, PPO, PPS, PEEK, PTFE, Polymers – Urea and Phenol formaldehydes)- Engineering Ceramics – Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON –Composites Classifications- Meta
Matrix and FRP – Applications of Composites.

MODULE-5	MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS	10Hours

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.

Totalhours:	48Hours

Text Book(s):

1. Introduction to Physical Metallurgy / Sidney H.Avener.2017
2. ATextofEssentialofMaterialsscienceandengineering/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. EngineeringMaterials andTheirApplications– R.AFlinnandPKTrojan/ JaicoBooks1995.

PROFESSIONAL ELECTIVE -3

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	FINITE ELEMENT METHODS						NECR BTECH (R21)	
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 FINITE ELEMENT METHODS**	10 Hrs

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.

MODULE-II	**1 D ANALYSIS OF TRUSSES AND BEAMS**	9 Hrs

Analysis of trusses: Stiffness Matrix for 1D truss element, Stress Calculations and Problems with maximum of threeelements.

Analysis of beams: Element Stiffness Matrix and Load vector for 1 D beam element, Hermite shape functions andsimple problems.

MODULE-III	**2D ANALYSIS**	10 Hrs

Finite element modeling of two dimensional stress analysis with constant strain triangles and treatment of boundaryconditions. Estimation of load Vector, Stresses.

Finite element modeling of Axi-symmetric solids subjected to axi-symmetric loading with triangular elements.

MODULE-IV	**QUADRILATERAL ELEMENTS & THERMAL ANALYSIS**	9 Hrs

Quadrilateral Elements: Isoparametric, Sub parametric and Super parametric elements, Modelling of 4 noded and 8noded quadrilateral elements and simple problems. Numerical Integration.

Steady state heat transfer analysis: One dimensional analysis of composite slab and fin.

MODULE-V	**DYNAMIC ANALYSIS**	10 Hrs

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 andEigen vectors for a bar and shaft.

	Total Hrs	48 Hrs

TEXT BOOKS:

1. T. Chandraputla, Ashok Belegundu, Introduction to Finite Element in Engineering, Pearson Publications, 4/e,
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, JohnWiley, 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.

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	REFRIGERATION & AIR CONDITIONING							NECR BTECH (R21)
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 REFRIGERATION	10 Hrs

Necessity and Applications, Carnot Refrigerator, First and Second Law Applied to Refrigerating Machines, Unit ofRefrigeration, COP, EER, Different Refrigeration Methods.

Air Refrigeration: Bell-Coleman Cycle, Ideal and Actual Cycles, Open and Dense Air Systems - NumericalProblems - Refrigeration Needs of Air Crafts

MODULE-II	VAPOUR COMPRESSION REFRIGERATION (VCR) SYSTEM	9 Hrs

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- Influence of Various Parameters on System Performance - Construction and Use of P-h Charts - Numerical Problems. Refrigerants - Desirable Properties - Classification of Refrigerants Used - Nomenclature- Secondary Refrigerants- Lubricants - Ozone Depletion - Global Warming- Newer Refrigerants.

MODULE-III	VAPOR ABSORPTION REFRIGERATION (VAR) SYSTEM	10 Hrs

Vapor Absorption Refrigeration (VAR) System-Description and Working of NH_3 - 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.

MODULE-IV	INTRODUCTION TO AIR CONDITIONING	9 Hrs

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.

MODULE-V	AIR CONDITIONING EQUIPMENT	10 Hrs

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.

	Total Hours	48 Hrs

TEXT BOOKS:

1. Refrigeration and Air Conditioning-P.L.Ballaney, 2/e, 2012.
2. Basic Refrigeration and Air-Conditioning - P.N.Ananthanarayanan / TMH, 4/e, 2013.

