Pondicherry Engineering College, Puducherry – 605014

(An Autonomous Institution of Government of Puducherry affiliated to Pondicherry University)

Curriculum and Syllabi
for
B.Tech. (Mechanical Engineering)

(With Effect from Academic year 2018-19)

(Approved in Fifth Academic Council Meeting held on 6th May 2019)

CURRICULUM

The Curriculum of B.Tech. (Mechanical Engineering) is designed to fulfil the Program Educational Objectives (PEO) and the Program Outcomes (PO) listed below.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO1	To provide necessary background in science, particularly in advanced mathematics, physics and chemistry that underlie modern mechanical engineering and technology (Fundamentals)
PEO2	To produce graduates who are strong in basics of technical education and prove their competency in diversified areas of mechanical engineering so that they can secure suitable positions in any technological enterprises, companies, organizations and industries both at national and international levels (Employability).
PEO3	To encourage a majority of our graduates to pursue advanced studies in thrust areas of mechanical engineering and to carry out scientific, industrial and defence research and development so as to meet/satisfy current requirements in respective sectors (Higher Studies).
PEO4	To prepare our graduates to improve their self-reliant capabilities, soft skills, leadership qualities which would help in building their own careers and make them become successful entrepreneurs to serve the nation and the society responsibly and ethically (Entrepreneurship).
PEO5	To familiarize our graduates with international and national codes and standards for good engineering practice in core and interdisciplinary fields and to help them evolve sustainable development in technological sphere with greater emphasis on mitigation of environmental impact (Professional Ethics).

PROGRAM OUTCOMES (PO)

PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization for the solution of complex engineering problems.
PO2	**Problem analysis**: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
PO4	**Conduct investigations of complex problems**: The problems: • that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline. • that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions. • that require consideration of appropriate constraints/requirements not explicitly given in the problem statement. (like: cost, power requirement, durability, product life, etc.). • which need to be defined (modelled) within appropriate mathematical framework. • that often require use of modern computational concepts and tools.

PO5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.
PO6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**Communication**: Communicate effectively on complex engineering activities with the engineering community and with t h e society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11	**Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSO)

PSO1	Graduates are acquainted well with the concepts and principles of Mechanical Engineering required for understanding and solving practical industrial problems of current interests to core mechanical industries.
PSO2	Graduates are initiated to work on Innovative Ideas that will eventually motivate them to pursue *Higher Studies and Research* in Mechanical &Allied Engineering and Management.
PSO3	Graduates can function in a *Multidisciplinary Environment* by being able to associate and integrate their domain knowledge with other disciplines.

Distribution of credits among the subjects grouped under various categories:

Courses are grouped under various categories and the credits to be earned in each category of courses are as follows:

Sl. No.	Category	Credits	Course Category Code (CCC)
1	Humanities, Social Sciences and Management Courses	6 + 2 / 3 *	HSM
2	Basic Science Courses (Mathematics, Physics, Chemistry and Biology)	25	BSC
3	Engineering Science Courses (Workshop, Drawing, Basics of Electrical/Mechanical/Computer etc.,)	25.5	ESC
4	Professional Core Courses	64.5	PCC
5	Professional Elective Courses (from chosen discipline)	15	PEC
6	Open Elective Courses (from other technical/ emerging disciplines)	10	OEC
7	Professional Activity Courses (Seminar, Entrepreneurship, Comprehensive Test, Internship, Project Work)	14	PAC
8	Mandatory non-Credit Courses (Induction, Environmental Sciences, Indian Constitution, Essence of Indian Traditional Knowledge, Professional Ethics)	Non-credit	MCC
	Total	**160**	

***included in the 10 credits under open elective category**

Semester-wise Courses and Credits

Semester I

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
FY201	Induction Programme	MCC	-	-	-	-	0
MA201	Mathematics I	BSC	TY	3	1	0	4
PH201	Physics	BSC	TY	3	1	0	4
CY201	Chemistry	BSC	TY	3	1	0	4
HS201	English for Communication	HSM	TY	2	0	2	3
ME201	Workshop and Manufacturing Practice	ESC	LB	0	0	3	1.5
PH202	Physics Laboratory	BSC	LB	0	0	3	1.5
CY202	Chemistry Laboratory	BSC	LB	0	0	3	1.5
Total				11	3	11	-
				25			**19.5**

Semester II

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
MA202	Mathematics II	BSC	TY	3	1	0	4
EE201	Basic Electrical Engineering	ESC	TY	3	1	0	4
CS201	Programming for Problem Solving	ESC	TY	3	0	0	3
ME202	Engineering Graphics and Computer Aided Drawing	ESC	TY	2	0	4	3
CE201	Environmental Science	MCC	-	3	0	0	0
EE202	Electrical Engineering Laboratory	ESC	LB	0	0	3	1.5
CS202	Programming Laboratory	ESC	LB	0	0	3	1.5
Total				14	2	10	-
				26			**17**

CCC - Course Category Code, **SET** – Semester Exam Type, **TY** – Theory, **LB** – Laboratory, **PR** - Project

Semester III

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
MA204	Transforms, PDE and Statistics	BSC	TY	3	1	0	4
ME203	Engineering Mechanics	ESC	TY	3	1	0	4
ME204	Fluid Mechanics and Hydraulic Machines	PCC	TY	3	1	0	4
ME205	Engineering Thermodynamics	PCC	TY	3	1	0	4
ME206	Materials Technology	PCC	TY	3	0	0	3
ME207	Machine Drawing	PCC	TY	2	0	3	3
SH202	Indian Constitution	MCC	-	2	0	0	0
Total				19	4	3	-
				26			**22**

Course Code	Open Elective/ Honors/ Minor Course	CCC	SET	Periods			Credits
				L	T	P	
ZZOXX*	Open Elective	OEC	TY	3	0	0	3
MEH01	Engineering Optimization	PCC	TY	3	1	0	4
MEM01	Heat Power Engineering	PCC	TY	3	1	0	4

Semester IV

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
SH201	Biology for Engineers	BSC	TY	3	0	0	2
EC234	Elements of Electronics	ESC	TY	3	0	0	3
ME208	Mechanics of Solids	ESC	TY	3	1	0	4
ME209	Thermal Engineering – I	PCC	TY	3	1	0	4
ME210	Machining Technology	PCC	TY	3	0	0	3
ME211	Kinematics of Machines	PCC	TY	3	1	0	4
ME212	Mechanical Engineering Lab –I (Fluid mechanics and machines/ Material technology /Machine shop)	PCC	LB	0	0	3	1.5
Total				18	3	3	-
				24			**21.5**

Course Code	Open Elective/ Honors/ Minor Course	CCC	SET	Periods			Credits
				L	T	P	
ZZOXX*	Open Elective	OEC	TY	3	0	0	3
MEH02	Production Drawing and Cost Estimation	PCC	TY	3	0	1	4
MEM02	Manufacturing Technology	PCC	TY	4	0	0	4

***ZZ in ZZOXX is the Department Code of the department offering Open Elective**

Semester V

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
ME213	Heat and Mass Transfer	PCC	TY	3	1	0	4
ME214	Manufacturing Processes	PCC	TY	4	0	0	4
ME215	Dynamics of Machines	PCC	TY	3	1	0	4
MEYXX	Professional Elective –I	PEC	TY	3	0	0	3
MEYXX	Professional Elective –II	PEC	TY	3	0	0	3
SH203	Essence of Indian Traditional Knowledge	MCC	-	2	0	0	0
ME216	Mechanical Engineering Lab –II (Dynamics Lab/ Special Machines / Heat Transfer Lab)	PCC	LB	0	0	3	1.5
Total				18	2	3	-
				23			**19.5**

Course Code	Open Elective/ Honors/ Minor Course	CCC	SET	Periods			Credits
				L	T	P	
ZZOXX	Open Elective	OEC	TY	3	0	0	3
MEH03	Computational biological thermo-fluid mechanics	PCC	TY	3	1	0	4
MEM03	Machine Design	PCC	TY	3	1	0	4

Semester VI

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
HS202	Industrial Economics and Management	HSM	TY	3	0	0	3
ME217	Thermal Engineering – II	PCC	TY	3	1	0	4
ME218	Metrology and Measurements	PCC	TY	4	0	0	4
ME219	Design of Machine Elements	PCC	TY	3	1	0	4
MEYXX	Professional Elective –III	PEC	TY	3	0	0	3
ME220	Seminar	PAC	-	0	0	3	1
ME221	Mechanical Engineering Lab –III (Thermal Engineering Lab / Measurements Lab / Modelling, simulation and analysis lab)	PCC	LB	0	0	3	1.5
Total				16	2	6	-
				24			**20.5**

Course Code	Open Elective/ Honors/ Minor Course	CCC	SET	Periods			Credits
				L	T	P	
ZZOXX	Open Elective	OEC	TY	3	0	0	3
MEH04	Product Design and Development	PCC	TY	3	1	0	4
MEM04	Quality Control and Improvement Techniques	PCC	TY	3	1	0	4

***ZZ in ZZOXX is the Department Code of the department offering Open Elective**

Semester VII

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
ME222	Operations Research	PCC	TY	3	1	0	4
ME223	Industrial Engineering and Management	PCC	TY	3	0	0	3
ME224	Advanced Manufacturing Technology	PCC	TY	4	0	0	4
MEYXX	Professional Elective –IV	PEC	TY	3	0	0	3
MEYXX	Professional Elective –V	PEC	TY	3	0	0	3
EP201	Entrepreneurship	PAC	TY	3	0	0	2
ME225	Professional Ethics	MCC	-	3	0	0	0
Total				22	1	0	-
				23			**19**

Course Code	Open Elective/ Honors/ Minor Course	CCC	SET	Periods			Credits
				L	T	P	
ZZOXX	Open Elective	OEC	TY	3	0	0	3
MEH05	Surface Engineering	PCC	TY	4	0	0	4
MEM05	Process Planning and Cost Analysis	PCC	TY	3	1	0	4

Semester VIII

Course Code	Course	CCC	SET	Periods			Credits
				L	T	P	
SWOXX	Open Elective through SWAYAM	OEC	-	3	0	0	2
SWOXX	Open Elective through SWAYAM	OEC	-	3	0	0	2
ME226	Comprehensive Test	PAC	-	0	0	3	1
ME227	Internship (3 months duration)	PAC	-	-	-	-	2
ME228	Project Work	PAC	PR	0	0	12	8
Total				6	0	15	-
				21			**15**

List of Professional Elective courses

Professional Electives	Course Code	Course	Semester
Professional Elective – I/II	MEY01	Energy and Environmental Engineering	V
	MEY02	Metal Forming Processes	
	MEY03	Engineering Tribology	
	MEY04	Automobile Engineering	
	MEY05	Mechatronics	
	MEY06	Fluid Power Automation	
Professional Elective – III	MEY07	Automotive Fuels, Pollution & Control	VI
	MEY08	Maintenance and Safety Engineering	
	MEY09	Computer Aided Design	
Professional Elective – IV / V	MEY10	Cryogenic Engineering	VII
	MEY11	Nano Technology and Surface Engineering	
	MEY12	Design of Transmission Systems	
	MEY13	Power Plant Engineering	
	MEY14	Total Quality Management	
	MEY15	Finite Element Method	

List of Open Electives

Course Code	Course
MEO01	Renewable Energy
MEO02	Solar Power Engineering
MEO03	Fluid and Thermal Machines
MEO04	Marketing Management
MEO05	Elements of Project Management
MEO06	Introduction to Nanoscience and Nanotechnology
MEO07	Industrial Automation
MEO08	Quantitative Techniques for Engineers
MEO09	Finite Element Analysis

Courses offered under various categories:

CCC	Course Code	Course	Semester	Credit	Total Credit
BSC	MA201	Mathematics – I	I	4	25
	PH201	Physics	I	4	
	CY201	Chemistry	I	4	
	PH202	Physics laboratory	I	1.5	
	CY202	Chemistry Laboratory	I	1.5	
	MA202	Mathematics –II	II	4	
	SH201	Biology for Engineers	IV	2	
	MA204	Transforms, Partial Differential Equations and Statistics	III	4	
ESC	ME201	Workshop and Manufacturing Practice	I	1.5	25.5
	EE201	Basic Electrical Engineering	II	4	
	CS201	Programming for Problem Solving	II	3	
	ME202	Engineering Graphics & Computer Aided Drawing	II	3	
	EE202	Electrical Engineering Laboratory	II	1.5	
	CS202	Programming Laboratory	II	1.5	
	ME203	Engineering Mechanics	III	4	
	ME208	Mechanics of Solids	IV	4	
	EC234	Elements of Electronics	IV	3	
PCC	ME204	Fluid Mechanics and Hydraulic Machines	III	4	64.5
	ME205	Engineering Applied Thermodynamics	III	4	
	ME206	Materials Technology	III	3	
	ME207	Machine drawing	III	3	
	ME209	Thermal Engineering - I	IV	4	
	ME210	Machining Technology	IV	3	
	ME211	Kinematics of Machines	IV	4	
	ME212	Mechanical Engineering Lab -I	IV	1.5	
	ME213	Heat and Mass Transfer	V	4	
	ME214	Manufacturing Processes	V	4	
	ME215	Dynamics of Machines	V	4	
	ME216	Mechanical Engineering Lab -II	V	1.5	
	ME217	Thermal Engineering – II	VI	4	
	ME218	Metrology and Measurements	VI	4	
	ME219	Design of Machine Elements	VI	4	
	ME221	Mechanical Engineering Lab –III	VI	1.5	
	ME222	Operation Research	VII	4	
	ME223	Industrial Engineering and Management	VII	3	
	ME224	Advanced Manufacturing Technology	VII	4	
PEC	MEYXX	Professional Elective – I	V	3	15
	MEYXX	Professional Elective – II	V	3	
	MEYXX	Professional Elective – III	VI	3	
	MEYXX	Professional Elective – IV	VII	3	
	MEYXX	Professional Elective – V	VII	3	
OEC	ZZOXX	Open Electives offered by other Departments	III - VII	6	10
	SWOXX	Open Electives offered under SWAYAM	-	4	

PAC	ME220	Seminar	VI	1	**14**
	EP201	Entrepreneurship	VII	2	
	ME226	Comprehensive Test	VIII	1	
	ME227	Internship	VIII	2	
	ME228	Project Work	VIII	8	
HSM	HS201	English for Communication	I	3	**6 + 3*/ 2***
	HS202	Industrial Economics and Management	VI	3	
	HSOXX	Humanities Open Elective offered by HSS Department	**-**	3*	
	SWOXX	Humanities Open Elective offered under SWAYAM	**-**	2*	
		Total			**160**

***included in the 10 credits under Open Elective category**

Department : **Humanties and Social Sciences**		Programme: **B.Tech.**						
Semester : **First**		Course Category Code: **MCC**			Semester Exam Type: -			
Course Code	Course	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
FY201	**Induction Programme**	-	-	-	Non-Credit	-	-	-
Prerequisite	**-**							
Course Outcome	The course will enable the student to							
	CO1	Acquire social awareness & knowledge for self-development						
	CO2	Be aware of nature & environment conscious and of Innovative nature.						
	CO3	Develop holistic attitude and harmony in the individual, family, and society						
	CO4	Know about the art and culture, language and literature of this vast secular nation						
	CO5	Integrating technical Education for betterment of society						
UNIT-I	**Proficiency in English**				**Periods: 12**			
Communication skills – Diagnostic test on Grammar – Synonyms, Antonyms, Tenses, Sentence Completion, Idioms & Phrases, One word substitution, Homophones, Homonyms, Use of Prepositions, Subject-verb agreement – Writing – Paragraph writing, Letter writing, Essay writing, Story Development.								**CO1**
UNIT-II	**Bridge course in Mathematics**				**Periods: 12**			
Fundamentals of differential and integral calculus: Theory, Practice & Test. Limit of function-Fundamental results on limits-Continuity of a function- Concept of differentiation- Concept of derivative- Slope of a curve-Differentiation Techniques- Derivatives of elementary functions from first principle-Derivatives of inverse functions-Logarithmic differentiation- Method of substitution- Differentiation of parametric functions-Differentiation of implicit functions- Higher order derivatives. Integrals of functions containing linear functions-Method of integration (Decomposition method, method of substitution, integration by parts) - Definite integrals. Simple definite integrals- Properties of Definite integrals- Reduction formulae-Area and volume- Length of curve- surface area of a solid.								**CO2**
UNIT-III	**Universal human values**				**Periods: 12**			
Current Status of the society (Sources of fear)-Reformation through education-Sanskar-What is success (getting good marks, college admission, Job etc)-What is aim of life (happiness, Prosperity and continuity of happiness and prosperity)-What is required for happiness (relationship, physical facilities)-Relationship involves all emotions and feelings-Physical facility-material things required for life-Difference between animal and human consciousness-Animal consciousness-depending on money, accumulating money by wrong means etc.-Human consciousness-right thinking, right understanding, right feeling-Happiness through Harmony in the individual, family, society and nature, leading to fearlessness in the society is the purpose of holistic education or value education.								**CO3**
UNIT-IV	**Literary activities**				**Periods: 12**			
Team building activities – Quiz – Oral Exercises – Group discussion, Debate, Extempore, Role play.								**CO4**
UNIT-V	**Creative arts**				**Periods: 12**			
Introduction to painting & renowned artworks – Documentary & Short films – Music – Vocal, Instrumental – Dance – Classical, Cinematic – Mimicry – Mime.								**CO5**
Lecture Periods: 60	**Tutorial Periods: -**	**Practical Periods: -**			**Total Periods: 60**			
Reference Books								
-								

Department : **Mathematics**			Programme: **B.Tech.**						
Semester : **First**			Course Category Code: **BSC**			Semester Exam Type: **TY**			
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
MA201	**Mathematics-I**		3	1	-	4	40	60	100
Prerequisite:	-								
Course Outcome	**CO1**	To apply differential calculus to notions of curvature, evolutes and involutes and they will have a basic understanding of Beta and Gamma functions							
	CO2	The mathematical tools needed in evaluating multiple integrals and their usage.							
	CO3	The effective mathematical tools for the solutions of differential equations that model physical processes							
	CO4	Able to solve simultaneous linear differential equations							
	CO5	Understands Vector calculus and its applications							
UNIT-I	**Differential Calculus**					**Periods: 12**			
Curvature, radius of curvature, evolutes and involutes. Beta and Gamma functions and their properties.									**CO1**
UNIT-II	**Multi variable calculus**					**Periods: 12**			
Multiple Integrals, change of order of integration in double integrals, Applications: Plane areas (double integration), Change of variables (Cartesian to polar), Double and triple integrations, Volumes by triple integration – Mass, Center of mass and Gravity (constant and variable densities).									**CO2**
UNIT-III	**First order Ordinary Differential Equation**					**Periods: 12**			
Exact equations, First order linear equations, Bernoulli's equation, Equations not of first degree, equations solvable for p, equations solvable for y, equations solvable for x - Clairaut's type - simple applications, orthogonal trajectories, growth and decay.									**CO3**
UNIT-IV	**Higher Order Ordinary Differential Equation**					**Periods: 12**			
Linear differential equations of higher order - with constant coefficients, the operator D, Euler's linear equation of higher order with variable coefficients, simultaneous linear differential equations, solution by variation of parameters method.									**CO4**
UNIT-V	**Vector Calculus**					**Periods: 12**			
Gradient, divergence and curl, their properties and relations. Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integral, Theorems of Green, Stokes and Gauss divergence (without proof). Simple applications involving cubes, sphere and rectangular parallelepipeds.									**CO5**
Lecture Periods: 45	**Tutorial Periods: 15**		**Practical Periods:-**			**Total Periods: 60**			

Reference Books:

1. Veerarajan T, Engineering Mathematics I , McGraw-Hill Education(India) Private Limited, 2014
2. Veerarajan T, Engineering Mathematics II , McGraw-Hill Education(India) Private Limited, 2015
3. Venkataraman M.K., Engineering Mathematics, Vol. I&II, The National Publishing Company, Chennai, 2008.
4. Erwin Kreyszig, Advanced Engineering Mathematics (9 th Ed), John Wiley & Sons, New Delhi, 2011.
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, Eleventh Reprint, 2010.
6. Bali N. and Goyal M., Advanced Engineering Mathematics, Laxmi Publications Pvt. Ltd., New Delhi, 9thEdition, 2011.

Department : **Mathematics**		Programme: **B.Tech.**						
Semester : **Second**		Course Category Code: **BSC**			Semester Exam Type: **TY**			
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MA202	**Mathematics-II**	3	1	-	4	40	60	100
Prerequisite:	-							

Course Outcome	**CO1**	Understands Matrix theory
	CO2	The tool of Fourier series for learning advanced Engineering Mathematics
	CO3	The tool of Fourier transform for learning advanced Engineering Mathematics
	CO4	The tools of differentiation of functions of a complex variable that are used in various techniques dealing engineering problems.
	CO5	The tools of integration of functions of a complex variable that are used in various techniques dealing engineering problems.

UNIT-I	**Matrices**	**Periods: 12**
Inverse and rank of a matrix, System of linear equations, Symmetric, Skew Symmetric and Orthogonal matrices, Eigenvalues and Eigenvectors of a real matrix, Characteristic equation, Properties of Eigenvalues. Cayley-Hamilton Theorem (statement only), Diagonalization of matrices.		**CO1**
UNIT-II	**Fourier Series**	**Periods: 12**
Dirichlet's conditions - Expansion of periodic functions into Fourier series- Change of interval- Half-range Fourier series. Complex form of Fourier series - Root mean square value - Parseval's theorem on Fourier coefficients - Harmonic analysis.		**CO2**
UNIT-III	**Fourier Transform**	**Periods: 12**
Fourier Integral Theorem(statement only)- Fourier transform, Inverse Fourier transform, definition and properties - Evaluation of integrals- Fourier cosine and sine transform, definitions and evaluation of integrals using cosine and sine transforms.		**CO3**
UNIT-IV	**Complex Valued function and Conformal Mapping**	**Periods: 12**
Definition of a Complex valued function f(z) and its derivative - Analytic functions -Necessary condition for a function f(z) to be analytic (in Cartesian) - Cauchy-Riemann equation - statement of C-R equation in polar form -sufficient condition for f(z) to be analytic(statement only)- harmonic function- Harmonic and orthogonal properties of analytic function – Construction of analytic functions. Conformal mapping – Simple and standard transformations like $w = z^2$, e^z, z+c, cz, sinz, 1/z, Bilinear transformation (excluding Schwarz- Christoffel transformation).		**CO4**
UNIT-V	**Complex Integration**	**Periods:12**
Cauchy's Integral theorem, Cauchy's integral formula (without proof) and problems, Taylor's and Laurent's theorem (without proof), Classification of singularities. Residues and evaluation of residues – Cauchy's Residue theorem, Contour integration – Evaluation of real integrals – unit circle and semi-circular contour (excluding poles on boundaries).		**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods:-**	**Total Periods: 60**

Reference Books:

1. Veerarajan T., Engineering Mathematics II , McGraw-Hill Education(India) Private Limited, 2018
2. Veerarajan T., Transforms and Partial Differential Equations , McGraw-Hill Education(India) Private Limited, 2016
3. Venkataraman M.K., Engineering Mathematics, Vol. II and III, The National Publishing Company, 2008.
4. Erwin Kreyszig, Advanced Engineering Mathematics (Ninth Edition), John Wiley & Sons, New Delhi, 2011
5. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, Eleventh Reprint, 2010.
6. Bali N. and Goyal M., Advanced Engineering Mathematics, Laxmi Publications Pvt. Ltd., New Delhi, Ninth Edition, 2011.

Department : **Physics**			Programme: **B.Tech.**						
Semester : **First/Second**			Course Category Code: **BSC**			Semester Exam Type: **TY**			
Course Code	Course		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
PH201	**Physics**		3	1	-	4	40	60	100
Prerequisite	-								
		The course will enable the student to:							
Course Outcome	**CO1**	Understand electric and magnetic field & potential							
	CO2	Study the basics of dielectric materials and its importance							
	CO3	Understand the concepts of wave mechanics and its applications							
	CO4	To study the optical phenomena arising due to interference, diffraction and polarization							
	CO5	To discuss the fundamentals of Lasers, fiber optics and its real time applications							

UNIT-I	**Electromagnetic theory**	**Periods: 12**
Brief review of electrostatics, electric field and potential – divergence and curl of electrostatic field – Gauss law and its applications, Laplace's equation in one, two and three dimension. Brief review of magnetostatics, Biot-Savart law – divergence and curl of static magnetic field – Ampere's law – magnetic vector potential – comparison of electrostatics and magnetostatics.		**CO1**
UNIT-II	**Dielectrics**	**Periods: 12**
Dielectric polarization and its mechanisms – dielectric loss – dielectric breakdown – calculation of electronic polarizabilities and ionic polarizabilities – temperature and frequency dependence of polarization – internal field in solids – Clausius-Mossotti relation – ferroelectricity – ferroelectric hysteresis.		**CO2**
UNIT-III	**Quantum mechanics**	**Periods: 12**
Matter Waves – de Broglie hypothesis – uncertainty principle – Schrödinger wave equations – time dependent – time independent – physical significance of wave function – application to particle in a one dimensional potential box – concept of quantum mechanical tunneling (without derivation) – applications of tunneling (qualitative) to alpha decay, tunnel diode, scanning tunneling microscope.		**CO3**
UNIT-IV	**Wave optics**	**Periods: 12**
Interference: airwedge – Newton's rings – Michelson's interferometer – types of fringes – determination of wavelength of a light source. **Diffraction:** concept of resolution of spectral lines – Rayleigh's criterion – resolving power of grating, prism & telescope. **Polarisation:** Basic concepts of double refraction – circular and elliptical polarization – quarter and half wave plates – optical rotation – specific rotatory power – Laurent's half shade polarimeter.		**CO4**
UNIT-V	**Lasers and Fiber optics**	**Periods: 12**
Lasers: Principles of laser – spontaneous and stimulated emissions – Einstein's theory of matter radiation interaction – A and B coefficients – population inversion and laser action – optical resonators(qualitative) – types of lasers –Nd:YAG, CO2 laser, GaAs laser – industrial & medical applications of lasers (any two). **Fiber optics:** Principle and propagation of light in optical fiber – numerical aperture and acceptance angle – step index and graded index fiber – qualitative ideas of attenuation in optical fibers – fiber optic communication (schematic), active and passive fiber optic sensors, endoscope.		**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 60**

Reference Books

1. David Griffiths, Introduction to Electrodynamics, 3rd Edition, Eastern Economy Edition., 2011
2. A.S. Vasudeva, Modern Engineering Physics, S. Chand & Co, 2006.
3. D. J. Griffiths, "Quantum mechanics", Pearson Education, 2014.
4. V. Rajendran, Engineering Physics, 2nd Edition, TMH, New Delhi 2011
5. Avadhanulu M. N. , Engineering Physics, S. Chand & Co, 2007
6. David Halliday, Robert Resnick and Jearl Walker, Fundamentals of Physics, Wiley publications, 2013
7. H.J. Pain, The physics of vibrations and waves, Wiley publications, 2005
8. Ajoy Ghatak, Optics, 5th Edition TMH, New Delhi, 2012
9. Orazio Svelto, 2nd Edition, plenum Press, Principles of Lasers, 1982.
10. K. Thyagarajan and Ajoy Ghatak, Lasers Fundamentals and Applications, 2nd Edition, Springer 2010.

Department : **Physics**			Programme: **B.Tech.**						
Semester : **First/Second**			Course Category Code: **BSC**			Semester Exam Type: **LB**			
Course Code	Course		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
PH202	**Physics Laboratory**		-	-	3	1.5	40	60	100
Prerequisite	-								
	The students will learn to experimentally measure:								
Course Outcome	**CO1**	Optical parameters related to the concepts included in theoretical curriculum							
	CO2	Characteristic parameters of Laser and optical fiber							
	CO3	Thermal conductivity and pressure coefficients							
	CO4	Magnetic field, electrical conductivity and Hall coefficient							
	CO5	Young's modulus, Rigidity modulus and acceleration due to gravity							

Choice of 10-12 experiments from the following

1. Radius of curvature of a Lens - Newton's rings 2. Thickness of a thin object by air – wedge 3. Spectrometer – resolving power of a prism 4. Spectrometer – resolving power of a transmission grating 5. Spectrometer - hollow prism / ordinary & extraordinary rays by calcite prism* 6. Lorent's Half shade polarimeter – determination of specific rotatory power	**CO1**
7. Determination of wavelength of a laser source using transmission grating, reflection grating (vernier calipers) & particle size determination 8. Determination of numerical aperture & acceptance angle of an optical fiber 9. Determination of optical absorption coefficient of materials using laser* 10. Michelson's interferometer*	**CO2**
11. Coefficient of thermal conductivity - radial flow method 12. Coefficient of thermal conductivity – Lee's disc method 13. Jolly's bulb apparatus experiment – determination of α*	**CO3**
14. Magnetism: I – H curve 15. Field along the axis of a coil carrying current 16. Vibration magnetometer – calculation of magnetic moment & pole strength 17. Electrical conductivity of semiconductor – two probe / four probe method* 18. Hall effect in a semiconductor*	**CO4**
19. Determination of Young's modulus and rigidity modulus 20. Acceleration due to gravity - compound pendulum *Demonstration experiments	**CO5**

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

Reference Books

1. Physics Practical Observation Manual, Department of Physics, Pondicherry Engineering College.

Department : **Chemistry**		Programme: **B.Tech.**						
Semester : **First/Second**		Course Category Code: **BSC**			Semester Exam Type: **TY**			
Course Code	Course	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CY201	**Chemistry**	3	1	-	4	40	60	100
Prerequisite:	-							
Course Outcome	The course will enable the student to:							
	CO1	Analyse microscopic chemistry in terms of orbitals, structure and intermolecular forces						
	CO2	Rationalize the bulk properties and processes						
	CO3	Study the concepts of electrochemistry and its applications						
	CO4	Understand the mechanism of chemical reactions and synthesis of molecules						
	CO5	Comprehension of the concepts of analytical techniques.						

