Shroff S.R. Rotary Institute of Chemical Technology

Ref: UPL University /SRICT/BOS/ME/2022-23/01
Date: 27-01-2023

Teaching Scheme for
Third Year Bachelor of Mechanical Engineering

Semester-V (Mechanical Engineering) Structure

Sl. No	Category of Course	Code No.	Course Title	Hours per week			Total contact hrs/ week	Total Credits	E	M	I	V	Total Marks
				L	T	P							
1	Humanities & Social Science	ME2301	PEM (Principle of Economics and Management)	3	0	0	3	3	70	30	0	0	100
2	Professional Core Course	ME2302	Heat Transfer	3	0	2	5	4	70	30	20	30	150
3	Professional Core Course	ME2303	Manufacturing Technology	3	0	2	5	4	70	30	20	30	150
4	Professional Core Course	ME2304	Machine Design - I	3	0	2	5	4	70	30	20	30	150
5	Professional Elective courses -2	ME2305, ME2306, ME2307	Any one Professional Elective courses -2	3	0	0	3	3	70	30	0	0	100
6	Open Elective Course - 1	ME2308, ME2309, ME2310	Any one open Elective courses - 1	3	0	0	3	3	70	30	0	0	100
7	In Plant Training	MH2303	Industrial Internship	0	0	0	0	1	0	0	50	0	50
8	Mandatory Course	MH2301	Contributor Personality Development Program - I	1	1	0	2	2	50	30	20	0	100
				19	**1**	**6**	**26**	**24**	**470**	**210**	**130**	**90**	900

5	Professional Elective courses -2	ME2305	Recent Advances in Renewable Energy
		ME2306	Tribology Engineering
		ME2307	Non Destructive Testing
			SWAYAM Course
6	Open Elective Course - 1	ME2308	Entrepreneurship and E-business
		ME2309	Ethics in Engineering
		ME2310	IOT and applications

Semester-VI (Mechanical Engineering) Structure

Sl. No	Category of Course	Code No.	Course Title	Hours per week			Total contact hrs/ week	Total Credits	E	M	I	V	Total Marks
				L	T	P							
1	Professional Core Course	ME2311	Dynamics of Machinery	3	0	2	5	4	70	30	20	30	150
2	Professional Core Course	ME2312	Machine Design - II	3	0	2	5	4	70	30	20	30	150
3	Professional Elective courses - 3	ME2313, ME2314, ME2315	Any one Professional Elective courses -3	3	0	2	5	4	70	30	20	30	150
4	Professional Elective courses - 4	ME2316, ME2317, ME2318	Any one Professional Elective courses -4	3	0	0	3	3	70	30	0	0	100
5	Open Elective Course - 2	ME2319, ME2320, ME2321	Any one open Elective courses -2	3	0	2	5	4	70	30	20	30	150
6	Open Elective Course - 3	ME2322, ME2323, ME2324	Any one open Elective courses -3	3	0	0	3	3	70	30	0	0	100
7	Mandatory Course	MH2302	Contributor Personality Development Program - II	1	1	0	2	2	50	30	20	0	100
				19	**1**	**8**	**27**	**24**	**470**	**210**	**100**	**120**	**900**

Professional Elective Courses -3	ME2313	Internal Combustion Engine
	ME2314	Design of Heat Exchanger
	ME2315	Cryogenic Engineering
Professional Elective Courses -4	ME2316	Product Design and Value Engineering
	ME2317	Industrial Engineering
	ME2318	Rapid Prototyping
		SWAYAM Course
Open Elective Course - 2	ME2319	Advance Welding Technology
	ME2320	Computer Aided Design
	ME2321	Automobile Engineering
Open Elective Course - 3	ME2322	Industrial Safety and Maintenance Engineering
	ME2323	Piping Design
	ME2324	Robotics

- **Course code and definition:**

Course code	Definitions
L	Lecture
T	Tutorial
P	Practical
E	Theory External Examination Marks
M	Theory Internal Examination Marks
I	Practical Internal Examination Marks
V	Practical External Examination Marks

Bachelor of Engineering
Subject Code: ME2301
Subject Name: Principle of Economics and Management

Shroff S.R. Rotary Institute of Chemical Technology

Semester: V

Type of course: Humanities & Social Science

Prerequisite: Zeal to learn the subject

Rationale: Linear and non-liner data structures, working experience of any one structured programming language.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	00	00	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Introduction to Economics**: Definitions, Nature, Scope, Difference between Microeconomics & Macroeconomics **Theory of Demand & Supply**: Law of demand, law of supply, equilibrium between demand & supply **Elasticity:** Elasticity of demand, price elasticity, income elasticity, cross elasticity.	6
2	**Theory of Production:** production function, meaning, factors of production (meaning & characteristics of Land, Labour, capital & entrepreneur), Law of variable proportions & law of returns to scale **Cost:** Meaning, short run & long run cost, fixed cost, variable cost, total cost, average cost, marginal cost, opportunity cost. **Break even analysis:** Meaning, explanation, numerical	6
3	**Markets :** Meaning, types of markets & their characteristics (Perfect Competition, Monopoly, Monopolistic Completion, Oligopoly)	6

Bachelor of Engineering
Subject Code: ME2301
Subject Name: Principle of Economics and Management

	National Income: Meaning, stock and flow concept, NI at current price, NI at constant price, GNP, GDP, NNP,NDP, Personal income, disposal income.	
	SECTION-B	
4	**Basic economic problems** : Poverty-meaning, absolute & relative poverty, causes, measures to reduce, **Unemployment**: Meaning, types, causes, remedies, Inflation; meaning, types, causes, measures to control **Money:** Meaning, functions, types, Monetary policy- meaning, objectives, tools, fiscal policy-meaning, objectives, tools, **Banking:** Meaning, types, functions, Central Bank- RBI, its functions, CRR, bank rate, repo rate, reverse repo rate, SLR	**6**
5	**Introduction to Management:** Definitions, Nature, Management, Difference between management & administration, skill, types and roles of managers **Management Principles:** Scientific principles, Administrative principles, Maslow's Hierarchy of needs theory **Functions of Management:** Planning, Organizing, Staffing, Directing, Controlling (meaning, nature and importance),Organizational Structures; meaning, principles of organization, types-formal and informal, line, line & staff, matrix, hybrid (explanation with merits and demerits), span of control, departmentalization, chain of command, centralization and decentralization	**7**
6	Organisational culture of Environment concept of culture and its importance, attributes culture, How does culture affect managers and employees **Corporate Social Responsibility:** Meaning, importance **Business Ethics:** Meaning, importance.	**5**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10%	10%	20%	35%	25%	00%

Bachelor of Engineering
Subject Code: ME2301
Subject Name: Principle of Economics and Management

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Engineering Economics, R.Paneerselvam, PHI publication
2. Fundamentals of Management: Essential Concepts and Applications, Pearson Education, Robbins S.P. and Decenzo David A.
3. Economics: Principles of Economics, N Gregory Mankiw, Cengage Learning
4. Principles and Practices of Management by L.M.Prasad
5. Principles of Management by Tripathy and Reddy
6. Modern Economic Theory, By Dr. K. K. Dewett & M. H. Navalur, S. Chand Publications

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	**Analyze** how elasticity affects revenue
CO-2	**Relate** production function and cost function
CO-3	**Evaluate** the optimal quantity and pricing decisions of firms in different market structures (perfect competition, monopoly, monopolistic competition) to achieve profit maximization
CO-4	**Understand** the concepts about economy, unemployment and banking system
CO-5	**Describe** the basic principles of management: planning, organizing, controlling, and directing
CO-6	**Explore** ethical dilemmas faced by business and managers.

List of Open-Source Software/Learning Website:

Bachelor of Engineering
Subject Code: ME2302
Subject Name: Heat Transfer

Shroff S.R. Rotary Institute of Chemical Technology

Semester: V

Type of course: Professional Core Course

Prerequisite: Zeal to learn the subject

Rationale: The course is prepared to provide the detailed understating of various modes of heat transfer and its applications in Mechanical Engineering. The course also provides the basic technical knowledge related to heat exchangers.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	PA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Conduction** Introduction, Fourier's law, effect of temperature on thermal conductivity of different solids, liquids and gases, generalized equation in Cartesian, cylindrical and spherical coordinates and its reduction to specific cases, One dimensional steady state conduction, heat conduction through plane and composite walls, cylinders and spheres, electrical analogy, critical radius of insulation for cylinder and sphere, overall heat transfer coefficient.	07
2	**Heat transfer from extended surface** Types of fin, heat flow through uniform cross-sectional area fin for various cases like infinitely long fin, fin insulated at the tip and fin losing heat at the tip, efficiency and effectiveness of fin. **Transient heat conduction** Lumped capacitance method for bodies of infinite thermal conductivity, time constant, one dimensional transient heat conduction in plane wall with finite conduction and convective resistances.	05

3	**Convection** Introduction, Newton's law of cooling, dimensional analysis applied to forced and free convection, dimensionless numbers and their physical significance, empirical correlations for free and forced convection, Continuity, momentum and energy equations, thermal and hydrodynamic boundary layer.	**06**
SECTION-B		
4	**Radiation** Introduction, Absorptivity, reflectivity and transmissivity, black, white and grey body, emissive power, emissivity, Kirchhoff's law, Planck's law, Wien's law, Stefan-Boltzmann law, intensity of radiation, radiation heat exchange between black bodies, shape factor, electrical analogy, radiation heat exchange between gray bodies, radiosity, irradiation, radiation shields.	**07**
5	**Heat exchanger** Introduction, Classification, heat exchanger analysis, LMTD for parallel and counter flow exchanger, condenser and evaporator, overall heat transfer coefficient, fouling factor, correction factors for multi pass arrangement, effectiveness-NTU method for parallel and counter flow heat exchanger.	**06**
6	**Two-phase heat transfer** Introduction, Boiling of liquids, Pool boiling curve, modes of pool boiling, correlation for pool boiling, condensation of vapor, film wise and drop wise condensation, condensation on flat surfaces and horizontal tubes.	**05**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20%	30%	30%	10%	10%	0%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Heat and Mass Transfer by P.K. Nag, McGraw Hill
2. Heat and Mass Transfer: Fundamentals and Application by Yunus Cengel, McGraw Hill
3. Fundamental of Heat and Mass Transfer by Incropera and Dewitt, Wiley Publication
4. Heat Transfer by Mills and Ganesan, Pearson Education
5. Heat Transfer by J P Holman , McGraw Hill
6. Heat and Mass Transfer by R K Rajput, S.Chand Publication

List of Practical/ Tutorials:

1. To determine the thermal conductivity of given metal.
2. To determine the thermal conductivity of the given composite walls.
3. To determine Stephan Boltzmann constant experimentally.
4. To determine the overall heat transfer co-efficient of shell and tube type heat exchangers.
5. To determine the overall heat transfer co-efficient of Plate heat exchangers.
6. To determine the emissivity of gray body.
7. To study film and drop wise condensation and to determine the film co-efficient.
8. To measure convective heat transfer co-efficient and effectiveness of the fin under forced convection.
9. To measure convective heat transfer co-efficient and effectiveness of the fin under natural convection.
10. To study the transient heat conduction and concept of critical radius of insulation.

Bachelor of Engineering
Subject Code: ME2302
Subject Name: Heat Transfer

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	Understand the basic of conduction and apply the principals of steady state one dimensional heat transfer to different applications.
CO-2	Apply the concept of heat transfer through extended surfaces and unsteady state conduction for commonly encountered Mechanical engineering problems.
CO-3	Ability to understand and solve the natural and forced convection related problems.
CO-4	Explain various laws of radiation heat transfer and to determine the radiation heat transfer between black and grey surfaces of simple Mechanical systems.
CO-5	Analysis of heat exchangers using LMTD and NTU methods.
CO-6	Learn the concept and principles of boiling and condensation.

List of Open-Source Software/Learning Website:

www.nptel.ac.in

Bachelor of Engineering
Subject Code: ME2303
Subject Name: Manufacturing Technology

Shroff S.R. Rotary Institute of Chemical Technology

Semester: V

Type of course: Professional Core Course

Prerequisite: Zeal to learn the subject

Rationale: Manufacturing Technology subject is designed to acquire theoretical and practical knowledge in foundry, metal forming, metal joining, manufacturing processes and plastic processing. The manufacturing program provides relevant industrial experience within the academic environment to apply theoretical and practical concepts to improve manufacturing processes and mechanical or manufacturing components. The student will be able to apply knowledge and skills in producing products of quality as per the quality standard of the industries.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Metal Casting Processes:** Types of patterns, allowances and material used for patterns, moulding materials, moulding sands, Moulding sands; properties and sand tastings, gating system design, Melting furnaces : Blast and Cupola Furnaces; Principle of special casting processes : Shell mouldng ,investment casting, Ceramic mould, Pressure die casting, Centrifugal casting, CO2 process, Defects in Sand casting	08
2	**Metal Joining Processes :** Operating principle, basic equipment, merits and applications of : Fusion welding processes : Gas welding: Types, Flame characteristics; Manual metal arc welding: Gas Tungsten arc welding , Gas metal arc welding, Submerged arc welding, Electro slag welding; Operating principle and applications of : Resistance welding, Plasma arc welding, Thermit welding, Electron beam welding, Friction welding and Friction Stir Welding; Brazing and soldering; Weld defects:	07

Bachelor of Engineering
Subject Code: ME2303
Subject Name: Manufacturing Technology

	types, causes and cure.	
3	**Advance Super finishing Technology:** Introduction, Lapping, Horning, Buffing, Barrel Tumbling, Burnishing, Powder coating, Polishing.	**03**
SECTION-B		
4	**Metal Forming Processes:** Hot working and cold working of metals, Forging Processes: Open, impression and closed die forging, forging operations. Rolling of metals: Types of Rolling, Flat strip rolling, shape rolling operations, Defects in rolled parts. Principle of rod and wire drawing, Tube drawing, Principles of Extrusion, Types: Hot and Cold extrusion.	**06**
5	**Sheet Metal Processes :** Sheet metal characteristics: shearing, bending and drawing operations, Stretch forming operations, Formability of sheet metal, Special forming processes: Hydro forming, Rubber pad forming, Metal spinning, Introduction of Explosive forming, magnetic pulse forming, peen forming, Super plastic forming ,Micro forming	**06**
6	**Manufacture of Plastic Components:** Introduction, Classification of Plastics, Ingredients of Moulding compounds, General Properties of Plastics, Plastic part manufacturing processes such as compression moulding,Transfer moulding, Injection moulding, Extrusion moulding, Blow moulding, Calendaring, Thermoforming, slush moulding, laminating.	**06**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15%	30%	25%	10%	10%	10%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Production Technology, by R.K. Jain, Khanna publishers.
2. Production Technology by P.C. Sharma S Chand & Co Ltd.
3. Manufacturing Technology Vol-II, By P.N. Rao, Tata McGraw Hill.
4. Manufacturing Engg. And Technology By S. Kalpakajain, PHI/Pearson.
5. Welding Technology, by O.P.Khanna, Dhanpat Rai publishers.