REFERENCES:

1. Refrigeration and Air Conditioning / Manohar Prasad / New Age, 2/e, 2013
2. Principles of Refrigeration - Dossat / Pearson Education, 4/e, 2007

NOTE: Tables/Codes: Thermal Engineering Data Book containing refrigerant and Psychrometric property Tables and charts are permitted in Exam

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	INDUSTRIAL ENGINEERING							NECR BTECH (R21)
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

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 – Systems Approach to Management.Organizational StructuresFunctional- virtual - Matrix Basic Concepts Related to Organization –

MODULE-II	**PLANT LOCATION AND PLANT LAYOUT**	9 Hrs

Product Life Cycle, Facility Location and Layout – 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- simple problems.

MODULE-III	**WORK STUDY**	10 Hrs

Definition, Objectives, Method Study – Steps Involved – Various Types of Process Charts –Micro motion and Memo motion Studies. Work Measurement - Definition, Time Study, Steps involved - Equipment, Different Methods of Performance Rating - Allowances, Standard Time Calculation. Work Sampling - Definition, Steps Involved, Standard Time Calculations - Applications

MODULE-IV	**INVENTORY MODELS**	9 Hrs

Deterministic models- EOQ Models – With and Without Shortages Models; Inventory Models with Price Breaks - Probabilistic Models –Discrete Variable, Continuous Variable. Inventory Control Systems

MODULE-V	**INSPECTION & QUALITY CONTROL**	10 Hrs

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 Hrs**

TEXT BOOKS

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, 5th Edition, McGraw Hill Education, 2017.

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	AUTOMATION IN MANUFACTURING						NECR BTECH (R21)	
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, Automationprinciples & StrategiesManufacturing 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, Continuousversus 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 ClassificationScheme, 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 Radhakrishnan and Subramanian, NewAge Publications, 2007
2. CAD / CAM/ CIM by Radhakrishnan.2008
3. Automation by W. Buekingham.1968

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	COMPOSITE MATERIALS						NECR BTECH (R21)	
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. Fiber Reinforced Plastic Processing: Lay up and curing, fabricating process, open and closed mould process,

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	9 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. IanGray, 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),
3. D. Hull and T.W. Clyne, "Introduction to Composite Materials", Cambridge University Press. (1996)
4. M.R. Piggott, "Load Bearing Fibre Composites", Pergamon press, Oxford. (1998)

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	INTELLIGENT MANUFACTURING SYSTEMS							NECR BTECH (R21)
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	**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 Hrs	48 Hrs

TEXTBOOKS:

1. Andre Kusaic, " *Intelligent Manufacturing Systems*", PHI,1989
2. Hamid R. Parsaei and Mohammad Jamshidi, "*Design and Implementation of Intelligent ManufacturingSystems*", 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.

PROFESSIONAL ELECTIVE- 4

NARAYANAENGINEERINGCOLLEGE::GUDUR								
	COMPUTATIONAL FLUID DYNAMICS							NECR BTECH (R21)
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
Introduction: Illustration of the CFD approach, CFD as an engineering analysis tool, Review of governing equations, Modeling in engineering, Partial differential equations- Parabolic, Hyperbolic and Ellipticequation, CFD application in Chemical Engineering, CFD software packages and tools.		
MODULE-II	**PRINCIPLES OF SOLUTION OF THE GOVERNING EQUATIONS**	9 Hrs
Principles of Solution of the Governing Equations: Finite difference and Finite volume Methods, Convergence, Consistency, Error and Stability, Accuracy, Boundary conditions, CFD model formulation		
MODULE-III	**MESH GENERATION**	10 Hrs
Mesh generation: Overview of mesh generation, Structured and Unstructured mesh, Guideline on mesh quality and design, Mesh refinement and adaptation. Solution Algorithms: Discretization schemes for pressure, momentum and energy equations - Explicit and implicit Schemes, First order upwind scheme, second order upwind scheme, QUICK scheme, SIMPLE, SIMPLER and MAC algorithm		
MODULE-IV	**CFD SOLUTION**	9 Hrs
CFD Solution Procedure: Problem setup – creation of geometry, mesh generation, selection of physics and fluid properties, initialization, solution control and convergence monitoring, results reports and visualization.		
MODULE-V	**CASE STUDIES**	10 Hrs
Benchmarking, validation, Simulation of CFD problems by use of general CFD software, Simulation ofcoupled heat, mass and momentum transfer problem		
	Total Hours	48 Hrs