UNIT-I	**Chemical bonding and isomerism**	**Periods: 12**
Chemical bonding-valence bond theory, overlapping of orbitals. Hybridization in carbon compounds-sp, sp^2 and sp^3. Electron pair repulsion. Hybridization and shape of water and ammonia molecules. Molecular orbital theory-combination of atomic orbitals. Bond order. Molecular orbital diagrams for homonuclear diatomic molecules-(hydrogen to neon). Ionic, dipolar and van der Waals interactions. Structural and stereo isomerism-geometrical isomerism in alkenes. Optical isomerism-optical activity, chiral carbon. Optical isomerism in lactic acid and tartaric acid. Enantiomers, diastereomers and meso compounds. Resolution of racemic mixtures, racemization, asymmetric synthesis, Walden inversion.		**CO1**
UNIT-II	**Water chemistry and reaction kinetics**	**Periods: 12**
Water chemistry-hard and soft water, removal of hardness by ion exchange and zeolite processes. Determination of hardness by EDTA method. Desalination-Reverse osmosis. Adsorption-adsorption of gases on solids-Freundlich and Langmuir adsorption isotherms. Factors affecting adsorption of gases on solids. Chemical kinetics-rate of a reaction, factors affecting rate of reaction, first and second order rate equations. Half-life of reactions.		**CO2**
UNIT-III	**Electrode potential and corrosion**	**Periods: 12**
Electrode potential, electromotive force, reference electrodes-hydrogen, Ag/AgCl, calomel and glass electrodes. Nernst equation and applications. Electrolyte concentration cell. Batteries-Primary and secondary batteries. Dry cell, alkaline battery, Ni-Cd battery and lead-acid battery. Fuel cell-Hydrogen-oxygen fuel cell. Corrosion-dry and wet corrosion, mechanism of electrochemical corrosion, galvanic, pitting and concentration cell corrosion. Factors influencing corrosion. Corrosion control by cathodic protection. Anodization.		**CO3**
UNIT-IV	**Introduction to reaction mechanism**	**Periods: 12**
Introduction to reaction mechanism-factors influencing a reaction, homolytic and heterolytic bond fission. Reaction intermediates-carbonium ion, carbanion, free radicals and carbenes. Electrophiles and nucleophiles. Mechanism of free radical substitution-chlorination of methane. Mechanism of electrophlic substitution-bromination of benzene. Nucleophilic substitution-S_N2-hydrolysis of methyl bromide, S_N1-hydrolysis of t-butyl bromide. Elimination reactions-E1 and E2. Addition reactions-nucleophilic and electrophilic. Synthesis of aspirin, paracetamol, sulfanilamide and chloroquine.		**CO4**
UNIT-V	**Analytical techniques**	**Periods: 12**
Absorption and emission of radiation. Beer-Lamberts law. Ultraviolet and visible spectroscopy-basic principles and instrumentation. Basic principles and instrumentation of atomic absorption spectrometry, hollow cathode lamp. Conductivity-equivalent and molar conductance, cell constant. Conductometric titration-types of conductometric titrations. Potentiometry-principle of acid base titration. Chromatography- Principles and instrumentation of gas Chromatograph.		**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 60**

Reference Books

1. P.C. Jain and Monika Jain, Engineering Chemistry, Dhanpat Rai Publishing Company, New Delhi, 2016.
2. S.S. Dara and S.S Umare, A Textbook of Engineering Chemistry, S. Chand & Co., Ltd. New Delhi, 2013.
3. Arun Bahl, B.S. Bahl and G.D. Tuli, Essentials of Physical Chemistry, S. Chand and Company Ltd, New Delhi, 2016
4. Arun Bahl and B.S. Bahl, A Text Book of Organic Chemistry, S. Chand and Company Ltd, New Delhi, 2011
5. B.R. Puri, L.R. Sharma and K.C Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi, 2007
6. G.R.Chatwal & S.K.Anand, Instrumental Methods of Chemical Analysis, Himalaya Publishing House P Ltd, Delhi,2005
7. D.A. Skoog, F.J. Holler and T.A. Nieman, Principles of Instrumental Analysis, Thomson Asia Pvt. Ltd, Singapore, 2004.

Department : **Chemistry**		Programme: **B.Tech.**						
Semester : **First/Second**		Course Category Code: **BSC**				Semester Exam Type: **LB**		
Course Code	Course	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CY202	**Chemistry Laboratory**	-	-	3	1.5	40	60	100
Prerequisite	-							
Course Outcome	The students will learn to:							
	CO1	Determine rate constants and order of reactions						
	CO2	Measure molecular/system properties such as surface tension, viscosity, partition coefficient, hardness of water, adsorption, saponification value and acid value						
	CO3	Analyze quantitatively the contents of samples						
	CO4	Use conductivity, potentiometric and chromatographic techniques						
	CO5	Analyse a salt sample						

Choice of 10-12 experiments from the following:

1. Kinetic study of acid hydrolysis of ethyl acetate	**CO1**
2. Determination of surface tension and viscosity 3. Partition of benzoic acid between benzene and water 4. Total hardness of water - Determination by EDTA method 5. Freundlich adsorption isotherm - Adsorption of acetic acid on charcoal 6. Saponification value and acid value of an oil	**CO2**
7. Chloride content of water - Determination by Mohr's method 8. Determination of oxalic acid by permanganometry 9. Determination of ferrous by permanganometry 10. Determination of ferrous and ferric by dichrometry 11. Determination of carbonate and bicarbonate in a mixture 12. Beer-Lamberts law - Determination of ferrous by colorimetry 13. Magnesium content in water - Determination by EDTA method 14. Acetic acid content in vinegar 15. Dissolved oxygen content in water - Determination by Winkler's method. 16. Determination of available chlorine in bleaching powder.	**CO3**
17. Conductometric titration 18. Potentiometric titration 19. Thin layer chromatography	**CO4**
20. Chemical analysis of salt for cations and anions	**CO5**

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

Reference Books

1. Lab Manual, Department of Chemistry, Pondicherry Engineering College, Puducherry, 2018.
2. V. Venkateswaran, R. Veeraswamy and A.R. Kulandaivelu, Basic Principles of Practical Chemistry, Sultan Chand & Sons, New Delhi, 2001.
3. J. Mendham, R.C. Denney, J.D. Barnes and M. Thomas, Vogel's Text Book of Quantitative Chemical Analysis, Pearson Education, New Delhi, 2002.

Department : **Humanities and Social Sciences**			Programme: **B.Tech.**						
Semester : **First/Second**			Course Category Code: **HSM**			Semester Exam Type: **TY**			
Course Code	Course		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
HS201	**English for Communication**		2	-	2	3	40	60	100
Prerequisite	-								
Course Outcome	**CO1**	To help the learners to develop their technical communication skills							
	CO2	To equip the learners with skills required for developing their reading prowess.							
	CO3	To enhance the writing skills of learners by providing practice in writing.							
	CO4	To instil confidence in learners to develop their speaking skills and enable them to articulate with ease.							
	CO5	To facilitate vocabulary enhancement and grammatical correctness in communication.							
UNIT-I	**TECHNICAL COMMUNICATION**					**Periods: 12**			
Nature of Technical communication – Forms of Technical Communication – General and Technical Communication – Importance and need –Organization in Technical Communication – Style – ABC of Technical Communication –Technical Communication Skills.									**CO1**
UNIT-II	**COMPREHENSION AND ANALYSIS**					**Periods: 12**			
Technical and Non-Technical passages – Reading methods – Skimming – Scanning– Extensive and Intensive reading – Inferring – Contextual meaning – summary – note making.									**CO2**
UNIT-III	**PRACTICE IN WRITING**					**Periods: 12**			
Sentence Structures – Use of phrases and clauses in sentences – coherence in writing – principles for paragraph writing –Essay Writing – describing – defining – classifying – Business letters – memorandum – instructions – E-mail –reports.									**CO3**
UNIT-IV	**SPEAKING PRACTICE**					**Periods: 12**			
Pronunciation –Basics of Phonetics– Conversations and dialogues –formal presentations – Group Discussions – Extempore speaking – Debates- Role Plays– interview skills.									**CO4**
UNIT-V	**GRAMMAR AND VOCABULARY BUILDING**					**Periods: 12**			
Word formation – root words from foreign languages and their use in English – Prefixes and suffixes –subject-verb agreement – Articles – voice – preposition– importance of punctuation – Redundancies – synonyms, Antonyms and standard abbreviations– Indianisms.									**CO5**
Lecture Periods: 30	**Tutorial Periods: -**		**Practical Periods: 30**			**Total Periods: 60**			

Reference Books

1. Sudarshana, N.P and C. Savitha. English for Technical Communication. Noida: CUP, 2016.
2. Shoba, K N and Lourdes Joavani Rayen. Communicative English. Chennai: CUP, 2017.
3. Rizvi, Ashraf, M. Effective Technical Communication. New Delhi: McGraw, 2017.
4. Daniel Jones. English Pronouncing Dictionary. Cambridge University Press, 2003.
5. Dutt, Kiranmai P and Geetha Rajeevan. Basic Communication Skills. New Delhi: CUP,2013
6. Sanjay Kumar and Pushpalata. Communication Skills. New Delhi: OUP, 2011.
7. Mohan, Krishna and Meera Banerji. Developing Communication Skills. 2nd edition. Delhi: Macmillan, 2012.
8. Relevant material from newspapers, magazines and journals will be used for integrated practice.

Department : **Mechanical Engineering**			Programme: **B.Tech.**						
Semester : **First/Second**			Course Category Code: **ESC**				Semester Exam Type: **LB**		
Course Code	Course		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
ME201	**Workshop and Manufacturing Practice**		0	0	3	1.5	40	60	100
Prerequisite									
Course Outcome	**CO1**	To convey the basics of mechanical tools used in carpentry section and establish hands on experience in making the different carpentry joints							
	CO2	To gain knowledge on types of tools and machines used in sheet metal shop and perform some exercises							
	CO3	To develop basic welding and fitting joints using the hand tools and establish the importance of joints and fitting in engineering applications							
	CO4	To gain knowledge of the different machines used in manufacturing processes which are commonly employed in the industry, to fabricate components using different materials							
	CO5	To carry out simple manufacturing operations in lathe, drilling and shaping machine							

UNIT-I	**Carpentry**	**Periods: 9**	
Study of tools and machines in carpentry Practice on :1.Half Lap joint 2.Corner Mortise joint and 3.Dovetail joint			**CO1**
UNIT-II	**Sheet Metal**	**Periods: 9**	
Study of tools and machineries in sheet metal shop 1.Frustum of cone 2.Waste collection tray and 3.Rectangular box			**CO2**
UNIT-III	**Welding and Fitting**	**Periods: 9**	
Lectures/demonstrations/videos on Welding and fitting operations with simple exercise. 1. Filing and Job preparation 2. V-Fitting and 3. Simple lap joint			**CO3**
UNIT-IV	**Study of tools and machines**	**Periods: 6**	
Study of tools and machines in manufacturing lab 1. Lathe machine 2.Drilling machine and 3.Shaping machine			**CO4**
UNIT-V	**Simple Exercises in Lathe/Drilling machine/Shaper**	**Periods: 12**	
Simple operations in lathe, drilling and shaping 1.Facing and Turning 2.Step Turning 3.Drilling in a flat plate with different drill dimensions and 4.Cube in Shaping			**CO5**

Lecture Periods: 3	**Tutorial Periods: -**	**Practical Periods: 42**	**Total Periods: 45**

Reference Books

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3. H.N.Gupta, R.C.Gupta and Arun Mittal, Manufacturing Processes, New Age Publications, 2001.

Department : **Mechanical Engineering**			Programme: **B.Tech.**						
Semester : **First/Second**			Course Category Code: **ESC**			Semester Exam Type: **TY**			
Course Code	Course		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
ME202	**Engineering Graphics and Computer Aided Drawing**		2	-	4	3	40	60	100
Prerequisite	-								
Course Outcome	**CO1**	Students learn to properly dimension and annotate engineering drawings as per standards of engineering drawing practice.							
	CO2	Students are made to follow and understand the basics of engineering drawing with simple solids.							
	CO3	Students can properly apply and produce sectional views.							
	CO4	Students are able to properly create multi-view orthographic drawings from three dimensional diagrams. Students are able to present a drawing in orthographic and isometric projections.							
	CO5	Students learn the application of engineering graphics through computer-aided drafting.							
UNIT-I						**Periods: 18**			
Introduction to Engineering graphics, Standards for Engineering Drawing practice, Lettering, Line work and Dimensioning, Projection of Lines, Projection of Planes									**CO1**
UNIT-II						**Periods: 18**			
Projections of simple solids									**CO2**
UNIT-III						**Periods: 18**			
Sections of solids and Development of surfaces									**CO3**
UNIT-IV						**Periods: 18**			
Isometric Projections and Orthographic Projections									**CO4**
UNIT-V						**Periods: 18**			
Introduction to Computer Graphics and Drafting, Auto CAD, 2-D diagrams of simple geometries using Auto-CAD script.									**CO5**
Lecture Periods: 30		**Tutorial Periods: -**			**Practical Periods: 60**			**Total Periods: 90**	

Reference Books

1. K.R. Gopalakrishna and Sudhir Gopalakrishna, Engineering Graphics, Inzinc Publishers, 2007.
2. K.Venugopal, Engineering Drawing & Graphics + Auto CAD, 4th edition, New Age Int'lPublication Ltd., 2004.
3. BIS, Engineering Drawing practices for Schools & College, SP 46: 2003.
4. T. Jeyapoovan, Engineering Graphics using AUTOCAD, 7th edition, VIKAS Publishing House (P) Ltd., 2015.
5. N.D. Bhatt, Engineering Drawing, 49th edition, Charotar Publishing House, 2014.
6. K.V. Natarajan, A Text Book of Engineering Drawing, Dhanalakshmi Publishers, 2006.
7. M. B. Shah and B. C. Rana, Engineering Drawing, 2nd edition, Pearson Publications, 2018.
8. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
9. http://www.3ds.com/products/catia/
10. http://en.wikipedia.org/wiki/CATIA

Department : **Electrical and Electronics Engineering**		Programme: **B.Tech.**						
Semester : **First/Second**		Course Category Code: **ESC**				Semester Exam Type: **TY**		
Course Code	Course	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EE201	**Basic Electrical Engineering**	3	1	-	4	40	60	100
Prerequisite	-							

Course Outcome	**CO1**	To understand the basic concepts of DC circuits and theorems.
	CO2	To explain the concepts of AC circuits and resonance.
	CO3	To understand the basic concepts of magnetic circuits and transformer.
	CO4	To explain the working principle, construction, applications of electrical machines.
	CO5	To Gain knowledge of working of power plants and fundamentals of switch gear and earthing.

UNIT-I	**DC Circuits**	**Periods: 12**
Electrical circuit elements (R, L and C) - Definition of Voltage, Current, Power and Energy – Ohm's law, Kirchoff current and voltage laws, analysis of simple circuits with DC voltage – Division of current in series and parallel circuits – Star-delta conversion – Node and mesh method of analysis of DC circuits – Network Theorems: Thevenin, Norton and Superposition Theorems.		**CO1**
UNIT-II	**AC Circuits**	**Periods: 12**
Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel). Resonance: Series and parallel resonance. Three-phase balanced circuits: voltage and current relations in star and delta connections – Power measurement by two Wattmeter method.		**CO2**
UNIT-III	**Transformers**	**Periods: 12**
Laws of Electromagnetic induction – Ampere's circuital law, Faraday's law and Lenz law – Dot rule. Magnetic materials, B-H characteristics. Single phase transformer: Construction and working, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.		**CO3**
UNIT-IV	**Electrical Machines**	**Periods: 12**
Elementary concept of rotating machines – Flemming's right hand and left hand rule – DC Machines: Construction and working of DC Machines - Generator and Motors – Emf equation of DC generator and back emf of DC motor –characteristics - Types of DC Machines. AC Machines: Construction and working of Single phase & three phase induction motors and synchronous generator (qualitative approach only).		**CO4**
UNIT-V	**Power Plants and LT Switch gear**	**Periods: 12**
Power Plants: Layout of thermal, hydro and nuclear power generation (block diagram approach only). Components of AC transmission and distribution systems – One-line diagram. Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables. Earthing. Elementary calculations for energy consumption.		**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 60**

Reference Books

1. D. P. Kothari and L. J. Nagrath, "Basic Electrical Engineering", 3rd Edition, Tata McGraw Hill, 2017.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", Tata McGraw Hill, 2011.
3. Rajendra Prasad, "Fundamentals of Electrical Engineering", 3rd Edition, PHI Learning Private Limited, 2014.
4. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
5. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
6. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

Department : **Electrical and Electronics Engineering**			Programme: **B.Tech.**						
Semester : **First/Second**			Course Category Code: **ESC**				Semester Exam Type: **LB**		
Course Code	Course		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
EE202	**Basic Electrical Engineering Laboratory**		-	-	3	1.5	40	60	100
Prerequisite	-								
Course Outcome	**CO1**	To understand the principles of domestic wiring and electrical components.							
	CO2	To illustrate handling of measuring instruments and demonstrate the concepts of network theorems							
	CO3	To analyze RL,RC,RLC circuits							
	CO4	To introduce concepts of single/three phase circuits							
	CO5	To demonstrate the working principle of electrical machines							

Any 10 experiments

1. Study of: Basic safety precautions. Concepts of domestic wiring- wires, switches, plugs, sockets, fuses and lamp holders. 2. Study of fan and tube light connections and earthing 3. Stair case wiring. 4. Bedroom wiring.	**CO1**
5. Use of measuring instruments. Verification of Kirchoff's voltage and current law 6. Verification of Thevenin and Norton theorems 7. Verification of Superposition Theorem.	**CO2**
8. Impedance calculation of R-L, R-C & R-L-C circuits and verification. 9. Measurement of power & power factor in a single phase AC circuit using three Ammeter Method 10. Resonance: Series and parallel.	**CO3**
11. Measurement of various line and phase quantities for a three phase star/delta ac circuit. 12. Measurement of three phase power using two wattmeter method. 13. Energy measurement using single phase energy meter.	**CO4**
14. Load test on a single phase transformer. 15. Load test on a single phase induction motor.	**CO5**

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

Reference Books

1. Laboratory Manual, Department of Electrical and Electronics Engineering, Pondicherry Engineering College.

Department : **Computer Science and Engineering**		Programme: **B.Tech.**						
Semester : **First/Second**		Course Category Code: **ESC**			Semester Exam Type: **TY**			
Course Code	Course	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CS201	**Programming for Problem Solving**	3	-	-	3	40	60	100
Prerequisite	-							

Course Outcome		
	CO1	Understood the phases of problem solving techniques for simple problems.
	CO2	Able to write programs using the basic language constructs.
	CO3	Able to build a larger programs using function oriented approaches.
	CO4	Could write efficient programs using advanced concepts to optimize the memory.
	CO5	Could write programs to access data from the secondary storage efficiently.

UNIT-I	**Algorithmic Problem Solving**	**Periods: 9**
History and Classifications of Computers – Components of Computer – Working Principle of Computer – Hardware – Software and its Types – Applications of Computers. Generations of Programming Languages – Introduction to Number System. Problem solving techniques: Program development life-cycle – Algorithms – building blocks of algorithms - Algorithmic problem solving-Flowchart– Pseudo code.		**CO1**
UNIT-II	**Data, Expressions, Statements**	**Periods: 9**
Introduction to C –C Program Structure – C Tokens: Keyword, Identifiers, Constants, Variables and Data types (simple and user-defined) – Operators and its types – Operator Precedence – Expression Evaluation – Type Conversion –Managing Input/output operations-Branching Statements – Looping Statements.		**CO2**
UNIT-III	**Arrays and Functions**	**Periods: 9**
Arrays – Two dimensional arrays, Multidimensional arrays. Character arrays. Functions: Function Prototype, Passing Arguments to Function – Call by Value and Call by Reference – Nested function call – Library Functions – User-defined Functions – Recursion. Strings – String I/O functions, String Library functions – Storage classes.		**CO3**
UNIT-IV	**Structures, Unions and Pointers**	**Periods: 9**
Structures – Arrays and structures – Nested structures – Structure as argument to functions–Union. Pointers – Declaration, Initialization and Accessing Pointer variable – Pointers and arrays – pointers as argument and return value – Pointers and strings - Pointers and structures.		**CO4**
UNIT-V	**File Management**	**Periods: 9**
Introduction to File Concepts in C – File types – I/O operations on files – File modes – Random access to files – Command line arguments. Dynamic Memory Allocation: MALLOC, CALLOC, FREE, REALLOC. Introduction to preprocessor: Macro substitution directives – File inclusion directives –Compiler Control directives – Miscellaneous directives.		**CO5**

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

Reference Books

1. Balagurusamy. E, “Programming in ANSI C”, Tata McGraw Hill, Seventh Edition, 2017.
2. Byron Gottfried & Jitender Chhabra, “Programming with C”, Schaum's Outlines Series, 2017.
3. Brian W. Kernighan & Dennis Ritchie. “The C Programming Language”, Pearson Education India; Second Edition, 2015.
4. Ashok N Kamthane, “Computer Programming”, Pearson education, Second Edition, 2012.

Department : **Computer Science and Engineering**		Programme: **B.Tech.**						
Semester : **First/Second**		Course Category Code: **ESC**				Semester Exam Type: **LB**		
Course Code	Course	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CS202	**Programming Laboratory**	-	-	3	1.5	40	60	100
Prerequisite	-							

Course Outcome		
	CO1	Understood the program editing and compilation environment.
	CO2	Able to write simple C programs using most frequently used control structures.
	CO3	Apply the methods problems using arrays and functions.
	CO4	Learnt to handle data processing using structures for simple applications.
	CO5	Write programs that could handle file i/o and pointers.

Programming Using C

1. Study of Compilation and execution of simple C programs 2. Basic C Programs a. Arithmetic Operations b. Area and Circumference of a circle c. Swapping with and without Temporary Variables	**CO1**
3. Programs using Branching statements a. To check the number as Odd or Even b. Greatest of Three Numbers c. Counting Vowels d. Grading based on Student's Mark 4. Programs using Control Structures a. Computing Factorial of a number b. Fibonacci Series generation c. Prime Number Checking d. Computing Sum of Digit	**CO2**
5. Programs using Arrays a. Sum of 'n' numbers b. Sorting an Array c. Matrix Addition, Subtraction, Multiplication and Transpose 6. Programs using Functions a. Computing nCr b. Factorial using Recursion c. Call by Value and Call by Reference	**CO3**
7. Programs using String Operations a. Palindrome Checking b. Searching and Sorting Names 8. Programs using Structure a. Student Information System b. Employee Pay Slip Generation c. Electricity Bill Generation	**CO4**
9. Programs using Pointers a. Pointer and Array b. Pointers as argument and return value c. Pointer and Structure 10. Programs using File Operation a. Counting No. of Lines, Characters and Black Spaces b. Content copy from one file to another c. Reading and Writing Data in File	**CO5**

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

Reference Books

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Department : **Civil Engineering**		Programme: **B.Tech.**						
Semester : **First/Second**		Course Category Code: **MCC**			Semester Exam Type: -			
Course Code	Course	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
CE201	**Environmental Science**	3	-	-	Non-Credit	-	-	-
Prerequisite	-							

Course Outcome		
	CO1	Able to understand about the environment and natural resources available
	CO2	Able to design the Rainwater harvesting and adopting the methods for recycle and reuse of domestic water
	CO3	Able to address the environmental issues namely pollution, depletion of natural resources and degrading ecosystem
	CO4	Able to develop models for resource and energy management, which are environmental friendly and work for sustainable development of the humanity.
	CO5	Able to participate in the Green initiatives in the society i.e. Energy conservation and Tree plantation.
	CO6	Able to make the solid waste segregation and conduct events related environmental issues.

Activity – 1	**Periods: 9**	**CO1**
Water resources- Water Cycle, Distribution, Groundwater flow, Demand for water, Water pollution- causes and effects, Water Act (1974).		
Activity – 2	**Periods: 9**	**CO2**
Rainwater Harvesting-Methodology, components, design of rainwater harvesting system for a single house (as per IS:15797-2008)		
Activity – 3	**Periods: 9**	
Domestic waste water- Definition, Characteristics, Recycling and Reuse of domestic waste water.		
Activity – 4	**Periods: 9**	**CO3**
Air Pollution- definition, classification, causes, Sources, effects and control measures, Air Act (1981)		
Activity – 5	**Periods: 9**	
Solid Waste management – Causes- effects and control measures of Urban and industrial waste, Waste management initiatives in India for human well-being.		
Activity – 6	**Periods: 9**	**CO4**
Renewable and non-renewable energy resources- use of alternating energy sources – Energy management.		
Activity – 7	**Periods: 9**	**CO5**
Green Buildings- Definition, Importance, building envelope, Problems in existing buildings, Energy use in Buildings, Greenhouse gas emissions and indoor air pollution, green construction materials, Green building assessment system, Case study		
Activity – 8	**Periods: 9**	
Importance of Tree Plantation, Display of usefulness of trees, Method of tree planting, Identify the trees available in the PEC campus, Mass Plantation inside/outside the campus in association with the H2EC /NSS of PEC, Store the trees to the planted by the dignitaries with the help of horticulture of PEC.		
Activity – 9	**Periods: 9**	**CO6**
Collection and segregation of solid waste in the PEC campus in association with the H2EC /NSS of PEC		
Activity – 10	**Periods: 9**	
Invite guest Lectures from the Environmental experts of DSTE (for environmental issues)/REAP (for energy efficient buildings)/Town and Country Planning/PWD of Puducherry, conducting competitions to students in the topics of slogan making, poster and seminar presentations, debate and observing the important national and international days on environmental issues to bring awareness among the students and public.		

Activity Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**	**Total Periods: 45**

Reference Books

1. P.Yugananth, R.Kumaravelan, Environmental Science and Engineering, Scitech Publications (Inida) P.Ltd., Delhi, 2017.
2. John Pichtel, Waste Management Practices: Municipal, Hazardous and Industrial, CRC Press,2014
3. V.S.K.V.Harish, Arunkumar, Green Building Energy Simulation and Modeling, Elsevier Science & Technology,2018

4. Anubha Kaushik and C.P.Kaushik, Environmental Science and Engineering, New Age International (P) Ltd., New Delhi, 2010.
5. S.S.Dara, A text book of Environmental Chemistry and Pollution Control, S.Chand and Company Ltd., New Delhi, 2014.
6. IS:15797:2008, Roof Top Rainwater Harvesting-Guidelines, BIS, New Delhi
7. Energy Conservation Building Code, 2017, Bureau of Energy Efficiency, Ministry of Power, Government of India.

Department : **Mathematics**		Programme: **B.Tech.**						
Semester : **Third**		Course Category Code: **BSC /** Semester Exam Type**: TY**						
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MA204	**Transforms, Partial Differential Equations and Statistics**	3	1	0	4	40	60	100
Prerequisite:								

Course Outcome		
	CO1	Understands Transform Calculus
	CO2	Understands how to form partial differential equations
	CO3	Solve the Partial Differential Equations
	CO4	Gain knowledge on solving Boundary Value Problems
	CO5	Understand basic statistics and distributions

UNIT-I	**LAPLACE TRANSFORMS**	**Periods: 12**
Definition of Laplace Transform, Inverse Laplace Transform, Linearity property, Laplace transform of unit step function, Unit impulse function and some elementary functions, Change of scale and first shifting property, Derivatives and integrals of Laplace transform, Transform of derivatives and integrals, Application: Solution of single ordinary linear differential equation with constant coefficients-Laplace transform of Periodic functions.		**CO1**
UNIT-II	**PARTIAL DIFFERENTIAL EQUATIONS**	**Periods: 12**
General and Singular solution of PDE, Complete Solution of First order Non-linear PDE, Lagrange's linear equation of first order, Solution of the simultaneous equations by the method of grouping and multipliers.		**CO2**
UNIT-III	**HIGHER ORDER PDE AND BOUNDARY VALUE PROBLEMS**	**Periods: 12**
Homogeneous linear PDE of higher order with constant coefficients. Solution of partial differential equation by the method of separation of variables. Application of PDE: Variable separable solutions of the one dimensional wave equation, Transverse vibration of a stretched string.		**CO3**
UNIT-IV	**ONE DIMENSIONAL AND TWO DIMENSIONAL HEAT FLOW**	**Periods: 12**
Heat Equation, Variable and separable solution of one dimensional heat equation, Temperature distribution with zero and non-zero boundary values, Two dimensional heat flow under steady state conditions(Cartesian).		**CO4**
UNIT-V	**PROBABILITY AND STATISTICS**	**Periods: 12**
Probability, Events, Sample space, Axioms of probability, Random variable (Discrete and Continuous), Expectation, Probability Distribution: Binomial, Poisson & Normal distribution and statistical parameters of these distributions, Correlation and Regression, Rank correlation.		**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 60**

Reference Books:

1. Veerarajan T, Engineering Mathematics II, McGraw-Hill Education(India) Private Limited, 2014
2. Veerarajan T, Transforms and Partial Differential Equations, Third Edition, McGraw-Hill Education(India) Private Limited, 2016.
3. Venkataraman M.K., Engineering Mathematics, Third Year, Part-B, The National Publishing Company, Chennai, 2008.
4. S.C.Gupta and V.K.Kapoor, Fundamentals of Mathematical Statistics, 10th Edition, Sultan Chand &Sons, New Delhi, 2000.
5. Erwin Kreyszig, Advanced Engineering Mathematics (9 th Ed), John Wiley & Sons, New Delhi, 2011.
6. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, Eleventh Reprint, 2010.
7. Bali N. and Goyal M., Advanced Engineering Mathematics, Laxmi Publications Pvt. Ltd., New Delhi, 9thEdition, 2011.