6. Processes and Materials of Manufacture by Roy. A. Lindberg, PHI / Pearson education, 2006
7. Elements of workshop Technology (Volume I & II) – S. K. Hajra Chaudary, Bose & Roy, Media Promoters and Publishers Limited.

List of Practical/ Tutorials:

1. Identify and understand various equipments and methods associated with casting process and various safety aspect of it.
2. Study of various casting defects, their causes and cure.
3. Edge preparation practice on given specimen for welding job.
4. Workshop job practice on plate welding-Lap joint ,V Butt joint
5. Study of modern welding processes.
6. Workshop job practice on given specimen with soldering operation
7. Study of various metal forging and rolling processes.
8. Workshop job practice on sheet metal specimen.
9. Study of various plastic manufacturing processes
10. Study of various superfinishing processes with advancement in manufacturing technology.

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	**Interpret** different foundry practices, merits and demerits, associated defects and their inspection.
CO-2	**Select** appropriate metal joining processes to join similar or dissimilar metals.
CO-3	**Distinguish** different Super Finishing Technology
CO-4	**Describe** various metal forming processes and compare difference hot working and cold working processes.
CO-5	**Understand** different types of sheet metal work and identify products manufactured with various sheet metal operation.
CO-6	**Classify** different plastic moulding processes and application

List of Open-Source Software/Learning Website

https://nptel.ac.in

Bachelor of Engineering
Subject Code: ME2304
Subject Name: Machines Design - 1

Shroff S.R. Rotary Institute of Chemical Technology

Semester: V

Type of course: Programme Core Course

Prerequisite: Nil

Rationale: The course aims to provide fundamental knowledge for material selection, analysis of components subjected to its failure and design.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Introduction:** Design procedure, Selection of preferred sizes, Aesthetic and Ergonomic considerations in Design, and Manufacturing considerations in Design, Mechanical Properties of Materials, Effect of Alloying elements and heat treatment on properties of steels, Materials Selection in Machine Design, IS coding of steels and Cast Irons.	4
2	**Design Against Fluctuating Loads:** Stress Concentration, Endurance limit and Fatigue failure, Factors affecting endurance limit, S-N Diagram, Design for reversed stresses and cumulative damage, Fluctuating stresses: Soderberg, Gerber, Goodman and Modified-Goodman criteria, Combined stresses.	7
3	**Design of Coupling** Types of coupling, Design of Muff coupling, Clamp coupling, Rigid flange coupling and Bush pin type flexible coupling.	7
	SECTION-B	

Bachelor of Engineering
Subject Code: ME2304
Subject Name: Machines Design - 1

4	**Design of Springs:** Classification of springs, Helical Spring: Style of ends, Stresses, Correction Factors, and Deflection, Design against static and fluctuating loads, Concentric springs, surge phenomenon. Helical Torsion and Spiral Springs, Multi-Leaf Spring: Terminology, Nipping, and Design of multi-leaf spring.	**6**
5	**Belt and Chain Drives:** **Flat Belt Drive:** Belt Construction, Flat Belt Drive: Length of the Belt: Open and Cross drive types, Ratio of Tensions on tight side to slack side, Condition for maximum power transmission, Creep phenomenon, Methods for tensioning, Selection of Belts from catalogues, Design of Pulley for flat belt drive. Timing belt selection. V-Belt Drive: Nomenclature, Selection of V-Belts from catalogues. Chain Drive: Nomenclature of roller chains, Length and power rating of chains, Design of chain drive.	**6**
6	**Pressure vessels** Thin cylinder, Thin spherical vessels, Thick cylinders, Lame's equation, Clavarino's and Birnie's equations, Cylinder with external pressure, Autofrettage, Compound cylinder.	**6**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20 %	20 %	20 %	20 %	10 %	10 %

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. V B Bhandari, Design of Machine Elements, 3/e, McGraw Hill.
2. R C Juvinall, Fundamentals of Machine Component Design, 4/e, Wiley.
3. P C Gope, Machine Design: Fundamentals and Applications, 1/e PHI.
4. R L Norton, Machine Design An Introduction, Pearson.
5. E J Hearn, Mechanics of Materials, BH.

Bachelor of Engineering
Subject Code: ME2304
Subject Name: Machines Design - 1

List of Practical/ Tutorials:

1. Exercise on material selection for given application.
2. Design of mechanical components subjected to fluctuating loads.
3. Design of Coupling.
4. Design of springs.
5. Design of belt drives & Chain drive.
6. Design of pressure vessels.

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	**Study and selection** of materials for mechanical components.
CO-2	**Analyze** components subjected to fluctuating loads.
CO-3	**Illustrate** the design of coupling
CO-4	**Design** springs for mechanical application.
CO-5	**Explain** Selection of belt and chain drives for mechanical application.
CO-6	**Rectify** the design and failure of pressure vessel.

List of Open-Source Software/Learning Website:

- https://nptel.ac.in/courses

Bachelor of Engineering
Subject Code: ME2305
Subject Name: Recent advances in Renewable Energy

Shroff S.R. Rotary Institute of Chemical Technology

Semester: V

Type of course: Professional Elective Course

Prerequisite: Fluid Mechanics, Heat Transfer

Rationale: The course is designed to give knowledge of various renewable energy sources, systems and applications in the present context and need.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Scenario of Renewable Energy Sources:** Needs of renewable energy, advantages and limitations of RE, present energy scenario of conventional and RE sources	04
2	**Solar Energy:** Energy available from the sun, spectral distribution, solar radiation outside the earth's atmosphere and at the earth's surface, solar radiation geometry, Instruments for solar radiation measurements, empirical equations for prediction of availability of solar radiation, radiation on tilted surface Types of solar collectors, evacuated and non-evacuated solar air heater, concentrated collectors, thermal analysis of liquid flat plate collector and air heater, solar energy thermal storage, solar pumping, solar cooker, solar still, solar drier, solar refrigeration and air conditioning. Solar photovoltaic systems, solar cell types, modules and arrays. Basic principal and working of Hydrogen power generation.	08
3	**Wind Energy:** Energy available from wind, basics of lift and drag, basics of wind energy	6

	conversion system, effect of density, angle of attack and wind speed, windmill rotors, horizontal and vertical axes rotors, drag, lift, torque and power coefficients, tip speed ratio, solidity of turbine, wind turbine performance curves, wind energy potential and site selection, basics of wind farm	
SECTION-B		
4	**Bio Energy :** Types of biogas plants, biogas generation, factors affecting biogas generation, advantages and disadvantages, biomass energy, energy plantation, gasification, types and applications of gasifiers	04
5	**Ocean Energy:** OTEC principle, open, closed and hybrid cycle OTEC system, Energy from tides, estimation of tidal power, tidal power plants, single and double basin plants, site requirements, advantages and limitations, wave energy, wave energy conversion devices, advantages and disadvantages. **Geothermal energy:** Introduction, vapor and liquid dominated systems, binary cycle, hot dry rock resources, magma resources, advantages and disadvantages, applications **MHD Power generation:** concept and working principle	08
6	**Economic Analysis & Auditing:** Basic definitions, present worth calculations, repayment of loan in equal annual installments, annual savings, cumulative saving and life cycle cost, economic analysis of solar system, payback period, clean development mechanism Phases of Energy and Environmental Audits	06

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15%	20%	30%	15%	10%	10%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Solar Energy: Principles of Thermal Collection and Storage, S. P. Sukhatme and J. K. Nayak, McGraw-Hill Education
2. Solar Engineering of Thermal Processes, John A. Duffie, William A. Beckman, John Wiley, New York
3. Non-conventional energy resources, Shobh Nath Singh, Pearson India
4. Solar Energy Engineering, Soteris Kalogirou, Elsevier/Academic Press.
5. Principles of Solar Energy, Frank Krieth & John F Kreider, John Wiley, New York

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	Importance of Renewable Energy sources
CO-2	Understand the design and applications of power generating devices using solar energy
CO-3	Understand the design and applications of wind energy systems.
CO-4	Classified various biomass conversion methods and able to design/develop biogas plant
CO-5	Understand the design and working of Ocean energy and geothermal systems.
CO-6	Carry out preliminary economic analysis and environment & energy audit.

List of Open-Source Software/Learning Website:

http://nptel.ac.in

Bachelor of Engineering
Subject Code: ME2306
Subject Name: Tribology Engineering

Shroff S.R. Rotary Institute of Chemical Technology

Semester: V

Type of course: Program Elective course

Prerequisite: Kinematics and Theory of Machines, Engineering Materials, Fluid Mechanics and Machine Design

Rationale: The course aim is to understand the tribological concept, bearing design and its application, lubrication practices.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	00	00	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Introduction to Tribology:** Importance of Tribology in Design, Tribology in Industry, Economic Considerations, Lubrication- Definition, Lubricant properties, Viscosity, its measurements- Numerical, basic modes of lubrication, types of lubricants, Standard Grades of lubricants, selection of lubricants, commonly used lubricants and Hazards, Recycling of used oil, Disposal of used oil, bearing materials, bearing construction, oil seals and gaskets.	05
2	**Friction and Wear:** Introduction, Laws of friction, kinds of friction, causes of friction, area of contact, friction measurement, theories of friction. Types of wear, various factors affecting wear, measurement of wear, wear between solids and flowing liquids, theories of wear.	05
3	**Hydrodynamic Lubrication:** Theory of hydrodynamic lubrication, mechanism of pressure development in an oil film. Two-dimensional Reynolds equation,	06

	Petroff's equation, pressure distribution in journal bearings - long & short, Load Carrying capacity, Somerfield number and its importance- Numerical. Introduction to Hydrodynamic Thrust Bearing.	
	SECTION-B	
4	**Hydrostatic Lubrication:** Introduction to hydrostatic lubrication, hydrostatic step bearing, load carrying capacity and oil flow through the hydrostatic step bearing- Numerical. Hydrostatic squeeze film: basic concept, circular and rectangular plate approaching a plane- Numerical.	**05**
5	**Elasto-Hydrodynamic Lubrication and Gas Lubrication:** Elasto - hydrodynamic lubrication: Basic concept, Elasto-hydrodynamic lubrication between two contacting bodies, different regimes in EHL contacts. Gas lubrication: Introduction, merits and demerits, applications, externally pressurized gas bearings, porous gas bearings, and Dynamic characteristics of gas lubricated bearing.	**05**
6	**Surface Engineering:** Concept and scope of Surface engineering, surface topography, apparent and real area of contact, tribological behavior of asperities contact-contact stress, surface roughness and hydrodynamic action- Numerical, surface coating-plating, fusion process, vapor phase processes, selection of coating for wear and corrosion resistance. Behavior of tribological components- selection of bearings, plain bearings, gears, wire ropes, seals and packings, conveyor belts, other tribological measures.	**06**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20%	25%	25%	15%	10%	05%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Tribology, H.G. Phakatkar, R.R. Ghorpade, Nirali Prakashan.
2. Fundamental of Tribology, S.K. Basu, S. N. Sengupta, PHI Learning Private Ltd.
3. Introduction to Tribology and Bearings, Mujumdar B. C, S. Chand and Company Ltd.
4. Introduction to Tribology, Bharat Bhushan, Wiley Publication.
5. Basic Lubrication Theory, Cameron and C.M. Mc. Ettles, Wiley Eastern Ltd.
6. Surface Engineering for Corrosion and Wear Resistance, Davis J, Woodhead Publishing.
7. Surface Engineering of Metals: Principles, Equipments and Technologies, Tadeusz Burakowski, Tadeusz Wierzchon, CRC Press.

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	Recognize the properties of lubricants used in different bearings and industrial process.
CO-2	Explain laws of friction, topology of surfaces, modes of wear and the wear-mechanism maps.
CO-3	Solve mathematical models of hydrodynamic bearings.
CO-4	Apply mathematical model of hydrostatic bearings.
CO-5	Identify the application of elasto-hydrodynamic bearings and air/gas lubrication bearing.
CO-6	Illustrate the behavior of tribological components subjected to different working conditions and describe different tribological measures.