TEXT BOOKS:

1 .S. V. Patankar, Numerical Heat Transfer and Fluid Flow, McGraw-Hill. 1980

2. John D. Anderson Jr, Computational Fluid Dynamics, McGraw Hill Book Company 2001

REFERENCES:

1. John C. Tannehill, Dale A. Anderson and Richard H. Pletcher, Computational Fluid Mechanics and Heat Transfer, Taylor &Francis. 2021

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	HYDRAULIC &PNEUMATICS SYSTEMS							NECR BTECH (R21)
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	**FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS**	10 Hrs

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 –

MODULE-II	**HYDRAULIC ACTUATORS AND CONTROL COMPONENTS**	9 Hrs

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 –

MODULE-III	**HYDRAULIC CIRCUITS AND SYSTEMS**	10 Hrs

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.

MODULE-IV	**PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS**	9 Hrs

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.

MODULE-V	**TROUBLE SHOOTING AND APPLICATIONS**	10 Hrs

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 – Low cost Automation – Hydraulic and Pneumatic power packs.

Total Hours	48 Hrs

TEXT BOOKS:

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

REFERENCES:

1 Anthony Esposito, "Fluid Power with Applications", Pearson Education 2005.

2. Majumdar S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw- Hill, 2001.

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	SURFACE ENGINEERING							NECR BTECH (R21)
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

Introduction to structure of solids: structure, morphology, energy, types and classification Surface dependent engineering properties: physical, chemical and mechanical –their definition, origin and importance

MODULE-II	**STRENGTHENING MECHANISM**	9 Hrs

Common surface initiated engineering degradation/failures and their mechanism: wear, friction, fatigue, corrosion, oxidation Importance of surface engineering (SE), Classification and scope of surface engineering of alloys and components, Methods and principles of surface modification of materials; Strengthening mechanism of engineering materials – metallic and non-metallic

MODULE-III	**SURFACE COATING TECHNIQUES**	10 Hrs

Conventional surface modification methods: shot peening, flame and inductionhardening, carburizing, nitriding, diffusion aided surface alloying Surface coating techniques by chemical/electro-chemical routes:electro/electroless deposition, anodizing, galvanizing

MODULE-IV	**ADVANCED SURFACE MODIFICATION METHODS**	9 Hrs

Advanced surface modification methods: laser, plasma, ion and electron beamassisted surface engineering

MODULE-V	**ADDITIVE MANUFACTURING**	10 Hrs

Additive manufacturing vis-à-vis subtractive manufacturing, Advantages andchallenges, recent trend and innovation, laser assisted additive manufacturing ofpolymers, metals and alloys, characterization and testing

Total Hours	48 Hours

TEXT BOOK

1 Surface Engineering for Wear Resistances (Introduction and classification of Wear), By: K.G. Budinski,Prentice Hall, Englewood Cliffs, 1988

2. Corrosion Engineering (classification of Corrosion), By: M.G. Fontana, M.C. Graw Hill, N. York, 1987

3. Introduction to Surface Engineering and Functionally Engineered Materials, by PeterMartin, WILEY, 2011

REFERENCES:

1. Surface Engineering of Metals: Principles, Equipment, Technologies, by:TadeuszBurakowski,TadeuszWierzchon, CRC Press, 1988
2. Surface Engineering for Corrosion and Wear Resistance, by JR Davis, ASMInternational, 2001
3. Additive Manufacturing by Andreas Gebhardt and Jan-Steffen Hötter, Springer, 2016
4. Additive Manufacturing of Metals by John O. Milewski, Springer, 2017

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	PRODUCTION AND OPERATIONS MANAGEMENT							NECR BTECH (R21)
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

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, Speed to Market, 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, Methodology in Value Engineering -Facility Location and Layout – 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-IV	**AGGREGATE PLANNING AND MRP**	9 Hrs