Department: **Mechanical Engineering**		Programme : **B.Tech (ME)**						
Semester **: Third**		Course Category Code**: ESC**			Semester Exam type**: TY**			
Course code	Course	Periods/ week			Credit	Maximum marks		
		L	T	P	C	CA	SE	TM
ME203	**Engineering Mechanics**	3	1	0	4	40	60	100
Prerequisite								

Course Outcomes	**CO1**	Students will able to determine the resultant force and moment for a given force system.
	CO2	Students will able to analyse planar and spatial systems to determine the forces in members of trusses, frames.
	CO3	Determination of friction force/ torque requires to operate the machine elements.
	CO4	Student will able to determine the centroid and second moment of area/mass through theoretical and experimental techniques.
	CO5	Students will able to Calculate the motion parameters for a rigid body subjected to a given force system through Kinematics and Kinetics approaches

UNIT- I	**Periods: 12**	
Introduction – Units and Dimensions – Laws of forces –– Vectorial representation of forces – Concurrent and non-concurrent coplanar forces, Conditions of static equilibrium for coplanar force system, stability and equilibrium, concept of free body diagrams. Fundamental Principles of mechanics: Principle of transmissibility, Principle of superposition, Law of gravitation, Law of parallelogram of forces. Application of Force System - Analysis of plane trusses – method of joints – method of sections.		**CO1**
UNIT-II	**Periods: 12**	
Friction: Laws of friction, Static dry friction, simple contact friction problems, simple screw jack, and Belt friction, Friction clutches, rolling friction, Journal bearing and thrust bearing friction.		**CO2**
Unit-III	**Periods: 12**	
Properties of Surfaces- Properties of sections – centroids, center of gravity, area moment of inertia, Parallel Axis Theorem, product moment of inertia, polar moment of inertia, radius of gyration, mass moment of inertia of Basic Shapes - Experimental Determination. Principle of virtual work – work done by force and couple – application to simple mechanical systems.		**CO3**
Unit-IV	**Periods: 12**	
Kinematics and Kinetics of Rigid Bodies. Circular Motion of Rigid bodies – Acceleration during circular motion – Rotation of rigid bodies – Angular motion – Relationship between Angular and linear motion – Kinetics of Rigid body rotation – General plane of motion – Kinematics – Instantaneous Axis of rotation – kinetics of Rolling bodies – Kinetics of General plane motion.		**CO4**
Unit-V	**Periods: 12**	
Simple harmonic motion – vibration of mechanical systems - basic elements of a vibrating system – spring mass model – undamped free vibrations – Determination of natural frequency of 1D free vibration systems-equilibrium method, energy method, Rayleigh's method – longitudinal, Translational and torsional systems.		**CO5**

Total Contact Hours: **45**	**Total Tutorials**: **15**	**Total Practical Classes**:	**Total Hours**: **60**

Reference Books:

1. Prabhu T. J., Engineering Mechanics, Scitech Publications (India) Pvt Ltd, 2015.
2. Bhavikatti,S.S and Rajashekarappa,K.G., Engineering Mechanics, New Age International (P) Ltd, New Delhi, 2013.
3. Beer, F.P and Johnson Jr. E.R, Vector Mechanics for Engineers, Vol. 1 Statics and Vol. 2 Dynamics, McGraw – Hill International Edition, 1997.
4. Timoshenko, S., Young, D.H., Rao, J.V. and Sukumar Pati, Engineering Mechanics, Fifth edition, McGraw Hill Education (India) Pvt. Ltd., 2013.
5. Dukkipati R.V , Textbook of Mechanical Vibrations , Prentice Hall India Learning Private Limited; 2 edition, 2012.

Department : **Mechanical Engineering**		Programme : **B.Tech (ME)**						
Semester **: Third**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ME204	**Fluid Mechanics & Hydraulic Machines**	3	1	0	4	40	60	100
Prerequisite:	Basic laws of Physics							
Course Outcome	**CO1**	Able to determine the fluid properties of fluid, calculate fluid pressure using manometer, solve problems on fluid statics						
	CO2	Able to Understand types of fluid motion, various mathematical functions, calculate velocity and acceleration, apply conservation of mass and energy to solve fluid flow problems						
	CO3	Able to solve problems on flow though pipes, perform dimensional & model analysis for fluid flow problems, and understand boundary layer flow						
	CO4	Able to apply impulse momentum principle to calculate power required/developed by hydraulic machines						
	CO5	Able to understand the performance characteristics of hydraulic machines						
UNIT-I					**Periods: 12**			
Fluid properties. Fluid statics: Pascal's law-hydrostatic law–scale of pressure measurement-Manometer: simple, inclined differential U-tube manometers. Hydrostatic forces on surfaces: centre of pressure and total pressure. Buoyancy and floatation.								**CO1**
UNIT-II					**Periods: 12**			
Kinematics of fluid flow: types of fluid flow, continuity equation in rectangular and cylindrical coordinate systems-velocity and acceleration-stream lines, path lines, streak lines and flow net-types of motion – rotation-velocity potential function and stream function. Dynamics of fluid flow: Equations of motion- Euler's equation. Bernoulli's equation and its applications: Venturimeter, Orifice meter and Pitot tube.								**CO2**
UNIT-III					**Periods: 12**			
Reynolds experiment: Flow through pipes: flow of viscous fluid through circular pipe and Hagen Poiseuille formula. Energy losses: major loss and minor losses - Darcy Formula-Compound pipe and equivalent pipe. Dimensional analysis- Application of Buckingham Pi theorem for problems in fluid mechanics -model analysis-Similitude-dimensionless numbers Introduction to Boundary layer flow: Flow over a flat plate (theoretical treatment only)								**CO3**
UNIT-IV					**Periods: 12**			
Impulse momentum equation- impact of jet: Force exerted by jet on stationary and moving plates/vanes –calculation of work and power. Hydraulic turbines: classification- Impulse Turbine-Pelton wheel- Reaction Turbine-Francis and Kaplan turbines-velocity triangles-calculation of power developed.								**CO4**
UNIT-V					**Periods: 12**			
Hydraulic pumps: Classification-Centrifugal pump- velocity triangles-calculation of power required- pump efficiency-priming. Performance of hydraulic machines: Unit quantities and specific speed, performance characteristics curves – Cavitation. Reciprocating pump-types-working principle-air vessels-gear pumps (theoretical treatment only).								**CO5**
Lecture Periods: 45	**Tutorial Periods:15**	**Practical Periods: Nil**			**Total Periods: 60**			

Reference Books:

1. R. K. Bansal, A textbook of fluid mechanics and hydraulic machines, Laxmi Publications, 2005.
2. P.N. Modi and S.M. Seth, Hydraulics and Fluid Mechanics Including Hydraulics Machines Rajsons publications Pvt Ltd, 2017
3. K. L. Kumar, Engineering Fluid mechanics, S. Chand, 2010.
4. Subramanya. K, Hydraulic machines, McGraw Hill Education (India) Private Limited,2013
5. Robert W Fox & Alan T. McDonald, Introduction to fluid mechanics, John Wiley & sons, Inc.,2013
6. Frank M. White, Fluid mechanics, McGraw Hill Education (India) Private Limited,2011
7. Yunus Cengel & John Cimbala, Fluid Mechanics: Fundamentals and Applications McGraw Hill Education (India) Private Limited, 2014.
8. Munson, Young, Okiishi and Huebsch, Fundamental of fluid mechanics, Wiley India Private Limited, 2009.
9. Som. S & Gautham Biswas, Introduction to fluid mechanics and fluid machines, McGraw Hill Education (India) Private Limited, 2011.

Department : **Mechanical Engineering**		Programme : **B.Tech (ME)**						
Semester : **Third**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ME205	**Engineering Thermodynamics**	3	1	0	4	40	60	100
Prerequisite:								

Course Outcome	**CO1**	Application of the first law of thermodynamics for simple closed and open systems under steady and unsteady conditions.
	CO2	Application of the second law of thermodynamics to thermodynamic cycles, calculation of entropy changes and performing exergy analysis of processes.
	CO3	Use of modified equations of state for gases and use of tables / charts for properties of steam.
	CO4	Derivation of relations involving properties of ideal gases and calculation of property changes in psychrometric processes.
	CO5	Calculation of air/fuel ratio during combustion of fuel, application of first law of thermodynamics to combustion.

UNIT-I	**Periods: 12**
Continuum – microscopic and macroscopic approach – thermodynamic systems, property and its types, process and its types, state – thermodynamic equilibrium – path and point functions – temperature and its measurement scales – zeroth law of thermodynamics – energy – stored forms and transitional forms of energy and their types – first law of thermodynamics applied to closed and open systems – steady and unsteady processes – first law efficiency.	**CO1**
UNIT-II	**Periods: 12**
Limitations of first law of thermodynamics – heat engines – heat pumps – thermal reservoirs – various statements of second law of thermodynamics – reversibility – Clausius inequality – entropy – entropy change in processes – entropy generation principle and its applications – entropy balance of closed and open systems. Exergy – reversible work, useful work for closed and open systems – decrease of exergy in processes – dead state – irreversibility – second law efficiency of thermal devices.	**CO2**
UNIT-III	**Periods: 12**
Ideal and real gases – gas laws, various equations of state – law of corresponding states – compressibility factor and charts. Mixture of gases – laws – property correlations – entropy – Gibbs function. Pure substances – phase change process – dryness fraction – property tables – 2D and 3D charts – Mollier diagram.	**CO3**
UNIT-IV	**Periods: 12**
Thermodynamic properties correlations – Maxwell's correlations – Tds equations – inversion temperature – Joule Kelvin effect – Clausius Clapeyron equation. Psychrometry – air and water vapour mixture – property tables and charts – adiabatic saturation temperature – psychrometric processes.	**CO4**
UNIT-V	**Periods: 12**
Combustion – Stoichiometry – air/fuel ratio – enthalpy of formation – enthalpy of combustion –first law of thermodynamics applied to combustion – heating values. Compressible flow – stagnation states – Mach number – relations for stagnation fluid properties – isentropic flows through nozzles.	**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 60**

Reference Books:

1. Nag.P.K., *"Engineering Thermodynamics"*, 6th Edition, McGraw Hill India, New Delhi, 2017.
2. Yunus A. Cengel & Michael A. Boles, *"Thermodynamics"*, 8th edition, McGraw Hill India, New Delhi, 2015.
3. C.P.Arora, *"Thermodynamics"*, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2003.
4. Rathakrishnan E, *"Fundamentals of Engineering Thermodynamics",* 2nd Edition, PHI Learning Pvt. Ltd., New Delhi, 2006.
5. Claus Borgnakke & Richard E. Sonntag *Fundamentals of Thermodynamics* 7th Edition John Wiley and Sons Inc. New York, 2009.

Department : **Mechanical Engineering**		Programme : **B.Tech (ME)**						
Semester : **Third**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ME206	**Materials Technology**	3	0	0	3	40	60	100
Prerequisite:								

Course Outcome	**CO1**	At the end of the course, the student will be able to: Mastery of the knowledge in Material selection
	CO2	Understanding the concepts of phase diagrams including iron-carbon diagram
	CO3	Examining the properties of ferrous and non ferrous materials for different applications
	CO4	Applying the different mechanical testing methods
	CO5	Examining the different failure mechanism of metals

UNIT-I	**Periods: 9**
Crystal structures (BCC, FCC and HCP systems), atomic packing factor, density, Crystalline perfections; point defects, line defects- edge and screw dislocations, surface defects, volume defects. Mechanism of Elastic & plastic deformation (slip and twinning), slip, work hardening theory, Changes in properties due to cold working & hot working. Microscopy, specimen preparation.	**CO1**
UNIT-II	**Periods: 9**
Solid solution, Hume Ruther's rule of solid, Allotropy, Concept of solidification of pure metals &alloys Cooling curves, Plotting of Equilibrium diagrams, Lever rule, Eutectic system and eutectoid system. Iron-iron carbide equilibrium diagram, critical temperatures, classification and application of steels & alloy steels, specification of steels. Classification & Effect of alloying elements, examples of alloy steels.	**CO2**
UNIT-III	**Periods: 9**
Heat treatment of steels: Annealing, Normalising, Hardening & Tempering, quenching media, other treatments such as Martempering, Austempering, Ausforming. temper embrittlement, quench cracks, Hardenability& hardenability testing, Defects due to heat treatment and remedial measures. Classification of surface hardening treatments, Carburising, heat treatment after Carburizing, Nitriding, Carbo-nitriding, Flame hardening, and Induction hardening.	**CO3**
UNIT-IV	**Periods: 9**
Nonferrousmetalsandalloys:Copper,Aluminium,Nickel,ZincandLeadbasedalloys.Heat treatment of Nonferrous metals: Precipitation/ Age Hardening, solid solution strengthening, dispersion strengthening.	**CO4**
UNIT-V	**Periods: 9**
Studyofdestructivetesting, Tensile test, engineering stress-strain curve, true stress-strain curve, types ofstress-strain curves, compression test, different hardness tests-Vickers, Rockwell, Brinell, Micro Hardness Test, Impact test, fatigue test, creeptest.	**CO5**

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

Reference Books:

1. RaghavanV,PhysicalMetallurgy–Principles and Practice, Prentice Hall India Pvt.Ltd., NewDelhi,2006.
2. H.Avner, Introduction to Physical Metallurgy, Tata-McGraw Hill Publishing Co., New Delhi, 2nd Ed., 26th Reprint, 2009.
3. Refe Donald R. Askeland, The Science and Engineering of Materials, Chapman and Hall, 1990.
4. G.E.Dieter, Mechanical Metallurgy, McGraw Hill Publishing Co., New York, 1988.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Third**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ME207	**Machine Drawing**	2	0	3	3	40	60	100
Prerequisite:								

Course Outcome	**CO1**	At the end of the course, the student will be able to : Students can prepare production drawing and assembly drawings required for manufacturing of any product.
	CO2	Acquire skill in preparing production drawings pertaining to various design
	CO3	Acquire the knowledge of assembly of various machine or engine components and miscellaneous machine components
	CO4	Draw the assembled views for the part drawings of miscellaneous machine components.
	CO5	Perform basic sketching techniques to draw engineering components.

PART - A	**Periods: 30**	
Conventions for sectioning and dimensioning, screw threads, rivets, bolts, nuts, pins, keys, cotter, gear, springs and welds. Introduction to geometrical tolerance -Component drawing assigning fits and tolerance machine symbol, surface finish - Introduction to AUTOCAD software, Introduction to Production drawing and concepts of P-7 drawing.		
PART - B	**Periods: 45**	
Preparation of drawings of parts and assembly of:- **Joints** Riveted joints - butt joints and lap joints Pin joints - knuckle joints Cotter joints -sleeve, socket and spigot joints **Couplings** Split muff couplings, flexible type flange coupling, universal coupling **Bearing** Pedestal bearing, swivel bearing, Plumber block Screw jack Connecting rods Tail stock steam stop valve		**CO1** **CO2** **CO3** **CO4** **CO5**

Lecture Periods: 30	**Tutorial Periods: -**	**Practical Periods: 45**	**Total Periods: 75**

Reference Books:

1. Gupta, R.B, “Machine Drawing” ,Satya Prakasham,1998.
2. Sidheswar, “Machine Drawing” Tata McGraw Hill edition, 2006.
3. Sadhu Singh and P.L. Sah, Fundamentals of Machine Drawing, PHI 2005.

Department : **Humanties and Social Sciences**			Programme : **B.Tech.**						
Semester : **Third**			Subject Category: MCC				Semester Exam Type: **-**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
SH202	**Indian Constitution**		2	-	-	-	-	-	-
Prerequisite	-								
Course Outcome	The course will enable the students to:								
	CO1	understand the essence and significance of the constitution							
	CO2	recognize ones fundamental duties and rights							
	CO3	appreciate the structure and functions of legislature, executive and judiciary							
	CO4	understand the functioning of state governments and union territories							
	CO5	understand the centre-state relations and functioning of constitutional bodies							
UNIT-I	**Introduction of Indian Constitution**					**Periods: 09**			
The Making of Indian Constitution - The Constituent Assembly - Sources of Indian Constitution - Preamble and the Supreme Court's Judgments on Preamble.									**CO1**
UNIT-II	**State, Rights and Duties**					**Periods: 09**			
State and Union Territories – Citizenship - Fundamental Rights - Directive Principles of State Policy - Fundamental Duties.									**CO2**
UNIT-III	**Union Government**					**Periods: 09**			
Union Government - The Powers and Functions of the President, Vice–President, Council of Ministers, Prime Minister, Judiciary, Supreme Court - Judicial Review - Judicial Activism- Public Interest Litigation - Power and Functions of the Parliament - Budget Power and Functions of Parliament, Speaker of Lok Sabha.									**CO3**
UNIT-IV	**State Governments**					**Periods: 09**			
State Governments – Governor - State Council of Ministers - Chief Minister- Legislative Assembly- High Courts - Union Territories - Panchayati Raj Institutions - 73th and 74th Constitutional Amendment - Gram Panchayats - Block Panchayats - Municipalities.									**CO4**
UNIT-V	**Union- State Relations, Constitutional Bodies**					**Periods: 09**			
Centre – State Relations - Public Service - Election Commission - NITI Ayog, Emergency Powers of the President- Constitution Amendment Procedure- Right to Information Act - Right to Education. Major Constitutional Amendments and their impact on Indian Political System.									**CO5**
Lecture Periods: 45	**Tutorial Periods:**	**Practical Periods:**				**Total Periods: 45**			

Reference Books:

1. Austin, Granville. The Indian Constitution: Cornerstone of a Nation. Oxford University Press, 1999.
2. Basu, Durga Das, et al. Introduction to the Constitution of India. 20th ed., Thoroughly Rev, Lexis Nexis Butterworths Wadhwa Nagpur, 2008.
3. Choudhry, Sujit, et al., editors. The Oxford Handbook of the Indian Constitution. Oxford University Press, 2016.
4. Bakshi, Parvinrai Mulwantrai, and Subhash C. Kashyap, The Constitution of India (Universal Law Publishing, 2016)
5. Bhargava, Rajeev, 'Politics and Ethics of the Indian Constitution', 2009
6. Rajeev Bhargava - 'The Promise of India's Secular Democracy', 2010
7. Chakrabarty, Bidyut, India's Constitutional Identity: Ideological Beliefs and Preferences (Routledge, 2019)
8. Jayal, Niraja Gopal, and Pratap Bhanu Mehta, The Oxford Companion to Politics in India, Oxford University Press, 2010
9. Kashyap, Subhash C., Our Constitution: An Introduction to India's Constitution and Constitutional Law (NBT India, 1994)
10. Kashyap, Subhash C. Our Parliament: An Introduction to the Parliament of India. Revised edition, National Book Trust, India, 2011.
11. Subhash C. Kashyap Our Constitution Paperback –. (NBT India, 2012).
12. Laxmikanth, M. "INDIAN POLITY". McGraw-Hill Education "Constitution of India". Ministry of Law and Justice, Govt. of India.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)-Honours**						
Semester : **Third**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEH01	**Engineering Optimization**	3	1	0	4	40	60	100
Prerequisite:								
Course Outcome	**CO1**	At the end of the course the student is able to understand: Knowledge in formulation of Optimization Problem						
	CO2	Understanding the Single Variable Optimization Problems						
	CO3	To get knowledge about Multivariable Optimization Algorithms						
	CO4	Explain the methods of optimization						
	CO5	Able to write algorithm to obtain optimal systems.						
UNIT-I					**Periods: 12**			
Introduction-Optimization Problem Formulation, Design Variables, Constraints, Objective Function, Variable Bounds, Engineering Optimization Problems, Optimization Algorithms.								**CO1**
UNIT-II					**Periods: 12**			
Single Variable Optimization Problems-Optimality Criterion, Bracketing Methods: Exhaustive Search Method, Bounding Phase Method. Region Elimination Methods-Interval Halving Method, Fibonacci Search Method, Golden Section Search Method. Point Estimation Method-Successive Quadratic Estimation Method. Gradient Based Methods-One of the followings-Newton-Raphson Method, Bisection Method, Secant Method, Cubic Search Method								**CO2**
UNIT-III					**Periods: 12**			
Multivariable Optimization Algorithms-Optimality Criteria, Unidirectional Search, Direct Search Methods: Any two of the following-Evolutionary optimization method, Simplex Search Method, Hooke-Jeeves pattern search method, Powell's Conjugate Direction Method. Gradient Based Methods-Cauchy's Steepest Descent Method. Newton's method, Marquardt's Method. Conjugate Gradient Method, Variable-metric Method								**CO3**
UNIT-IV					**Periods: 12**			
Constrained Optimization Algorithms, Kuhn Tucker Conditions, Transformation Methods-Penalty Function Method, Method of Multipliers, Sensitivity analysis								**CO4**
UNIT-V					**Periods: 12**			
Non-Traditional Optimization Algorithms-Genetic Algorithms: Working Principle, Differences between Gas and traditional methods, GAs for constrained optimization. Other GA operators. Simulated Annealing-Analogy, Algorithm, Application								**CO5**
Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: Nil**				**Total Periods: 60**		

Reference Books:

1. Kalyanmoy Deb, 2010. Optimization for engineering design: algorithms and examples. Prentice-Hall of India Private Limited, New Delhi.
2. Singiresu S Rao, 2009. Engineering optimization: theory and practice. Fourth Edition, New Age International(P) Limited Publishers, New Delhi.
3. Ravindran, K. M. Ragsdell, G. V. Reklaitis, 2006. Engineering optimization - methods and applications. Second Edition, John Wiley & Sons, Inc. Andreas Antoniou and Wu-Sheeng Lu, 2007. Practical Optimization: Algorithms and applications, Springer Science+Business Media, LLC

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)-Minor**						
Semester : **Third**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEM01	**Heat Power Engineering**	3	1	0	4	40	60	100
Prerequisite:	Studied a course on Thermodynamics in Basic Sciences							
Course Outcome	**CO1**	Upon Completion students will be able to convey the basics of the thermodynamic principles						
	CO2	Able to understand IC Engines ,its performance and analyse air standard cycles						
	CO3	Able to understand power plants ,its components and analyse vapour power cycles						
	CO4	Able to understand the role of refrigeration and Air-conditioning as energy systems						
	CO5	Able to understand the Principles , Performance and working of air machines						

UNIT-I	**Periods: 12**	
Energy conversion and efficiencies of steam and nuclear power plants, internal combustion engines, gas turbine and refrigeration systems- Thermodynamic systems, properties and state - Thermodynamic equilibrium- path and point functions - Temperature - Zeroth law of thermodynamics – First law of Thermodynamics, Second law of Thermodynamics.		**CO1**
UNIT-II	**Periods: 12**	
IC engines – Classification – Working principles - diesel and petrol engines: two stroke and four stroke engines – Merits and demerits- Port and Valve timing diagrams- Air standard cycles - Otto and Diesel - Testing of IC engines.		**CO2**
UNIT-III	**Periods: 12**	
Power Generation Systems – Conventional and Non-Conventional- Layout of a modern steam power plant, Steam generators Classification – Constructional features– Boiler mountings and accessories – Merits and demerits – Applications - Steam turbines: Classification.		**CO3**
UNIT-IV	**Periods: 12**	
Basics of refrigeration – Methods of refrigeration: ice refrigeration, evaporative refrigeration– Unit of refrigeration – Reverse Carnot cycle- p-h and T-s diagrams - COP - Vapor compression refrigeration cycle and systems - Properties of refrigerants- ODP & GWP-Gas refrigeration cycle - Absorption refrigeration system – Liquefaction – Solidification - Air conditioning systems.		**CO4**
UNIT-V	**Periods: 12**	
Air machines- classification-compressor-reciprocating compressor-single stage compressor and multistage compressor. Rotary compressor-centrifugal and axial flow compressor. Blower-roots and vane blower. Fan centrifugal and axial flow fans.		**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: Nil**	**Total Periods: 60**

Reference Books:

1. Nag, P. K., "Engineering Thermodynamics", 5 th edition, McGraw - Hill Education India Pvt. Ltd., New Delhi, 2013.
2. V.Ganesan, IC Engines, Tata Mc Graw Hill Publication,1995
3. Kothandaraman, C. P., and Domkundwar, A course in Thermal Engineering, Dhanpat Rai & Co, 2013
4. Arora, C. P., Refrigeration and Air conditioning, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2000
5. Yahya S.M., Fundamentals of Compressible Flow, New Age International, New Delhi, 2012.

Department : **Chemistry**			Programme : **B.Tech.**						
Semester : **Fourth**			Subject Category: **BSC**			Semester Exam Type: **TY**			
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
SH201	**Biology for Engineers**		3	-	-	2	40	60	100
Prerequisite	-								
Course Outcome	After studying the course, the student will be able to:								
	CO1	Convey that classification *per se* is not what biology is all about but highlight the underlying criteria, such as morphological, biochemical and ecological							
	CO2	Highlight the concepts of recessiveness and dominance during the passage of genetic material from parent to offspring							
	CO3	Convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine							
	CO4	Gain a basic understanding of enzyme action and factors affecting their activity.							
	CO5	Identify and classify microorganisms.							

UNIT-I	**Classification**	**Periods: 9**
Classification outline based on (a) cellularity- Unicellular or multicellular (b) ultrastructure prokaryotes or eukaryotes (c) Energy and Carbon utilisation -Autotrophs, heterotrophs, lithotropes (d) Ammonia excretion – aminotelic, uricoteliec, ureotelic (e) Habitats- acquatic or terrestrial (e) Molecular taxonomy three major kingdoms of life.		**CO1**
UNIT-II	**Genetics**	**Periods: 9**
Mendel's laws, Concept of segregation & independent assortment. Concept of allele. Recessiveness, and dominance. Single gene disorders in humans – Sickle cell disease, Phenylketonuria.		**CO2**
UNIT-III	**Biomolecules**	**Periods: 9**
Carbohydrates: Types, Structural & functional importance. Lipids: Classification - Simple, compound, & derived, Importance of lipid soluble vitamins. Amino acids – general structure, essential amino acids. Proteins - Levels of protein structure, structural & functional importance of proteins, Enzymes- Definition, Enzyme Activity & Units, Specific Activity, Specificity, Factors affecting enzyme activity. Nucleic acids: Types and importance.		**CO3**
UNIT-IV	**Metabolism**	**Periods: 9**
Introduction: Food chain & energy flow. Definitions - Anabolism & Catabolism. Photosynthesis: Reaction and importance. Glycolysis & TCA cycle. ATP – the energy currency of cells		**CO4**
UNIT-V	**Microbiology**	**Periods: 9**
Concept of single celled organisms. Concept of species & strains. Identification & classification of microorganisms. Virus – Definition, types, examples.		**CO5**

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

Reference Books:

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M,L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H. John Wiley and Sons
3. Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freemanand Company
4. Molecular Genetics (Second edition), Stent, G. S.; and Calender, R. W.H. Freeman andcompany, Distributed by Satish Kumar Jain for CBS Publisher
5. Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C.Brown Publishers.

Department: **Electronics and Communication Engineering**			Programme : **B.Tech.(ME)**						
Semester : **Fourth**		Course Category Code: **ESC /** Semester Exam Type: **TY**							
Course Code	Course		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
EC234	**Elements of Electronics**		3	0	0	3	40	60	100
Prerequisite	Nil								
Course Outcome	**CO1**	Understanding the basic theory of semiconductors and diodes.							
	CO2	Knowledge about various transistor configurations and also could comprehend the need for proper biasing of devices.							
	CO3	Understanding the operation of Field Effect Transistor devices.							
	CO4	Gain knowledge on Thyristors and optical devices.							
	CO5	Acquire knowledge on Transducers and Sensors.							

UNIT – I	**Periods: 9**	
Semiconductor Fundamentals and PN junction diode: Introduction to semiconductors – Types of semiconductors -Energy band diagram of semiconductor - Diode equivalent circuit -Diode current equation - Construction, working and VI characteristics of PN junction diode – Energy band structure of open circuited PN junction- Effect of temperature on PN junction diodes - Capacitance effects –Types of breakdown – Zener diode - Application of diode as half wave, full wave and bridge rectifiers, Clipper and Clamper circuits. Regulators - Zener diode as Voltage regulator.		**CO1**
UNIT-II	**Periods: 9**	
Bipolar Junction Transistor: Construction- Types of configurations: Operation of NPN and PNP transistors- working and characteristics of CE, CB and CC configurations –Early effect - Thermal runaway – Heat sinks - Need for transistor biasing – dc load line – Q point-Voltage divider bias - Application of BJT as amplifier and switch.		**CO2**
UNIT-III	**Periods: 9**	
Field Effect Transistor: Types – Construction and operation of N-channel and P-channel JFET – Characteristics and parameters of JFET- JFET biasing circuits –fixed bias and potential divider bias (derivations not required) Construction ,working and characteristics of E-MOSFET and Depletion MOSFET - Working and application of CMOS as inverter.		**CO3**
UNIT-IV	**Periods: 9**	
Thyristors and Optical Devices: Construction, working and characteristics of SCR, DIAC , TRIAC, UJT. Construction, working and characteristics of LED, LASER, PIN diode, APD, Optocoupler. LDR, photo multiplier, LCD.		**CO4**
UNIT-V	**Periods: 9**	
Transducers and Sensors: Basic principle – Classification of Transducers – Mechanical Transducers – Displacement to Pressure Transducer – Passive Electrical Transducers – Resistive - Inductive - Capacitive Displacement Transducers – Active Electrical Transducers – Piezoelectric Transducers – Hall Effect Transducers -Photo voltaic -Semiconductor Sensors – Smart Sensor – Hall effect sensor – Thermal Detector Sensor – Ultrasonic sensor – Fiber optic pH and Humidity sensor – Chemical Sensors – Semiconductor Gas Detectors - Biomedical Sensors.		**CO5**

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

Reference Books:

1. J.Millman, C.Halkias and Satyabrata ,"Electronic devices and Circuits", Third edition,McGraw Hill, 2010.
2. Robert L. Boylestead and Louis Nashelsky, "Electron Devices and Circuits Theory ", Prentice Hall of India, 11th Edition,2013.
3. David A. Bell, "Electronic Devices and Circuits", Prentice Hall of India, 5th Edition, 2008.
4. Theodore F. Bogart, **"**Electronic Devices and Circuits", Pearson Education India ,2011.
5. Murthy D. V. S, "Transducers and Instrumentation", Prentice Hall, 2nd Edition, 2012.S.Salivahanan and etal, "Electronic Devices and Circuits", Tata Mcgraw Hill, Fifth Reprint, 2008.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Fourth**		Course Category Code: **ESC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ME208	**Mechanics of solids**	3	1	0	4	40	60	100
Prerequisite:								

Course Outcome	**CO1**	Students will able to analyse stresses, shear force and bending moment diagrams, deflections for different types of beams.
	CO2	Students will Follow and understand the basics of Mechanics of solids.
	CO3	Students will be able to Learn the basic concept (elementary) of thin shells, thick shells and buckling of columns.
	CO4	Student will be able to Develop natural curiosity to explore the various facets Mechanics of solids.
	CO5	Students will able to Demonstrate about various types of loading and stresses induced in the machine components.