List of Open-Source Software/Learning Website:

- https://nptel.ac.in

Bachelor of Engineering
Subject Code: ME2307
Subject Name: Non Destructive Testing

Shroff S.R. Rotary Institute of Chemical Technology

Semester: V

Type of course: Professional Elective courses

Prerequisite: Basic Knowledge of Material Science and Metallurgy

Rationale: Non Destructive Testing is a study of different non-destructive methods to evaluate the condition of material/product manufactured to satisfy customers need as per their required quality standards. To impart comprehensive knowledge about differentiate various defect types and select the appropriate NDT methods and their industrial applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	00	00	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Introduction:** Fundamentals of an introduction to destructive and non-destructive testing. Scope and limitations of NDT, Visual examination methods, Different visual examination aids.	05
2	**Dye penetrant Testing / liquid penetrant testing:** Principle, procedure, characteristics of penetrant and types of penetrants, application, advantages and limitations. **Magnetic Particle Testing:** Principle, magnetizing technique, procedure, equipment, application, advantages and limitations.	06
3	**Ultrasonic Testing:** Basic principles of sound propagation, types of sound waves, Principle of UT, methods of UT, their advantages and limitations, Piezoelectric Material, Various types of transducers/probe, calibration methods, use of standard blocks, technique for normal beam inspection, flaw characterization technique, defects in welded products by UT, Thickness determination by ultrasonic method.	07

Bachelor of Engineering
Subject Code: ME2307
Subject Name: Non Destructive Testing

SECTION-B		
4	**Radiographic testing:** X-ray and Gamma-Ray radiography, Their principles, methods of generation, Industrial radiography techniques, inspection techniques, applications, limitations. Safety in industrial radiography.	**06**
5	**Eddy current testing:** Principle, instrument, techniques, sensitivity, application, limitation. Thermal methods of NDT. **Leak and pressure testing:** Definition of leak and types, Principle, Various methods of pressure and leak testing, Application and limitation.	**06**
6	**Recent Advances in NDT techniques:** Advance non-destructive testing techniques use in the industries. Phased Array Ultrasonic Testing (PAUT), Ultrasonic thickness measurement at High temperature (Up to 400'C), Corrosion Under Insulation (CUI).	**06**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10%	20%	40%	20%	10%	00%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Text Books:

1. O. P. Khanna, "A Textbook of Material Science and Metallurgy", Edition, 5, Dhanpat Rai, 1987.

Reference Books:

1. Practical Non-destructive Testing – Baldev Raj, T. Jayakumar & M. Thavasimuthu, Norosa Publishing House, New Delhi.

2. Treaties on Non-destructive testing, Vol. 1,2 & 3 Edited by Dr. E.G. Krishnadas Nair, NDT Centre, Hal, Bangalore.

3. Non-destructive testing, Warren J. McGonnagle, Gordon Breach, Science Publishers Ltd.

4. Ultrasonic Testing of Materials, J. Krautkramer & Herbert Krautkramer, Narosa Publishing House, New Delhi.

5. Non-destructive testing, R. Hatmshaw.

6. Ultrasonic Methods of Testing Materials, Leszek Filipezynski, Zdzislaw Pawlowski & Jerzywehr, Butterworths, London.

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	Understand the basic concept of destructive and non-destructive testing.
CO-2	Know the principle & use of Dye Penetrant and Magnetic Particle testing methods.
CO-3	Identify the application of Ultrasonic testing methods with their advantages & limitatio
CO-4	Illustrate the procedure, advantages, limitations & applications of X-ray & Gamma-ray radiography and Eddy current testing techniques.
CO-5	Describe and identify the various types of leaks in the cylinder.
CO-6	Recognize the recent advancement in non-destructive testing methods.

List of Open-Source Software/Learning Website:

- www.nptel.ac.in
- www.nde-ed.org

Bachelor of Engineering
Subject Code: ME2308
Subject Name: Entrepreneurship and E-business

Shroff S.R. Rotary Institute of Chemical Technology

Semester: V

Type of course: Open Elective Course

Prerequisite: Zeal to learn the subject

Rationale: Entrepreneurship and e-business subject is introduced with motive to develop entrepreneurial attitude in today's competitive environment. Further this subject creates awareness about adopted technologies in the business

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Entrepreneurship:** Characteristics of successful entrepreneurs; role of entrepreneurship in economic development; Entrepreneurship process; factors impacting emergence of entrepreneurship; managerial vs. entrepreneurial approach.	04
2	**Starting the venture and Feasibility study:** Generating business idea–sources of new ideas, methods of generating ideas, creative problem solving, opportunity recognition; environmental scanning, competitor, and industry analysis. Market feasibility, Technical /operational feasibility, Financial feasibility;	07
3	**Functional plans and sources of finances:** Marketing plan – marketing research for the new venture, steps in preparing marketing plan, contingency planning. Organizational plan - Form of ownership, designing organization structure, job design, manpower planning. Financial plan - cash budget, working capital, break even analysis. Debtor equity financing, commercial banks, venture capital; financial institutions supporting entrepreneurs.	07

Bachelor of Engineering
Subject Code: ME2308
Subject Name: Entrepreneurship and E-business

	SECTION-B	
4	**Overview of E – business and Collaborative Partnerships:** Concept of E-business, Business Success through adoption of technology, information management for business Initiatives, Performance improvement through e-business. Introduction to various collaborative partnerships, E-commerce: Sectors of e-commerce, B to C, B to B and C to C ecommerce, E-commerce success factors, clicks and Bricks in e-commerce, collaborative commerce. E-Marketplace, M-commerce, E-Government; Various E-business Models, Challenges of the E-Business Models, Globalization of E-business.	**07**
5	**Customer Relationship Management and Enterprise Resource Planning:** The evolution of CRM, functional areas of CRM, contemporary trends - SRM, PRM AND ERM, Future Trends of CRM; Core and Extended ERP; components of ERP system; Benefits and Risks of ERP implementation.	**07**
6	**Legal Issues and Ethics:** Intellectual property rights patents, trademarks, copyrights, trade secrets, licensing, Franchising. Ethics and Information, Ethical Computer Use Policy, Information Privacy Policy, E-mail Privacy Policy, Internet Use Policy, Employee Monitoring Policies.	**04**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10%	20%	25%	25%	10%	10%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Entrepreneurship (Fifth Edition 2002); Robert Hisrich, Michael Peters; Tata McGraw Hill Publication
2. Entrepreneurship: New venture creation by David Holt, Prentice Hall of India Pvt. Ltd.
3. Business Driven Technology – Haag/Baltzan/Philips – Tata McGraw Hill Publication
4. Management of Information Technology – Carroll W. Frenzel and John C. Frenzel, Thomson Press
5. e-Business 2.0 Roadmap for Success by Dr. Ravi Kalakota, Marcia Robinson, Pearson Education

6. E-commerce – A Managerial Perspective- P. T. Joseph, Prentice Hall India Publications.

List of Practical/ Tutorials: NIL

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	Understand basics of Entrepreneurship and factors impacting emergence of entrepreneurship.
CO-2	Determine various business ideas for starting a venture and carryout feasibility study.
CO-3	Demonstrate Entrepreneurship functional plans and identify source of finance.
CO-4	Describe basics of E business and collaborative partnership.
CO-5	Explain basics of Customer Relationship Management and Enterprise Resource Planning.
CO-6	Understand importance of ethics and IPR in Entrepreneurship and E-Business.

List of Open-Source Software/Learning Website:

- https://nptel.ac.in/

Bachelor of Engineering
Subject Code: ME2309
Subject Name: Ethics in Engineering

Shroff S.R. Rotary Institute of Chemical Technology

Semester: V

Type of course: Open Elective Course

Prerequisite: Zeal to learn the subject

Rationale: The course aims at providing fundamental knowledge of importance of ethics in engineering.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	00	00	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Concepts and theories of Business Ethics:** Definitions of Ethics, Personal ethics and Business ethics, Morality and law, How are moral standards formed? Religion and Morality, Morality, Etiquette and Professional codes, Indian Ethical Traditions.	06
2	**Business Ethics:** Principles of personal Ethics, Principles of Professional ethics, Evolution of Ethics Over the years, Honesty, Integrity and Transparency are the touchstones of Business Ethics, Distinction Between Values and Ethics, Roots of unethical Behaviour, Ethical Decision – Making	06
3	**Ethical Dilemmas, Sources and Their resolutions:** What is an Ethical Dilemma, Sources of Ethical Behaviour, Code of Personal Ethics for Employees, How to Resolve an Ethical Problem, How to Resolve Ethical Dilemmas.	06
	SECTION-B	
4	**Ethical Decision – marking in Business:** Ethical Models that Guide Decision making, Which Approach to use, Ethical Decision Marking with Cross – holder conflicts and competition, Applying Moral Philosophy to Ethical Decision Making, Kohlberg's	06

Bachelor of Engineering
Subject Code: ME2309
Subject Name: Ethics in Engineering

	Model of Cognitive Moral Development, Influences on Ethical Decision Making, Personal values and Ethical Decision Marking	
5	**Individual Factors:** Moral Philosophies and values – Moral Philosophy defined, Moral philosophies, Applying Moral Philosophy to Ethical decision Making, Cognitive moral Development, White – Collar Crime, Individual factors in Business Ethics	**07**
6	Human Values for Indian Managers, Lessons from Ancient Indian Education system, The law of Karma, Quality of Working life, Ethics of Vivekananda, Gandhiji, Aurobindo and Tagore.	**05**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
25%	20%	10%	20%	20%	05%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Business Ethics by AC Fernando
2. Business Ethics by Ferrell, Fraedrich and Ferrell.
3. Ethics in Management and Indian Ethos by Biswanath Gosh

Course Outcomes:

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

Sr. No.	**CO Statement**
CO-1	Awareness of types of ethical challenges and dilemmas confronting members of a range of professions (business, media, police, law, medicine, research)
CO-2	Identify and describe relevant theoretical concepts related to professional ethics in engineering
CO-3	Understand the basic perception of profession, professional ethics, various moral Issues & uses of ethical theories.
CO-4	Distinguish among morals, values, ethics, and the law and to explore how they each impact engineering practice
CO-5	To understand and identify the importance of individual factors in business ethics.
CO-6	Apply learning from Indian history and ethos to ethical practices in engineering.

List of Open-Source Software/Learning Website:

- https://www.nspe.org/
- https://onlineethics.org/

Bachelor of Engineering
Subject Code: ME2310
Subject Name: IOT and Applications

Shroff S.R. Rotary Institute of Chemical Technology

Semester: V

Type of course: Open Elective Course

Prerequisite: Zeal to learn the subject

Rationale: To make students know the IOT ecosystem. To provide an understanding of the Technologies and the standards relating to the Internet of Things. To develop skills on IOT technical Planning.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**IoT & Web Technology:** The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.	07
2	**M2M to IoT:** A Basic Perspective, Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, an emerging industrial structure for IoT, the international driven global value chain and global information monopolies. M2M to IoT, An Architectural Overview, Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.	07
3	**IoT Architecture -State of the Art** Introduction, State of the art, Architecture Reference Model, Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture, Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.	04

Bachelor of Engineering
Subject Code: ME2310
Subject Name: IOT and Applications

SECTION-B		
4	**IoT Applications for Value Creations:** Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT for Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.	**07**
5	**Internet of Things Privacy, Security and Governance:** Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smart Approach. Data Aggregation for the IoT in Smart Cities, Security.	**06**
6	**Internet of Things Security :** Security and Privacy for IoT Case Study: Smart Home, Smart Grid Network, Modern Vehicle, Wearable Computing & BYOD, Mobile HealthCare.	**05**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20%	20%	25%	15%	15%	05%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Dr. Jeeva Jose, Internet of Things, Khanna Publishing House.
2. Nitesh Dhanjani, Abusing the Internet of Things, Shroff Publisher/O'Reilly Publisher.
3. Internet of Things, RMD Sundaram Shriram K Vasudevan, Abhishek S Nagarajan, John Wiley and Sons.
4. Internet of Things, Shriram K Vasudevan, Abhishek S Nagarajan, RMD Sundaram, John Wiley & Sons.
5. Cuno Pfister, "Getting Started with the Internet of Things", Shroff Publisher/Maker Media.

Bachelor of Engineering
Subject Code: ME2310
Subject Name: IOT and Applications

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	Understand the technology and standards relating to IoTs.
CO-2	Evaluating the critical ecosystem required to mainstream IoTs.
CO-3	Acquire skills on developing their own national and enterprise level technical Strategies.
CO-4	Explore network security and how they are implemented in real world.
CO-5	Learn the basics of security and various types of security issues.
CO-6	Get an insight of various issues of Web security and Smart Home.

List of Open-Source Software/Learning Website:

www.nptel.ac.in

Shroff S.R. Rotary Institute of Chemical Technology

Type of course: Work-Personality Development

Prerequisite: To keep open mind and will to learn humanity for oneself and society.

Rationale: The Contributor Program aims to accomplish the following outcomes in the lives of students–

- Improve the employability of students by giving them the right work ethic and thinking that employers are looking for.
- Build their confidence with which they can go into any job and contribute meaningfully.
- Improve their ability to engage better in the workplace and to be able to handle the challenges that come up there.
- Build their career-worthiness and help them develop into future-ready contributors with ability to navigate a career in a volatile, changing world.
- Widen their choices of career and success, so that they are able to open up more opportunities for themselves and take up unconventional career pathways.
- Enable them to recognize how they, as technical professionals, can participate and make a positive contribution to their communities and to their state.

Towards this goal, the Contributor Program has been designed to awaken and strengthen students from within, in terms of building positive self-esteem, increasing their confidence level and I-can attitude, improving their aspirations, giving them new methods of thinking, building their cognitive capacities, exposing them to the skills and practices associated with being contributors in the workplace (not mere employees).

The Program content is also designed to expose students to real-world workplace scenarios and sensitize them to some of the challenges faced in society around them, especially in the local communities around them and in their own state of Gujarat.

The Contributor Program syllabus has been evolved and fine-tuned over several years, (a) to address the changing need and contemporary challenges being faced by industry and what employers of today are looking for in the people they hire and (b) by working extensively with universities and students building an appreciation of their challenges and concerns. At the core, the program is guided by the higher ideas and principles of practical Vedanta in work.

Bachelor of Engineering
Subject Code: MH2301
Subject Name: Contributor Personality Development Program – 1

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
1	1	0	2	50	30	00	20	100

Note:

- Weekly 2 hours of Classroom facilitated sessions are planned which include Solutioning and Self- discovery sessions.
- In addition, there will be individual/ team projects as part of Practical's. Students can do this on their own, with faculty as guide.