Aggregate Planning and MRP: Aggregate Planning – Definition, Different Strategies, Various Models of Aggregate Planning- Transportation and Graphical Models, Master scheduling, Material Requirement Planning (MRP)- Terminology, Types of Demands, Inputs to MRP, Techniques of MRP, , Benefits and Drawbacks of MRP, Just in Time (JIT) Philosophy, Kanban System, , Pull Systems vs. Push Systems, Requirements for Implementation of JIT, JIT Production Process, 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 ShopScheduling, 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 HillEducation, 1987.
5. Steven Nahmias, Tava Lennon Olsen, Production and Operation Analysis: Strategy – Quality –Analytics – Applications, 7th Edition, Waveland Press Inc., 2015.

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	AUTOMATION & ROBOTICS						NECR BTECH (R21)	
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	AUTOMATION	10 Hrs

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.
Automated flow lines& transfer mechanisms, fundamentals of transfer Lines, flow lines with or without buffer storage

MODULE-II	ASSEMBLY LINE BALANCING AND AUTOMATED MANUFACTURING SYSTEM	9 Hrs

Assembly Line Balancing: Assembly process and systems assembly line, line balancing algorithms, ways of improving line balance, flexible assembly lines.
Material handling and Identification Technologies: Overview of automatic material handling systems, principles and design consideration, material transport systems, storage systems, overview of automatic identification methods.
Automated Manufacturing Systems: Components, classification and overview of manufacturing systems, manufacturing cells, GT and cellular manufacturing, FMS and its planning and implementation.

MODULE-III	ROBOTICS	10 Hrs

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

MODULE-IV	KINEMATICS AND DYNAMICS OF A MANIPULATOR	9 Hrs

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 - Eulerformations

MODULE-V	ROBOT PROGRAMMING AND APPLICATIONS	10 Hrs

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

	Total Hours	**48 Hrs**

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.

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	NANO MATERIALS							NECR BTECH (R21)
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

Introduction: Scope of nano science and nanotecnology, nano science in nature, classification of nanostructured materials, importance of nano materials. Synthetic Methods: Bottom-Up approach:- Sol-gel synthesis, microemulsions or reverse micelles, co-precipitation method, solvo thermal synthesis, hydrothermal synthesis, microwave heating synthesis and sono chemical synthesis.

MODULE-II	TOP-DOWN APPROACH	9 Hrs

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.

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

MODULE-IV	STUDIES OF NANO-STRUCTURED MATERIALS	9 Hrs

Synthesis, properties and applications of the following nanomaterials, fullerenes, carbon nanotubes, core-shell nanoparticles, nanoshells, selfassembled monolayers, and monolayer protected metal nanoparticles, nanocrystalline materials, magnetic nanoparticles and important properties in relation to nanomagnetic materials, thermoelectric materials, non-linear optical materials, liquid crystals.

MODULE-V	APPLICATIONS	10 Hrs

Engineering Applications of Nanomaterials-aviation and space, chemical industry, automotive engineering,building , consumer electronics- fuel cells, batteries , sensors

	Total Hrs	48 Hrs

TEXT 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, Wiley-Interscience, 2008.

REFERENCES:

1. Nanochemistry: A Chemical Approach to Nanomaterials, by G. Ozin and A. Arsenault, RSCPublishing, 2005
2. Nanophysics and Nanotechnology: An Introduction to Modern Concepts in Nanoscience, Edward L.Wolf, Wiley-VCH, 2nd Reprint (2005)

PROFESSIONAL ELECTIVE-5

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	DESIGN OF HEAT EXCHANGERS						NECR BTECH (R21)	
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

Types of heat exchangers, shell and tube heat exchangers – regenerators and recuperators - Temperature distribution and its implications - Parts description, Classification as per Tubular Exchanger Manufacturers Association (TEMA)

MODULE-II	**PROCESS DESIGN OF HEAT EXCHANGERS**	9 Hrs

Heat transfer correlations, Overall heat transfer coefficient, analysis of heat exchangers – LMTD and effectiveness method. Sizing of finned tube heat exchangers, U tube heat exchangers, Design of shell and tube heat exchangers, fouling factors, pressure drop calculations.