UNIT-I	**Periods: 12**	
Simple Stresses and Strain – Relation between three modulus and Poisson's ratio – Thermal Stress – Principal stress and Principal planes - Shear Force – Bending Moment – Cantilever and simply supported beams subjected to point loads and uniformly distributed loads.		**CO1**
UNIT-II	**Periods: 12**	
Theory of simple bending - stress variation in beam cross Section; Normal and Shear stress in Beams – Beam of uniform strength for bending, combined direct and bending stresses		**CO2**
UNIT-III	**Periods: 12**	
Deflection of beams -Double integration method – moment area method		**CO3**
UNIT-IV	**Periods: 12**	
Torsion of circular solid and Hollow shafts – Shafts in Series and parallel – Combined bending and torsion - Application of Torsion in helical springs: Open and closed coil springs, Leaf Springs.		**CO4**
UNIT-V	**Periods: 12**	
Euler's Equation – short and long column, Empirical formulae: Johnson – Rankine. Introduction to thin cylinder – Thick cylinder – Lame's Equation – Compound Cylinders – Interference fit.		**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: Nil**	**Total Periods: 60**

Reference Books:

1. U.C.Jindal - Strength of Materials, Galgotia Publication Pvt. Ltd., New Delhi, 1998.
2. R.K.Rajput - Strength of Materials, S.Chand and Company Ltd., New Delhi, 2003.
3. Beer F, Jonston E R, DeWolf J, Mechanics of Materials, McGraw-Hill Publications, 2005
4. R K Bansal, Strength of Materials, 4th Edition, Laxmi Publications, New Delhi, 2007
5. Bhavikatti. S. S., Strength of Materials, Vikas Publishing House (P) Ltd., New Delhi, 2nd Edition, 2002.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Fourth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ME209	**Thermal Engineering - I**	3	1	0	4	40	60	100
Prerequisite:								

Course Outcome	**CO1**	Able to analyse air standard cycles, know the properties of fuel and perform combustion calculations
	CO2	Able to identify different components & systems of IC Engines, combustion phenomena and analyse engine performance
	CO3	Able to analyse vapour power cycles and understand the functions of different components of modern steam power plant
	CO4	Able to analyse the performance of steam turbines and nozzles
	CO5	Able to understand the functioning of high pressure boilers, condensers and cooling towers and analyse the performance of condenser

UNIT-I	**Periods: 12**
Air standard cycles: The air standard Carnot cycle - Air standard Otto cycle, diesel cycle, dual cycle and their comparison – Gas turbine - Brayton cycles and their efficiencies. Fuels and Combustion: Fuel properties and their determination - Stoichiometry – reactant and product quantities	**CO1**
UNIT-II	**Periods: 12**
IC Engines-Classification-Four stroke and two stroke cycles- SI and CI Engines-Port and Valve timing diagrams. Combustion in SI engines-Ignition lag-Flame propagation-abnormal combustion-Knocking-Rating of SI engine fuels. Combustion in CI engines-Delay period-knocking-Rating of CI engine fuels Introduction to fuel supply, Cooling and Lubrication systems of SI and CI Engines Testing of IC engines-Heat balance test-Engine performance characteristics	**CO2**
UNIT-III	**Periods: 12**
Analysis of vapour power cycles-Rankine cycle- Reheat cycle-regeneration cycle- Reheat- regenerative cycle-binary vapour power cycle. Layout of a modern steam power plant.	**CO3**
UNIT-IV	**Periods: 12**
Steam turbines: Classification-impulse and reaction turbines-compounding- velocity diagram- work done and efficiencies: blade efficiency, stage efficiency Steam nozzles-types-flow of steam through nozzles-condition for maximum discharge – friction-supersaturated flow through nozzle – general relationship between area, velocity and pressure in nozzle flow.	**CO4**
UNIT-V	**Periods: 12**
Boilers: Classification- High pressure boilers-supercritical boilers Condensers: Classification- Jet condensers and surface condensers- Air removal-vacuum measurement-vacuum and condenser efficiency – cooling water requirement for condensation of steam-Cooling towers and their types	**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods:**	**Total Periods: 60**

Reference Books:

1. V.Ganesan, IC Engines, Tata Mc Graw Hill Publication,1995
2. Kothandaraman, C. P., and Domkundwar, A Course in Thermal Engineering, Dhanpat Rai & Co, 2013
3. Sarkar, B.K,"Thermal Engineering" Tata McGraw-Hill Publishers, 2007
4. Rudramoorthy, R, "Thermal Engineering ",Tata McGraw-Hill, New Delhi,2003
5. Ramalingam. K.K., "Thermal Engineering", SCITECH Publications (India) Pvt. Ltd., 2009.
6. Cengel, Y.A. and Boles, M.A., "Thermodynamics - An Engineering Approach", 7th edition, Tata Mc-Graw Hill Education, 2011.
7. John B Heywood,IC engine Fundamentals, McGraw Hill International Edition,1988
8. Collin R. Ferguson–Internal Combustion Engines-Applied Thermo sciences, Wiley, 2004.
9. Willard W. Pulkrabek– Internal Combustion Engines, Prentice Hall of India, 2002

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Fourth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ME210	**Machining Technology**	3	0	0	3	40	60	100
Prerequisite:								

Course Outcome	**CO1**	At the end of the course, the student shall be able to, Describe the details and operations on lathe.
	CO2	Understand the mechanism of metal cutting in drilling and milling machines.
	CO3	Identify the basic parts and operations of shaper, planner and slotting machines.
	CO4	Understand the evolution, classification and need of unconventional machining technology in modern manufacturing.
	CO5	Select cutting fluids and cutting tool materials for improving machinability and tool life.

UNIT-I	**Periods: 9**	
Lathe – Types, Designation, Work holding devices – Cutting Speed, Feed and Depth of Cut, Material Removal Rate - Operations, Machining Time.		**CO1**
UNIT-II	**Periods: 9**	
Drilling Machine – Types, Operations, Machining Time - Boring, Reaming and Tapping (Definition of operations only). Milling Machine – Types, Process, Operations, Machining Time, Material Removal Rate and Gear cutting.		**CO2**
UNIT-III	**Periods: 9**	
Shaper – Types, Shaping Operations, Planner – Types, Planning Operations, Slotting Machine and its Operations.		**CO3**
UNIT-IV	**Periods: 9**	
Unconventional Machining Process - Classification, Laser Beam Machining, Electric Discharge Machining, Electrochemical Machining, Electrochemical Grinding, Ultrasonic Machining, Abrasive Jet Machining.		**CO4**
UNIT-V	**Periods: 9**	
Tool Materials, Nomenclature and Geometry of Cutting Tools, Tool wear Mechanisms, Tool Life – Tool Life Criteria. Cutting fluids – Functions, characteristics and types, Selection of cutting fluids.		**CO5**

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

Reference Books:

1. P.N.Rao, "Manufacturing Technology- Metal Cutting and Machine Tools", - Tata McGraw Hill Publishing Company Ltd, 3rd edition, New Delhi, 2013.
2. Amitabha Ghosh and Asok Kumar Malliik, "Manufacturing Science", Affliated East- West Press Private Ltd, 2nd edition, New Delhi, 2010.
3. Kalpakjain S, Schimd S, "Manufacturing Engineering and Technology", Pearson Education, 7th edition, New Delhi, 2018.
4. Sharma, P.C., "A Textbook of Production Technology", S. Chand & Company Ltd., New Delhi, 8th edition, 2014
5. A.B. Chattopadhyay "Machining and Machine Tools", Wiley India, 2011.
6. Roy A. Lindberg, "Processes and Materials of Manufacture ", Prentice Hall of India (P) Ltd, New Delhi, 4thedition, 2008.
7. G Boothroyd, "Fundamentals of Machining and Machine Tools", CRC Press, NewDelhi, 3rd edition, 2005.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Fourth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ME211	**Kinematics of Machines**	3	1	0	4	40	60	100
Prerequisite								

Course Outcome	**CO1**	Students will able to understand and visualise any given practical machines as simple kinematic chain.
	CO2	Students will be able to determine velocity and acceleration at any point in the given planar mechanism.
	CO3	Student will be able to design Four bar and slider crank mechanism for simple applications.
	CO4	Students will be able to analyse follower motion of the CAM from kinematic point of view and suggest suitable CAM drive for the given application.
	CO5	Able to design gears with interference problem and also able to determine speed of different gear trains given.

UNIT-I	**Periods: 12**
Introduction: Mechanisms and machines; Elements of kinematic chain, mobility and range of movements, Definition & Concept - inversion of single and double slider chain and four bar chain and its applications. Mechanism with lower pairs -Pantograph, Straight line mechanism- exact and approximate Motion, Engine indicator, Motor car Steering gears, Hooke joint, Toggle mechanism. Introduction: Mechanisms and machines; Elements of kinematic chain, mobility and range of movements, Definition & Concept - inversion of single and double slider chain and four bar chain and its applications. Mechanism with lower pairs - Pantograph, Straight line mechanism- exact and approximate Motion, Engine indicator, Motor car Steering gears, Hooke joint, Toggle mechanism.	**CO1**
UNIT-II	**Periods: 12**
Kinematic Analysis of Mechanisms: Analysis of displacement, velocity & acceleration diagrams of simple planar mechanisms by graphical (Instantaneous center method and relative velocity method), analytical and computer aided methods (for four-bar and slider crank mechanism only), coriolis component of acceleration.	**CO2**
UNIT-III	**Periods: 12**
Kinematic Synthesis of Mechanisms: Kinematic synthesis, graphical method using relative pole method, Inversion method and overlay 3 point synthesis problems - Motion, path & function generation, Chebyshev's spacing of accuracy points. Freudenstein Method of 3 point synthesis of four link mechanism and slider crank mechanism. Coupler curves.	**CO3**
UNIT-IV	**Periods: 12**
Cams: Types of cams and followers, displacement velocity and acceleration curves for uniform velocity, uniform acceleration and retardation, SHM, cycloidal motion, layout of profile of plate cams of the above types with reciprocating, oscillating, knife-edge, roller and flat faced followers. Cylindrical and face cams, polynomial cams, cams with special contours. Tangent cams with reciprocating roller follower, circular arc cam with flat faced follower**.**	**CO4**
UNIT-V	**Periods: 12**
Gears and Gear Trains: Classification and terminology used, Fundamental law of gearing – friction wheel, teeth for positive action and condition for constant velocity ratio. Conjugate profiles cycloidal and involute teeth profiles. Involute construction, properties and computation of path of contact and contact ratio. Interference and undercutting- Minimum number of teeth to avoid Interference, methods to avoid Interference. Introduction, classification, examples, gear ratio in simple and compound gear trains, Automobile gear box, Planetary gear trains-methods of evaluating gear ratio - Differential gear box.	**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: Nil**	**Total Periods: 60**

Reference Books:

1. Rattan S. S., Theory of Machines, McGraw Hill Education; Fourth edition (2017)
2. Amitabha Ghosh and Ashok Kumar Mallik, Theory of Mechanisms and Machines, East West Press Pvt. Ltd., New Delhi (2000)
3. Shigley J. E. and John Joseph Uicker, Theory of Machines and Mechanisms, 2nd edition McGraw-Hill international edition (2003)
4. Reuleaux F, The Kinematics of Machinery: Outlines of a Theory of Machines, Forgotten Books (2018)

Department : **Mechanical Engineering**			Programme : **B.Tech.(ME)**						
Semester : **Fourth**			Course Category Code: **PCC**				Semester Exam Type: **LB**		
Course Code	Course		Periods / Week			Credit	Maximum Marks		
			L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ME212	**Mechanical Engineering Lab-I** (Fluid Mechanics & Machines/Material Technology/Machine Shop)		0	0	3	1.5	40	60	100
Prerequisite	Study of Fluid Mechanics & Machines/ Materials Technology/Machining Technology.								
Course Outcome	At the end of the course, the student will be able to								
	CO1	Understand the basics of fluid mechanics with applications							
	CO2	Understand the principles and working of Fluid machines							
	CO3	Understand the practical aspects of specimen preparation for micro structural Examination							
	CO4	Students will be able to understand the microstructures of ferrous and non-ferrous materials							
	CO5	Students gain hands on practical learning in lathe							
	CO6	Students gain hands on practical learning in shaping and milling in machines							

Fluid Mechanics & Machines Lab: 1.Determination of Minor and Major losses in a fluid flow system 2. Determination of the coefficient of discharge of given Orifice meter and Venturimeter 3. Conducting experiments and drawing the characteristics curves of centrifugal pump and Submersible Pump 4. Conducting experiments and drawing the characteristics curves of Reciprocating and Gear Pump 5. Conducting experiments and drawing the characteristics curves of Impulse and Reaction turbine (Pelton and Francis)	**CO1 & CO2**
Materials Technology Lab: Microstructural examination of mild steel and copper	**CO3 & CO4**
Machining Technology Lab: 1. Step turning, and Taper turning 2 grooving and chamfering, V – thread cutting 3 Cube milling and Step milling 4 Shaping and grooving in shaping machine 5 Cylindrical grinding 6 Spur gear hobbing	**CO5 & CO6**

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

Reference Books

1. N. Kumarasamy, Fluid Mechanics and Machinery laboratory manual, Charotar Publishing House Pvt. Ltd. 2012.
2. P.N.Rao,"manufacturingTechnology-MetalCuttingandMachineTools"-TataMcGrawHillPublishing Company Ltd, NewDelhi,2008
3. RaghavanV,PhysicalMetallurgy–PrinciplesandPractice,PrenticeHallIndiaPvt.Ltd.,NewDelhi,2006.

Department : **Mechanical Engineering**			Programme : **B.Tech.(ME)-Honours**					
Semester : **Fourth**			Course Category Code: **PCC**			Semester Exam Type: **TY**		
Course Code	Course	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEH02	**Production Drawing & Cost Estimation**	3	0	1	4	40	60	100
Prerequisite:	Machine drawing							
Course Outcome	**CO1**	Acquiring the knowledge of conventions used in the Production drawing.						
	CO2	Interpret and perform calculations on tolerances and reading different notations GD&T						
	CO3	Understand the importance of cost estimation and solve simple cases.						
	CO4	Grading and judging the cost estimation parameters of different jobs						
	CO5	Designing by studying the machining time of different jobs						
UNIT-I					**Periods: 12**			
Standards and Conventions-ISO-Conventions representation for dimensioning, sectioning and common machine elements - screw threads, rivets, bolts, nuts, pins, keys, cotter, gear, springs, welds and surfaces textures. Elements of Production Drawing, 2D and 3D– Need for Production drawing – Advantages and disadvantages.								**CO1**
UNIT-II					**Periods: 12**			
System of tolerance- Deviation and Fits – Geometric tolerance – Symbols, Terms and rules, Datum, Form, Orientation, Position, Location, Coaxiality, Concentricity and Symmetry, Runout and Profile – Simple Problems.								**CO2**
UNIT-III					**Periods: 12**			
Objective of cost estimation-Characteristics-Importance-Introduction to e-Design-Fundamentals of Cost Analysis-Manufacturing cost models-software for cost estimations-simple case studies.								**CO3**
UNIT-IV					**Periods: 12**			
Types of cost estimates-methods- estimates development - data requirements and sources – allowances in estimation- Estimation different types of jobs – Forging - Welding - Foundary								**CO4**
UNIT-V					**Periods: 12**			
Production Cost Estimation – Material cost – labour cost – overhead cost- allocation – estimation of machining time for lathe, drilling, boring shaping, planning and grinding operations – simple case studies.								**CO5**
Lecture Periods: 45	**Tutorial Periods:**		**Practical Periods: 15**			**Total Periods: 60**		

Reference Books:

1. Engineering Drawing Practice for Schools & Colleges, SP 46:2003, Bureau Of In Dian Standards, New Delhi 110002
2. Geometric Dimensioning and Tolerancing for Mechanical Design, Gene R. Cogorno, McGraw Hill, 2006
3. Process Planning And Cost Estimation, R. Kesavan, C. Elanchezhian, B. Vijaya Ramnath, New Age International (P) Limited, Publishers,2009
4. Process planning and cost Estimation, M. Adithan, New Age International (P) Limited, Publishers,2009
5. Dimensioning and Tolerancing Handbook, Paul J. Drake, Jr. McGraw-Hill, 1999
6. System Approach to Computer Integrated Design and Manufacturing, Nanua Singh, John Wiely & Sons, New York, 1996

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)-Minor**						
Semester : **Fourth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEM02	**Manufacturing Technology**	4	0	0	4	40	60	100
Prerequisite:								

Course Outcome	**CO1**	At the end of the course, the student shall be able to: Gain theoretical and practical knowledge in various metal casting processes.
	CO2	Discuss in detail about various welding processes and the physics of welding.
	CO3	Study the details of various metal forming processes and techniques associated.
	CO4	Identify, understand and apply various surface finishing processes.
	CO5	Explain the steps involved in powder metallurgy technique for preparation of products.

UNIT-I	**Periods: 12**
Metal Casting Processes – Casting, steps involved in making a casting, advantages and applications of metal casting, pattern making, types of pattern, pattern allowances, mould materials, moulding tools and equipment, properties of moulding sand, solidification of casting, special casting processes-centrifugal, investment, die casting, continuous casting, casting defects.	**CO1**
UNIT-II	**Periods: 12**
Metal Joining Processes – Classification of welding process, advantages and disadvantages of welding, applications of welding, types of welded joints, MIG and TIG welding, Resistance welding, spot welding, projection welding, ultrasonic welding, friction welding, heat affected zone, welding defects, soldering, brazing.	**CO2**
UNIT-III	**Periods: 12**
Metal Forming Processes – Roll forming, flexible die forming, peen forming, swaging, cold heading, thread rolling, spinning, drawing, types of presses and press tools, blanking, piercing, bending, embossing, coining.	**CO3**
UNIT-IV	**Periods: 12**
Surface Finishing Processes – Grinding, Types of grinding, Types of grinding machines and specifications, grinding operations, grinding fluids, different types of abrasives and bond types, lapping, honing, polishing and buffing.	**CO4**
UNIT-V	**Periods: 12**
Powder Metallurgy – Introduction to powder metallurgy process, preparation of powders, types & function of binders, green compaction, sintering process and its effect on the product, advantages of powder metallurgy products, applications of powder metallurgy products.	**CO5**

Lecture Periods: 60	**Tutorial Periods: Nil**	**Practical Periods: Nil**	**Total Periods: 60**

Reference Books:

1. Rajput R.K., "A Text Book of Manufacturing Technology", Laxmi Publications, New Delhi, 2nd edition, 2017.
2. Shan H.S., "Manufacturing Processes", Volume – I, 1st Edition, Pearson Education, New Delhi, 2012.
3. Roy A. Lindberg, "Processes and Materials of Manufacture ", Prentice Hall of India (p) Ltd, New Delhi, 4thedition, 2008.
4. George.E. Dieter, "Engineering design (A materials and processing approach)", Tata McGraw Hill, 4th edition, 2008.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Fifth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ME213	**Heat and Mass Transfer**	3	1	0	4	40	60	100
Prerequisite:								

Course Outcome	**CO1**	At the end of the course the student is able to distinguish clearly different modes of heat and mass transfer
	CO2	to apply methods of estimation of heat transfer
	CO3	to apply the knowledge to design of heat exchangers
	CO4	to apply methods of estimation of mass transfer suitably
	CO5	to apply the knowledge to real-time applications

UNIT-I	**Periods: 12**
Heat Transfer by Conduction: Concept of heat conduction – Law of heat conduction – heat conduction equations; solution for steady state conduction; conduction with heat sources; extended surfaces – transient heat conduction, solution using Heisler's charts – measurement of thermal conductivity – effects of temperature on thermal conductivity – electrical analogy.	**CO1**
UNIT-II	**Periods: 12**
Heat Transfer by Convection and with Phase Change: Convection – forced convection, external flow, laminar and turbulent flow over flat plate, cylinder and sphere – internal flow, laminar and turbulent flow through circular tubes – free convection, laminar flow over plates and tubes. Condensation – concept of condensation – types - Nusselt's theory – heat transfer during condensation. Boiling – pool boiling; regimes – nucleate boiling, film boiling, critical heat flux – flow boiling, pattern, heat flux.	**CO2**
UNIT-III	**Periods: 12**
Heat Transfer by Radiation: Nature of thermal radiation-concept of black body, Stefan-Boltzman law, Kirchoff's law, intensity of radiation -radiative heat exchange between surfaces – shape factors – concept of grey body radiation between surfaces separated by non-absorbing medium-electrical analogy.	**CO3**
UNIT-IV	**Periods: 12**
Double pipe heat exchangers, parallel and counter flows – Log Mean Temperature Difference (LMTD) – multi pass heat exchangers, analysis using correction factors – heat exchanger effectiveness – effectiveness expressed in terms of NTU for different configurations – effectiveness Vs NTU charts.	**CO4**
UNIT-V	**Periods: 12**
Similarity between phenomena of heat transfer and mass transfer – diffusion mass transfer, Fick's Law of diffusion, species conservation equation-initial and boundary conditions, steady state molecular diffusion-diffusive mass transfer and convective mass transfer– momentum, heat and mass transfer analogies, convective mass transfer correlations, evaporation of water into air.	**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods:**	**Total Periods: 60**

Reference Books:

1. Incropera, F.P. and Dewitt, D. P., Fundamentals of Heat and Mass Transfer, IV Edition, John Wiley &Sons, 2000.
2. Holman, J.P., Heat Transfer, X Edition, McGraw Hill Book Company, NY, 2009.E.Paul DeGarmo,
3. Bejan, A., Heat Transfer, John Wiley & Sons, 1993,
4. Ozisik, M. N., Heat Transfer: A Basic Approach, McGraw Hill Book Company, New York, 1985.
5. Sachdeva, R. C., Fundamentals of Engineering Heat and Mass Transfer, Wiley Eastern Ltd., 1997.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Fifth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ME214	**Manufacturing Processes**	4	0	0	4	40	60	100
Prerequisite:								

Course Outcome		
	CO1	Students will able to get good exposure about the manufacturing processes
	CO2	Mastery in casting design and process
	CO3	to choose and demonstrate proper metal joining process
	CO4	Demonstrate knowledge in metal forming and surface finishing operations
	CO5	Explain the different types of polymers and their industrial applications

UNIT-I	**Periods: 12**	
Introduction to manufacturing processes – classification – steps involved in casting process – different types of casting – pattern and core making – materials, types and allowances – moulding tools and equipment - properties of moulding sand - casting defects and remedies.		**CO1**
UNIT-II	**Periods: 12**	
Typesofweldingprocesses–weldability-gaswelding–oxyacetylenewelding-Introduction to arc welding– types and equipment–resistance welding–types and applications-welding defects– Introduction to welding standards–welding of dissimilar metals and non-metals		**CO2**
UNIT-III	**Periods: 12**	
Classification of metal forming processes – Rolling, Forging, Extrusion, Drawing and other Sheet metal operations: terminology used, processes, machines and defects.		**CO3**
UNIT-IV	**Periods: 12**	
Surface Finishing Processes: Surface Finish and Surface Roughness, Honing – Lapping – Superfinishing – Abrasive Belt Finishing – Mass Finishing Processes – Polishing – Buffing. Grinding: Types of grinding – Types of Grinding machines–SizeandspecificationofGrindingmachines-WorkHoldingDevices– GrindingOperations-Grinding Fluids – Grinding Speed, Feed and Depth of Cut.		**CO4**
UNIT-V	**Periods: 12**	
Plastics and polymers – structure of polymers – additives in plastics – thermoplastics and thermosetting plastics – manufacturing of plastic products – different moulding methods – forming or shaping methods – laminating methods – machining of plastics – joining of plastics – industrial applications of plastics		**CO5**

Lecture Periods: 60	**Tutorial Periods:**	**Practical Periods:**	**Total Periods: 60**

Reference Books:

1. B.S.Nagendra Parashar & R.K.Mittal – Elements of Manufacturing Processes, Prentice HallIndia Pvt. Ltd., 2003.
2. J.P.Kaushish–ManufacturingProcesses,PrenticeHallIndiaPvt.Ltd.,2008.
3. E.Paul DeGarmo, Ronald A.Kosher – Materials and Processes in Manufacturing, Prentice Hall India Pvt. Ltd.,2008.
4. RoyA.Lindberg-ProcessesandMaterialsofManufacture,PrenticeHallIndiaPvt.Ltd.,2002.
5. S.K.Hajra Choudry - Workshop Technology, Vol.-I,&II, Media Promoters and Publishers Pvt. Ltd.,1997.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Fifth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ME215	**Dynamics of Machines**	3	1	0	4	40	60	100
Prerequisite:								

Course Outcome	**CO1**	Students will able to Mastery of the knowledge in dynamics of slider crank mechanism.
	CO2	Students will Understand and design of simple single degree freedom longitudinal vibrating systems subjected to free and forced damped/undamped vibrations.
	CO3	Students will Able to calculate natural frequencies of simple single degree transverse and torsional vibrating systems of design such systems.
	CO4	Student will Explain the principles of mechanisms used for speed control (Flywheel & centrifugal Governors).
	CO5	Students will able to get knowledge about stability of Automobiles, ships and airplanes

UNIT-I	**Periods: 12**
D'Alembert's Principle-Inertia forces of reciprocating parts, Dynamic analysis of four link and slider-crank mechanisms, Engine force Analysis Turning moment on crankshaft, Dynamically Equivalent system, Inertia forces in a reciprocating engine , Turning Moment diagrams, Fluctuations of Energy and speed, Flywheel.	**CO1**
UNIT-II	**Periods: 12**
Basic concepts of S.H.M, Causes and effects of vibration and degrees of freedom. Natural frequency of free oscillations – equivalent system – energy method – simple problems, Damped free vibration of single degree of freedom system, forced vibration. Basic of vibration isolation, Transmissibility and vibration absorbers.	**CO2**
UNIT-III	**Periods: 12**
Transverse vibrations of beams-Natural frequency by energy method, Dunkerly's method, Whirling of shafts calculation of whirling speed for loaded shafts. Torsional vibrations-causes of Torsional vibration. Torsional Vibration of two and three rotor systems. Equivalent shaft system, Geared system.	**CO3**
UNIT-IV	**Periods: 12**
Governors - Types - Centrifugal governors - Gravity controlled and spring controlled centrifugal governors – Characteristics - Effect of friction - Controlling Force - other Governor mechanisms. Gyroscopes - Gyroscopic forces and Torques - Gyroscopic stabilization - Gyroscopic effects in Automobiles, ships and airplanes.	**CO4**
UNIT-V	**Periods: 12**
Static and dynamic balancing of rotating masses in different planes - partial balancing of reciprocating masses of inline, V, W and radial engines.	**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: Nil**	**Total Periods: 60**

Reference Books:

1. J.E.Shigley and J.J.Uicker - Theory of Machines & Mechanisms, McGraw Hill International Edition, 2012.
2. Rattan - Theory of Machines, Tata McGraw Hill, 2014.
3. J.S.Rao and R.V.Dukkipati - Mechanism and Machine Theory, New Age International, 2010.
4. Thomas Bevan - Theory of Machines, CBS Publishers & Distributors, 2004.
5. P.L.Ballaney - Mechanics of Machines, Khanna Publishers, 2005.
6. Robert F.Steidel Jr. - An introduction to Mechanical Vibrations, John Wiley & Sons Inc.,New York, 2008.