Note:

It is the responsibility of the institute heads that marks for PA of theory & ESE and PA of practical for each Students are entered online into the UPL University Portal at the end of each semester within the dates Specified by UPL University.

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**The Contributor Work Ideal** In this topic, students explore what is their "ideal" of work - is the ideal to be a "worker" or to be a "contributor"? For example, an employee who has the ideal of a "worker" goes to work to pass time, earn a living, get benefits; in contrast to an employee with the ideal of a "contributor" who wants to make a difference, get things done well, create value for the company. This enables students to transform their expectation of themselves in work	04 hrs Classroom engagement (including self-discovery/ solutioning sessions)

2	**Identity & Self-esteem** In this topic, students engage with the question "who am I?" or on what basis they define themselves. Is their identity defined by what others think of them (extrinsic self-esteem) or by what they think of themselves (intrinsic self-esteem)? Further, they discover positive identities that lead to intrinsic self-esteem, such as an I-can identity based on one's capacity and inner strength. This enables them to build confidence and self-esteem.	04 hrs Classroom engagement (including self-discovery/ solutioning sessions)
3	**Become a Creator of one's destiny** In a "victim stance", we see the career environment as full of difficulties and hurdles. We feel powerless or blame our circumstances for not having many opportunities. This makes us fearful of uncertainty and makes us settle for jobs where we remain mediocre. In this topic, students discover the "creator of destiny stance" to challenges and situations. This stance frees them to try out new things, open up new possibilities, take on responsibility, and see the opportunity hidden in their environment.	04 hrs Classroom engagement (including self- discovery/ solutioning sessions)
	SECTION-B	
4	**Achieving Sustainable Success** In this topic, students discover how to achieve sustainable or lasting success, by building one's "engine of success", making them success- worthy. Where their focus shifts to building one's "engine of success"rather than being on chasing the "fruits of success". This is important, because over a lifetime of work, all people go through ups and downs – where the fruits are not in their control. People who are focused on the fruits of success, fall prey to disappointment, loss in motivation, quitting too early, trying to find shortcuts – when fruits don't come. Whereas people focused on building their engine of success continue to contribute steadily, irrespective of whether fruits come or not. And with a strong engine of success, fruits come to them in time.	04 hrs Classroom engagement (including self- discovery/ solutioning sessions)

5	**Career Development Models** In this topic, students explore a range of diverse "career development models" and the possibilities for contribution each opens up to them (e.g. start-up career model, change-maker career model, etc.). This opens their mind to different and even unconventional career models possible, beyond the usual (such as "stable large company career model" where one gets an engineering degree, then MBA, then get a job in a large company). This frees them from a herd mentality when making career choices.	04 hrs Classroom engagement (including self- discovery/ solutioning sessions)
6	**Expanding contribution in every role** In this topic, students explore the many roles they can play in their life & discover the power they have to expand the contribution possible in any role. (E.g. role of student, role of manager, role of a project site engineer). So, the potential of a role is in the individual's hands. This opens their mind to an alternative way of career growth.	04 hrs Classroom engagement (including self- discovery/ solutioning sessions)

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
-	**20**	**20**	**20**	**20**	**20**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference resources:

A. Basic reference for both students and teachers

1. Contributor Personality Program textbook cum workbook developed by Illumine

2. Web-based ActivGuide™ for self-exploration of rich media resources to vividly understand many of the ideas, watch role models, learn from industry people, get reference readings – that help them enrich the understanding they gained in the class published by Illumine Foundation

B. Advanced reference for teachers

1. On Contributors, Srinivas V.; Illumine Ideas, 2011
2. Enlightened Citizenship and Democracy; Swami Ranganathananda, Bharatiya Vidya Bhavan, 1989
3. Eternal Values for a Changing Society – Vol I-IV, Swami Ranganathananda; Bharatiya Vidya Bhavan
4. Karma Yoga, Swami Vivekananda; Advaita Ashrama
5. Vivekananda: His Call to the Nation, Swami Vivekananda; Advaita Ashrama
6. Six Pillars of Self Esteem, Nathaniel Branden; Bantam, 1995
7. Mindset: The New Psychology of Success, Carol S. Dweck; Random House Publishing Group, 2007
8. Lasting Contribution: How to Think, Plan, and Act to Accomplish Meaningful Work, Tad Waddington; Agate Publishing, 2007
9. Why not?: how to use everyday ingenuity to solve problems big and small, Barry Nalebuff, Ian Ayres; Harvard Business School Press, 2003
10. The value mindset: returning to the first principles of capitalist enterprise (Ch 8 & 9); Erik Stern, Mike Hutchinson; John Wiley and Sons, 2004
11. The Power of Full Engagement: Managing Energy, Not Time, is the Key to High Performance and Personal Renewal, Jim Loehr, Tony Schwartz; Simon and Schuster, 2003
12. Creating Shared Value, Michael E. Porter and Mark R. Kramer; Harvard Business Review; Jan/Feb2011, Vol. 89 Issue 1/2
13. The Speed of Trust: The One Thing That Changes Everything, Stephen M. R. Covey, Rebecca,R. Merrill, Stephen R. Covey; Free Press, 2008
14. The Courage to Meet the Demands of Reality, Henry Cloud; HarperCollins, 2009
15. Responsibility at work: how leading professionals act (or don't act) responsibly, Howard Gardner; John Wiley & Sons, 200

Bachelor of Engineering
Subject Code: MH2301
Subject Name: Contributor Personality Development Program – 1

Course Outcomes:

Students will be able to:

Sr. No.	CO statement
CO-1	Students will be able to recognize & appreciate two alternative ideals of work – "worker" and "contributor".
CO-2	Students will be able to recognize & appreciate alternative ways in which they could define themselves & their identity – that will lead to building intrinsic self-esteem and confidence in oneself.
CO-3	Students will be able to recognize & appreciate the way people approach challenges and situations; and how it frees individuals to take on challenges and open up Opportunities.
CO-4	Students will be able to differentiate between two alternative approaches to success - 'building one's engine of success' and 'chasing the fruits of success'Lead to sustainable or lasting success in the long run.
CO-5	Students will be able to recognize & appreciate different career models and their Value; to help them make more informed career-related choices.
CO-6	Students will be able to recognize & appreciate how one can expand the contribution possible in any role, thereby opening up an alternative way of career Growth to them.

Prepared By: Ms. Aakancha Sanjeev Kumar

Moderated By: Dr Purvi Naik

Bachelor of Engineering
Subject Code: ME2311
Subject Name: Dynamics of Machinery

Shroff S.R. Rotary Institute of Chemical Technology

Semester: VI

Type of course: Programme Core Course

Prerequisite: Kinematics and Theory of Machines

Rationale: The course is designed to give fundamental knowledge of behavior of machines under dynamic condition. To analyze the effects of unbalance forces and vibrations on the systems and techniques to determine them and counter them.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Dynamic force analysis of mechanisms::** Introduction, D'alembert's principle, equivalent offset inertia force, dynamic analysis of four link mechanism, dynamic analysis of slider crank mechanism, velocity & acceleration of piston, angular velocity & angular acceleration of connecting rod, engine force analysis, dynamically equivalent system inertia of the connecting rod, inertia force in reciprocating engines.	05
2	**Balancing of Rotating Masses:** Concept of static and dynamic balancing, Analysis of effect of unbalanced masses in single and multiple planes in rotating elements, Approaches and equipment for measurement of unbalanced masses.	05
3	**Balancing of Reciprocating Masses:** Introduction, Partial balancing of reciprocating mass, Balancing of locomotives, Effects of partial balancing in locomotives, Multi Cylinder Engines: Effect of phase angles, firing order and number of strokes, Balancing of V-engines, Balancing of Radial engines.	08
	SECTION-B	
4	**Free vibrations and damped free vibrations:** Introduction, Types of vibrations, elements constituting vibration, spring mass system, free undamped vibrations, equation of motion, equivalent	09

	spring stiffness, free damped vibrations, equation of motion for viscous damper, damping factor, under damped system, critically damped system, over damped system, logarithmic decrement, free torsional vibration of a two and three rotor system, torsionally equivalent shaft, torsional vibration of a geared system.	
5	**Forced damped vibrations:** Analytical solution of forced damped vibration, vector representation of forced vibrations, Magnification factor, force transmissibility, forced vibration with rotating and reciprocating unbalance, forced vibration due to excitation of support.	**06**
6	**Critical speeds of shafts:** Whirling of shafts, Critical speed and its practical importance in the design of shafts, Application of Dunkerley's method and Rayleigh's method for estimating the critical speed of shafts. **Vibration Measurement:** Introduction to vibration measurement and analysis devices: Vibrometer, velocity pickup, accelerometer, FFT analyser.	**03**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10%	15%	15%	35%	20%	05%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Theory of Machines, Rattan S. S., Tata McGraw-Hill.
2. Mechanical Vibrations, V. P. Singh, Dhanpat Rai & Co.
3. Mechanical Vibrations, S. S. Rao, Pearson Education.
4. Mechanical Vibration and Noise Engineering, A. G. Ambekar, PHI Learning Pvt. Ltd..
5. Dynamics of Machinery, Farazdak Haideri, Nirali Publication,
6. Kinematics and Dynamics of Machinery, R. L.Norton, McGraw-Hill.
7. Theory of Mechanisms and Machines, A. Ghosh & A. K. Malik, East-West Press.
8. Theory of Machines: Kinematics and Dynamics, Sadhu Singh, Pearson.
9. Dynamics of Machines, S. Balaguru, Cengage Learning India Pvt. Ltd.
10. Mechanical Vibration by Schaum Series, Mc-Graw Hill.

11. , Engineering Mechanics,Dynamics, J.L. Meriam, L.G. Kraige John & Wiley Sons Inc.

List of Practical/ Tutorials:

1. To analyzing the concept of statically and dynamically balancing of rotating masses.
2. To study the oscillations of simple pendulum.
3. To determine the radius of gyration of a compound pendulum and bi-filar suspension.
4. To study the natural vibrations of a spring mass system.
5. To study the Torsional vibrations of single rotor system.
6. To study the Torsional vibrations of two rotor system.
7. To study the Damped Torsional vibrations of single rotor system.
8. To study Undamped force vibrations of a spring mass system.
9. To study forced damped vibrations of a spring mass system.
10. To verify Dunkerley's rule for transverse vibrations.
11. To determine whirling speed of the shaft and study effect of shaft diameter and end conditions on the same.

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	**Analyze** static and dynamic forces on mechanisms.
CO-2	**Describe** basic terminology of balancing & vibration and its significance on engineering design.
CO-3	**Illustrate** analytical and graphical techniques for calculating balancing of rotar reciprocating masses.
CO-4	**Find** natural frequency of mechanical systems represented in lumped form.
CO-5	**Explain** critical speed of shafts with unbalanced rotors.
CO-6	**Measure** vibrations, vibration characteristics and **use** various methods for vibration control for real life problem.

List of Open-Source Software/Learning Website:

- http://nptel.ac.in

Bachelor of Engineering
Subject Code: ME2312
Subject Name: Machine Design II

Shroff S.R. Rotary Institute of Chemical Technology

Semester: VI

Type of course: Professional Core Course

Prerequisite: Machine Design I

Rationale: This course is essential to introduce the design of elements of machines and their functionality for gear, gear box and IC Engine component.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Gear Design:** Classification of gears, Selection of type of gears, Law of Gearing, Gear terminology, Standard system of gear tooth, force analysis, Interference and undercutting, number of teeth, gear tooth failures, selection of material. **Spur and Helical Gears:** Stress in gear tooth: Lewis formula, AGMA bending stress equation and AGMA pitting resistance formula, Gear quality and selection aspects. **Bevel and Worm gears:** Specifications and design of bevel and worm gears.	**08**
2	**Design of Gear Box for Machine Tools:** Comparison and Choice of progression (Arithmetic, Geometric, Harmonic and Logarithmic), general design procedure, selection of the best structure diagram, selection of gear layout and ray diagram, determination of number of teeth on gears.	**06**
3	**Material Handling Equipment:** Basic objectives of material handling system, Types of load, Classification and application of various Material handling equipment, Basic principles in selection of material handling system. Classification	**04**

	of cranes. Steel Wire ropes: Classification and coding.	
SECTION-B		
4	**Rolling Contact Bearings:** Classification, Static load carrying capacity, Stribeck's equation, Dynamic load carrying capacity, Equivalent bearing load, Load-Life relation, Selection of bearing life, Load factor, Selection of bearing from catalogue, Design for cyclic loads and speeds, Bearing with probability of survival other than 90%, Selection of taper roller bearing, Bearing failure, Lubrication of rolling contact bearing.	**07**
5	**Sliding contact bearings:** Basic mode of lubrication, Measurement of viscosity, Viscosity index, Petroff's equation, McKee's equations, Interpretation of Reynold's equation, Difference between hydrodynamic and hydrostatic bearing, Performance parameters for journal bearings, Bearing design – selection of parameters for journal bearing.	**06**
6	**IC Engine Components:** Design of cylinder and Cylinder head, Design of piston & Design of valve-gear mechanism.	**05**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15 %	25 %	25 %	20 %	10 %	05 %

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. R L Norton, Machine Design An Introduction, Pearson.
2. R G Budynas, and K J Nisbett, Shigley's Mechanical Engineering Design, McGraw-Hill
3. V B Bhandari, Design of Machine Elements, 3/e, McGraw Hill.

4. V B Bhandari, Machine Design Databook, McGraw Hill.
5. R C Juvinall, Fundamentals of Machine Component Design, 4/e, Wiley.
6. P C Gope, Machine Design: Fundamentals and Applications, 1/e PHI.

List of Practical/ Tutorials:

1. Design of Spur Gears & Helical Gear.
3. Design of Bevel Gear & Worm and Worm wheel.
5. Design of Gearbox.
7. Selection of Rolling Contact bearing.
6. Design of Sliding contact Bearing
7. Design of IC engine components.
8. Study of Various type of Material Handling Equipment.