MODULE-III	**STRESS ANALYSIS**	10 Hrs

Stress in tubes – header sheets and pressure vessels – thermal stresses, shear stresses - types of failures, buckling of tubes, flow induced vibration.

MODULE-IV	**COMPACT AND PLATE HEAT EXCHANGER**	9 Hrs

Types- Merits and Demerits- Design of compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations.

MODULE-V	**CONDENSERS AND COOLING TOWERS**	10 Hrs

Types- Merits and Demerits- Design of compact heat exchangers, plate heat exchangers, performance influencing parameters, limitations.

	Total Hours	48 Hrs

TEXT BOOK

1. SadikKakac and Hongtan Liu, "Heat Exchangers Selection", Rating and Thermal Design, CRCPress, 2002.

2. Shah,R. K., Dušan P. Sekulic, "Fundamentals of heat exchanger design", John Wiley & Sons,2003.

REFERENCES:

1. Kays, V.A. and London, A.L., “Compact Heat Exchangers”, McGraw Hill,1998.
2. Kuppan, T, Macel Dekker, “Heat Exchanger Design Handbook” CRC Press ,June 2013
3. Schunder E.U., “Heat Exchanger Design Hand Book”,Hemisphere Pub,May 2015
4. Donald Q Kern, “Process Heat transfer”,McGraw Hill,1983

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	AUTOMOBILE ENGINEERING						NECR BTECH (R21)	
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 VEHICLE STRUCTURE AND ENGINE COMPONENTS**	10 Hrs

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.

MODULE-II	**IGNITION AND FUEL SUPPLY SYSTEMS**	9 Hrs

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.

MODULE-III	**STEERING AND SUSPENSION SYSTEM**	10 Hrs

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.

MODULE-IV	**WHEELS, TYRES AND BRAKING SYSTEM**	9 Hrs

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).

MODULE-V	**AUTOMOBILE ELECTRICAL SYSTEMS AND ADVANCES IN AUTOMOBILE ENGINEERING**	10 Hrs

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.

Total Hours	48 Hrs

TEXT BOOKS:

1. Kirpal Singh, Automobile Engineering, Vol.1&2, Standard Publications, 13/e, 2020.
2. William.H.Crouse, Automotive Mechanics, 10/e , McGraw-Hill, 2006.
3. David A. Corolla, Automotive Engineering: Powertrain, Chassis System and Vehicle Body, Butterworth-Heinemann Publishing Ltd, 2009.
4. Richard Stone, Jeffrey K. Ball, Automotive Engineering Fundamentals" SAE International, 2004

REFERENCES:

1. Bosch, Automotive Hand Book, 6/e, SAE Publications, 2007.
2. K. Newton and W. Steeds, The motor vehicle, 13/e, Butterworth-Heinemann Publishing Ltd, 1989.
3. Joseph Heitner, Automotive Mechanics Principles and Practices, 2/e, CBS publishing 2004.

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	Manufacturing & Inspection of Gears						NECR BTECH (R21)	
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 GEARS	10 Hrs

Types of gears, classification, gear drawings, gearboxes, application of gears, gear production methods, anoverview.

GEAR MATERIALS

Non-metallic, ferrous and non-ferrous gears. Properties of gear materials, selection of material for typicalgears 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. Duplex cutter, straight bevel gear generator, Spiral bevel gear generator.

MODULE-III	HEAT TREATMENT OF GEARS	10 Hrs

Through hardening, case hardening, flames hardening, induction hardening of gears, Nitriding of gears. Tuftriding of gears. Inspection of gears for hardening defects

GEAR FINISHING

Gear finishing advantages, finishing of gears by grinding, shaving, lapping, honing methods and cold rollingof 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 Hrs

TEXT BOOKS:

1. Society of Manufacturing engineers, Gear Processing and Manufacturing", 2nd 3 Edition1984
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.