Department : **Humanties and Social Sciences**			Programme : **B.Tech.**						
Semester : **Fifth**			Subject Category: **MCC**			Semester Exam Type: -			
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
SH203	**Essence of Indian Traditional Knowledge**		2	-	-	-	-	-	-
Prerequisite	-								
Course Outcome	The course will enable the student to:								
	CO1	understand connect up and explain basics of Indian traditional knowledge in modern scientific perspective							
UNIT-I						**Periods: 23**			
Basic structure of Indian knowledge system, Modern science and Indian knowledge system, Yoga and holistic health care.									**CO1**
UNIT-II						**Periods: 22**			
Philosophical tradition, Indian linguistic tradition, Indian artistic tradition.									
Lecture Periods: 45	**Tutorial Periods:**		**Practical Periods:**			**Total Periods: 45**			

Reference Books:

1. N. Sivaramakrishnan (Ed.) Culteral Heritage of India – Course Materal, BharatiyaVidyaBhavan, Mumbai 5th edition, 2014.
2. Swami Jitatmanand, Modern Physics and Vedanta, BharatiyaVidyaBhavan.
3. Fritzof Capra, Tao of Physics.
4. Yoga Sutra of Patanjali, Ramakrishna Mission, Kolkatta.
5. R.N. Jha, Science of Conciousness Psychotherapy and yoga Practices, VidyanidhiPrakashan, Delhi 2016.
6. S.C Chaterjee and D.M Datta, An Introduction to Indian Philosophy, University of Calcutta, 1984.
7. Krishna Chaitanya, Arts of India, Abhinav Publications, 1987

Department : **Mechanical Engineering**			Programme : **B.Tech. (ME)**						
Semester : **Fifth**			Course Category Code: **PCC**				Semester Exam Type: **LB**		
Course Code	Course		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
ME216	**Mechanical Engineering Lab-II** (Dynamics lab/Special Machines/Heat Transfer Lab)		0	0	3	1.5	40	60	100
Prerequisite	Study of Fluid Mechanics & Machines/ Materials Technology/Machining Technology.								
Course Outcome	At the end of the course, the student will be able to								
	CO1	know how to avoid resonance and proper use of dampers for different applications.							
	CO2	Select a governor for given applications, tactics to balance rotary machineries and to tackle gyroscopic effects in Automobiles, ships and airplanes.							
	CO3	Develop process planning of any simple product manufacturing.							
	CO4	Estimate machining time involved and its cost analysis.							
	CO5	Understands basics of thermodynamics and heat transfer with applications							
	CO6	Understands the principles and working of different heat transfer equipment							

Dynamics Lab: 1. Determination of radius of gyration of a given compound pendulum 2. Determination of radius of gyration, moment of inertia – bifilar suspension method – trifilar suspension method 3. Determination of characteristic curves of Watt, Porter, Proell and spring loaded governors. 4. Resonance frequency of equivalent spring mass system – undamped and damped condition (a)To plot amplitude Vs frequency graph for different damping. 5. Whirling of shafts/ determination of critical speed with and without Rotors	**CO1 & CO2**
Special Machines Lab: Lathe: 1. Turning between centers 2. Square thread cutting 3. Multi start thread cutting 4. Shaping Machine: V – shaping 5. Milling Machine: Spur gear in milling	**CO3 & CO4**
Heat Transfer Lab: Determination of Heat transfer coefficient by natural convection Determination of Heat transfer coefficient by forced convection Determination of thermal conductivity and thermal resistance of composite wall Determination of temperature distribution and effectiveness for Pin fin apparatus by forced / natural convection. Performance analysis of parallel flow and counter flow heat exchanger/ cooling tower.	**CO5 & CO6**

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

Reference Books

1. J.S.Rao and R.V.Dukkipati - Mechanism and Machine Theory, New Age International, 2010.
2. Kalpakjain S, Schimd S, "Manufacturing Engineering and Technology", Pearson Education, 7th edition, New Delhi, 2018.
3. Engineering Thermodynamics By PK.Nag
4. Heat and Mass Transfer by Holman.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)-Honours**						
Semester : **Fifth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEH03	**Computational Biological Thermo-Fluid Mechanics**	3	1	0	4	40	60	100
Prerequisite:								
Course Outcome	**CO1**	Mechanism of transport phenomena at the level of species, momentum, energy and charge taking place at multi scales of temporal and spatial contexts						
	CO2	Use of mathematical/computer models for virtual prototyping of medical devices and implants						
	CO3	Understanding of fundamental physical principles and interaction with complex physiological systems						
	CO4	Introducing Multidisciplinary and Multi-physics nature of computational investigation and analysis						
	CO5	Role of computational modelling as indispensable tool for skill set development						
UNIT-I					**Periods: 12**			
Review of Modelling and Simulation in Medicine and Biology – Types, Scaling, ODEs – Examples, Solver implementations								**CO1**
UNIT-II					**Periods: 12**			
PDEs – Modelling, Equations, Boundary Conditions, Numerical Solution – FDM, FEM and FVM								**CO2**
UNIT-III					**Periods: 12**			
Solid Mechanics and Electrical Stimulation – Respirator Strap tension, Myocardial shear, Electrode disc resistance, Nerve Cuff, Deformation Analysis of Cornea								**CO3**
UNIT-IV					**Periods: 12**			
Fluid Mechanics, Heat Transfer and Species Diffusion – Physiology, Drug delivery, Modelling blood flow, Intraventricular Flow analysis, RF Atrial Ablation								**CO4**
UNIT-V					**Periods: 12**			
Model based diagnostics, Multiscale Modelling, Evolutionary computing – global optimization, natural selection, types, GA, GP, Cellular Automata - Applications								**CO5**
Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods:**				**Total Periods: 60**		

Reference Books:

1. Socrates Dokos (2017), Modelling organs, tissues, cells and devices, Springer, New York.
2. James W. Haefner, (2005), Modeling Biological Systems, Springer, New York.
3. Tomislav Maric, Jens Hopken and Kyle Mooney (2014), The OpenFOAM Technology Primer, Sourceflux, Duiburg.
4. Masao Tanaka, Shigeo Wada and Masanori Nakamura (2012), Computational Biomechanics, Springer, New York.
5. H. Versteeg and W. Malalasekra (2016), An Introduction to Computational Fluid Dynamics, Pearson, New Delhi.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)-Minor**						
Semester : **Fifth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEM03	**Machine Design**	3	1	0	4	40	60	100
Prerequisite								

Course Outcome	**CO1**	Students will able To understand the fundamentals of Machine Design.
	CO2	Students will To understand the different theories of failure and Manufacturing process.
	CO3	Students will be able to design simple joints and belt drives.
	CO4	Student will be able to design shafts and couplings for simple configurations.
	CO5	Students will able to select rolling element bearings and cylinders.

UNIT-I	**Periods: 12**
Introduction to design - Design philosophy, Optimised design. Review of common engineering materials and their properties, Different types of materials – Metallic Ferrous, Non Ferrous, Non-metallic, Composites, ceramic, Plastics, Polymers, etc. Improvement of properties through heat treatment and alloying.	**CO1**
UNIT-II	**Periods: 12**
Modes of failure, Review of stress calculation in various situations - axial, bending, torsion loads and combined effect, stress concentration, Factor of safety, Theories of failure and choice of failure theory of design. Manufacturing aspects of design – Manufacturing processes (casting, forming, machining, welding etc.) Fit and tolerance, surface roughness.	**CO2**
UNIT-III	**Periods: 12**
Design of joints – Static and Symmetric - Load only – weld joint – Gib and cotter – knuckle joint. Design of Fasteners for Static Load. Belt drives –Flat belts.	**CO3**
UNIT-IV	**Periods: 12**
Design of Shaft, key and splines- Couplings.	**CO4**
UNIT-V	**Periods: 12**
Design of rolling element bearings – Thin cylinders and Thick Cylinders.	**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods:**	**Total Periods: 60**

Reference Books:

1. V. B. Bhandari, Design of Machine Elements, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi, 2010.
2. T. J. Prabhu, Design of Transmission Elements, Mani Offset, Chennai, 2008.
3. S. G. Kulkarni, Machine Design, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2010.
4. R. L. Norton, Design of Machinery, Fifth Edition, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2011.
5. B. J. Hamrock, B. Jacobson and S. R. Schmid, Fundamentals of Machine Elements, Third Edition, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2014.

Department : **Humanities and Social Sciences**		Programme : **B.Tech.**						
Semester : **Fourth**		Course Category Code: **HSM**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
HS202	**Industrial Economics and Management**	3	0	0	3	40	60	100
Prerequisite:								
Course Outcome	**CO1**	Assess the knowledge of mathematics to understand industrial micro economics/ macroeconomics.						
	CO2	Implement various management techniques based on the needs.						
	CO3	Implement various investment evaluation based on the needs						
	CO4	Apply formula and workout problem						
	CO5	Case studies on General, Production and Financial management.						

UNIT-I	**Periods: 9**
MICRO AND MACRO ECONOMICS AND ITS APPLICATIONS: Nature and Scope of Economic science: Micro – Macro Economics, Economic decisions and Technical decisions. Demand and Supply concepts: Types of Demand, Determinants of Demand and Supply, concept of Equilibrium, Elasticity of Demand, cost components, Concepts of ISO-Quant – Break Even Analysis – Market structure – Price of Product Nature of pricing in different types of competition Small Scale Industries – Role of SSI in Indian Economy. Macro Economics: Nature and functions of Money – National Income – GNP and Savings – Inflation and Deflation concept – Business Cycle – Foreign Trade and Balance of payment.	**CO1**
UNIT-II	**Periods: 9**
MANAGEMENT TECHNIQUES: Types and Principles of Management – Elements of Management – Planning, Organising, Staffing, Directing, Coordinating Controlling - Scope of Management – Types of Organization Merits and Demerits – Types of (Ownership) of a firm Merits and Demerits.	**CO2**
UNIT-III	**Periods: 9**
INDUSTRIAL FINANCE: Need for Finance – Types of finance – Sources of finance – Types of Investment – Evaluation of Investment – Preparation of Trading, Profit and loss Account and Balance Sheet – types of accounting and significance of each types.	**CO3**
UNIT-IV	**Periods: 9**
PRODUCTION MANAGEMENT: Theory of Production Function – Types of Production Merits and Demerits – Process Planning – Routing – Scheduling – Material Control Concepts of Productivity – Measurement of Productivity – Inspection and Dispatches.	**CO4**
UNIT-V	**Periods: 9**
MARKETING MANAGEMENT: Core Concepts of Marketing -0 Needs – Wants – Demand, Marketing Vs Selling – Products and Markets – Pricing and related factors – Channels of Distribution – Promotion Advertising – Market Research Vs Marketing Research	**CO5**

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

Reference Books:

1. Varshney Maheswari "Managerial Economics" S Chand & Co, New Delhi 2011
2. Dutt & Sundaram, "Indian Economy" S Chand & Co New Delhi 2015
3. Pandey I.M, "Elements of Financial Management" Wiley Eastern Ltd New Delhi 2015
4. H.L. Ahuja, "Macro Economics for Business and Management, S Chand & Company Ltd 2011
5. O.P Khanna, "Industrial Engineering and Management, Dhanpat Rai and Sons, 2009.
6. Philip B Kotler, "Marketing Management, Mac Millan, New York 2011.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Sixth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ME217	**Thermal Engineering - II**	3	1	0	4	40	60	100
Prerequisite:	Studied a course on Thermodynamics							

Course Outcome	**CO1**	Identify different types of refrigeration systems, and calculate the performance of vapour compression refrigeration system.
	CO2	Able to understand principle of vapour absorption system, types & properties of refrigerants and fundamentals of cryogenics
	CO3	Identify the different types of air-conditioning systems and their components
	CO4	Calculate load on air conditioning system and subsequently estimate the capacity of air-conditioner
	CO5	Able to analyse the performance of reciprocating and rotary air handling equipment.

UNIT-I	**Periods: 12**
Air refrigeration system- Reversed Carnot cycle –Carnot COP-limitations-reversed Brayton cycle - Unit of refrigeration - simple vapour compression system: p-h and T-s diagrams - Effect of evaporator pressure, condenser pressure, sub-cooling and super heating on performance- Actual vapour compression cycle-Analysis and problems	**CO1**
UNIT-II	**Periods: 12**
Simple and practical vapour absorption refrigeration system- comparison between vapour compression and vapour absorption refrigeration-COP. Refrigerants: classification: primary and secondary refrigerants – Nomenclature -desirable properties of refrigerants – Selection of refrigerants- ODP & GWP. Introduction to Cryogenics (Theoretical treatment only): Liquefaction – Air liquefaction system-simple Linde cycle-Claude cycle	**CO2**
UNIT-III	**Periods: 12**
Air-conditioning- Requirement for comfort air-conditioning – Factors governing human comfort – Comfort chart- Air-conditioning systems: summer air-conditioning and winter air-conditioning – Central, unitary and unitary-central air-conditioning systems – Air-conditioning equipment and components: Package units and central units. air cleaners, air filters, humidifiers, dehumidifiers, fans and blowers – cooling towers.	**CO3**
UNIT-IV	**Periods: 12**
Sources of heat load – Conduction load – Sun load – Load from occupants – Equipment load – Infiltration air-load – Load from moisture gain – Fresh air load – ASHRAE standards –room sensible heat factor-grand sensible heat factor-effective room sensible heat factor- Calculation of load on air-conditioning system	**CO4**
UNIT-V	**Periods: 12**
Air machines: Compressor-classification, reciprocating compressor –single stage compressor with and without clearance-multistage compressor with inter cooling-calculation of power required and efficiencies Rotary compressors (Theoretical treatment only): centrifugal and axial flow compressor. Blowers: roots and vane blower. Fans: centrifugal and axial flow fans.	**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: Nil**	**Total Periods: 60**

Reference Books:

1. Kothandaraman, C. P., and Domkundwar, A course in Thermal Engineering, Dhanpat Rai & Co, 2013
2. Sarkar, B.K,"Thermal Engineering" Tata McGraw-Hill Publishers, 2007
3. Rudramoorthy, R, "Thermal Engineering ",Tata McGraw-Hill, New Delhi,2003
4. Ramalingam. K.K., "Thermal Engineering", SCITECH Publications (India) Pvt. Ltd., 2009.
5. Arora, C. P., Refrigeration and Air conditioning, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2000
6. Stoecker, W. F. and Jones, J. W., Refrigeration and Air conditioning, McGraw Hill Book Publishing Co. Ltd.,New York, 1995
7. S. N. Sapali Refrigeration and Air Conditioning, second Edition, PHI, May 2014

Department : **Mechanical Engineering**		Programme : **B.Tech. (ME)**						
Semester : **Sixth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ME218	**Metrology and Measurements**	4	0	0	4	40	60	100
Prerequisite:								

Course Outcome	**CO1**	Ability to understand the significance of measurement in industrial applications.
	CO2	Understanding the correct procedure to be adopted to measure the dimension of the components.
	CO3	Identify the uses of gauges, comparators, coordinate measuring machine in industries.
	CO4	Study various methods and handling of geometric form like flatness, roundness, thread, gear measuring instruments
	CO5	Interpret measurements of field variables like force, torque and pressure and Comprehend the fundamentals of thermo-couple and strain measurement.

UNIT-I	**Periods: 12**
Introduction to Metrology – Need – Elements – Work piece, Instruments – Persons – Environment – their effect on Precision and Accuracy – Errors – Errors in Measurements – Types – Control – Types of standards.	**CO1**
UNIT-II	**Periods: 12**
Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges – gauge design – terminology – procedure – concepts of interchange ability and selective assembly – Angular measuring instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar – Angle alignment telescope – Autocollimator – Applications.	**CO2**
UNIT-III	**Periods: 12**
Basic concept of lasers Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications – Straightness – Alignment. Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System – Element – Applications.	**CO3**
UNIT-IV	**Periods: 12**
Principles and Methods of straightness – Flatness measurement – Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications.	**CO4**
UNIT-V	**Periods: 12**
Force, torque, power - mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube – Temperature: bimetallic strip, thermocouples, electrical resistance thermometer – Reliability and Calibration – Readability and Reliability	**CO5**

Lecture Periods: 60	**Tutorial Periods: Nil**	**Practical Periods: Nil**	**Total Periods: 60**

Reference Books:

1. Jain R.K. “Engineering Metrology”, Khanna Publishers, 2005.
2. Gupta. I.C., “Engineering Metrology”, Dhanpatrai Publications, 2005.
3. Charles Reginald Shotbolt, “Metrology for Engineers”, 5th edition, Cengage Learning EMEA,1990.
4. Backwith, Marangoni, Lienhard, “Mechanical Measurements”, Pearson Education , 2006

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Sixth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ME219	**Design of Machine Elements**	3	1	0	4	40	60	100
Prerequisite:								

Course Outcome	**CO1**	Students will be able to design simple machine components based on 1-D assumptions.
	CO2	Demonstrate understanding of various design considerations.
	CO3	Design machine elements for static as well as dynamic loading
	CO4	Design machine elements on the basis of strength/ rigidity concepts
	CO5	Use design data books in designing various components

UNIT-I	**Periods: 12**	
Fundamentals of machine design - Design philosophy- Engineering Materials- Brief overview of design and Manufacturing – Principal Stresses -Failure Theories - Design of Welded Joints -Types – Strength – Eccentric Loaded welded joints – Welded joints subjected to fluctuating load.		**CO1**
UNIT-II	**Periods: 12**	
Strength and Stability Criteria, Design of Power Screws. Threaded Joints – Bolted Joints under fluctuating load, Combined Stresses, and eccentric loading.		**CO2**
UNIT-III	**Periods: 12**	
Design of Couplings – Design of Rigid and flange Couplings – Types of Clutches and Design of Clutches. Types of Brakes – Design of Brakes.		**CO3**
UNIT-IV	**Periods: 12**	
Introduction to Design of Helical Springs-Design of Helical Springs for Variable Load-Design of Leaf Springs- Design of Pipe Joints – Cotter and Knuckle joints.		**CO4**
UNIT-V	**Periods: 12**	
Design of Shafts under static load: members subjected to Eccentric loading – stresses in curved beams. Design of Shafts under Fluctuating Load: Design for Finite and Infinite life – Soderberg and Goodman equations – combined stresses.		**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: Nil**	**Total Periods: 60**

Reference Books:

1. V.B.Bhandari -Design of Machine Elements, Tata McGraw Hill publishing Co., 2010.
2. Sharma and Purohit, Design of Machine Elements, PHI, 2009.
3. Ganesh Babu, K. and Srithar, K., Design of Machine Elements, McGraw Hill Education (India) Pvt. Ltd., Noida, 2009
4. T. Jagadeesha, Design of Machine Elements, Universities Press(India) Private limited, Hyderabad,2018
5. J. Shigley, Mechanical Engineering Design, McGraw Hill International Edition, 2011.
6. Abdul Mubech, Machine Design, III Edition, Khanna Publishers, 1998.
7. Sadhu Singh, Machine Design, III Edition, Khanna Publishers, 2001.
8. Design Data Hand Book, PSG College of Technology, Coimbatore

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Sixth**		Course Category Code: **PAC**				Semester Exam Type: -		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ME220	**Seminar**	-	-	3	1	100	-	100
Prerequisite:								
Course Outcome	**CO1**	To write technical documents and give oral presentations related to the work completed						
	CO2	To utilize technical resources						
	CO3	To work in actual working environment						
	CO4	To Identify, understand and discuss current, real-world issues.						
	CO5	To Apply principles of ethics and respect in interaction with others.						
		Seminar is a course in which students are trained for presentation skills. Each one of the students will be assigned a Seminar Topic in the current and frontier areas. The student has to conduct a detailed study/survey on the assigned topic and prepare a report. The student will make an oral presentation followed by a brief question and answer session. The Seminar (presentation and report) will be evaluated by an internal assessment committee for a total of 100 marks Presentation will take place during weekly class session. The following etiquette are to be followed • Dress properly • Behave well • Portray good image as a professional						
Lecture Periods: -		**Tutorial Periods: -**			**Practical Periods: 45**		**Total Periods: 45**	

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Sixth**		Course Category Code: **PCC**				Semester Exam Type: **LB**		
Course Code	Course	Periods / Week			Credit	Maximum Marks		
		L	**T**	**P**	**C**	**CA**	**SE**	**TM**
ME221	**Mechanical Engineering Lab-III** (Thermal Engg. Lab/ Measurements lab/ Modelling, Simulation & Analysis lab)	0	0	3	1.5	40	60	100
Prerequisite	Study of Thermodynamics, Heat Transfer, Thermal Engineering/ Metrology & Measurements/design of machine elements, Engineering Mechanics, Mechanics of Solids.							
Course Outcome	At the end of the course, the student will be able to							
	CO1	Understands fundamentals of Heat transfer, IC engines and Refrigeration and air conditioning and its applications						
	CO2	Understands the principles and working of IC engines, calorimeters and HVAC.						
	CO3	Calibrate the simple mechanical measurement instrumentation and their uses.						
	CO4	Demonstrate different measurement Techniques for the precise measurement of Industrial Components.						
	CO5	Get the skill of solving the problems using computer programming.						
	CO6	Get the skill of using computer aided drafting and modelling software available in industries where they get employed.						

Thermal Lab: 1. Determination of flash point and fire point and calorific values of gaseous fuel using Junkers gas calorimeter. 2. Determination of kinematic viscosity using Redwood viscometer and determination of calorific values of solid/ liquid fuels using Bomb calorimeter. 3. Performance test on Vapour compression refrigeration system. 4. Performance test on single/ multi cylinder diesel / petrol engine. 5. Heat balance test in a single cylinder 4S diesel engine.	**CO1 & CO2**
Measurements Lab: 1. Measurement of taper using Sine Bar. 2. Measurement of Pressure using Strain Gauges. 3. Measurement of Force using Transducers. 4. Study of Displacement using LVDT and RVDT. 5. Measurement of speed using stroboscope. 6. Inspection of gear tooth profile using profile projectors.	**CO3 & CO4**
Modelling, Simulation and Analysis Lab: 1. Plane Stress Analysis on Plate with Central hole 2. SF and BMD diagrams for all kinds of beams 3. 1-D heat transfer analysis of a simple plate. 4. Computer aided design of machine components Design and drafting of the following components using FORTRAN / C or C++/ Matlab a) Transmission shafts, b) Journal bearings, c) Flange couplings etc. 5. Write programs in FORTRAN/C or C++ / MATLAB for the following: a) Finding roots of the given non-linear equation with single variable using Newton Raphson Method. b) Solution of system of linear equations using Gauss elimination / Gauss Seidel methods. c) Numerical single and double integration using trapezoidal and Simpson's one third rule. d) IV order Runge-Kutta method for solving first order ordinary differential equations. 6. Assembly modelling of components having a minimum of six machine elements.	**CO5 & CO6**

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

Reference Books

1. IC engines – V. Ganesan.
2. Gupta, I.C., "Engineering Metrology", Dhanpat Rai Publications (P) Ltd., 2003.
3. Ajeet Singh, Machine Drawing Includes AutoCAD, Tata McGraw-Hill Publishing Co., New Delhi, 5th Reprint, 2011.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)-Honours**						
Semester : **Sixth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEH04	**Product Design and Development**	3	1	0	4	40	60	100
Prerequisite:								
Course Outcome	**CO1**	Students will develop cross-discipline products and prototype them using product realization tools in a multi-disciplinary team setting.						
	CO2	Students know how to apply mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical systems.						
	CO3	Students know the variety of mechanical components available and emphasize the need for quality and continue earning.						
	CO4	Students get the knowledge of patenting a new product						
	CO5	Students know the product manufacturing aspects.						
UNIT-I						**Periods: 12**		
Introduction to product design and manufacturing, product design: definition and evolution, Product design morphology, Product design morphology: Preliminary and detailed design. NPD and PAP								**CO1**
UNIT-II						**Periods: 12**		
Value Engineering: a product design approach, Elements of Value Engineering, Value Engineering tools, Case study in Value Engineering – Product manufacturing: Process selection, Design for Manufacturing (DFM), Design for Manufacturing and Assembly (DFMA), Design for Environment: Life Cycle Impact Assessment.								**CO2**
UNIT-III						**Periods: 12**		
Product costing: Elements of product cost, Product costing: Life Cycle Costing Material selection: Metals and alloys, Material selection: Plastics, Ceramics, Rubber- Integrated Product and Process Design and Development. Quality monitoring: Control charts for processes, Quality monitoring: Control charts for attributes and defects, Quality Assurance.								**CO3**
UNIT-IV						**Periods: 12**		
Patenting: Creativity versus Innovation, Patenting: need and processes, Prototyping: Basks and Principles of Prototyping, methods of prototyping.								**CO4**
UNIT-V						**Periods: 12**		
Product manufacturing aspects: Layout design, Product manufacturing aspects: Soft tools, Product manufacturing aspects: Process simulation, Managing competitiveness: Benchmarking, Outsourcing and mass customization.								**CO5**
Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: Nil**				**Total Periods: 60**		

Reference Books:

1. Eppinger, S. and Ulrich, K., 2015. Producdt design and development. McGraw Hill Higher Education.
2. Magrab, E.B., Gupta, S.K., McCluskey, F.P. and Sandborn, P., 2009. Integrated products and process design and development: the product realization process. CRC Press.
3. Boothroyd, G., 1994. Product design and manufacture and assembly. Computer-Aided Design, 26(7), pp505-520.
4. Benjamin W. Neibel and Alanb. Daper Product Design and Process Engineering, McGraw Hill Book Co.
5. A.K.Chitale and R.C. Gupta, Product Design and Manufacturing, McGraw Hill International Edition 2004.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)-Minor**						
Semester : **Sixth**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEM04	**Quality Control and Improvement Techniques**	3	1	0	4	40	60	100
Prerequisite:								
Course Outcome	**CO1**	Understanding the importance of improving quality of a product/process to meet the target specifications and reduce wastages						
	CO2	Knowledge on how Quality control measures directly improve cost benefits, reliability factors and overall productivity						
	CO3	Procedures for Process reversal by estimating the shift in target value by scrutinizing the defectives and defects.						
	CO4	Overview of the adaptation of sampling & inspection procedures to maintain quality throughout the transformation process						
	CO5	Learn the fundamental methods of measurement, precision &accuracy, measurement devices & testing methods						

UNIT-I	**Periods: 12**	
Importance of quality, meaning of quality, quality dimensions, quality planning, quality control, SQC, Quality assurance, quality costs, economics of quality, quality and productivity, quality and reliability, quality loss function.		**CO1**
UNIT-II	**Periods: 12**	
Process variation,– Statistical basis, 3 – sigma control limits, Rational sub-grouping, X ,R and S charts, Interpretation of charts, warning and modified control limits, operating characteristic curve for X – chart, SPC -process capability analysis – Cp, CPK, Cpm, Machine capability, Gauge capability.		**CO2**
UNIT-III	**Periods: 12**	
P, np, C, U and ku charts, demerits control chart, Multi – variable chart, individual measurement charts – moving average and moving range charts, quality control in service sector.		**CO3**
UNIT-IV	**Periods: 12**	
Need for Acceptance sampling, economics of sampling, sample selection, single and Double sampling – O.C. curves, Average outgoing quality (AOQ), Average sample Number (ASN), Average total inspection (ATI), Multiple and sequential sampling, sampling plans – military standards, Dodge – Roming, IS 2500.		**CO4**
UNIT-V	**Periods: 12**	
Fundamental methods of measurement, precision & accuracy, measurement devices -Linear and Angular - Coordinate Measuring Machine, Destructive and Non- Destructive Testing methods. Design of Experiments, Six Sigma concepts.		**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: Nil**	**Total Periods: 60**

Reference Books:

1. Douglus C. Montgomery, Introduction to Statistical Quality Control, John Wiley & Sons, 2004.
2. Statistical Quality Control, Eugene L. Grant and Richard S. Leaven Worth, TMH, Seventh Edition, 2000
3. Quality Control. Dale H. Besterfield, Pearson Education Asia, Seventh Edition,2004.
4. Statistical Quality Control, M. Mahajan, Dhanpat Rai & co (P) Ltd 2012

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Seventh**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ME222	**Operation Research**	3	1	0	4	40	60	100
Prerequisite:								

Course Outcome	**CO1**	At the end of the course the student is able to understand about operations research Problem
	CO2	Understanding the necessity of Inventory Control and its problems
	CO3	To get knowledge about Linear Programming
	CO4	Explain the various methods.
	CO5	Able to solve problems to obtain optimal systems

UNIT-I	**Periods: 12**
Basics of Operations Research-Development of Operations Research, Definition of Operations Research, Characteristics of Operations Research, Scope of Operations Research, Operations Research and Decision-Making, Scope of Operations Research in Management, Scope of OR in Financial Management, Application of various OR Techniques, Objective of Operations Research	**CO1**
UNIT-II	**Periods: 12**
Inventory Control-Necessity for Maintaining Inventory, Inventory Costs, Inventory Control Problem, Classification of Fixed Order Quality Inventory Models, Inventory Models with Deterministic Demand, Model 1(a).Classical EOQ Model(Demand Rate Uniform, Replenishment Rate Infinite),Model 1(b).(Demand Rate Non-Uniform, Replenishment Rate Infinite),Model 1(c).(Demand Rate Uniform, Replenishment Rate finite),Model 2(a).(Demand Rate Uniform, Replenishment Rate infinite, shortage allowed),Model 2(b). (Demand Rate Uniform, Production Rate finite, shortage allowed), Inventory Models with Probabilistic Demand, Inventory	**CO2**
UNIT-III	**Periods: 12**
Linear Programming-Introduction, Formulation of Linear Programming problems, Graphical Method of Solution, The General Linear Programming problem, Canonical and Standard Forms of Linear Programming Problem, Theory of Simplex Method, Analytical Method or Trial and Error Method, The Simplex Method(Technique or Algorithm),Artificial Variables Techniques, The Big-M Method, The Two-Phase Method	**CO3**
UNIT-IV	**Periods: 12**
The Transportation Model-Introduction to the Model, Definition of the Transportation Model, Matrix Terminology, Formulation and solution of Transportation Models, Variants in Transportation Problems, Additional Problems. Network Analysis-Network models, Draw network diagram Analyze the network using Earliest Start Time (ES) Latest Start Time (LS), Earliest Event Time (ET), Latest Event Time (LT), Apply PERT using Optimistic, Most likely, pessimistic times of activities, Minimal spanning tree problem, Shortest route problem, Maximal flow problem, Critical Path Method (CPM), Program Evaluation and Review Technique (PERT), Network representation of simple projects. Crashing of project duration	**CO4**
UNIT-V	**Periods: 12**
The Assignment Model-Definition of the Assignment Model, Mathematical Representation of the Assignment Model, Comparison with the Assignment Model, The Hungarian Method for Solution of the Assignment Problems, Formulation and solution of the Assignment Models, Variations of the Assignment Problem, The Travelling Salesman Problem. Sequencing Models-Sequencing problems, Assumptions in Sequencing Problems, Processing n Jobs through one Machine, Processing n Jobs through two Machines, Processing n Jobs through three Machines, Processing two Jobs through m Machines, Processing n Jobs through m Machines, Problems related to Sequencing(Routing Problems in Networks),Minimal Path Problem	**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods: -**	**Total Periods: 60**