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	**Study** of gears design and its failure.
CO-2	**Design** of Multi Speed Gear Box.
CO-3	**Illustrate** the application for Material Handling Equipment.
CO-4	**Explain** the design of Rolling Contact bearing
CO-5	**Evaluate** the design principle of Sliding contact bearing
CO-6	**Analyze** the design of IC Engine component.

List of Open-Source Software/Learning Website:

- www.nptel.ac.in

Bachelor of Engineering
Subject Code: ME2313
Subject Name: Internal Combustion Engine

Shroff S.R. Rotary Institute of Chemical Technology

Semester: VI

Type of course: Professional Elective Course

Prerequisite: Zeal to learn the subject and basics of Thermodynamics

Rationale:

The course aims at providing fundamental knowledge of internal combustion engines. The principles that govern engine operation and working are discussed. The course is a basic course in Internal Combustion Engines that provides the student with sufficient knowledge to take active part in design and development work within the automotive industry.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Introduction:** Comparison of SI and CI Engines, Difference in thermodynamic and operating variables, comparison of performance characteristics, comparison of initial and maintenance costs application of SI and CI engine.	03
2	**Fuels and its supply system for SI and CI engine:** Important qualities of IC engine fuels, rating of fuels, Carburetion, mixture requirement for different loads and speeds, simple carburetor and its working, types of carburetors, MPFI, types of injection systems in CI engine, fuel pumps and injectors, types of nozzles, spray formation.	07
3	**Combustion in SI and CI Engines:** Combustion equations, calculations of air requirement in I C Engine, stoichiometric air fuel ratio, proximate and ultimate analysis, enthalpy of formation, adiabatic flame temperature.	08

	Stages of combustion in SI engines, abnormal combustion and knocking in SI engines, factors affecting knocking, effects of knocking, control of knocking, combustion chambers for SI engines, Stages of combustion in CI engines, detonation in C.I. engines, factors affecting detonation, controlling detonation, combustion chamber for SI and CI engine	
SECTION-B		
4	**Engine lubrication:** Types of lubricants and their properties, SAE rating of lubricants, Types of lubrication systems **Engine Cooling:** Necessity of engine cooling, disadvantages of overcooling, Cooling systems and their comparison: Air cooling, Liquid cooling **Supercharging/Turbo-charging:** Objectives, Limitations, Methods and Types, Different arrangements of turbochargers and superchargers **Emission of IC engine:** Emission from SI engine, effect of engine maintenance on exhaust emission control of SI engine, diesel emission, diesel smoke and control, diesel and control comparison of gasoline and diesel emission. Measurement and calculation for of emission constituents.	**07**
5	**Rating, Testing and Performance:** Measurements of speed, air flow, fuel consumption, indicated power brake power, frictional horse power, and smoke, testing of engines as per Indian Standard 10001, performance test for variable speed I C Engines, heat balance sheet, governing test for constant speed IC engines, effect of fuel injection parameters in CI engines and ignition advance of SI engines on performance of engine. Rating of internal combustion engine based on (I) continuous operation of engine (II) Maximum power an engine can develop (III) Power calculated from empirical formula, Trouble Shooting and Overhauling of Engines.	**08**
6	**Induction to Hybrid Electric Vehicle:** Social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid Drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis. **Indian & Global Scenarios in Electric:** Vehicles Technology Scenario, Market Scenario, Policies & Regulations, Payback & Commercial Model, Policies in India.	**03**

Bachelor of Engineering
Subject Code: ME2313
Subject Name: Internal Combustion Engine

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
25%	30%	30%	10%	5%	00%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. I. C. Engines by Heywood.
2. I. C. Engines by Mathur& Sharma, Dhanpatrai
3. I. C. Engines by V.Ganeshan, Tata McGraw Hill
4. I. C. Engines by Domkundwar&Domkundwar, Dhanpatrai
5. I. C. Engines by R.K.Rajput, LaxmiPrakashan
6. Electric and Hybrid Vehicles: Design Fundamentals by Iqbal Hussein, CRC Press, 2003.
7. Electric Vehicle Technology by James Larminie, John Lowry, Wiley, 2003.

List of Practical/ Tutorials:

1. To demonstrate various engines and their components.
2. Demonstration of valve timing diagram
3. To demonstrate about the fuel injection system for C.I. Engine
4. To demonstrate about carburetor and its types.
5. To carry out the performance analysis of single cylinder two stroke petrol engine.
6. To carry out the performance analysis of multi cylinder four stroke petrol engine.
7. To carry out the performance analysis of multi cylinder four stroke diesel engine.
8. To carry out various Performance tests: Morse Test and William Line Plot

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	Describe and explain the major phenomena going on in an internal combustion engine such as gas exchange, combustion and emissions formation/reduction.
CO-2	To understand working of different fuel supply system of internal combustion engine.
CO-3	Analyze the combustion phenomena occurring in internal combustion engine.

CO-4	Understand the need of lubrication, cooling and supercharging systems of internal combustion engine.
CO-5	Explain the performance and evaluation of internal combustion engine and to discuss how this is affected.
CO-6	To aware about the alternative fuels and their properties and brief the latest development of unconventional engines.

List of Open-Source Software/Learning Website:

- https://nptel.ac.in

Bachelor of Engineering
Subject Code: ME2314
Subject Name: Design of Heat Exchanger

Shroff S.R. Rotary Institute of Chemical Technology

Semester: VI

Type of course: Professional Elective Course

Prerequisite: Engineering Thermodynamics, Fluid Mechanics, Heat Transfer

Rationale: The course is design to provide fundamental knowledge of different type of heat exchangers used for thermal application and to learn the sizing of heat exchangers, thermal analysis for various heat exchange applications.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Heat Exchangers:** Classification of heat exchangers, Classification according to transfer processes, number of passes, surface compactness, construction features, flow arrangements, heat transfer mechanisms, selection of heat exchanger, Shell and tube heat exchanger, fouling, concept of overall heat transfer coefficient.	03
2	**Basic design methodologies for heat exchanger:** LMTD method for heat exchanger analysis, Correction factor for LMTD, Sizing and rating problem using LMTD method in parallel, counter, multi-pass and cross flow heat exchanger, Determination of area, length, number of tubes required for a given duty in different configurations using LMTD method of analysis. Concept of Effectiveness- NTU method, definition of effectiveness, e-NTU method for heat exchanger analysis, fouling, cleanliness factor, percent over surface, techniques to control fouling, additives, rating and sizing problems, heat exchanger design methodology.	09

Bachelor of Engineering
Subject Code: ME2314
Subject Name: Design of Heat Exchanger

3	**Design of double pipe heat exchangers:** Thermal and hydraulic design of inner tube and annulus, hairpin heat exchanger with bare and finned inner tube, total pressure drop	**06**
SECTION-B		
4	**Design of Shell & tube heat exchangers:** Basic components, basic design procedure of heat exchanger, TEMA code, J-factors, conventional design methods, Bell-Delaware method.	**07**
5	**Design of compact heat exchangers:** Heat transfer enhancement, plate fin heat exchanger, tube fin heat exchanger, heat transfer and pressure drop	**07**
6	**Heat Transfer Enhancement and Performance Evaluation:** Enhancement of heat transfer, Performance evaluation of Heat Transfer Enhancement technique. Introduction to pinch analysis.	**04**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15%	15%	20%	25%	20%	05%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Heat Exchanger Selection, Rating and Thermal Design by Sadik, Kakac, CRC Press
2. Fundamentals of Heat Exchanger Design by Ramesh K Shah, Wiley Publication
3. Compact Heat Exchangers by Kays, V.A. and London, A.L., McGraw Hill
4. Heat Exchanger Design Handbook by Kuppan, T, Macel Dekker, CRC Press
5. Heat Exchanger Design Hand Book by Schunder E.U., Hemisphere Pub.
6. Process Heat transfer by Donald Q Kern, McGraw Hill

Bachelor of Engineering
Subject Code: ME2314
Subject Name: Design of Heat Exchanger

List of Practical/ Tutorials:

1. Design of heat exchange equipment by using LMTD method.
2. Design of heat exchange equipment by using effectiveness– NTU method.
3. Measure the effectiveness of shell and tube heat exchanger.
4. Design and analysis of Parallel flow and Counter flow heat exchanger.
5. Design and analysis of Shell and tube type heat exchanger.
6. Design and analysis of Plate type heat exchanger.

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	Understand classification and selection of Heat Exchanger
CO-2	Demonstrate Basic design methodologies for heat exchanger
CO-3	Design of double pipe heat exchangers:
CO-4	Analyze Shell & tube heat exchangers:
CO-5	Design of compact heat exchangers:
CO-6	Evaluate Heat Transfer Enhancement and Performance Evaluation

List of Open-Source Software/Learning Website:

www.nptel.ac.in

Bachelor of Engineering
Subject Code: ME2315
Subject Name: Cryogenic Engineering

Shroff S. R. Rotary Institute of Chemical Technology

Semester: VI

Type of course: Professional Elective Course

Prerequisite: Basic knowledge of thermodynamics, Heat transfer, Refrigeration and Air-conditioning

Rationale: The course is designed to give fundamental knowledge of types of cryogenic engineering, fluids, behavior of materials and properties at low temperature, cryogenic hazards and prevention, safety, cryogenic refrigeration and liquefaction, insulation, system requirement and measuring instruments.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Introduction:** Properties of Cryogenic Fluids, Properties of Cryogenic Materials, Super conductivity, Hazards and prevention, Safety in cryogenic fluid handling, storage and use.	04
2	**Applications of cryogenic systems:** Super conductive devices such as bearings, motors, cryotrons, magnets, D.C. transformers, tunnel diodes, space technology, space simulation, cryogenics in biology and medicine, food preservation and industrial applications, nuclear propulsions, chemical propulsions.	07
3	**Cryogenic Refrigeration & Liquefaction:** Refrigeration: Ideal isothermal and reversible isobaric source refrigeration cycles, Joule Thomson system, cascade or pre-cooled joule–Thomson refrigeration systems, COP, FOM Liquefaction: Introduction, Principle and Methods of production of low temperature	07

Bachelor of Engineering
Subject Code: ME2315
Subject Name: Cryogenic Engineering

SECTION-B		
4	**Cryogenic insulation:** Types of insulation, vacuum insulation, evacuated powder & fibrous insulation, opacified powder insulation, multi-layer insulation, comparison of performance of various insulations.	**04**
5	**Cryogenic System Requirements:** Cryogenics Heat Exchangers, Compressors, Expanders, Effect of various parameters in performance and system optimization, Storage equipment for cryogenic fluids, industrial storage and transfer of cryogenic fluids	**09**
6	**Cryogenic instrumentation:** Properties and characteristics of instrumentation, strain displacement, pressure, flow, liquid level, density and temperature measurement in cryogenic range.	**05**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10%	30%	35%	10%	10%	05%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Cryogenic fundamentals by Haselden, Academic press New York
2. Cryogenic systems by Baron, McGraw-Hill book
3. Cryogenic technology by Vance
4. Low Temperature Superconductivity & Superconductivity by Christian Enss & Siegfried Hunklinger
5. Cryogenic engineering by T. M. Flynn
6. Cryogenic engineering by Scott

Bachelor of Engineering
Subject Code: ME2315
Subject Name: Cryogenic Engineering

List of Practical/ Tutorials:

1. Study of cryogenic properties of hydrogen and helium.
2. Study of low temperature measurement instrument.
3. Study of flow measurement and quality measurement instrument.
4. Study of liquid level measurement.
5. Study of insulation used in cryogenic equipment.
6. Study of cryogenic application in space technology.
7. Study of cryogenic application in bio medical and food preservation.
8. Study of ideal liquefaction system

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	Illustrate basic knowledge of cryogenics, materials, fluids, hazard & safety
CO-2	Study of various applications of cryogenics
CO-3	Analyze design of cryogenic systems
CO-4	Understand cryogenic insulation and its types
CO-5	Explain various requirements of cryogenic systems
CO-6	Demonstrate cryogenic instrumentations

List of Open-Source Software/Learning Website:

- https://www.nptel.ac.in

Bachelor of Engineering
Subject Code: ME2316
Subject Name: Product Design and Value Engineering

Shroff S.R. Rotary Institute of Chemical Technology

Semester: VI

Type of course: Professional Elective course

Prerequisite: NIL

Rationale: The product development through engineering aspects is always remains challenges to engineers. The aim of present course is to introduce the students about the basic product design process based on mechanical aspects applying innovative thinking and fundamentals of mechanical engineering.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Product Design:** Introduction, Product life cycles, Characteristics of Successful Product development, Design and development of Products, Types of Design and Redesigns, Engineering Designs, Duration and cost of product development, The challenges of Product development.	05
2	**Product Design Methods:** Design for manufacturing and assembly, Design for Maintainability, Design for Environment, Legal factors and Social issues, Engineering Ethics and Issues of society related to design of products, Design for safety, Vision and Illumination design: Climate, Noise, Motion, Sound and Vibration, Product Costing	07
3	**Product Development Processes and Product Planning:** A generic development process, concept development: the front-end process, adopting the generic product development process, the AMF development process, product development organizations, the AMF organization. The product planning process, identify opportunities, Evaluate and prioritize projects, allocate resources and plan timing, complete pre-project planning, reflect all the results and the process.	06

Bachelor of Engineering
Subject Code: ME2316
Subject Name: Product Design and Value Engineering