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	INDUSTRIAL MANAGEMENT						NECR BTECH (R21)	
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	**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 ofmanagement, managerial skills, managerial roles, Forms of Organization- Line , Line –staffetc

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, Juran's and Demings view of quality, Quality Management Assistance Tools: Ishikawa diagram – Pareto Analysis – Poka Yoke (Mistake Proofing).quality circles, TQM, Kaizen, Five S (5S), Six sigma

MODULE-IV	**HUMAN RESOURCE DEVELOPMENT**	9 Hrs

Strategic importance HRM; objectives of HRM; challenges to HR professionals; role, Responsibilities andcompetencies of HR professionals; HR department operations; Human Resource Planning - objectives and process; human resource information system.. Talent acquisition; recruitment and selection strategies, careerplanning 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, Classification of information systems, Functional Business systems – sales & marketing, Human resources, accounting, manufacturing etc.

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-HillInternational Editions.1985

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	COMPUTER AIDED PROCESS PLANNING							NECR BTECH (R21)
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

The Place of Process Planning in the Manufacturing cycle-Process planning and production Planning-Processplanning and Concurrent Engineering, CAPP, Group Technology.

MODULE-II	**PART DESIGN REPRESENTATION**	9 Hrs

Design Drafting-Dimensioning-Conventional Tolerance- Geometric Tolerance-CAD-input/output devices- Topology – Geometric transformation-Perspective transformation-Data Structure-Geometric modeling for process planning–GT Coding-The OPITZ system-The MICLASS System.

MODULE-III	**PROCESS ENGINEERING AND PROCESS PLANNING**	10 Hrs

Experience based planning-Decision table and Decision trees-Process capability analysis-Process planning- Variant process planning-Generative approach-Forward and backward planning, Input format, AI.

MODULE-IV	**COMPUTER AIDED PROCESS PLANNING SYSTEMS**	9 Hrs

Logical Design of process planning- Implementation considerations-Manufacturing system components, Production Volume, No. of production families – CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO,CPPP.

MODULE-V	**INTEGRATED PROCESS PLANNING SYSTEMS**	10 Hrs

Totally integrated process planning systems-An Overview-Modulus structure-Data Structure-Operation-Report Generation, Expert process planning

	Total Hours	48 Hrs

TEXT BOOKS:

1. Gideon Halevi and Roland D. Weill, “Principle of process planning- A Logical Approach”,Chapman & Hall, 1995
2. Chang T. C. & Richard A.Wysk, “An Introduction to automated process planning systems”,Prentice Hall 1985
3. Chang, T.C., “An Expert Process Planning System”, Prentice Hall, 1985

REFERENCES:

1. Nanua Singh, “Systems Approach to Computer Integrated Design and Manufacturing”, John Wiley & Sons, 1996

Rao P.N., “Computer Aided Manufacturing”, Tata McGraw Hill Publishing Co., 2000.

NARAYANAENGINEERINGCOLLEGE:GUDUR								
	SMART MATERIALS						NECR BTECH (R21)	
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

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-II	PROPERTIES OF SMART MATERIALS	9 Hrs

Physical principles of optical, Electrical, Dielectric, Piezoelectric, Ferroelectric, Pyroelectric and Magneticproperties of smart materials

MODULE-III	SYNTHESIS OF SMART MATERIALS	10 Hrs

Solid state reaction technique, Chemical route: Chemical vapour deposition, Sol-gel technique, Hydrothermal method, Co-precipitaiton. Green synthesis, Mechanical alloying and Thin film deposition techniques: Chemical etching, Sol-gel, spray pyrolysis

MODULE-IV	CHARACTERIZATION TECHNIQUES	9 Hrs

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-V	MATERIALS AND DEVICES	10 Hrs

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 thesmart materials.

Total Hours	48 Hrs

TEXT BOOKS:

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

REFERENCES:

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. Electroceramics: Materials, Properties, Applications -A.J. Moulson and J.M. Herbert, 2nd Edn., JohnWiley & Sons, 2003.