Reference Books:

1. Operations Research : Principles and Practice 2nd Edition, Ravindran, Solberg, Phillips, Wiley, 2008
2. Introduction to Operations Research 9th Edition, Ferald J. Lieberman, Badhibrata Nag, Tata McGraw Hill, 2011
3. Operations Research 2nd Edition Paperback R. Panneerselvam, PHI, 2011
4. Operations Research, an Introduction by Hamdy Taha
5. Introduction to Operations Research by Hillier & Lieberman
6. Operations Research by V K Kapur

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Seventh**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ME223	**Industrial Engineering and Management**	3	0	0	3	40	60	100
Prerequisite:								

Course Outcome	**CO1**	At the end of the course the student will be able to have an ability to identify, formulate, and solve engineering problems
	CO2	an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice
	CO3	an ability to design and conduct experiments, as well as to analyze and interpret data
	CO4	an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
	CO5	the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

UNIT-I	**Periods: 9**
PLANT LOCATION, LAYOUT & MATERIAL HANDLING: Plant Location : influencing factors – rural and urban locations – evaluation of location alternatives for Single facility location problems – solving simple problems. Plant Layout : classification of production systems – principles of layout – basic types of layout – line balancing – simple problems in line balancing using Ranking Positional Weight Method. Material Handling : functions – principles – classification of material handling equipments (only classification and no description) - factors to be considered in selection of material handling equipment.	**CO1**
UNIT-II	**Periods: 9**
WORK STUDY: Method Study : objectives - basic procedure - various recording techniques – process charts, multiple activity charts, SIMO chart, Flow diagram, string diagram, cyclegraph and chronocyclegraph - principles of motion economy – Therbligs - micromotion study & memomotion study. Work Measurement : purpose - basic procedure – various techniques of work measurement – stop watch time study – time study equipments – different systems of performance rating – time allowances – PMTS - work sampling – simple problems involving the determination of standard time and compensation	**CO2**
UNIT-III	**Periods: 9**
PRODUCTION MANAGEMENT: Production Planning and Control : functions – qualitative and quantitative techniques of forecasting – simple problems in forecasting using moving average, weighted moving average, simple exponential smoothing and regression methods - routing – loading and scheduling – different methods of scheduling – expediting – dispatching – functions and objectives of materials management – Introduction to inventory control and ABC analysis.	**CO3**
UNIT-IV	**Periods: 9**
GENERAL & FINANCIAL MANAGEMENT: Management: Basic Concepts – Scientific management – Fayol's principles - functions of management. Financial Management : fixed and working capital - sources of finance - evaluation of investment alternatives using present worth / future worth / annuity / rate of return methods – different methods of determining depreciation - Elements of cost & cost ladder - break-even analysis – simple problems.	**CO4**
UNIT-V	**Periods: 9**
MARKETING & HUMAN RESOURCES MANAGEMENT: Marketing Management : Concepts of Marketing - products and markets – pricing - channels of distribution - sales promotion - advertising - basics of market research Human Resources Management : individual and group behaviour – Maslow's hierarchy of needs – motivation and morale – fatigue : causes & remedy – accidents : causes and prevention - manpower planning – job analysis – job evaluation and merit rating - management by objectives (MBO).	**CO5**

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

Reference Books:

1. R .Panneerselvam - Production and Operations Management, Prentice Hall of India Pvt. Ltd., 2003.
2. O.P.Khanna - Industrial Engineering and Management, Dhanpat Rai Sons (P) Ltd., 1999.
3. Martand Telsang - Industrial and Business Management, S.Chand & Co., 2001.
4. Joseph Monks - Operations Management, McGraw Hill, New York, 1986.
5. R.M.Barnes - Motion and Time Study, John Wiley Eastern, New York, 1985.
6. Roger G.Schroeder - Operations Management, III Edition, McGraw Hill, New York, 1989.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Seventh**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ME224	**Advanced Manufacturing Technology**	4	0	0	4	40	60	100
Prerequisite:								

Course Outcome		
	CO1	Get a broad view about automated manufacturing system
	CO2	Useful for modern industrial environment using NC, CNC, DNC
	CO3	Work in automated production environment using robotics
	CO4	Familiarize with group technology and flexible manufacturing systems
	CO5	Explore the concepts of additive manufacturing

UNIT-I	**Periods: 12**
Automation: Introduction to Automation in Manufacturing – Types of Automation – Need – Automation Strategies - Study of the principles of single spindle and multi spindle automates – Applications. Automated flow lines – transfer machines – types – mechanisms – applications, Transfer, Handling, Location, Orientation and Parts feeding devices. Introduction to Industry – 4.0 concepts.	**CO1**
UNIT-II	**Periods: 12**
NC machines – Introduction, Types, Advantages and Applications. CNC, DNC (Direct and Distributed) and Adaptive Control. Introduction to Programming languages, APT Programming, Examples on CNC Turning, Milling & Drilling operations.	**CO2**
UNIT-III	**Periods: 12**
Robot Anatomy and Configurations, Work volume, End effectors- Types of grippers, tools as end effectors. Robot sensors- External and Internal, Types – Position sensors, Velocity Sensors, Tactile, Proximity and Range sensors, Machine vision – Applications. Automated Material Handling and Storage Systems- Types, Major components.	**CO3**
UNIT-IV	**Periods: 12**
Group Technology: Part families – parts classifications and coding, Examples, Applications. Flexible Manufacturing Systems: Types, Components, Planning and Implementation Issues. Introduction to Lean and Agile Manufacturing Systems – Comparison.	**CO4**
UNIT-V	**Periods: 12**
Additive Manufacturing: Basic Concept - Classification – Liquid Based System – Stereo lithography - Principle, Process, Advantages and Applications – Solid Based System –Fused Deposition Modeling – Principle, Process, Advantages and Applications – 3D Printing	**CO5**

Lecture Periods: 60	**Tutorial Periods:**	**Practical Periods:**	**Total Periods: 60**

Reference Books:

1. Mikel P. Groover, Automation, Production Systems and Computer Integrated Manufacturing, PHI Ltd., New Delhi, 2003.
2. G. Boothroyd et al, Automatic Assembly, Marcel Dekker Inc., New York, 1993.
3. Chua C.K., Leong K.F., And Lim C.S., "Rapid Prototyping: Principles and Applications", Third Edition, World Scientific Publishers, 2010
4. P.N. Rao et al, Computer Aided Manufacturing, Tata McGraw Hill Publishers, 1993.
5. P. Radhakrishnan and S. Subramanian – CAD/CAM/CIM, Wiley Eastern Ltd., 2000.N.D. Bhatt, Engineering Drawing, 49thedition, Charotar Publishing House, 2006.
6. P. Radhakrishnan, NC Machine Tools, Dhanpat Rai & Sons, New Delhi, 2000.

Department : **IEDC**		Programme : **B.Tech.**						
Semester : **Seventh**		Course Category Code: **PAC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
EP201	**Entrepreneurship**	3	0	0	2	40	60	100
Prerequisite:								

Course Outcome	**CO1**	The student will gain conceptual understanding of Entrepreneurship and design thinking.
	CO2	The students will become knowledgeable about business model development and MVP
	CO3	The students will gain knowledge about costing and revenue.
	CO4	The students will learn about marketing and sales.
	CO5	Student will get understanding of team formation and compliance requirements.

UNIT-I	**Periods: 9**	
PROBLEM AND CUSTOMER: Effectuation, Finding the flow. Entrepreneurial style, business opportunity, problems worth solving, methods for finding problems, problem interviews. Design Thinking, Consumer and customer, market types, segmentation and targeting, early adopters, Gains, Pains and "Jobs-To be done, Value Proposition Canvas (VPC), Identifying Unique Value Proposition (UVP).		**CO1**
UNIT-II	**Periods: 9**	
BUSINESS MODEL AND VALIDATION: Types of Business Models, Lean Canvas, Risks. Building solution demo, solution interviews, problem-solution test, competition, Blue Ocean Strategy. MVP- Build-Measure-Learn feedback loop, MVP Interviews, MVP Presentation.		**CO2**
UNIT-III	**Periods: 9**	
REVENUE AND COST: Revenue Streams-Income, costs, gross and net margins - primary and secondary revenue streams- Different pricing strategies - product costs and Operations costs; Basics of unit costing. Financing New Venture- various sources - investor expectation- Pitching to Investors.		**CO3**
UNIT-IV	**Periods: 9**	
MARKETING AND SALES: Difference between product and brand - positioning statement. Building Digital Presence, Social media- company profile page – Sales Planning - buying decisions, Listening skills, targets. Unique Sales Proposition (USP), sales pitch, Follow-up and closing a sale.		**CO4**
UNIT-V	**Periods: 9**	
TEAM AND SUPPORT: Team Building - Shared leadership - role of a good team - team fit - defining roles and responsibilities - collaboration tools and techniques- project management, time management, workflow, delegation of tasks. Business regulations - starting and operating a business - compliance requirements.		**CO5**

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

Reference Books:

1. Nandan H,"Fundamentals of Entrepreneurship",Prentice Hall India,2013.
2. LearnWISE–Digital learning platform by Wadhwani Foundation, www.learnwise.org
3. Khanka S.S,"Entrepreneurial Development",S Chand & Company,2007.
4. Sangeetha Sharma,"Entrepreneurship Development"– Prentice Hall India,2017.
5. Anil Kumar.S,"Entrepreneurship Development"– New Age Publishers, 2003.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Seventh**		Course Category Code: **MCC**				Semester Exam Type: -		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ME225	**Professional Ethics**	3	0	0	0	-	-	-
Prerequisite:								
Course Outcome	**CO1**	Upon completion of this course the students are motivated to strive for higher ethical standards.						
	CO2	Student will be capable of understanding basic cultural / social issues inherent in the discipline of Mechanical Engineering.						
	CO3	Student will be capable of understanding legal / safety issues inherent in the discipline of Mechanical Engineering.						
	CO4	Student will be capable of understanding moral issues inherent in the discipline of Mechanical Engineering.						
	CO5	Students will be capable of understanding the societal responsibilities and human rights.						
		1. Engineering Ethics – Moral issues, Ethical theories and their uses 2. Engineering as Experimentation – Code of Ethics 3. Engineer's responsibility for safety 4. Responsibilities and rights 5. Global issues of engineering ethics						
Lecture Periods: 45		**Tutorial Periods: -**			**Practical Periods: -**		**Total Periods: 45**	

Reference Books:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall of India, New Delhi, 2004.
3. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
4. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
5. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
6. Edmund G Seebauer and Robert L Barry, "Fundametals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
7. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd.,New Delhi 2013.
8. World Community Service Centre, " Value Education", Vethathiri publications, Erode, 2011.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)-Honours**						
Semester : **Seventh**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEH05	**Surface Engineering**	4	0	0	4	40	60	100
Prerequisite:								

Course Outcome		
	CO1	Explain the important of surface engineering in industries
	CO2	To control the factors that affects the metal corrosion.
	CO3	Explain the process and mechanism of different coating process
	CO4	To prevent corrosion by coatings and inhibitors, etc.
	CO5	To explore the possibility of various testing methods in corrosion

UNIT-I	**Periods: 12**
Introduction tribology, surface degradation, wear and corrosion, types of wear, roles of friction and lubrication- overview of different forms of corrosion, introduction to surface engineering, importance of substrate- surface cleaning- selection and classification of cleaning processes.	**CO1**
UNIT-II	**Periods: 12**
Surface pre-treatment, deposition of copper, zinc, nickel and chromium - principles and Practices, alloy plating, electro composite plating, Electroless plating of copper, nickel phosphorous, nickel-boron; Electroless composite plating; application areas, properties, test Standards (ASTM) for assessment of quality deposits.	**CO2**
UNIT-III	**Periods: 12**
SURFACE MODIFICATION PROCESSES: Thermal spray coatings – chemical Vapour disposition coating processes– plasma-enhanced chemical Vapour deposition – physical Vapour deposition coating processes – vacuum deposition – reactive evaporation and gas evaporation – sputter deposition – ion plating - ion-beam-assisted deposition – arc deposition – ion implantation – diffusion coatings	**CO3**
UNIT-IV	**Periods: 12**
ENGINEERING MATERIALS: Introduction – Advanced alloys – Super alloys, Titanium alloys, Magnesium alloys, Aluminium alloys, and Nickel based alloys – Ceramics – Polymers – Biomaterials – Applications – Bio Tribology Nano Tribology.	**CO4**
UNIT-V	**Periods: 12**
TESTING: Purpose of corrosion testing - Classification - Susceptibility tests for intergranular corrosion-Stress corrosion test. Salt spray test humidity and porosity tests, accelerated weathering tests. ASTM standards for corrosion testing and tests for assessment of wear	**CO5**

Lecture Periods: 60	**Tutorial Periods:**	**Practical Periods:**	**Total Periods: 60**

Reference Books:

1. ASM Handbook, Vol.5, Surface Engineering", ASM International, 1994.
2. Fontana and Greene. "Corrosion Engineering". McGraw Hill Book Co. New York. USA,1986
3. Varghese C.D, 'Electroplating and Other Surface Treatments - A Practical Guide', TMH,1993
4. Denny A. Jones,"Principles and Prevention of Corrosion" 2nd Edition, Prentice Hall of India, 1996.
5. Uhlig. H.H. "Corrosion and Corrosion Control". John Wiley & Sons. New York. USA. 1985..
6. P. Radhakrishnan, NC Machine Tools, Dhanpat Rai & Sons, New Delhi, 2000.
7. S.K.Basu, S.N.Sengupta & B.B.Ahuja ,"Fundamentals of Tribology", Prentice –Hall of India Pvt Ltd , New Delhi, 2005

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)-Minor**						
Semester : **Seventh**		Course Category Code: **PCC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEM05	**Process Planning & Cost Analysis**	3	1	0	4	40	60	100
Prerequisite:								

Course Outcome	**CO1**	At the end of the course the student will be able to:do effectively process planning for a manufacturing industry
	CO2	Conduct method study and apply the principles of motion economy in a manufacturing
	CO3	Use process planning and method study to increase the productivity
	CO4	Estimate the cost of a product
	CO5	Estimate the machining time for various operations

UNIT-I	**Periods: 12**
INTRODUCTION TO PROCESS PLANNING: Introduction- methods of process planning-Drawing interpretation-Material evaluation – steps in process selection-.Production equipment and tooling selection.	**CO1**
UNIT-II	**Periods: 12**
PROCESS PLANNING ACTIVITIES: Process parameters calculation for various production processes- Selection of jigs and fixtures - selection of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies. -	**CO2**
UNIT-III	**Periods: 12**
INTRODUCTION TO COST ESTIMATION: Importance of costing and estimation –methods of costing- elements of cost estimation –Types of estimates – Estimating procedure- Estimation labour cost, material cost- allocation of overhead charges- Calculation of depreciation cost.	**CO3**
UNIT-IV	**Periods: 12**
PRODUCTION COST ESTIMATION: Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop.	**CO4**
UNIT-V	**Periods: 12**
MACHINING TIME CALCULATION: Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations ,Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.	**CO5**

Lecture Periods: 45	**Tutorial Periods: 15**	**Practical Periods:**	**Total Periods: 60**

Reference Books:

1. Peter Scalon, “Process planning, Design/Manufacture Interface”, Elsevier Science Technology Books, Dec 2002.
2. Sinha.B.P., "Mechanical Estimating and Costing", Tata McGraw-Hill, Publishing Co.,1995
3. Ostwalal P.F. and Munez J., “Manufacturing Processes and systems”, 9th Edition, John Wiley, 1998.
4. Russell R.S and Tailor B.W, “Operations Management”, 4th Edition, PHI, 2003.
5. Chitale A.V. and Gupta R.C., “Product Design and Manufacturing”, 2nd Edition, PHI, 2002.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Eighth**		Course Category Code: **PAC**				Semester Exam Type: -		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
ME226	**Comprehensive Test**	0	0	3	1	100	-	100
Prerequisite:								
Course Outcome	**CO1**	Student will be able to explain the satisfactory operation of any mechanical system						
	CO2	Student will possess the knowledge of principles of operation of all mechanical machines, devices and equipment						
	CO3	Student will exhibit his talent in adopting procedural methods in design and manufacturing of mechanical components						
	CO4	Student will become capable to identify any trouble shooting in mechanical systems						
	CO5	Student will become capable of understanding the basic principles of the Mechanical Engineering subjects.						
		The student is required to take a comprehensive test on a scheduled date in the beginning of the VIII semester. Comprehensive test is meant for testing the higher order and critical thinking of the student in the respective domain. This test will have the standard of GATE examination. The comprehensive test is conducted through an objective type examination of 3 hours' duration. The test shall carry 100 marks and cover the syllabi of all mechanical core courses. The question paper contains 50 questions of 2 marks each. The question shall be framed to test the critical thinking of the students and of the standard of any national level competitive examination. A committee comprising of two faculty members will coordinate the conduct and evaluation of comprehensive test.							
Lecture Periods: -		**Tutorial Periods: -**			**Practical Periods: 45**		**Total Periods: 45**	

Department : **Mechanical Engineering**			Programme : **B.Tech. (ME)**						
Semester : **Eighth**			Course Category Code: **PAC**			Semester Exam Type: -			
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
ME227	**Internship**		0	0	3	2	100	-	100
Prerequisite:									
Course Outcome	**CO1**	Experience of applying existing engineering knowledge in similar or new situations; to identify when new engineering knowledge is required, and apply it							
	CO2	Ability to integrate existing and new technical knowledge for industrial application							
	CO3	Ability to demonstrate the impact of the internship on their learning and professional development							
	CO4	Understanding of lifelong learning processes through critical reflection of internship experiences and It Provide students with the skills and experience							
	CO5	opportunity to seek, identify and further develop an appropriate level of professionalism							
	Final year students of B. Tech program undergo a mandatory semester long internship in leading organizations as a part of their curriculum. This enables them to get exposure in tackling live problems that occur in the working of an individual entity. These internships, along with various industrial visits keep the students informed about latest industrial trends. This is a two credit course, compulsory for all students where the student is evaluated by a committee comprising of two faculty members by evaluating the internship report and the oral presentation by the student. The duration of the internship is of 12 weeks between January to April, making the student a comprehensive package for the industry. The main purpose of the internship is to enhance the general professional outlook and capability of student to advance his chances of improving the career opportunities. The students should get approval from the head of the department before undertaking the internship and submit a detailed report after completion for the purpose of assessment.								
Lecture Periods: -		**Tutorial Periods: -**			**Practical Periods: 45**			**Total Periods: 45**	

Department : **Mechanical Engineering**			Programme : **B.Tech. (ME)**						
Semester : **Eighth**			Course Category Code: **PAC**				Semester Exam Type: **PR**		
Course Code	Course Name		Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CA	SE	TM
ME228	**Project Work**		0	0	3	8	60	40	100
Prerequisite:									
Course Outcome	**CO1**	Student will become competent to model / produce any mechanical system and component and test their strength and performance using advanced techniques							
	CO2	Student will exhibit his/her ability to design parts of mechanical machines, devices and equipment using prevailing norms and standards							
	CO3	Student will expose his/her skill to execute different mechanical operations through a coordinated approach with team mates							
	CO4	Student will reveal his/her knowledge in handling modern tools and machines involved in fabrication and assembling of mechanical components							
	CO5	Student will demonstrate capability to develop suitable numerical or mathematical methods for off-line performance analysis of mechanical systems and components individually or collectively							
	The student shall carryout a project work in the eighth semester. The student is given an option to carry out this project either in the institute or in an industry/Research laboratory/Higher learning Institute. The project would be carried out under the supervision of a project guide from the department. In the case of students carrying out the project outside the college an external guide from relevant organization shall be assigned in addition to the internal guide from the department. The project work is to acquaint the student in the analysis of problems posed to him in the method of conducting a detailed literature survey and reviewing the state of art in the area of the problem. The work may be purely theoretical / analytical / completely experimental / design and fabrication. In few cases the project can also involve the above all. At the end, a student or a group of students shall prepare and submit a project report which is expected to show clarity of thought and expressions, critical appreciation of the existing literature and analytical/experimental/design streams. The project work should be of relevant nature for the current and the future needs of the country. The project work will be continuously monitored and assessed by the guide / project evaluation committee as a part of internal evaluation and at the end project work and the report will be examined by the panel of examiners through viva-voce.								
Lecture Periods: -		**Tutorial Periods: -**			**Practical Periods: 45**			**Total Periods: 45**	

Professional Elective Courses

Department: **Mechanical Engineering**		Programme: **B Tech. (ME)**						
Semester: **Fifth**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods/week			Credit	Maximum marks		
		L	T	P	C	CA	SE	TM
MEY01	**Energy and Environmental Engineering**	3	0	0	3	40	60	100
Prerequisite	--							
Course Outcome	At the end of the course the student is able							
	CO1	to know different energy conversion systems and pollutions						
	CO2	to understand how energy management could effectively be applied from the point of view of conservation						
	CO3	to understand the methods of energy conservation through case studies						
	CO4	To identify different types of pollutants and their impact on environment						
	CO5	to implement pollution control measures to be adopted for major sources of pollution						

Unit – I	**Periods: 9**
Energy conversion – global energy scenario – Indian context of energy – environmental aspects of fossil, nuclear, hydro and biomass energy conversion – gaseous emissions – solid waste – liquid waste.	**CO1**
Unit – II	**Periods: 9**
Energy management – need for energy conservation – energy auditing – role of energy manager – energy audit instruments – first and second law approach towards energy conservation.	**CO2**
Unit – III	**Periods: 9**
Energy conservation in boilers – procedure for efficiency calculation – energy conservation in industries: pumps, fans, compressed air systems, refrigeration and air conditioning system, DG sets, electrical motors, variable speed motors.	**CO3**
Unit – IV	**Periods: 9**
Pollutants – types – physical and chemical properties of air pollutants – behaviour and fate of air pollutants – air pollutants and global climate – air pollutant effects. Pollution control laws and regulation – national and international – role of environmental monitoring in environmental management systems – continuous emissions monitoring systems.	**CO4**
Unit – V	**Periods: 9**
Pollution control – review of pollution control methods in thermal power plants – industrial – nuclear –automobiles – disposal/treatment of solid and liquid wastes – alternate fuels.	**CO5**

Lecture Periods: 45	**Tutorials Periods:**	**Practical Periods:**	**Total Periods: 45**

Reference books:

1. Culp, A.W., Principles of Energy Conversion, McGraw Hill Book Co., 1991.
2. Noel de Nevers, Air Pollution Control Engineering, McGraw Hill Book Co., 2000.
3. Rao, C. S., Environmental Pollution Control Engineering, New Age International Pvt. Ltd., 1995.
4. Callaghan, P.O., Energy Management, McGraw Hill Book Co., 1993
5. http://nptel.iitm.ac.in/courses/Webcourse-contents

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Fifth**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEY02	**Metal Forming Processes**	3	0	0	3	40	60	100
Prerequisite:								

Course Outcome	**CO1**	Upon completion of the course, the students should have the ability to understand the importance of the metal forming processes,
	CO2	To choose right metal forming machine tools
	CO3	To select suitable processes to fabricate an engineering product.
	CO4	Students are expected to determine the forming force, stress and strain experimentally as well as analytically
	CO5	To understand the mechanisms of different High Energy Rate forming processes

UNIT-I	**Periods: 9**
Classification of forming processes – flow curves and their significance in forming – Effect of temperature, speed and metallurgical structure on forming processes – Effect of friction on forming processes. Basic concepts of yield criteria –types.	**CO1**
UNIT-II	**Periods: 9**
Classifications of forging processes - Forging equipment – forging die design procedure for simple products – forging defects – determination of forging load – concept of P/M forging – Applications.	**CO2**
UNIT-III	**Periods: 9**
Rolling mills – Estimation of rolling load and power – rolling defects – Applications. Direct extrusion equipment - hydrostatic extrusion - extrusion of tubes – determination of extrusion stress - extrusion defects – Applications	**CO3**
UNIT-IV	**Periods: 9**
Drawing of rods, wires and tubes-Determination of drawing loads through conical dies, sheet metal forming: Shearing, blanking, bending, punching, piercing, stretch forming, deep drawing, rubber pad forming –Applications	**CO4**
UNIT-V	**Periods: 9**
High rate energy forming processes: Introduction - Effect on mechanical properties and microstructures – Explosive forming, Electro hydraulic forming – Electromagnetic forming, Water hammer forming.	**CO5**

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

Reference Books:

1. Dieter, Mechanical Metallurgy, McGraw-Publishing Co., New York,1998.
2. P.C.Sharma,ProductionEngineering,S.Chand&Co.,NewDelhi,1995.
3. Serope Kalpakjian, Steven R Schmid, “Manufacturing Process for Engineering Materials” Pearson Education, 4th Edition,2003.
4. GyrilDonaldson,ToolDesign,TataMcGrawHillPublishingCo.Ltd.,1989.
5. AltanT.,Metalforming–Fundamentalsandapplications–AmericanSocietyofMetals,Metalspark,2003

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Fifth**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEY03	**Engineering Tribology**	3	0	0	3	40	60	100
Prerequisite:								

Course Outcome	**CO1**	Students will be able to identify the surface related problems which lead to failure of the components.
	CO2	Students are made to follow and understand the basic of Engineering Tribology.
	CO3	Students will be able to come up with ideas to design against tribological problems based on genesis and theories of friction.
	CO4	Students are made to solve problems on Reynolds Equation journal And thrust bearings.
	CO5	Students will be able to understand the basic concepts of lubrication

UNIT-I	**Periods: 9**
Introduction to tribology-Factors influencing Tribological phenomena-Engineering surfaces-Surface Characterization, Computation of surface parameters. Surface measurement techniques-Apparent and real area of contact	**CO1**
UNIT-II	**Periods: 9**
Genesis of friction-Various laws and theory of friction-friction in contacting rough surfaces-sliding and rolling friction-frictional heating and temperature rise. Friction and Wear: Laws of friction, types, friction coefficient, wear, types, control of wear. Wear and wear types-Mechanisms of wear - Adhesive, abrasive, corrosive, erosion, fatigue, fretting, etc., -Wear of metals and non-metals- Wear models – wear maps-wear damage.	**CO2**
UNIT-III	**Periods: 9**
Introduction to lubrication-Lubrication regimes-Thick Film, EHL, Mixed, Boundary - Hydrodynamic Journal and Thrust Bearings- General Reynolds equation- Various mechanisms of pressure development in oil film-Performance parameters. Design of hydrodynamically lubricated bearings using Raimondi-Boyd charts. Composition and properties of lubricant, Evaluation and testing of lubricants.	**CO3**
UNIT-IV	**Periods: 9**
Surface modification techniques-Improving wear resistance-Surface coating techniques such as electrochemical depositions, anodizing, thermal spraying, Chemical Vapour Deposition (CVD), Physical Vapour Deposition (PVD), etc. and their applications.	**CO4**
UNIT-V	**Periods: 9**
Micro/Nano-tribology and applications – Tribology for MEMS, wear resistant coatings - New industrial applications of tribology – Nano scale wear, Micro scale scratching and Micro scale wear - Wear mapping and Nano lubrication and specialized materials selection for NanoTribology - tribological case studies.	**CO5**

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

Reference Books:

1. Halling, J., Principles of Lubrication, Macmillan Press Ltd., 1975.
2. Cameron, A.Basic lubrication theory, Ellis-Harwood Limited, 1976.
3. Hamrock, B.J. Schmid S.R., Jacobson B.OFundamentals of fluid film lubrication, 2nd Ed., Marcel Dekkar,2004.
4. Bharat Bhushan,Introduction to Tribology, John Wiley & sons. 2002.
5. Majumdar, B.C. Introduction to Tribology of Bearings, Allied Publishers, 1992.
6. Basu, Sen Gupta and Ahuja,Fundamentals of Tribology, PHI, 2000
7. Bhushan and B. K. Gupta BHandbook of Tribology: Materials, Coatings and Surface Treatments McGraw Hill, NewYork.
8. M.J. NealeTribology Handbook Butterworth Publication.
9. Athre, K Biswas,SBearings selection and Maintenance, Galcotia Publishers, 2004.
10. R.C. Gunther,Lubrication, Baily Brothers and Swinfen Limited.
11. Kragelski, Friction, Wear and Lubrication, Vol. I, II, III, MIR Publishers, 1983.
12. Paulo Davim Tribology for Engineers: A Practical Guide, Woodhead Publishing, 2011.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Fifth**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEY04	**Automobile Engineering**	3	0	0	3	40	60	100
Prerequisite:								

Course Outcome		
	CO1	understand the layout and arrangement of principal parts of an automobile
	CO2	understand the power transmission system of an automobile
	CO3	understand the suspension system of an automobile
	CO4	understand the braking system of an automobile
	CO5	know automobile electrical and air conditioning and passengers safety features