SECTION-B		
4	**Identifying Customer Needs:** Customer Satisfaction: Voice of customer, Customer Populations, Types of customer needs, Customer need models; Gathering Customer needs: Need Gathering Methods: Conducting Interviews: Like Dislike Method, Articulated-Use Method, Product feel and Industrial Design, Organizing and Prioritizing Needs: Grouping Interpreted needs, Affinity Diagram, Determining need Importance, Customer use patterns, Customers need Documentation.	**06**
5	**Value Engineering Introduction:** Definition, value engineering recommendations, programmes, advantages, Evaluation of function, determining function, classifying function, evaluation of costs, evaluation of worth, determining worth, evaluation of value. **Value Engineering Job Plan:** Introduction, orientation, information phase, Function phase, creation phase, evaluation phase, Investigation phase, implementation phase, speculation phase, analysis phase.	**05**
6	**Selection of Evaluation of Value Engineering Projects:** Project selection, Methods selection, value standards, application of Value Engineering methodology. **Initiating Value Engineering Programme:** Introduction, training plan, career development for Value Engineering specialties. **Fast Diagramming:** Cost models, life cycle costs.	**07**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10%	25%	30%	20%	10%	05%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Product Design, by Kevin Otto, Kristin wood, Pearson Education Inc.
2. Product design and development, by K.T. Ulrich and S.D. Eppinger, Tata McGraw Hill
3. Product Development, by Chitale & Gupta, Tata McGraw Hill

4. The Mechanical Process Design, by David Ullman, McGraw hill Inc
5. Engineering Design Process, by Yousef Haik, T M M Shahin, Cengage Learning
6. Product design & process Engineering by Niebel & deeper, McGraw hill
7. Value Management by Heller, Addison Wasley
8. Value Engineering A how to Manual S. S. Iyer, New age International Publishers
9. Value Engineering : A Systematic Approach by Arthur E. Mudge - Mc GrawHill
10. New Product Development Timjones. Butterworth Heinmann, Oxford.
11. Value Engineering A how to Manual S. S. Iyer, New age International Publishers
12. Value Engineering : A Systematic Approach by Arthur E. Mudge - Mc GrawHill

List of Practical/ Tutorials: NA

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	**Describe** the characteristics used for product design and development.
CO-2	**Explain** generic product development process.
CO-3	**Illustrate** the steps in product planning process.
CO-4	**Assess** the customer requirements in product design.
CO-5	**Identify** various aspects of design such as industrial design, design for manufacture, assembly, service and quality and product architecture.
CO-6	**Propose** value engineering and analysis aspects in product design & development and practical.

List of Open-Source Software/Learning Website:

- http://nptel.ac.in

Bachelor of Engineering
Subject Code: ME2317
Subject Name: Industrial Engineering

Shroff S.R. Rotary Institute of Chemical Technology

Semester: VI

Type of course: Professional Elective course

Prerequisite: NIL

Rationale: Basics of Industrial Engineering course is to prepare students to understand different aspects like: Plant location and its selection, Plant layout within the plant. It also helps to understand and apply different concept of production planning and control. Study of productivity and Work-study are important tools, after studying it student are able to apply it in the industry for productivity enhancement. This course gives idea about how to prepare job plan, and also gives knowledge of industrial legislation. Finally it provides knowledge about different aspects related to quality.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Plant Location And Layout:** Introduction and Meaning, Need for Selecting a Suitable Location, Factors Influencing Plant Location, Choice of site for selection, Comparison of location, Location Models, Locational Economics, Objectives & Principles of Plant layout, , Types of layout, Factors affecting layout, Factors governing flow pattern, travel chart, analytical tools of plant layout, layout of manufacturing shop floor, repair shop, services sectors and process plant.	05
2	**Production Planning and Control:** Types of Production systems and their Characteristics, functions and objectives of Production Planning and Control, Sales forecasting: Techniques and Applications, Steps of Production Planning and Control: Process planning, Scheduling, Sequencing, Aggregate Planning, Master Production Schedule, Material Requirement Planning, Dispatching, Loading and Expediting with illustrative examples.	08
3	**Productivity and Work Study:**	08

	Definition of productivity, application and advantages of productivity improvement tools, reasons for increase and decreases in productivity. Areas of application of work study in industry. Reaction of management and labour to work study. **Method Study:** Objectives and procedure for methods analysis, Recording techniques, Operations Process Chart, Flow Process Chart, Man-Machine, Multiple Activity Chart, Travel Chart, Two Handed process chart, String Diagram, Therbligs. **Micro motion and macro-motion study:** Principles of motion economy, Normal work areas and work place design. **Work Measurement:** Objectives, Work measurement techniques – time study, Determination of time standards. Observed time, basic time, normal time, rating factors, allowances, and standard time, Introduction to ergonomics.	
SECTION-B		
4	**Job Evaluation and Wage Plan:** Objective, Methods of job evaluation, job evaluation procedure, merit rating (Performance appraisal), method of merit rating, wage and wage incentive plans.	**05**
5	**Industrial Legislation:** Need for Industrial legislation, Factories act 1948, Industrial dispute act 1947, The Indian trade unions act 1926, Industrial employment act 1946, Payment of wage act 1936, Workmen compensation act 1923, Payment of bonus act 1965, Employees provident fund scheme 1952.	**05**
6	**Inspection and Statistical Quality Control:** Inspection – functions, types, objectives and benefits, quality control principles, Concepts of quality circles, Total quality management, Quality assurance, Quality audit, Basic Concept ISO 9000, ISO 14000 and QS 9000, Six sigma: Concept, Principle, Methodology, Scope, Advantage and limitations. SQC Concept, variable and attributes, normal distribution curves and its property charts for variable and attributes and their applications and interpretation (analysis) process capability. Acceptance sampling, sampling plans, OC curves and AOQ curves.	**08**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10%	15%	25%	30%	15%	05%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Manufacturing Organisation and Management, Harold Amrine, John Ritchey, Moodie, Kmec, 6ht Ed., Pearson
2. Production System, Planning, Analysis and Control – By J.L. Riggs 3rd ed. Wiley
3. Production and Operations Management – By R. Panneerselvam, PHI Private Ltd.,
4. Industrial Engineering and Production Management Martand Telsang S Chand & company.
5. Industrial Engineering and Production Management by Banga and Sharma, Khanna Publishers.
6. Industrial Engineering and Management by Dr. B. Kumar Khanna Publishers
7. Work study by International Labour Organization, ILO

List of Practical/ Tutorials: NA

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	**Describe** location decision, site selection and plant layout.
CO-2	**Illustrate** production planning and control.
CO-3	**Analyse** various techniques of method study and work measurement for enhancement of productivity.
CO-4	**Propose** method/procedure for job evaluation and devise appropriate wage.
CO-5	**Apply** statistical quality control techniques for inspection.
CO-6	**Explain** industrial legislation.

List of Open-Source Software/Learning Website:

- http://nptel.ac.in

Bachelor of Engineering
Subject Code: ME2318
Subject Name: Rapid Prototyping

Shroff S.R. Rotary Institute of Chemical Technology

Semester: VI

Type of course: Professional Elective Course

Prerequisite: Zeal to learn the subject

Rationale: In present era it is highly essential to be able to prepare final product or its prototypes at the earliest. This is desirable to ensure that all the expected requirement of product are addressed and if required, its performance is also assessed from the prototype. Rapid prototyping offers a convenient option for manufacturing of product or its prototype from the CAD model.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Introduction:** Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Classification of Rapid Manufacturing Processes: Additive, Subtractive, Formative, Generic RP process.	4
2	**CAD Modelling** for RP: CAD model preparation, basics of data interfacing: formats (STL, SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP), conversation, validity checks, repair procedures.	7
3	**Data Processing** for rapid prototyping for Part orientation and support generation, Support structure design, Model Slicing algorithms and contour data organization, direct and adaptive slicing, Tool path generation.	7

Bachelor of Engineering
Subject Code: ME2318
Subject Name: Rapid Prototyping

SECTION-B		
4	**Basics of Rapid Prototyping Processes:** Process Physics, Tooling, Process Analysis, Material and technological aspects, Applications, limitations and comparison of various rapid manufacturing processes.	**4**
5	**Basics and Application of RP Processes:** Photopolymerization (Stereolithography (SL), Micro-stereolithography), Powder Bed Fusion (Selective laser Sintering (SLS), Electron Beam melting (EBM)), Extrusion-Based RP Systems (Fused Deposition Modelling (FDM)), 3D Printing, Sheet Lamination (Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC)), Beam Deposition (Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD)).	**9**
6	**Errors in RP Processes:** Pre-processing, processing, post-processing errors, Part building errors in SLA, SLS.	**5**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20%	20%	30%	10%	10%	10%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Chua C K, Leong K F, Chu S L, Rapid Prototyping: Principles and Applications in Manufacturing, World Scientific.
2. Gibson D W Rosen, Brent Stucker., Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer.
3. Noorani R, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons.
4. Liou W L, Liou F W, Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press.

5. Kamrani A K, Nasr E A, Rapid Prototyping: Theory and practice, Springer,

List of Practical/ Tutorials: NIL

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	Understand the basics and applications of Rapid Prototyping.
CO-2	Generate/use/convert the CAD model for rapid prototyping
CO-3	Process the CAD model for generating part with rapid prototyping
CO-4	Understand the basics of various rapid prototyping processes.
CO-5	Select and apply rapid prototyping process based on given constrains.
CO-6	Identify and rectify errors that may arise during the rapid prototyping process.

List of Open-Source Software/Learning Website:

- https://www.nptel.ac.in

Bachelor of Engineering
Subject Code: ME2319
Subject Name: Advance Welding Technology

Shroff S.R. Rotary Institute of Chemical Technology

Semester: VI

Type of course: Open Elective Course

Prerequisite: Zeal to learn the subject

Rationale: Welding is one of the major manufacturing processes used in the fabrication of process equipment, steel structures, piping and ship building, Plenty of Engineering equipment like Pressure vessels, Pharmaceutical & drug Processing, Food & dairy equipment, Chemical Processing vessels & storage tanks, agricultural equipment, turbines etc. The subject focuses on knowledge and understanding of welding processes and equipments, the fundamental principles and their relative merits and demerits. Basic understanding of weldability of different metals and alloys is emphasized. The student will be able to apply knowledge and skills of welding in producing products of quality as per the quality standard of the industries.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Introduction:** Welding as compared with other fabrication processes, Importance and application of welding, classification of welding processes, Health & safety measures in welding. **Welding Power Sources:** Physics of welding Arc, Basic characteristics of power sources for various arc welding processes, Transformer, rectifier and generators. **Physics of Welding Arc:** Welding arc, arc initiation, voltage distribution along the arc, arc characteristics, arc efficiency, heat generation at cathode and anode, Effect of shielding gas on arc, isotherms of arcs and arc blow.	06

2	**Modern Welding Processes:** Manual Metal Arc Welding (MMAW), TIG, MIG, Plasma Arc, Submerged Arc Welding, Electrogas and Electroslag, Flux Cored Arc Welding, Resistance welding, Friction welding, Brazing, Soldering and Braze welding processes, Laser beam welding, Electron beam welding, Ultrasonic welding, Explosive welding, Friction Stir Welding, Underwater welding & Microwave welding.	**08**
3	**Heat Flow Welding:** Calculation of peak temperature, Width of Heat Affected Zone (HAZ), cooling rate and solidification rates, weld thermal cycles, residual stresses and their measurement, weld distortion and its prevention.	**04**
	SECTION-B	
4	**Repair & Maintenance Welding:** Welding defects, weld cracking Phenomena and its prevention, Repairing of weld joints, .Hardfacing, Cladding, Surfacing, Metallizing processes and Reclamation welding. **Weldability:** Effects of alloying elements on weld ability, welding of plain carbon steel, Cast Iron and Aluminum & Titanium. Welding of dissimilar metals, Micro & Macro structures in welding.	**06**
5	**Weld Design:** Types of welds & joints, Joint Design, Welding Symbols, Introduction to Welding Procedure Specification & Procedure Qualification Record.	**04**
6	**Weldment Inspection and Testing:** **Codes governing welding inspection:** Structural welding code; ASME boiler and pressure vessel code, spot examination of welded joints, duties of the inspector, ASTM standards, API standards **Testing of Welded joints:** Review of Inspection and Chemical, Metallurgical, and Mechanical testing of welded joints, Weld Solidification Cracking Susceptibility Test Methods.	**08**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10%	15%	20%	25%	25%	05%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. "Welding Handbook", Volumes 1, 2 and 3, 9th edition, American Welding Society
2. Larry J and Jeffus L, "Welding Principles and Applications", 5th edition, Delmer Publications
3. Parmer R. S., 'Welding Engineering and Technology', Khanna Publishers, 1997
4. Manufacturing Technology (Foundry, Forming and Welding)-P.N.Rao, Tata Mc-Graw Hill.
5. Welding Technology- O.P. Khanna, Khanna Publications.
6. AWS D1.1 Structural Welding Code
7. API 5L
8. API 1104
9. ASME Section VIII – Division 1,2
10. ASME Section IX
11. ASME Section II Part A and C

List of Practical/ Tutorials:

1. Identify and understand various parts of welding machines and various safety aspect of it.
2. Edge preparation practice on given specimen.
3. Practice on Bead-on-plate welding-Lap joint ,V Butt joint
4. Study of Effect of welding parameters on weld bead by GTAW,GMAW, Manual Arc welding.
5. Study of Microstructure observation of weldments (Carbon steel, Aluminum alloy, Dissimilar joints).
6. Perform soldering operation with applications.
7. Study of preparation of welding procedure specification.
8. Study of preparation of procedure qualification record.
9. Study of various welding defects and their remedies.
10. Study of various DT and NDT for weld joints like Tensile testing, Ultrasonic testing, and visual inspection.

Bachelor of Engineering
Subject Code: ME2319
Subject Name: Advance Welding Technology

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	Acquire the theoretical aspects of welding technology in depth
CO-2	Select the appropriate welding process for a particular application.
CO-3	Describe the basic metallurgy of the melted and heat-affected zone of a metal or alloy.
CO-4	Identify the cause of welding defects and use various method for repairing and analyse effects of various alloying elements on weld ability.
CO-5	Choose or adjust welding parameters and techniques to optimize the weldment properties.
CO-6	Apply knowledge to check the weldment quality using various inspection and testing methods.

List of Open-Source Software/Learning Website

https://nptel.ac.in

Bachelor of Engineering
Subject Code: ME2320
Subject Name: Computer Aided Design

Shroff S.R. Rotary Institute of Chemical Technology

Semester: VI

Type of course: Open Elective Course

Prerequisite: NIL

Rationale: This course intends to introduce students to use of computers in the phases of product design using 2D & 3D software viz. conceptualization, geometric modeling & graphical representation.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Introduction:** Introduction to CAD/CAED/CAE, Elements of CAD, Essential requirements of CAD, Concepts of integrated CAD/CAM, Necessity & its importance, Engineering Applications Computer Graphics-I CAD/CAM systems.	**04**
2	**Computer Graphics-I:** Graphics Input devices-cursor control Devices, Digitizers, Keyboard terminals, Image scanner, Speech control devices and Touch, panels, Graphics display devices-Cathode Ray Tube, Random & Raster scan display, Color CRT monitors, Direct View Storage Tubes, Flat Panel display, Hard copy printers and plotters	**07**
3	**Curves and Surfaces:** Parametric representation of lines: Locating a point on a line, parallel lines, perpendicular lines, distance of a point, Intersection of lines. Parametric representation of circle, Ellipse, parabola	**07**

	and hyperbola. Synthetic Curves: Concept of continuity, Cubic Spline: equation, properties and blending. Bezier Curve: equations, properties; Properties and advantages of B-Splines and NURBS. Various types of surfaces along with their typical applications.	
	SECTION-B	
4	**Mathematical representation of solids:** Geometry and Topology, Comparison of wireframe, surface and solid models, Properties of solid model, properties of representation schemes, Concept of Half-spaces, Boolean operations. Schemes: B-rep, CSG, Sweep representation, ASM, Primitive instancing, Cell Decomposition and Octree encoding.	**06**
5	**Geometric Transformations:** Homogeneous representation; Translation, Scaling, Reflection, Rotation, Shearing in 2D and 3D; Orthographic and perspective projections. Window to View-port transformation.	**06**
6	**3D Graphics:** Polygon surfaces-Polygon mesh representations, Quadric and Super quadric surfaces, Solid modeling-Solid entities, Fundamentals of Solid modeling, Constructive solid geometry, Sweep representation, Color models. Basic application commands for 2d drafting software like AutoCAD/Draft sight (any one) & 3d solid modeling software Solid Works/Autodesk Inventor/ PTC Creo /Catia (Any one) etc.	**06**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
15 %	25 %	30 %	15 %	10 %	05 %

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Ibrahim Zied, CAD / CAM: Theory and Practice, McGraw-Hill

2. Hearn E J and Baker M P, Computer Graphics, Pearson
3. David F. Rogers and J. Alan Adams, "Mathematical Elements for Computer Graphics", McGraw-Hill.
4. M. Groover, Computer Aided Design And Manufacturing, Pearson publication

List of Practical/ Tutorials:

1. Study of CAD/CAM/CAE Necessity & its importance, Engineering Applications
2. Study of Computer graphics and graphics input devices.
3. Study of Curve and surfaces used in computer Aided Design.
4. Study of Mathematical representation of solids use in computer Aided Design.
5. Study of Geometric Transformation in CAD.
6. Design and draft CAD 2D & 3D object using Mechanical CAD Software.

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	Demonstrate basic concept of computer aided design and its applications.
CO-2	Study of various types of computer graphics use in CAD
CO-3	Discuss the various type of curve and surface use in CAD.
CO-4	Explain the mathematical representation use in CAD software.
CO-5	Analyze geometric transformations.
CO-6	Prepare an 3D model using CAD Software.

List of Open-Source Software/Learning Website:

- https://nptel.ac.in/courses

Bachelor of Engineering
Subject Code: ME2321
Subject Name: Automobile Engineering

Shroff S.R. Rotary Institute of Chemical Technology

Semester: VI

Type of course: Open Elective Course

Prerequisite: Basics of Mechanical Engineering, Environmental Sciences, Kinematics and Theory of Machines and Internal Combustion Engines.

Rationale: The aim is to introduce students to the vehicle structure and associated systems. Fundamentals related to vehicle and its systems' layouts, basic design of vehicle body structure and selection of systems components are introduced.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	Introduction: Automobile classification and specification, Automobile chassis: General layout, types of layout and its arrangement, Body construction type and materials, Functional requirements of vehicle body, Body trim and fittings	03
2	Road Load Analysis: Vehicle Loads: Forces acting on vehicle in motion, Transmission efficiency, Factors affecting it. Rolling resistance, Grade resistance and tractive force with uniform speed and with acceleration of vehicle, Traction characteristic. Dynamic factor, weight transfer due to various resistance acting on a vehicle in motion. Stability of a vehicle in motion around the curve.	05
3	Power Transmission systems: Clutch: Constructional features and working of single plate, multi plate, semi centrifugal and centrifugal clutch, Calculation of surface area and number of driving and driven plates. Transmission gear box: sliding mesh, constant mesh, synchromesh gearboxes and four wheel drive. Propeller shaft and Final drive: Propeller	10

	shaft, universal joints, Hotchkiss & Torque tube Drives, front drive shaft types and its construction and working, Differential gear box, rear axle. Automatic Transmission and CVT Fault and diagnosis of power transmission system.	
	SECTION-B	
4	Axle, Suspension and Steering System: Axle: Classification, types of front axle, Construction, Components and their functions, types of rear axle and application. Suspension: Principle, Types of suspension systems, Functional requirements of suspension systems, types and Constructional features of Front Suspension and Rear suspension system, Spring types, Rubber and Air suspensions, Factors affecting design and selection; Steering System: Steering Layout, types of steering gears, steering linkages, steering mechanism, definitions, and significance of camber, caster king, pin inclination, toe in and toe out on turn. Measurement and adjustment of various steering system layouts, steering ratio, under steering and over steering, power assisted steering, steering geometry, wheel alignment, and diagnosis of fault. *Brake system: Components and configurations, Fundamentals of braking: braking distance, braking efficiency, weight transfer, wheel skidding, Brake proportioning and adhesion utilization, Hydraulic brake system, Power assisted brakes, ABS and EBD: Working principles, Features and advantages, Fault and diagnosis. *Wheel and Tyres: Types of wheels, types of tyres, tyre construction, constituents of tyre, tyre tread pattern, tyre pressure and wear, tyre properties, tyre size, tyre maintenance.	06
5	Electrical, Electronics and Safety Systems: Engine control Unit, Monitoring and Instrumentation, Safety interlocks and alarms, Lamps, Lighting and other circuits, fuel gauge, temperature gauge, wiper, speedometer and odometer. Active and Passive Safety systems, Seat belt, Air bag, ACD, Electronic Stability Control (ESC), Tire Pressure Monitoring System (TPMS), Lane Departure Warning System (LDWS), Adaptive Cruise Control (ACC), Driver Monitoring System (DMS), Blind Spot Detection (BSD) and Night Vision System (NVS).	10
6	Modern Automobiles: Layout and components of Electric and Hybrid Vehicle, Types of Hybrid vehicles, Batteries, Electric Motors, Regenerative Braking.	02

***Topics covered in Practical Season.**

Bachelor of Engineering
Subject Code: ME2321
Subject Name: Automobile Engineering

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
30%	25%	20%	15%	05%	05%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Automobile Engineering Vol- I & II, Dr. Kirpal Singh, Standard Pub. & Dist.
2. Automobile Engineering, .B.Gupta , Satya Prakashan.
3. Automobile Engineering Vol- I & II, Dr. K.M.Gupta, Umesh Pub.
4. Automotive Mechanics. W.Crouse , Tata Mc Graw Hill
5. Automobile Engineering, G.B.S.Narang, Khanna Pub.
6. Automobile Technology, Dr. N.K.Giri, Khanna Pub.

List of Practical/ Tutorials:

1. Study of different types of layout of Automobiles.
2. Study of different types of Transmission gearbox.
3. Fault and diagnosis of power transmission system.
4. Study of constructional features of Front and rear suspension system.
5. Study of Hydraulic braking system.
6. Study of safety features of the automobile system.
7. Study of Electronic system of Automobiles.
8. Study of Hybrid vehicles.

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	Compare and select type of vehicle as per safety, features and applications.
CO-2	Evaluate vehicle performance for different driving and road conditions.
CO-3	Demonstrate working of various Automobile Systems.
CO-4	Study of wheel and tyre, identity faults and diagnosis of automobile systems.
CO-5	Identify the different electric and electronic components of vehicles.
CO-6	Study of modern hybrid Automobiles.

List of Open-Source Software/Learning Website:

- http://nptel.ac.in/

Bachelor of Engineering
Subject Code: ME2322
Subject Name: Industrial Safety and Maintenance Engineering

Shroff S.R. Rotary Institute of Chemical Technology

Semester: VI

Type of course: Open Elective course

Prerequisite: NIL

Rationale: This subject focuses on applying engineering concepts to the optimization of equipment, procedures, and departmental budgets to achieve better maintainability, reliability, and availability of equipment. Maintenance, and hence maintenance engineering, is increasing in importance due to rising amounts of equipment, systems, machineries and infrastructure. The subject also focuses on various safety engineering aspects like understanding hazards, quantifying risk, design for safety, investigating accident, safety education and training.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Quality, Reliability and Maintainability(QRM):** Productivity; Quality and Quality circle in Maintenance, engineering Reliability, Reliability Assurance through Redundancy, Maintainability and maintainability improvement, Maintainability vis a vis Reliability.	05
2	**Maintenance jobs and Technologies:** Wear and service life of equipment: Methods of assembly and fitting – assembly of keyed joints, splined joints, fixed joints, assembly of ball and roller bearings, repairs and assembly of gears. Wear of machines- types and reasons of wear, defects due to wear of equipment, corrosion and its prevention. Recovery and strengthening of machine elements various methods of recovery and increasing service life.	05
3	**Defect list Generation and Defect/Failure Analysis:** Defect Generation: types of failure, defect reporting and recording, defect analysis, failure analysis, equipment downtime analysis, breakdown analysis: FTA, FMTA, FMECA) **Maintenance Types/Systems:**	08

	Planned and unplanned Maintenance, Breakdown Maintenance, corrective Maintenance, Opportunistic Maintenance, Routine Maintenance, Preventive Maintenance, Predictive Maintenance, Condition Base Maintenance System (CBMS): Online offline Monitoring, Visual and Temperature Monitoring, Leakage Monitoring, Vibration Monitoring: causes, Identification and monitoring. Ferrography, Spectroscopy, Cracks Monitoring. Design Out maintenance, Selection of Maintenance Systems.	
SECTION-B		
4	**Maintenance Planning and Scheduling:** Factors involved in effective planning of maintenance work, Various methods of scheduling work, Categorization of plant/equipment for the purpose of priorities. Short term and Long Term Maintenance Plans: Major repair, Capital Repair and Annual Overhauls, Renovation, Revamping and Modernization.	**05**
5	**Safety Engineering:** Introduction, Hazard and Operability Study (HAZOP), Fundamental of Industrial Safety, Types and Categorization of Accidents. Accidents preventions, Safety Training. Onsite offsite Emergency Plans, Job Safety Analysis (JSA), Safety Survey, Reporting of accidents and dangerous occurrence	**08**
6	**Safe Design and Operation of Plants:** Procedure for Ensuring Safety in Planning, Building and Operating Plants: Process Design, Planning, Construction and Commissioning of Plants, Alarm and Hazard Defense Plans, Information of the Public. Safety measures: Inherent Safety Measures, Passive Safety Measures, Active Safety Measures, Organizational Measures, Design of Safety Systems. Plant Layout and Spacing. Personal Safety and Personal Protective Equipment	**05**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20%	30%	20%	15%	10%	05%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. Maintenance Engineering and management by R.C. Mishra & K. Pathak, PHI publication

2. Maintenance Engineering and management by K. VenkatRamana, PHI publication
3. Maintenance of Ind. Equipments-by Gellery & Pakelts, MIR publications
4. Ind. Maintenance by H.P. Garg, S. Chand & company
5. Modern Maintenance Management, by Miller & Blood
6. Industrial Safety and Maintenance by Deshmukh, Tata McGraw Hill
7. Industrial Safety Health Environment and Security By Basudev Panda, University Science Press
8. Process and Plant Safety, Hauptmanns, Ulrich, Springer Publication

List of Practical/ Tutorials: NA

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	**Describe** Quality, Reliability and Maintainability.
CO-2	**Illustrate** the principles, functions and practices adapted in industry for the successful management of maintenance activities.
CO-3	**Practice** Defects and Failure analysis and different types of maintenance system.
CO-4	**Analyse** wear and service life of equipment.
CO-5	**Propose** various Maintenance Planning and Scheduling techniques.
CO-6	**Explain** safety practice aspects in industry.

List of Open-Source Software/Learning Website:

- http://nptel.ac.in

Bachelor of Engineering
Subject Code: ME2323
Subject Name: Piping Design

Shroff S.R. Rotary Institute of Chemical Technology

Semester: VI

Type of course: Open Elective Course

Prerequisite: Fluid Mechanics, Material Science and Metallurgy.