UNIT-I	**Periods: 9**
Classification of vehicles – drives - general layout. Engine - Diesel and Petrol and hybrid engines for automobiles - electric vehicle - comparison of performance - factors affecting choice - power requirements of an automobile - rolling, wind and gradient resultant-factors affecting resistance and power requirement.	**CO1**
UNIT-II	**Periods: 9**
Power transmission system - requirement of transmission system – clutches - plate clutches - semi automatic & automatic clutches - Gear box: manual shift four speed and positive speed gear boxes - synchromesh devices -fluid transmission - fluid flywheel and torque converter-automatic transmission - drive line - differential, conventional and non-slip types - drive axle.	**CO2**
UNIT-III	**Periods: 9**
Suspension system – requirements - rigid axle and independent suspension - types of suspension - leaf spring - coil spring - torsion rod and air suspension - shock absorbers. Front axle : types - front wheel geometry - conditions for true rolling. Steering geometry - Ackerman and Davis steering - steering linkages - steering gear box-power and power assisted steering. Wheel alignment - Tyres: materials and types static and rolling properties of pneumatic tyres.	**CO3**
UNIT-IV	**Periods: 9**
Braking system - hydraulic braking systems - drum type and disc type brakes - power and power assisted brakes - factors affecting brake performance - tests on brakes - skid and skid prevention. Chassis - types of bodies - chassis frame - integral body - vehicle stability.	**CO4**
UNIT-V	**Periods: 9**
Battery: types - Chemical reaction – charging - battery rating - battery life - battery testing. Starting motor and alternator: constructional features and Ignition: types - ignition coil - contact breaker – distributor - firing order - spark plug. Automotive lighting - Electronics in automobile. Automobile air conditioning- passengers safety features in automobiles.	**CO5**

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

Reference Books:

1. William H. Crouse & Donald L. Anglin, Automotive Mechanics, TMH, 10th Edition, 2007. ISBN: 13:978-0-07-0634350
2. K.K.Ramalingam, Fundamentals of Automobile Engineering, SciTech Publications (India) Pvt. Ltd. ISBN: 10-8188429481, ISBN: 13: 978-8188429486.
3. R. B. Gupta, Automobile Engineering, Satya Prakashan, 4th Edition.1984. ISBN: 9788176843799.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Fifth**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEY05	**Mechatronics**	3	0	0	3	40	60	100
Prerequisite:								

Course Outcome		
	CO1	Students understands the role of electronics in different mechanical systems.
	CO2	Emphasize the importance of mechatronics in engineering design, measurements and mechanical systems.
	CO3	Students understands the role of interfacing and image processing in different mechanical systems.
	CO4	Students understands how to develop models in different mechanical systems.
	CO5	Students understands the role of electronics in different bio-mechanical systems

UNIT-I	**Periods: 9**
Introduction to mechatronics system – key element -- Mechatronics Design process – Types of Design -- Design Parameter– Traditional and Mechatronics designs – Advanced approaches in Mechatronics -- Industrial design and ergonomics, safety - Mechatronics Approach.	**CO1**
UNIT-II	**Periods: 9**
Introduction - Input isolation, DC amplifier, power amplifier, and differential amplifier – feedback, Op-Ampelectrometer amplifier, carrier Amplifier – instrument power supply. Oscillagraphic – galvanometric - X-Y, magnetic recorder, storage oscilloscopes – electron microscope – PMMC writing systems – Telemetry Principles – Bio telemetry. Electrocardiograph measurements – blood pressure measurement: by ultrasonic method – plethysonography.	**CO2**
UNIT-III	**Periods: 9**
Introduction-selection of interface cards-DAQ card-single channel-multichannal-RS232/422/485 communication- IEEE 488 standard interface-GUI card-GPIB-Ethernet switch -Man machine interface. Introduction –Fuzzy based Washing machine – pH control system – Autofocus Camera, exposure control– Motion control using D.C.Motor & Solenoids – Engine management systems. – Controlling temperature of a hot/cold reservoir using PID- Control of pick and place robot – Part identification and tracking using RFID – Online surface measurement using image processing, System principle - Component design – System design – Scaling laws – Micro actuation – Micro robot – Micro pump – Applications of micro mechatronic components.	**CO3**
UNIT-IV	**Periods: 9**
Introduction-model categories-fields of application-model development-model verification-model validation model simulation-design of mixed systems-electro mechanics design-model transformation-domain-independent description forms-simulator coupling.	**CO4**
UNIT-V	**Periods: 9**
Blood flow measurement by electromagnetic flow meter cardiac output measurement by dilution method – phonocardiography – vector cardiography. Heart lung machine – artificial ventilator – Anesthetic machine – Basic ideas of CT scanner – MRI and ultrasonic scanner – Bio-telemetry –laser equipment and application – cardiac pacemaker – DC – defibrillator patient safety - electrical shock hazards. Centralized patent monitoring system.	**CO5**

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

Reference Books:

1. George plez, Mechatronics Systems: Modelling and simulation with HDL's, john Wiley and sons Ltd, 2003.
2. Devdas Shetty, Richard A. kolk, " Mechatronics System Design", Thomson Learning Publishing Company, Vikas publishing house, 2001.
3. Bolton, Mechatronics – Electronic control systems in mechanical and electrical Engineering- 2nd Edition, Addison Wesley Longman Ltd, 1999.
4. Bishop, Robert H, Mechatronics hand book, CRC press, 2002.
5. Bradley, D.Dawson , N.C. Burd and A.J. Loader, Mechatronics: Electronics in products and Processes chapman and hall, London 1991.
6. Khandpur, R.S., "Handbook of biomedical instrumentation", TMH, 1989.
7. Arumugam M., "Bio Medical Instrumentation", Anuradha agencies pub., 2002.

8. Geddes L.A., and Baker, L.E., " Principles of applied bio Medical Instrumentation" , 3rd Edition , John Wiley and sons, 1995.
9. David G. Aliciatore and Mecheal.B> Histand, Introduction of Mechatronics and Measurement Systems, McGraw Hill International Edition, 1999.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Fifth**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEY06	**Fluid Power Automation**	3	0	0	3	40	60	100
Prerequisite:								

Course Outcome	**CO1**	On completion of the course the students will be able to apply the concepts of fluid power and pneumatic circuits for automation in mechanical field, devices associated and operation, maintenance and safety of such systems.
	CO2	students will be able to apply the concepts of fluid power for control systems
	CO3	students will be able to apply the concepts of fluid power for actuating mechanism.
	CO4	students will be able to apply the concepts of pneumatic circuits for automation in mechanical devices.
	CO5	students will be able to apply the concepts of combined fluid power and pneumatic circuits for automation in mechanical systems.

UNIT-I	**Periods: 9**	
Introduction to Fluid power - Advantages- Filters - Seals - Hydraulic pumps - Classification - selection factors - Hydraulic Actuators - Linear - Rotary fluid motors.		**CO1**
UNIT-II	**Periods: 9**	
Pressure – Direction - Flow control valves, relief valves, non-return and safety valves - Accumulators - Linear circuits - Regenerative circuits- Intensifier circuits - metering - In our circuits.		**CO2**
UNIT-III	**Periods: 9**	
Reciprocation operation of multi cylinder - Quick return - Sequencing - Accumulator circuits - Use of pressure switches & limit switches - Hydrostatic transmission circuits - Fluid power maintenance and safety.		**CO3**
UNIT-IV	**Periods: 9**	
Basic principles of Pneumatics – Types of Compressors – Elements of Pneumatic systems – Filters, lubricator, Muffler – Types of directional control valve - Air motors - Air cylinder		**CO4**
UNIT-V	**Periods: 9**	
Basic Pneumatic circuits - Speed control - Sequencing of motion - Hydro pneumatic circuits - cascade methods - Automation and Principle of circuit design – PLC- SCADA-Pneumatic control applications in machine tool and other mechanical fields – Maintenance		**CO5**

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

Reference Books:

1. Anthony Esposeto – Fluid power with Application, IV Edition, Prentice Hall, 1980.
2. S.R. Majumdar – Pneumatic systems – Principles and maintenance, Tata McGraw Hill Publishing Company Ltd, 1995.
3. Dudley A. Pease – Basic Fluid power, II Edition, Prentice Hall, 1998
4. John J. Pippinger and Andrew Parr – Hydraulic and Pneumatic, Jaico Publishing House, 1999

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Sixth**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEY07	**Automotive Fuels , Pollution and Control**	3	0	0	3	40	60	100
Prerequisite:								
Course Outcome	**CO1**	At the end of the course the student is able to understand the applications of different types of automotive fuels, its properties						
	CO2	At the end of the course the student is able to understand the harmful emissions from SI Engines /automobiles and the methods of control of pollution						
	CO3	At the end of the course the student is able to understand the harmful emissions from CI Engines /automobiles and the methods of control of pollution						
	CO4	At the end of the course the student is able to understand the emission standard and testing of emission						
	CO5	At the end of the course the student is able to understand the emission standard and the role of alternate fuels in reducing pollution and replacing conventional fuels						
UNIT-I						**Periods: 9**		
Liquid fuels: gasoline and diesel – thermo-chemistry - properties-testing of fuels-specific gravity-calorific value, boiling range, flash point, ignition temperature, viscosity, cloud and pour point, flammability limits, Octane rating and Cetane rating-fuel additives-requirement of additives, petrol and diesel fuel additives-fuel specification. Different pollutant from IC engines-their effect on human health and environment								**CO1**
UNIT-II						**Periods: 9**		
SI engine pollutants-mechanism of formation of unburnt hydrocarbon, carbon monoxide and nitrogen oxides. Factors affecting the formation of Pollutants- effect of engine variables. Emission control methods in SI engines thermal and catalytic reactors, oxidation ,reduction and 3 way catalytic reactors, closed loop feedback control catalysts and substrates-recent development in SI engine for emission control-lean burn engine-stratified charge engine-multipoint fuel injection.								**CO2**
UNIT-III						**Periods: 9**		
CI engine pollutants-formation of hydrocarbons, oxides of nitrogen and particulate matter-smoke and its types factors affecting smoke formation-diesel engine emission control –effect of engine variables-recent developments in CI engine for emission control- low heat rejection engine-dual fuel engine-common rail diesel injection system ultra-high pressure diesel injection- HCCI engine-lean de-NOx catalysts-diesel particulate filters.								**CO3**
UNIT-IV						**Periods: 9**		
Emission standards, test procedures, driving cycles. Measurement of CO, HC, NOx, PM and smoke -Bosch smoke meter-Hatridge smoke meter-measurement of particulate meter.								**CO4**
UNIT-V						**Periods: 9**		
Alternative fuels for emission control: biodiesel and ethanol, gashol. Gaseous fuels: LPG, natural gas-biogas- producer gas, hydrogen, physical and chemical properties- Engine combustion performance and emission characteristics								**CO5**
Lecture Periods: 45	**Tutorial Periods: Nil**	**Practical Periods: Nil**				**Total Periods: 45**		

Reference Books:

1. John b Heywood, IC Engine Fundamentals, McGraw hill international edition,1988
2. V.Ganesan, IC.Engines, Tata Mcgraw Hill international Edition,1995
3. 3.Pundir, Engine Emission, Narosa Publishing House,New Delhi, 2007

Department: **Mechanical Engineering**		Programme: **B.Tech.(ME)**						
Semester: **Sixth**		Course Category Code: **PEC**			Sem. Exam. Type: **TY**			
Course Code	Course Name	Periods/week			Credit	Maximum marks		
		L	T	P	C	CA	SE	TM
MEY08	**Maintenance and Safety Engineering**	3	0	0	3	40	60	100
P**rerequisite**								

Course Outcome	At the end of the course the student is able	
	CO1	to understand the objectives of maintenance
	CO2	to identify the methods of maintenance to match with applications
	CO3	to understand the trouble shooting in devices with examples
	CO4	to understand the necessity for safety so as to avoid accidents
	CO5	to know safety measures and standards to be followed as precautions

Unit – I	**Periods: 9**	
Objectives of maintenance - types of maintenance – Breakdown, preventive and predictive maintenance - Repair cycle - Repair Complexity, Lubrication system – Lubricants - inspection. Maintenance of Mechanical transmission systems - align machinery – static and dynamic balancing - process plants – air conditioning – water purification – environmental control.		**CO1**
Unit – II	**Periods: 9**	
Predictive Maintenance - vibration analysis data and noise as maintenance tool – wear debris analysis - Condition monitoring concepts applied to industries – diagnose faults – overhaul – testing and measurement using approved procedures - Total Productive Maintenance (TPM) - Economics of Maintenance- Computer aided maintenance – modern practice – modern manufacturing aspects.		**CO2**
Unit – III	**Periods: 9**	
Reliability: Definition, concept of reliability based design, failure rate, MTTF, MTBF, failure pattern, system reliability: Series, Parallel and Mixed configurations - Availability and Maintainability concepts-applications – electro, proportional and servo hydraulic components – shutdown machinery – isolation – dismantle – inspect – NDT - assembly – fans – pumps – valves – bearings – static – dynamic seals.		**CO3**
Unit – IV	**Periods: 9**	
Safety and productivity - causes of accidents in industries – accident reporting and investigation - measuring safety performance - Safety organizations and functions - Factories act and rules - Manufacture, Storage and Import of Hazardous Chemical rules - Explosive act - Gas cylinder rules – Electricity act.		**CO4**
Unit – V	**Periods: 9**	
Safety Codes and Standards – Air Quality – indoor - outdoor – safe drinking water - General Safety considerations in Material Handling equipments - Machine Shop machineries-pressure vessels and pressurized pipelines – IBR - welding equipments – operation and inspection of extinguishers – prevention and spread of fire – emergency exit facilities - NFPA Standards – ISO 14000.		**CO5**

Lecture Periods: 45	**Tutorials Periods: Nil**	**Practical Periods: Nil**	**Total Periods: 45**

Reference books:

1. Gopalakrishnan, P. and Banerji, A. K., Maintenance and Spare Parts Management, PHI Learning Pvt. Ltd., New Delhi, 2013.
2. Patrick D. T. O'Connor – Practical Reliability Engineering, Wiley, 2008.
3. Dhillon, B. S., Engineering Safety – Fundamental Techniques and Applications, World Scientific, 2003.
4. Mishra, R. C. and Pathak, K., Maintenance Engineering and Management, PHI Learning Pvt. Ltd., New Delhi, 2012
5. Garg, H.P., Industrial Maintenance, S.Chand & Co Ltd., New Delhi, 1990
6. Arora, C. P., Refrigeration and Air conditioning, Tata McGraw Hill Publishing Co. Ltd., 2000.
7. Birolini, Reliability Engineering, Springer, 2014.
8. Rolland P.Blake - Industrial Safety, Prentice Hall of India Pvt. Ltd., New Delhi, 1973.
9. http://nptel.iitm.ac.in/courses/Webcourse-contents
10. http://ocw.mit.edu/courses/mechanical engineering.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Sixth**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEY09	**Computer Aided Design**	3	0	0	3	40	60	100
Prerequisite:								

Course Outcome	**CO1**	At the end of the course, the student will be able to Students will understand the basic working principle of drafting and modelling software.
	CO2	Understand geometric construction
	CO3	Student will get ability to use standards for model transformation.
	CO4	Get idea about how to write effective software with proper data base to develop an expert system.
	CO5	Get knowledge about Computer aided design and the application of computer aided design in research and development areas.

UNIT-I	**Periods: 9**
Design process - Morphology of design, Types of design models, Application of design models, concurrent Engineering – CAD system architecture. CAD Hardware: workstation – CPU, mass storage, input devices (keyboard, light pen, thumb wheel joy stick, mouse, digitizer etc.,) and output devices (printers, plotters) Display Devices	**CO1**
UNIT-II	**Periods: 9**
Bresenham's line and circle algorithms. Transformation in Graphics: co-ordinate system used in Graphics and windowing and view port transformations, Clipping , hidden line elimination, 2D transformations – rotation, scaling, translation, mirror, reflection and shear – homogeneous transformations-concatenation, 3D Transformation – orthographic and Perspective Projections	**CO2**
UNIT-III	**Periods: 9**
Classification of Geometric Modelling – Wire frame, Surface and Solid Modelling, applications – representation of curves and surfaces – Parametric form – Design of curved shapes- Cubic spline – Bezier curve – B-spline – Design of Surfaces - features of Surface Modelling Package – Solid Primitives, CSG, B-rep and description of other modelling techniques like Pure primitive instancing, cell decomposition, spatial occupancy enumeration, Boolean Operations (join, cut, intersection), Creating 3D objects from 2D profiles (extrusion, revolving etc.)	**CO3**
UNIT-IV	**Periods: 9**
Standards for computer graphics (GKS) and Data exchange standards – IGES, STEP. Data structures for Entity storage – Data structures for interactive modelling- Relational databases introduction to SQL language. Role of OOPS in CAD.	**CO4**
UNIT-V	**Periods: 9**
Expert Systems –strategies for Knowledge Acquisition, representation of knowledge – Inference schemes. Parametric and variational modelling, Feature based modelling, Design information system an overview of modelling software like PRO-E, CATIA, IDEAS, SOLID EDGE etc.	**CO5**

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

Reference Books:

1. Chris Mcmahon and Jimmie Browne - CAD/CAM – Principle Practice and Manufacturing Management, 2nd Edition, Addision Wesley England, 2000.
2. Sadhu Singh - Computer Aided Design and Manufacturing, II Edition, Khanna Publishers, New Delhi, 2014
3. P.Radhakrishnan et al - CAD/CAM/CIM, New Age International P Ltd., New Delhi, 2012.
4. M.P.Groover and E.W.Zimmers - CAD/CAM; Computer Aided Design and Manufacturing, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2010.
5. Ibrahim Zeid - CAD/CAM Theory and Practice, Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2013

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Seventh**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEY10	**Cryogenic Engineering**	3	0	0	3	40	60	100
Prerequisite:								
Course Outcome	**CO1**	At the end of the course the student is able to understand operation of low temperature technologies						
	CO2	to analyse cryogenic liquefaction systems and components effectively						
	CO3	to analyse select cryogenic refrigeration systems in accordance with applications						
	CO4	to choose and design cryogenic systems according to requirements						
	CO5	to solve problems associated with real-time applications						

UNIT-I	**Periods: 9**	
Basics of cryogenics and liquefaction systems: Introduction to cryogenics – Applications involving cryogenic engineering – Cryogenic fluids and properties – Low-temperature properties of solids: mechanical, thermal, electrical and magnetic properties – Superconductivity – Super fluidity.		**CO1**
UNIT-II	**Periods: 9**	
Gas liquefaction systems: Production of low temperature: Joule-Thomson effect – Inversion curve – Adiabatic expansion – Cryogenic liquefaction systems: Linde-Hampson system, pre-cooled Linde-Hampson system, Linde dual pressure system, Claude system, pre-cooled Claude system, Kapitza system, Heylandt system, Collin's helium liquefaction system and Simon helium-liquefaction system.		**CO2**
UNIT-III	**Periods: 9**	
Cryogenic refrigerators and gas-separation and gas-purification: Joule-Thomson refrigeration system – Cascade Joule-Thomson refrigeration system – Expansion-engine refrigeration system – Cold gas refrigeration system – Philips refrigerator – Solvay refrigerator – A.D. Little refrigerator – Vuilleumier refrigerator – Refrigerators using solids as working media – Principles of gas separation – air-separation systems – hydrogen-separation systems – helium-separation systems – gas-purification methods.		**CO3**
UNIT-IV	**Periods: 9**	
Cryogenic instrumentation: Properties characterizing cryogenic instrumentation – strain gauges – displacement and position transducers – pressure measurement – temperature measurement – flow measurement – liquid level measurement – density measurement.		**CO4**
UNIT-V	**Periods: 9**	
Cryogenic fluid storage and transfer systems: Insulation concepts – expanded-foam insulation – gas-filled powder and fibrous insulation – vacuum insulation – evacuated-powder and fibrous insulation – opacified-powder – storage vessels – basic vessel and design – liquid shielded vessels – vapour-shielded vessels –suspension systems – piping – drain and access ways – safety devices. Transfer systems – uninsulated lines – porous-insulated lines – vacuum-insulated lines – cryogenic valves and pumps – cool down of storage and transfer systems – vacuum technology in cryogenics.		**CO5**

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

Reference Books:

1. Randall Barron,Cryogenic Systems, McGraw Hill Book Publishing Co. Ltd., New York, 1966
2. Timmerhaus, K. D. and Flynn, T. M., Cryogenic Process Engineering, Plenum Press, New York, 1989
3. Haselden, G. G., Cryogenic Fundamentals, Academic Press, 1971

Department : **Mechanical Engineering**		Programme : **B.Tech. (ME)**						
Semester : **Seventh**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEY11	**Nano Technology and surface Engineering**	3	0	0	3	40	60	100
Prerequisite:								
Course Outcome	**CO1**	Get a broad view about nanotechnology concepts and basics						
	CO2	Expose to methods of synthesis of nano materials						
	CO3	Know characterization techniques						
	CO4	Familiarize with Metal cleaning and preview on surface engineering						
	CO5	Explore the concepts of Tribological Aspects of Surfaces and surface coatings						

UNIT-I	**Periods: 9**
Introduction to Nano Technology: Elements of Nano science and Nano technology, fundamentals and overview of Nano science, Nano revolution of the 20th century, Properties at Nano scale (optical, electronic and magnetic). Theory, definitions and scaling	**CO1**
UNIT-II	**Periods: 9**
Synthesis of Nano materials, Synthesis of bulk Nano – structured materials, sol gel processing, Mechanical alloying and mechanical milling and Inert gas condensation technique. Nano lithography, chemical synthesis, CVD, wet deposition techniques, self-assembly (Supra molecular approach), Molecular design and modelling.	**CO2**
UNIT-III	**Periods: 9**
Physical and Chemical Characterization Techniques: Characterization – Scanning Electron Microscopy (SEM), Scanning Probe Microscopy (SPM), TEM and EDAX analysis, X-Ray diffraction, Fluorescence Microscopy and Imaging, STM – AFM and their application in Nanotechnology.	**CO3**
UNIT-IV	**Periods: 9**
Metal cleaning and preview on surface engineering: Need And Relevance Of Surface Engineering, Pre-Treatment Of Coating, General Cleaning Process For Ferrous And Non-Ferrous Metals And Alloys, Selection Of Cleaning Process – Alkaline Cleaning – Emulsion Cleaning- Ultrasonic Cleaning – Acid And Pickling Salt Bath Descaling – Abrasive Bath Cleaning– Polishing And Short Peening – Classification Of Surface Engineering Processes.	**CO4**
UNIT-V	**Periods: 9**
Tribological Aspects of Surfaces and surface coatings: Tribological aspects of adhesion, friction and wear – Friction and Friction Types – Theories of Macro and Nano scale friction – Difference between macro and Micro/ Nano tribology - Characterization techniques for friction and wear – Tribometer, Friction Force Microscopy and Nano scratching - Surface Coatings - hot dip coating and diffusion coatings.	**CO5**

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

Reference Books:

1. Charles Poole, Jr., and Frank J. Owens, Introduction to Nanotechnology, John Wiley and sons, 2003.
2. Nano chemistry: A Chemical Approach to Nanomaterials – Royal Society of Chemistry, Cambridge UK 2005.
3. CNR Rao, Achim Muller andAnthony K. Cheetham, Chemistry of Nanomaterials: Synthesis, properties and applications, John Wiley & Sons, 2004
4. Cullity, B.D., Elements of X-ray Diffraction, 4th Edition, Addison Wiley, 1978.
5. Loretto, M. H., Electron Beam Analysis of Materials, Chapman and Hall, 1984.
6. T.A. Delcher, Vacuum Physics and Techniques, Chapman & Hall.
7. Gabe. D.R., “Principles of Metal Surface Treatment and Protection”, Pergamon, 1990
8. Ryan Richards, Surface and Nano molecular Catalysis, Taylor & Francis, Boca Raton, 2006.
9. Niku-Lavi, “Advances In Surface Treatments”, Pergamon, 1990.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Seventh**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEY12	**Design of Transmission Systems**	3	0	0	3	40	60	100
Prerequisite:								

Course Outcome		
	CO1	Students will able to understand the design principles of various transmission systems.
	CO2	Students are made to get knowledge in bearing and bearing materials.
	CO3	Students will be able to come up with ideas to design of belt drives and types based on Buckingham equation.
	CO4	Student will able to Select bearings for a given application from the manufacturers catalogue.
	CO5	Students will able to solve design problems on gear drives and wear criteria.

UNIT-I	**Periods: 9**
Theory of hydrodynamic bearing –design of journal bearing – heat dissipation – elementary ideas of hydrostatic bearings – bearing materials and lubricants. Rolling contact bearings – load capacity and life – selection of rolling contact bearings for radial and axial loads.	**CO1**
UNIT-II	**Periods: 9**
Belt drives – types – selection and design of flat and V-belts Chain drives – roller chains – polygonal effect – sprocket wheels – silent chain	**CO2**
UNIT-III	**Periods: 9**
Advantage of gear drives over other drives, nomenclature, failures of gear tooth, design of spur gears & helical gears -based on bending and wears criteria – based on Lewis and Buckingham equation.	**CO3**
UNIT-IV	**Periods: 9**
Bevel gears - nomenclature, design of gears – based on bending and wear criteria– based on Lewis and Buckingham equation, worm and worm wheel – nomenclature – design procedure	**CO4**
UNIT-V	**Periods: 9**
Geometric progression – standard step ratio – ray diagram, kinematics layout – design of sliding mesh gear box – constant mesh gear box – design of multi speed gear box.	**CO5**

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

Reference Books:

1. T.J.Prabhu, Design of transmission elements, Madras book house, Chennai, 1997.
2. T.J.Prabhu, Fundamentals of machine design, Madras book house, Chennai, 1997.
3. T. Jagadeesha, Design of Machine Elements, Universities Press(India) Private limited, Hyderabad,2018
4. J.E.Shigley, Mechanical engineering design, I metric edition, McGraw Hill International Edition, 2011.
5. S.K.Basu, Design of machine tools, Oxford & IBH., 1990.
6. Sadhu singh, Machine design, Khanna publishers, 2001.
7. R.B.Gupta, Auto Design, Satyaprakashan, 1990.
8. Design Data Hand Book, PSG College of Technology, Coimbatore

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Seventh**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEY13	**Power Plant Engineering**	3	0	0	3	40	60	100
Prerequisite:								

Course Outcome		
	CO1	Able to understand essential components of steam power plant
	CO2	Able to understand components of gas turbine power plants
	CO3	Able to the design and working of Hydroelectric power plants
	CO4	Able to the design and working of nuclear power plants
	CO5	Able to understand load estimation and the economics of power plants

UNIT-I	**Periods: 9**	
Steam Power Plant: layout- Accessories: Feed water Pump, economiser, air-preheater, superheater, steam separator, Separator drums, Feed water heaters. Fuel handling: layout of fuel handling equipment, Combustion equipment for steam boilers: Burners– Fluidised bed combustion. Air handling system: forced draught fans, primary and secondary air system for solid fuels. Ash handling equipment. Chimney draught- natural, forced and induced draughts. Indian Boiler Act		**CO1**
UNIT-II	**Periods: 9**	
Gas turbine plant-site selection-classification – layout-classification of gas turbines-fuels-constant pressure and constant volume combustion turbines-effect of operating variables on thermal efficiency-combined gas turbine and steam plant cycles		**CO2**
UNIT-III	**Periods: 9**	
Hydro Electric Power Plant: Application-advantages and disadvantages-Site selection - Essential elements like catchment area, reservoir, dam, spill way etc., Classification of Hydro Electric Power Plant (Low, medium and high head). Hydrology-hydrologic cycle, measurement of run-off-hydrographs- flow duration curve-mass curve.		**CO3**
UNIT-IV	**Periods: 9**	
Nuclear Power Plant: General aspects of nuclear engineering- nuclear reactors-classification- PWR, BWR-Components of a nuclear power plant-- Nuclear fuels – coolants – moderators – radiation shield – Nuclear Power Plant Layout – Waste disposal-site selection-advantages and applications of nuclear power plants.		**CO4**
UNIT-V	**Periods: 9**	
Power Plant Economics and Tariffs: Load curve, load duration curve, different factors related to plants and consumers, Cost of electrical energy, depreciation, generation cost, effect of load factor on unit cost. Fixed and operating cost of different plants, role of load diversity in power system economy. Objectives and forms of Tariff: Causes and effects of low power factor, advantages of power factor improvement, different methods for power factor improvements.		**CO5**

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

Reference Books:

1. P.K.Nag, Power Plant Engineering, Tata McGraw Hill, 2000.
2. P.C.Sharma, Power Plant Engineering, DewanSanjeev Kumar Kataria, 1994.
3. Frederick T.Morse, Power Plant Engineering, Affiliated East-west Press Ltd., 1953.
4. William A.Vapert, Power Station Engineering and Economy, Tata McGraw Hill, 1972.
5. M.D.Burghardt, Engineering Thermodynamics with Applications, Harper Row, 1986
6. El Wakil M M, Power Plant Technology, McGraw-hill Publications, 2002

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Seventh**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEY14	**Total Quality Management**	3	0	0	3	40	60	100
Prerequisite:								
Course Outcome	**CO1**	At the end of the course the student is able to understand basics about TQM concepts						
	CO2	Understanding the necessity of TQM in an organization and its problems						
	CO3	To get knowledge about TQM approach						
	CO4	Explain the various QC tools						
	CO5	Able to solve problems on quality system						

UNIT-I	**Periods: 9**	
Introduction to TQM, Concept of quality, Need for quality, Evolution of quality, Dimensions of manufacturing and service quality, Basic concepts of TQM, Definition of TQM, TQM Framework, Barriers to TQM, quality control and quality management		**CO1**
UNIT-II	**Periods: 9**	
TQM Principles, Leadership, Strategic quality planning, Quality statements, Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention, Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal, Continuous process improvement, PDSA cycle, 5s, Kaizen - Supplier partnership, Partnering, Supplier selection, Supplier Rating		**CO2**
UNIT-III	**Periods: 9**	
Science of quality, human resources and quality, Quality organization and management, Quality manual, quality cost, quality related tasks. Quality information system: Planning, hardware-software.		**CO3**
UNIT-IV	**Periods: 9**	
The seven traditional tools of quality, New management tools, Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT, Bench marking, Reason to bench mark, Bench marking process, FMEA – Stages, Types, Quality circles, Quality Function Deployment (QFD), Taguchi quality loss		**CO4**
UNIT-V	**Periods: 9**	
Statistical process control and quality deployment techniques, controlling quality through measurement and through counting, Quality system and I.S.O. 9000 series, Quality assurance. Reports on quality, quality audit, quality training, newer quality management approaches, Quality tools.		**CO5**

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

Reference Books:

1. Total Quality Management 3rd Edition Dale H. Besterfield, Carol Besterfield Michna, Mary Besterfield Sacre, Glen H. Bester field, Hemant Urdhwareshe, Rashmi Urdhwareshe, Pearson, 2010.
2. Mukherjee, P.N., "Total Quality Management", Prentice Hall of India Ltd., New Delhi, 2006.
3. Total Quality Management (TQM), R. Ashley Rawlins, Autherhouse, 2008
4. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 6th Edition, South-Western (Thomson Learning), 2005.
5. Oakland, J.S., "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, 3rd Edition, 2010
6. James I Bossert, "Quality Function Deployment", ASQC Quality press, Wisconsin, 1994.
7. Kanishka Bedi, "Total Quality Management", Oxford University Press 8th Impression, 2011.