Rationale: Piping design and engineering is a key area in various streams of engineering. Piping and accessories constitute over 25% of the total capital investment in the chemical process industry, petroleum and petrochemical industry, pharmaceutical industry, power plants, and so on. The present course is intended to familiarize undergraduate students about the fundamental design aspects of piping components and their applications in process industries.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	00	00	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Fundamentals of piping:** Classification of pipe, Codes and standards, Pipe Fabrication, vibration, its prevention and control in piping systems, Mechanical Properties of material, schedule number, Piping materials and selection.	04
2	**Design calculations for piping:** Determination of pipe size, Calculation of pressure drop in pipe, Equivalent length of pipe line for fittings and valves, Energy losses in pipe line, Different types of pumps and their selection criteria, NPSHA & NPSHR, Power required by pump, Calculation of flow measurement in pipe line.	07
3	**Piping component:** Types of Fitting, Different types of flange and gasket, their selection criteria and applications, Different types of valves, their selection criteria	07

	and applications, Determination of valve size, Steam separators and steam traps	
SECTION-B		
4	**Flow through pipe line:** Introduction, Calculation of pressure drop for two phase flow through pipe line by using Lockhart and Martinelli correlations, Piping drainage and water hammer in process plant, Calculations for water hammer in pipe line	**05**
5	**Mechanical design of piping:** Operating pressure and temperature, Design Pressure & Design Temperature for Piping Systems, Design equation for longitudinal, hoop and allowable stresses, Determinations of thickness required by steel pipe for withstanding, internal and external pressure, Determinations of thickness required by jacketed steel pipe for withstanding external pressure	**07**
6	**Pipe supports and P & I diagram:** Functions of Supports and selection, Types of loads, Different types of piping support, Determination of support location, Maximum span between the supports suggested by ASME B 31.1, Thermal expansion in pipe line, Different types of expansion joints and their applications, Difference between a PFD and P&ID, Typical P&I diagrams for pumps, distillation column, Reactors and Shell and tube heat exchanger	**06**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10%	25%	25%	20%	15%	05%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy

Reference Books:

1. Perry R.H., "Chemical Engineers' Handbook", McGraw-Hill, 2009.
2. Thakore S.B., Bhatt B.I., "Introduction to Process Engineering and Design", 2nd Edition, Tata McGraw Hill Publication, 2017.
3. Nayyar M.L., "Piping Handbook", 7th Edition, Tata McGraw Hill Publication, 2000.

4. Coulson J.M, Richardson J.F and Sinnott, R.K., "Coulson and Richardson's Chemical Engineering", Vol. 6, 4th Edition, Elesevier, New Delhi, 2006.
5. McCabe W.L, Smith J.C, Harriott P., "Unit Operations of Chemical Engineering", Mc Graw Hill Publication
6. Ludwig E., Chemical Process Equipment Design, 3rd Edition, Gulf Publications, 2002.
7. Kellogg, M. W Company., "Design of Piping Systems", Pullman Power Products, New York, 1976.

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	Understand the safety and practical engineering aspects of piping systems.
CO-2	Recognize the design and principles used in piping system.
CO-3	Identify important components of piping system.
CO-4	Diagnose different losses occurring during flow through pipe.
CO-5	Know the terminology, concepts, equipment, and process used piping network.
CO-6	Get an idea of pipe support with other accessories and P& I diagram

List of Open-Source Software/Learning Website:

- www.nptel.ac.in

Bachelor of Engineering
Subject Code: ME2324
Subject Name: Robotics

Shroff S.R. Rotary Institute of Chemical Technology

Semester: VI

Type of course: Open Elective Course

Prerequisite: Zeal to learn the subject

Rationale: This course aims to familiarise students with basic terminologies of the robotics sciences and essential knowledge required to get started in the field of Robotics.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	0	3	70	30	0	0	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Introduction to robotics:** Brief History, Basic Concepts of Robotics such as Definition, Three laws, Elements of Robotic Systems i.e. Robot anatomy, DOF, Misunderstood devices etc. Classification of Robotic systems on the basis of various parameters such as work volume, type of drive, etc. Associated parameters i.e. resolution, accuracy, repeatability, dexterity, compliance, RCC device etc.	06
2	**Grippers and Sensors for Robotics:** Types of Grippers, Guidelines of design for robotic gripper, Force analysis for various basic gripper system. Types of Sensors used in Robotics, Classification and applications of sensors, Characteristics of sensing devices, Selections of sensors. Need for sensors and vision system in the working and control of a robot.	08
3	**Drives and Control for Robotics:** Types of Drives, Types of transmission systems, Actuators and its selection while designing a robot system. Control Systems: Types of Controllers, Introduction to closed loop control.	04
	SECTION-B	
4	**Programming and Languages for Robotics**: Robot Programming: Methods of robot programming, WAIT, SIGNAL and DELAY commands, subroutines, Programming Languages: Generations of	08

	Robotic Languages, Introduction to various types such as VAL, RAIL, AML, Python ROS etc. Development of languages since WAVE till ROS.	
5	**Related Topics in Robotics:** Socio Economic aspect of robotic station Economical aspects for robot design, Safety for robot and standards, Introduction to Artificial Intelligence, AI techniques, Need and application of AI, New trends & recent updates in robotics.	**05**
6	**Introduction Automation:** Introduction Automation to Principles& Strategies of Automation, Types &Levels of Automations, Need of automation, Industrial applications of robot.	**05**

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
20%	25%	15%	20%	15%	05%

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference Books:

1. S.K.Saha, Introduction to Robotics 2e, TATA McGraw Hills Education (2014)
2. Asitava Ghoshal, Robotics: Fundamental concepts and analysis, Oxford University Press (2006)
3. Dilip Kumar Pratihar, Fundamentals of Robotics, Narosa Publishing House,(2019)
4. R.K.Mittal, I.J.Nagrath, Robotics and Control, TATA McGraw Hill Publishing Co Ltd, New Delhi(2003)
5. S.B. Niku, Introduction to Robotics Analysis, Control, Applications,3rd edition, John Wiley & Sons Ltd.(2020)
6. J.Angeles, Fundamentals of Robotic Mechanical Systems Theory Methods and Algorithms, Springer(1997)
7. Mikell Groover, Mitchell Weiss, Roger N. Nagel, Nicholas Odrey, Ashish Dut, Industrial Robotics 2nd edition, SIE, McGraw Hill Education (India) Pvt Ltd (2012)

Bachelor of Engineering
Subject Code: ME2324
Subject Name: Robotics

Course Outcomes:

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

Sr. No.	CO Statement
CO-1	Express views as per terminologies related to Robotics technology.
CO-2	Apply logic for selection of robotic sub systems and systems.
CO-3	Analyses basics of principles of robot system integration.
CO-4	Understand ways to update knowledge in the required area of robotic technology.
CO-5	Demonstrate an understanding of principle of robotic.
CO-6	Recognize basic principles of Automation.

List of Open-Source Software/Learning Website:

www.nptel.ac.in

Shroff S.R. Rotary Institute of Chemical Technology

Type of course: Work-Personality Development

Prerequisite: To keep open mind and will to learn humanity for oneself and society.

Rationale: The Contributor Program aims to accomplish the following outcomes in the lives of students–

- Improve the employability of students by giving them the right work ethic and thinking that employers are looking for.
- Build their confidence with which they can go into any job and contribute meaningfully.
- Improve their ability to engage better in the workplace and to be able to handle the challenges that come up there.
- Build their career-worthiness and help them develop into future-ready contributors with ability to navigate a career in a volatile, changing world.
- Widen their choices of career and success, so that they are able to open up more opportunities for themselves and take up unconventional career pathways.
- Enable them to recognize how they, as technical professionals, can participate and make a positive contribution to their communities and to their state.

Towards this goal, the Contributor Program has been designed to awaken and strengthen students from within, in terms of building positive self-esteem, increasing their confidence level and I-can attitude, improving their aspirations, giving them new methods of thinking, building their cognitive capacities, exposing them to the skills and practices associated with being contributors in the workplace (not mere employees).

The Program content is also designed to expose students to real-world workplace scenarios and sensitize them to some of the challenges faced in society around them, especially in the local communities around them and in their own state of Gujarat.

The Contributor Program syllabus has been evolved and fine-tuned over several years, (a) to address the changing need and contemporary challenges being faced by industry and what employers of today are looking for in the people they hire and (b) by working extensively with universities and students building an appreciation of their challenges and concerns. At the core, the program is guided by the higher ideas and principles of practical Vedanta in work.

Bachelor of Engineering
Subject Code: MH2302
Subject Name: Contributor Personality Development Program – II

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE (E)	PA (M)	ESE (V)	PA (I)	
1	1	0	2	50	30	00	20	100

Content:

Sr. No.	Content	Total Hrs.
	SECTION-A	
1	**Finding Solutions** The market environment in which organizations are operating, is becoming increasingly dynamic and uncertain. So, employers are increasingly seeking out people who can innovate and figure out solutions in the face of any challenge (unlike in the past when it was the people who were most efficient and productive, who were valued by organizations). At the heart of innovation lies this way of thinking of "finding solutions" rather than "seeing problems or roadblocks". Students learn how to build this way of thinking, in this topic.	04 hrs Classroom engagement (including self-discovery/ solutioning sessions)
2	**Creating Value** Companies are also looking for employees who do not just work hard, or work efficiently or productively - but those who will make a valuable difference to the fortunes of the company. This difference may come from innovation, but it may also come from focusing on the right things and identifying what really matters – both to the company and to the customers. In this topic, students learn how to build this capability.	04 hrs Classroom engagement (including self-discovery/ solutioning sessions)

3	**Engaging deeply** The environment we live in is becoming increasingly complex because more and more things are getting interconnected, new fields are emerging, technologies are rapidly changing, capabilities and knowledge one is trained in will become fast obsolete. In such a scenario, the student's ability to quickly understand and master what is going on, dive deep, get involved in any area, rapidly learn new capabilities that a job demands, is important. Engaging deeply is a core way of thinking that can help them in this. In this topic, students learn how to engage deeply.	04 hrs Classroom engagement (including self-discovery/ solutioning sessions)
	SECTION-B	
4	**Enlightened self-interest & collaboration at work** The changing nature of work in organizations and in the global environment is increasingly demanding that people work more collaboratively towards shared goals and more sustainable goals. A key to working successfully when multiple stakeholders are involved is "thinking in enlightened self-interest". In this topic, students learn how to develop this way of thinking (going beyond "narrow self-interest").	04 hrs Classroom engagement (including self-discovery/ solutioning sessions)
5	**Human-centered thinking & Empathy** In this topic, students explore a human-centric approach to work – where the ability to recognize and respond to other people (whether they are users or customers or team members) as a human being with human needs and difficulties, is essential. This is at the heart of user-centric design of products and solutions, at the heart of genuine customer- centricity in services, and of any successful interaction with other people.	04 hrs Classroom engagement (including self-discovery/ solutioning sessions)
6	**Trust Conduct** The biggest currency in a sustainable career is "trust" i.e. being trusted by team members, bosses, and customers. When we are trusted, people listen to us, they are willing to give us the chance to grow, give us the space to make	04 hrs Classroom engagement (including self-discovery/ solutioning sessions)

	mistakes, and work seamlessly with each other without always having to "prove ourselves". In this topic, students learn how to demonstrate conduct that builds the trust of people.	

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
-	**20**	**20**	**20**	**20**	**20**

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)

Reference resources:

A. Basic reference for both students and teachers

1. Contributor Personality Program textbook cum workbook developed by Illumine
2. Web-based ActivGuide™ for self-exploration of rich media resources to vividly understand many of the ideas, watch role models, learn from industry people, get reference readings – that help them enrich the understanding they gained in the class published by Illumine Foundation

B. Advanced reference for teachers

1. On Contributors, Srinivas V.; Illumine Ideas, 2011
2. Enlightened Citizenship and Democracy; Swami Ranganathananda, Bharatiya Vidya Bhavan, 1989
3. Eternal Values for a Changing Society – Vol I-IV, Swami Ranganathananda; Bharatiya Vidya Bhavan
4. Karma Yoga, Swami Vivekananda; Advaita Ashrama
5. Vivekananda: His Call to the Nation, Swami Vivekananda; Advaita Ashrama
6. Six Pillars of Self Esteem, Nathaniel Branden; Bantam, 1995
7. Mindset: The New Psychology of Success, Carol S. Dweck; Random House Publishing Group, 2007
8. Lasting Contribution: How to Think, Plan, and Act to Accomplish Meaningful Work, Tad Waddington; Agate Publishing, 2007

9. Why not?: how to use everyday ingenuity to solve problems big and small, Barry Nalebuff, Ian Ayres; Harvard Business School Press, 2003
10. The value mindset: returning to the first principles of capitalist enterprise (Ch 8 & 9); Erik Stern, Mike Hutchinson; John Wiley and Sons, 2004
11. The Power of Full Engagement: Managing Energy, Not Time, is the Key to High Performance and Personal Renewal, Jim Loehr, Tony Schwartz; Simon and Schuster, 2003
12. Creating Shared Value, Michael E. Porter and Mark R. Kramer; Harvard Business Review; Jan/Feb2011, Vol. 89 Issue 1/2
13. The Speed of Trust: The One Thing That Changes Everything, Stephen M. R. Covey, Rebecca R. Merrill, Stephen R. Covey; Free Press, 2008
14. The Courage to Meet the Demands of Reality, Henry Cloud; HarperCollins, 2009
15. Responsibility at work: how leading professionals act (or don't act) responsibly, Howard Gardner; John Wiley & Sons, 2007

Course Outcomes:

Students will be able to:

Sr. No.	CO statement
CO-1	Students will be able to recognize & appreciate the thinking required to find solutions in the face of any challenge.
CO-2	Students will be able to recognize & appreciate different types of value that can be created and the different ways to create value for others.
CO-3	Students will be able to recognize & appreciate how to engage deeply, and its need, value, payoffs and consequences in different contexts.
CO-4	Students will be able to differentiate between 'enlightened self-interest' and 'narrow self-interest' & appreciate the payoffs/ consequences of both when working with multiple stakeholders.
CO-5	Students will be able to recognize & appreciate the human side of situations or interactions or projects that will help them develop a more human-centric approach/ response to work.
CO-6	Students will be able to recognize & appreciate conduct which builds trust of people in contrast to conduct which breaks trust of people - in teams / organization & the value of trust conduct in various situations.

Prepared By: Ms. Aakancha Sanjeev Kumar

Moderated By: Dr. Purvi Naik.