Department : **Mechanical Engineering**		Programme : **B.Tech.(ME)**						
Semester : **Seventh**		Course Category Code: **PEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEY15	**Finite Element Method**	3	0	0	3	40	60	100
Prerequisite:								

Course Outcome	**CO1**	Students will able to understand the fundamentals of finite element method.
	CO2	Students will able to apply finite element method for bar and truss applications.
	CO3	Students will able to apply finite element method for plane stress, plane strain and axisymmetric conditions.
	CO4	Student will be able to determine temperature distribution in one and two dimensional engineering applications.
	CO5	Students will get idea about how to Implement finite element method using isoparametric elements and introduction to ANSYS software.

UNIT-I	**Periods: 9**
INTRODUCTION: Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations. Relevance and scope of finite element methods - strain vs displacement relations - stresses and equilibrium - natural and essential boundary conditions - Rayleigh Ritz - Galerkin method- FEM procedure - Discretization of domain-element shapes, types, size, location and numbers.	**CO1**
UNIT-II	**Periods: 9**
ONE-DIMENSIONAL ELEMENTS: Coordinate system types-global, local and natural, shape function of 1D bar element -Finite element formulation - stiffness matrix, load vector, boundry condition and assembly of global equation-1D bar element and two node truss element- problems in 2D truss. Introduction to beam element.	**CO2**
UNIT-III	**Periods: 9**
TWO-DIMENSIONAL SCALAR VARIABLE PROBLEMS: Second Order 2D Equations involving Scalar Variable Functions – Variational formulation –Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts –Quadrilateral elements – Higher Order Elements.	**CO3**
UNIT-IV	**Periods: 9**
TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS: Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements.	**CO4**
UNIT-V	**Periods: 9**
ISOPARAMETRIC FORMULATION: Natural co-ordinate systems – Isoparametric elements – Shape functions for iso parametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Introduction to Analysis Software.	**CO5**

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

Reference Books:

1. David V. Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill Publishing Company Pvt. Ltd., New Delhi, 2005.
2. Reddy. J.N., “An Introduction to the Finite Element Method”, 3rd Edition, Tata McGraw-Hill, 2005
3. Logan, D.L., “A first course in Finite Element Method”, Thomson Asia Pvt. Ltd., 2002
4. S. S. Rao, Finite Element Method in Engineering, Elsevier India, 2005.
5. Robert D. Cook, s. David , Malkucs Michael E. Plesha, Concepts and Applications of Finite
6. Element Analysis, John Wiley, New Delhi,2007.
7. T. R. Chandrupatla and A. D. Belegundu, Introduction to Finite Elements Engineering, Pearson Education, New Delhi, 2002.
8. S. S. Bhavikati, Finite Element Analysis, New Age International Publishers, 2015.

Open Elective Courses

Department : **Mechanical Engineering**		Programme : **B.Tech.**						
Semester : **Third to Eighth**		Course Category Code: **OEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEO01	**Renewable Energy**	3	0	0	3	40	60	100
Prerequisite:								

Course Outcome	**CO1**	Understand the basic concept of solar radiation and different types of active and passive solar system and photovoltaic principle
	CO2	To identify the site selection and wind data estimation and also study safety, environmental aspects of wind power generation
	CO3	Understand the concepts and energy conversion principle of geothermal power plants.
	CO4	Understand the concepts and energy conversion principle of ocean and hydrogen energy systems
	CO5	To understand the biogas, ethanol and bio diesel production .

UNIT-I	**Periods: 9**
Introduction to solar energy- Solar radiation-radiation at the earth's surface–measurement of solar radiation - Solar water heating system – Solar air heating system – Solar cooling– Solar power systems –electrical power generation (direct –indirect)–solar thermal power plants –low, medium and high temperature power generation systems.	**CO1**
UNIT-II	**Periods: 9**
Wind Data and Energy Estimation –Types of Wind Energy Systems –Performance - Site Selection –Details of Wind Turbine Generator – Safety and Environmental Aspects.	**CO2**
UNIT-III	**Periods: 9**
Geothermal Energy-origin- geothermal resources-classifications-hydro-thermal system- water dominated and vapour dominated fields, hot dry rock systems, utilization of geothermal resources – direct utilization – electricity generation – dry steam power plants – flash steam power plant – binary cycle power plants – geothermal fossil hybrid power plants – geothermal heat pump.	**CO3**
UNIT-IV	**Periods: 9**
Tidal energy – Wave Energy – Open and Closed OTEC Cycles – Small Hydroelectric power systems – Hydrogen and Storage - Fuel Cell Systems – Hybrid Systems.	**CO4**
UNIT-V	**Periods: 9**
Biomass – resources – conversion systems - gasifiers - Biogas plants –Digesters–Ethanol production –Bio diesel –Biomass Applications.	**CO5**

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

Reference Books:

1. S.P.Sukhatme, Solar Energy –Principles of Thermal Collection and storage, Tata McGraw Hill Publishing Co., New Delhi, 1996.
2. N.K.Bansal et al, Renewable Energy Sources and Conversion Technology, Tata McGraw Hill Publishing Co., New Delhi, 1990.
3. Rai. G.D., "Non Conventional Energy Sources", Khanna Publishers, New Delhi, 2011.
4. Twidell, J.W. & Weir, A., "Renewable Energy Sources", EFN Spon Ltd., UK, 20
5. B.H.Khan " Non – Conventional Energy Resources" McGraw Hill Publishing Co., Chennai – 2017
6. Godfrey Boyle, "Renewable Energy,Power for a Sustainable Future", Oxford University Press,U.K., 1996.
7. Tiwari. G.N., Solar Energy – "Fundamentals Design, Modelling & Applications", Narosa Publishing House, New Delhi, 2002

Department : **Mechanical Engineering**		Programme : **B.Tech.**						
Semester : **Third to Seventh**		Course Category Code: **OEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEO02	**Solar Power Engineering**	3	0	0	3	40	60	100
Prerequisite:								

Course Outcome	**CO1**	Able to analyse the techniques and methods involved in solar energy harvesting systems
	CO2	Able to design and develop a prototype model of solar power system.
	CO3	Able to synthesis a new option for a solar power system
	CO4	Able to evaluate the performance characteristics of a solar direct power system
	CO5	Able to analyse the suitability of application of solar system over conventional system

UNIT-I	**Periods: 9**
Introduction to solar energy – solar energy utilization in India - Solar radiation – measurement of solar radiation - solar radiation data geometry – solar radiation on horizontal and inclined surfaces – relationship among absorption and emittance and reflectance – Selective surfaces.	**CO1**
UNIT-II	**Periods: 9**
Solar thermal devices: Flat plate collectors – materials for flat plate collector - collector efficiency – overall heat loss coefficient – performance of flat Plate collector. Concentrating collectors – improving efficiency of flat collector – cylindrical parabolic collector – compound parabolic collector – central receiver collector.	**CO2**
UNIT-III	**Periods: 9**
Solar heating – air heating system – solar energy heat pump system – solar water heating system: forced and natural circulation system – passive solar heating system –Solar cooling – absorption cooling – solar dryers - solar pond – solar furnace	**CO3**
UNIT-IV	**Periods: 9**
Photovoltaic Principle – materials for photovoltaic cells – efficiency of solar cell – solar cell materials - performance analysis of photovoltaic cells – Thermoelectric generator solar cell – photochemical solar cells – photovoltaic applications	**CO4**
UNIT-V	**Periods: 9**
Solar power systems – electrical power generation – solar thermal power plants – low, medium and high temperature power generation systems: using flat plate collectors or solar ponds, concentrating collectors, central receiver and solar chimneys – solar energy process economics	**CO5**

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

Reference Books:

1. S.P. Sukhatme, Solar Energy – Principles of Thermal Collection and storage, Tata McGraw Hill Publishing Co., New Delhi, 2008
2. J.A. Duffie & W. Beckmann, Solar Thermal Processes, John Wiley, 1980.
3. H.P.Garg and J. Prakash, Solar Energy, Tata McGraw – Hill Publishing Company Limited ,2007
4. G.D. Rai, Solar Energy Utilization, Khanna Publishers, 2005
5. Solar Cells – Operating Principles, Technology and System Applications /Martin A. Green/Prentice Hall Inc.
6. John Twidell and Tony Weir, Renewable Energy Resources, Routledge; 2 Edition (24 November 2005)
7. G.D. Rai Non-Conventional Energy Sources Published 2011 by Khanna Publishers
8. Dr. R.K. Singal, Non-conventional energy resources. S.K. Katara publication limited.
9. Jiu Sheng Hsieh, Solar Energy Engineering, Prentice Hall, 1991
10. M.A.Greem, Solar Cells, Prentice Hall Inc., Englewood Cliffs, 1982.

Department : **Mechanical Engineering**		Programme : **B.Tech.**						
Semester : **Third to Seventh**		Course Category Code: **OEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEO03	**Fluid and Thermal Machines**	3	0	0	3	40	60	100
Prerequisite:								

Course Outcome		
	CO1	At the end of the course the student is able to gain knowledge about fluid mechanics Problem
	CO2	Understanding the necessity of hydraulic machines and its problems
	CO3	To get knowledge about turbines and pumps
	CO4	Explanation on various pumps and its efficiency
	CO5	Performance and characteristics of Steam turbine power plant

UNIT-I	**Periods: 9**	
Fluid mechanics-Introduction; Reynolds Transport Theorem; Integral form of continuity, momentum and energy equations; Eulerian and Lagrangian view-points; Constitutive relations; Navier Stokes equations		**CO1**
UNIT-II	**Periods: 9**	
Exact solutions; Potential flow; Boundary layer theory; Separation and drag; Turbulent flow: Reynolds averaged equations; Turbulent flows in pipes and channels; compressible flows		**CO2**
UNIT-III	**Periods: 9**	
Hydraulic machines- Theory of turbo machines and their classification, Elements of hydro-electric power plant, Impulse Turbine:- principle, constructional features, Installation of Pelton Turbine, Velocity Diagram and Analysis, Working proportions, Design parameters, Performance characteristics, Governing. Pumps: Roto-dynamic and positive displacement pumps – centrifugal pump: parts, working, performance – priming – cavitation – Specific speed – reciprocating pump: parts, working, performance – indicator diagram – use of air vessel		**CO3**
UNIT-IV	**Periods: 9**	
Similitude - Types of similarities, Dimensionless number and their significance, Unit and Specific Quantities, Model Testing: - Application to hydraulic turbine and hydrodynamic pumps, Miscellaneous Water Lifting Device: - Air lift pumps, Hydraulic Ram, Submersible pump, Regenerative pumps		**CO4**
UNIT-V	**Periods: 9**	
Steam turbine power plant- Properties of steam – steam turbine power plant: components, working – simple, Rankine cycle – reheating – regeneration – steam turbines: impulse and reaction turbines, compounding of impulse turbines, governing of steam turbines – condensers and cooling towers – problems in simple Rankine cycle		**CO5**

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

Reference Books:

1. Cengel, Y. and Cimbala, J., *Fluid Mechanics: Theory and Applications*, McGraw-Hill Education, New York (2010).
2. Currie, I.G., *Fundamental Mechanics of Fluids,* McGraw-Hill, New York, 1993.
3. Hydraulic & Compressible Flow Turbo-machines, A. T. Sayers, Mc-Graw Hill.
4. Mechanics of Fluids, Merle C. Potter, CL-Engineering
5. Fluid Mechanics, John F. Douglas, Pearson
6. Balaney P L, "Thermal Engineering", Khanna Publishers, New Delhi, 2007Jiu Sheng Hsieh, Solar Energy Engineering, Prentice Hall, 1991
7. M.A. Greem, Solar Cells, Prentice Hall Inc., Englewood Cliffs, 1982.

Department : **Mechanical Engineering**		Programme : **B.Tech.**						
Semester : **Third to Seventh**		Course Category Code: **OEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEO04	**Marketing Management**	3	0	0	3	40	60	100
Prerequisite:								

Course Outcome	**CO1**	At the end of the course the student will be able to explain the different strategies that are used for different markets
	CO2	Identify the components of the marketing environment and how they impact marketing
	CO3	Understand the theories and practices behind the marketing mix variables
	CO4	Demonstrate an understanding of the entire marketing process
	CO5	Distinguish between the specific nature of different markets, goods and services

UNIT-I	**Periods: 9**
MARKETING PROCESS: Definition, Marketing process, dynamics, needs, wants and demands, marketing concepts, environment, mix, types. Philosophies, selling versus marketing, organizations, industrial versus consumer marketing, consumer goods, industrial goods, product hierarchy.	**CO1**
UNIT-II	**Periods: 9**
BUYING BEHAVIOUR AND MARKET SEGMENTATION: Cultural, demographic factors, motives, types, buying decisions, segmentation factors - demographic - Psycho graphic and geographic segmentation, process, patterns.	**CO2**
UNIT-III	**Periods: 9**
PRODUCT PRICING AND MARKETING RESEARCH: Objectives, pricing, decisions and pricing methods, pricing management. Introduction, uses, process of marketing research.	**CO3**
UNIT-IV	**Periods: 9**
MARKETING PLANNING AND STRATEGY FORMULATION: Components of marketing plan-strategy formulations and the marketing process, implementations, portfolio analysis, BCG, GEC grids.	**CO4**
UNIT-V	**Periods: 9**
ADVERTISING, SALES PROMOTION AND DISTRIBUTION: Advertising: Characteristics, impact, goals, types, and sales promotions - point of purchase - unique selling proposition. Characteristics, wholesaling, retailing, channel design, logistics, and modern trends in retailing, Modern Trends, e-Marketing.	**CO5**

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

Reference Books:

1. Philip Kolter & Keller, “Marketing Management”, Prentice Hall of India, 14th edition, 2012.
2. Chandrasekhar. K.S., “Marketing Management Text and Cases”, 1st Edition, Tata McGraw Hill, 2010.
3. Czinkota & Kotabe, “Marketing management”, Thomson learning, Indian edition 2007
4. Adrain palmer, “ Introduction to marketing theory and practice”, Oxford university press IE 2004.
5. Philip Kotler and Gary Armstrong “Principles of Marketing” Prentice Hall of India, 2000.
6. Graeme Drummond and John Ensor, "Introduction to marketing concepts", Elsevier, Indian Reprint, 2007.

Department : **Mechanical Engineering**		Programme : **B.Tech.**						
Semester : **Third to Seventh**		Course Category Code: **OEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEO05	**Elements of Project Management**	3	0	0	3	40	60	100
Prerequisite:								

Course Outcome	**CO1**	At the end of the course the student will be able to Identify key components of a project
	CO2	Describe the stages of a project and how each stage can be effectively managed
	CO3	Outline some of the tools and techniques that can be helpful when planning a project
	CO4	Explain the concept of risk management, as relevant to projects, and describe some techniques for identifying and managing risks
	CO5	Explain the importance of evaluating the effectiveness of a project and describe ways of doing this

UNIT-I	**Periods: 9**
Indian project management scenario, Projects - Project ideas and preliminary screening. Developments - Project planning to Project completion - Pre-investment phase, Investment phase, operational phase - Governmental Regulatory framework. Capital Budgeting: Capital cost-time-value (CTV) system, managing project resources flow.	**CO1**
UNIT-II	**Periods: 9**
Stages - Opportunity studies - General opportunity studies, specific opportunity studies, pre-feasibility studies, functional studies or support studies, feasibility study expansion projects, data for feasibility study. Market and Technical Appraisal: Market and Demand analysis, Market Survey, Demand forecasting. Technical analysis- Materials and inputs, Choice of Technology, Product mix, Plant location, capacity, Machinery and equipment.	**CO2**
UNIT-III	**Periods: 9**
Appraisal process, Concepts and Techniques, Cost and Benefit from Financial angle - Basic principles for measuring costs and benefits, components of cash flow. Time value of money - Present and future value. Appraisal criteria - Urgency, Payback period, Rate of return, Debt service coverage ratio, Net present value, Benefit cost ratio, Internal rate of return, Annual capital charge, Investment appraisal in practice.	**CO3**
UNIT-IV	**Periods: 9**
Cost of capital - Cost of different sources of finance, Cost of debt, preference capital, and Equity capital, Weighted average Cost of capital, Marginal cost of capital. Risk analysis- Measures of risk, Sensitivity analysis, and Decision tree analysis. Social cost benefits analysis (SCBA) - Rationale for SCBA, UNIDO approach. Cost of Capital. Means of financing, Term Loans, Financial Institutions. Profitability - Cost of Production, Break-even analysis. Assessing the tax burden and financial projections.	**CO4**
UNIT-V	**Periods: 9**
Forms of Project Organization, Project Planning, Implementation, and Control - Network construction, CPM, PERT, Development of Project schedule, Crashing of Project Network, Scheduling based on the availability of Resources (Manpower and Release of Funds). Introduction to Foreign collaboration projects - Governmental policy framework, Need for foreign technology, Royalty payments, Foreign investments and procedural aspects.	**CO5**

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

Reference Books:

1. Prasanna Chandra, Projects - Preparation, Appraisal, Budgeting and Implementation, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1980.
2. P.Gopalakrishnan and V.E.Rama Moorthy - Project Management, Macmillan India Ltd., New Delhi, 1993.
3. R.C.Mishra and Tarun Soota - Modern Project Management, New Age International (P) Ltd, New Delhi, 2005.
4. Goel, B.B., Project Management - Principles and Techniques, Deep & DeepPublications, New Delhi, 1986.
5. UNIDO Series on Project Management

Department : **Mechanical Engineering**		Programme : **B.Tech.**						
Semester : **Third to Seventh**		Course Category Code: **OEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEO06	**Introduction to Nano Science and Nano Technology**	3	0	0	3	40	60	100
Prerequisite:								
Course Outcome	**CO1**	Get a broad view about nanoscience concepts and basics						
	CO2	Expose to Supramolecular nanostructures and biological materials						
	CO3	Know Nanostructures and its applications						
	CO4	Familiarize with Emerging technologies for environmental remediation						
	CO5	Explore the concepts of Semiconductor nanoparticles – applications						
UNIT-I					**Periods: 9**			
Evolution of Nano science: Introduction, length scale of different structures, definition of Nano science and nanotechnology - Electronic structure of various nanostructures - Discovery of fullerenes and the evolution of Nano science, Size dependent properties, size dependent absorption - Phonons in nanostructures.								**CO1**
UNIT-II					**Periods: 9**			
Supramolecular nanostructures and biological materials: Supramolecular structures, transition metal mediated type, dendritic molecules, and supramolecular dendrimers. Solid disordered nanostructures: Metal Nano cluster composite glasses. biological nanostructures, polypeptide nanowire and protein nanoparticles, nucleic acids, and protein synthesis, examples of biological nanostructures.								**CO2**
UNIT-III					**Periods: 9**			
Nanostructures and its applications: Classifications of nanomaterials - Zero dimensional, one-dimensional and two dimensional nanostructures- Kinetics in nanostructured materials- multilayer thin films and super lattice- clusters of metals, semiconductors and nanocomposites. Application of Nano materials in Electronics, Medicine, Military, Defense, textiles etc.								**CO3**
UNIT-IV					**Periods: 9**			
Emerging technologies for environmental remediation: Use of nanoparticles for environmental remediation and water treatment- Role of Dendrimer- single enzyme-nanoparticle and metalloprotein. Case studies and Regulatory Needs.								**CO4**
UNIT-V					**Periods: 9**			
Semiconductor nanoparticles – applications: Optical luminescence and fluorescence from direct band gap semiconductor nanoparticles, surface-trap passivation in core-shell nanoparticles, carrier injection, polymer-nanoparticle, LED and solar cells, electroluminescence, light emission from indirect semiconductors, light emission form Si Nano dots.								**CO5**
Lecture Periods: 45	**Tutorial Periods: -**	**Practical Periods: -**				**Total Periods: 45**		

Reference Books:

1. Poole, Jr., Frank J. Owens and Charles, Introduction to Nanotechnology, John Wiley and sons, 2003.
2. G. Cao and Y. Wang, Nanostructures and nanomaterials: synthesis, properties and applications, World Scientific, 2nd edition, 2011
3. H.S. Nalwa, Encyclopedia of nanoscience and nanotechnology, American Scientific Publishers, 2007
4. S.Yang and P.Shen: “Physics and Chemistry of Nanostructured Materials”, Taylor & Francis, 2000.
5. J. Twidell and T. Weir, Renewable Energy Resources, E & F N Spon Ltd, London, 1986.

Department : **Mechanical Engineering**		Programme : **B.Tech.**						
Semester : **Third to Seventh**		Course Category Code: **OEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEO07	**Industrial Automation**	3	0	0	3	40	60	100
Prerequisite:								
Course Outcome	**CO1**	Students understand the various automation processes						
	CO2	Students understand the various automation techniques in manufacturing processes						
	CO3	Students understand the various automations in machining processes						
	CO4	Students understand the various automations in robotics						
	CO5	Students understand the various planning and implementation processes						

UNIT-I	**Periods: 9**	
Hardness Automation – I: Introduction to Automation in Manufacturing – Types of Automation – Study of the principles of working of automates – Applications.		**CO1**
UNIT-II	**Periods: 9**	
Hardness Automation - II: Automated flow lines – Types. Transfer machines – types, mechanisms, applications, Transfer, Handling, Location, Orientation and Parts Feeding devices – Types and principles of working only. Buffer storage. NC machines – Introduction, Types, Economics, Advantages and Applications. CNC, DNC (Direct and Distributed), and Adaptive Control.		**CO2**
UNIT-III	**Periods: 9**	
Turning and Machining Centres – Description and types of ATC, Applications. NC Part Programming – Types – Introduction to programming languages, APT Programming, Examples on CNC Turning, Milling & Drilling operations. Preliminary study on simulation of CAD based NC programming.		**CO3**
UNIT-IV	**Periods: 9**	
Robot anatomy and Configuration, Work Volume, End effectors – Types of grippers, tool as end effectors. Robot Sensors – External and Internal, Types - Position sensors, Velocity sensors, Tactile, Proximity and range sensors, Machine vision – Applications. Automated Material Handling and Storage Systems – Types, Design and Interfacing Preliminaries		**CO4**
UNIT-V	**Periods: 9**	
Group Technology: Part Families – Parts Classification and Cooling, Examples. Applications. Flexible Manufacturing Systems: Types, Components, Planning and Implementation Issues. Introduction to Lean and Agile Manufacturing Systems - Comparison		**CO5**

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

Reference Books:

1. Mikel P.Grover, Automation, Production Systems and Computer Integrated Manufacturing, PHI Ltd., New Delhi, 2003.
2. P. Radhakrishnan, NC Machine Tools, Dhanpat Rai & Sons, New Delhi,2000
3. G. Boothroyd et al, Automatic assembly, Marcel Dekker Inc., New York, 1993.
4. P.N. Rao et al, Computer Aided Manufacturing, Tata McGraw Hill Publishers, 1993.
5. P. Radhakrishnan and S. Subramanian – CAD/CAM/CIM/, Wiley Eastern Ltd., 2000.

Department : **Mechanical Engineering**		Programme : **B.Tech.**						
Semester : **Third to Seventh**		Course Category Code:**OEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEO08	**Quantitative Techniques for Engineers**	3	0	0	3	40	60	100
Prerequisite:								

Course Outcome		
	CO1	At the end of the course the student is able to understand Quantitative Techniques
	CO2	Understanding the concepts of operation research
	CO3	To get knowledge about various operation techniques
	CO4	Explain about Queuing Theory
	CO5	Understanding of financial management

UNIT-I	**Periods: 9**	
Introduction, Historical Background, Scope of Operations Research , Features of Operations Research, Phases of Operations Research, Types of Operations Research Models, Operations Research Methodology, Operations Research Techniques and Tools , Structure of the Mathematical Model, Limitations of Operations Research		**CO1**
UNIT-II	**Periods: 9**	
Linear Programming – Graphical and Simplex Methods, Duality and Post – Optimality Analysis – Transportation and Assignment Problems		**CO2**
UNIT-III	**Periods: 9**	
Inventory Control - EOQ - Quantity Discounts - Safety Stock – Replacement Theory – PERT and CPM – Simulation Models – Quality Control.		**CO3**
UNIT-IV	**Periods: 9**	
Mathematical Analysis of Queuing Theory: Introduction, Mathematical Analysis of Queuing Process, Properties of Queuing System, Notations, Service System, Single Channel Models, Multiple Service Channels, Erlang Family of Distribution of Service Times, Applications of Queuing Theory, Limitations of Queuing Theory		**CO4**
UNIT-V	**Periods: 9**	
FINANCIAL MANAGEMENT: Working Capital Management – Compound Interest and Present Value methods –Discounted. Cash Flow Techniques – Capital Budgeting		**CO5**

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

Reference Books:

1. Hamdy A.Taha, Operations Research: An Introduction, Prentice Hall, 2010.
2. Kumar, A.C.S, Operations Research, Yes Dee Publishing Pvt Ltd, 2015.
3. Levin, R.I, Rubin,D.S., and Stinson J., Quantitative Approaches to Management, McGraw Hill College, 1993.
4. Vohra, Nd., Quantitative Techniques in Management, Third Edition, Tata McGraw-Hill Company Ltd, 2007.

Department : **Mechanical Engineering**		Programme : **B.Tech.**						
Semester : **Third to Seventh**		Course Category Code: **OEC**				Semester Exam Type: **TY**		
Course Code	Course Name	Periods / Week			Credit	Maximum Marks		
		L	T	P	C	CA	SE	TM
MEO09	**Finite Element Analysis**	3	0	0	3	40	60	100
Prerequisite:								

Course Outcome	**CO1**	At the end of the course the student is able to Understand the fundamentals of finite element method.
	CO2	Apply finite element method for bar and truss applications.
	CO3	Apply finite element method Heat Transfer Problems.
	CO4	Apply finite element method Solid Mechanics Problems.
	CO5	Implement finite element method using ANSYS software.

UNIT-I	**Periods: 9**	
INTRODUCTION- Historical Background – Basic Concepts – comparison of FEM and Exact Solutions – General Procedure – Examples- Finite Element formulation from Governing differential equations		**CO1**
UNIT-II	**Periods: 9**	
FINITE ELEMENT FORMULATION OF BOUNDARY VALUE PROBLEMS - Weighted residual methods – general weighted residual statement – weak formulation of the weighted residual statement – comparisons – piecewise continuous trial functions-example of a bar finite element –functional and differential forms – principle of stationary total potential – Rayleigh Ritz method – piecewise continuous trial functions – finite element method – application to bar element. Coordinate system types-global, local and natural, shape function of 1D bar element - problems in 2D truss.		**CO2**
UNIT-III	**Periods: 9**	
ONE DIMENSIONAL FINITE ELEMENT ANALYSIS - General form of total potential for 1-D applications – generic form of finite element equations – linear bar element – quadratic element –nodal approximation – development of shape functions – element matrices and vectors – example problems – extension to plane truss– development of element equations – assembly – element connectivity – global equations – solution methods –beam element – nodal approximation – shape functions – element matrices and vectors – assembly – solution – example problems.		**CO3**
UNIT-IV	**Periods: 9**	
TWO DIMENSIONAL FINITE ELEMENT ANALYSIS- Introduction – approximation of geometry and field variable – 3 node triangular elements – four node rectangular elements. Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements.		**CO4**
UNIT-V	**Periods: 9**	
APPLICATIONS OF FEM –– Simple Problems in Solid Mechanics – Heat Transfer – Fluid Mechanics. Introduction to software – ANSYS.		**CO5**

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

Reference Books:

1. Seshu.P, Textbook of Finite Element Analysis, PHI Learning Private Limited, Delhi- 110092, 2014
2. David V. Hutton, Fundamentals of Finite Element Analysis, Tata McGraw Hill PublishingCompany Pvt. Ltd., New Delhi, 2005.
3. Logan, D.L., "A first course in Finite Element Method", Thomson Asia Pvt. Ltd., 2002
4. S. S. Rao, Finite Element Method in Engineering, Elsevier India, 2005.
5. Robert D. Cook, s. David, Malkucs Michael E. Plesha, Concepts and Applications of Finite
6. Element Analysis, John Wiley, New Delhi, 2007.
7. S. S. Bhavikati, Finite Element Analysis, New Age International Publishers, 2015.