The Graduate Attributes of the NBA

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

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

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

4. 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 besolved in many ways and lead to multiple possible solutions.
- that require consideration of appropriate constraints/requirements notexplicitly given in the problem statement. (like: cost, power requirement,durability, product life, etc.).
- which need to be defined (modeled) within appropriate mathematicalframework.
- that often require use of modern computational concepts and tools.#

5. 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.

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

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

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

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

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with 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.

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

12. Life-long learning: Recognise 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 Educational Objectives of the department

1. **Preparation:** To strive for overall personality development of students so as to nurture not only quintessential technocrats but also responsible citizens and to steer the organization towards becoming a pace setting centre of excellence.

The scheme of Mechanical Engineering is designed considering the important fields of study and market requirement. This structure is a unique combination of Basic sciences, humanities and core competency. The various subjects are introduced at various levels considering the prerequisites of the subjects as well as skill level of the students.

2. **Core Competence:** To educate students with the fundamentals of engineering sciences, basic Mechanical engineering, mechanical design and analysis to improve their overall engineering skills so that graduates will able to design mechanical systems containing functionality, aesthetics, safety, cost effectiveness and sustainability.

3. **Breadth:** To impart students with the skills for the design, improvement and installation of integrated systems of Men, material and machine for the social & national cause.

4. **Professionalism:** To inculcate the value systems & ethics, leadership and team work skills, bring holistic development of personality and to promote entrepreneurial thinking among students.

5. **Learning environment:** Democratic learning environment that develops confidence and stimulates innovative thinking for successful professional career.

6. **Creating a Dream:** To make every student dream. Dream about a government /private sector job or dream about higher studies or dream about becoming an entrepreneur.

7. **Employment avenues:** As per the fast changing global trend and demand, to make the students aware and assist for offering employment in various sectors.

Programme Outcomes (POs)

Based on the curricula & the PEOs, this department envisages its graduate students to exhibit:

a. An ability to apply knowledge of mathematics, science, and engineering.
b. An ability to design and conduct experiments as well as to analyze and interpret data.
c. 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
d. An ability to function on multidisciplinary teams.
e. An ability to identify, formulate and solve engineering problems.
f. An understanding of professional and ethical responsibilities.
g. An ability to communicate effectively.
h. The broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context.
i. The recognition of the need for and an ability to engage in life-long learning.
j. The knowledge of contemporary issues.
k. An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

B.E. Mechanical Engineering

Curriculum – 2014-'15

(Applicable for students admitted from the Academic year 2014-15 onwards)

SEMESTER: FIRST								
Sr. No.	Sub. Code No.	Catagory	SUBJECT	Teaching Scheme				Examination Scheme-
				L	T	P	Total Hours/ Week	Credits
1.	IA1	B	Engineering Mathematics-I	4	1	-	5	5
2.	IA2	B	Engineering Physics	3	1	-	4	4
3.	IA3	E	Engineering mechanics	3	1	-	4	4
4.	IA4	E	Engineering Drawing	3	-	-	3	3
5.	IA5	E	Workshop	-	-	2	2	2
6.	IA6	B	Engineering Physics	-	-	3	3	2
7.	IA7	E	Engineering mechanics	-	-	3	3	2
8.	IA8	E	Engineering Drawing	-	-	4	4	2
		TOTAL		13	3	12	28	24

Legend:

L - Number of lecture hours per week
T - Number of tutorial hours per week
P - Number of practical hours per week
C - Number of credits for the course

Category of courses:

G - General
B - Basic Sciences
E - Engineering Sciences and Technology
P - Professional Subjects

SEMESTER: SECOND								
Sr. No.	Sub. Code No.	Catagory	SUBJECT	Teaching Scheme				Examination Scheme-
				L	T	P	Total Hours/ Week	Credits
1.	IB1	B	Engineering Mathematics-II	4	1	-	5	5
2.	IB2	B	Engineering Chemistry	3	1	-	4	4
3.	IB3	G	Computer Programming	4	1	-	5	5
4.	IB4	E	Electrical Engineering	3	1	-	4	4
5.	IB5	E	Workshop-II	-	-	2	2	2
6.	IB6	B	Engineering Chemistry	-	-	3	3	2
7.	IB7	G	Computer Programming	-	-	2	2	1
8.	IB8	E	Electrical Engineering	-	-	3	3	2
			TOTAL	**14**	**4**	**10**	**28**	**25**

SEMESTER: THIRD								
Sr. No.	Sub. Code No.	Cata gory	SUBJECT	Teaching Scheme				Examination Scheme-
				L	T	P	Total Hours/ Week	Credits
1.	3ME01	B	Mathematics-III	4	1		5	5
2.	3ME02	E	Mechanics of Materials	3	1		4	4
3.	3ME03	E	Fluid Power-I	4			4	4
4.	3ME04	E	Engineering Thermodynamics	4	1		5	5
5.	3ME05	P	Manufacturing Process-I	4			4	4
6.	3ME06	E	Mechanics of Materials Lab	-		2	2	2
7.	3ME07	P	Fluid Power-I Lab	-		2	2	2
8.	3ME08	P	Manufacturing Process-I Lab	-		2	2	2
			TOTAL	**19**	**3**	**6**	**28**	**25**

SEMESTER: FOURTH								
Sr. No.	Sub. Code No.	Catag ory	SUBJECT	Teaching Scheme				Examination Scheme-
				L	T	P	Total Hours/ Week	Credits
1.	4ME01	P	Basic Electrical Driver & Control	3	1		4	4
2.	4ME02	P	Engineering Metallurgy	4	--		4	4
3.	4ME03	P	Energy Conversion-I	4	1		5	5
4.	4ME04	P	Manufacturing Process-II	4	--		4	4
5.	4ME05	P	Machine Design & Drawing-I	3	--		3	3
6.	4ME06	P	Basic Electrical Driver & Control Lab			2	2	1
7.	4ME07	P	Engineering Metallurgy Lab			2	2	1
8.	4ME08	P	Energy Conversion-I Lab			2	2	1
			TOTAL	18	2	10	30	25

SEMESTER: FIFTH								
Sr. No.	Sub. Code No.	Cata gory	SUBJECT	Teaching Scheme				Examination Scheme-
				L	T	P	Total Hours/ Week	Credits
1.	5ME01	P	Production Technology	4			4	4
2.	5ME02	P	Heat Transfer	4	1		5	5
3.	5ME03	P	Measurement System	4			4	4
4.	5ME04	P	Theory of Machine –I	3	1		4	4
5.	5FEME05	OE	Free Elective-I	3			3	3
6.	5ME06	P	Production Technology Lab			2	2	1
7.	5ME07	P	Heat Transfer Lab			2	2	1
8.	5ME08	P	Measurement System Lab			2	2	1
9.	5ME09	P	Theory of Machine –I Lab			2	2	1
10.	5ME10	P	Computer Software Appli-I Lab			2	2	2
			TOTAL	18	2	10	30	26

NOTES:
1. Students have to select the Free Elective-I (5FEME05) from the other disciplines, offered by other departments of their institute.

2. List of Free Elective-I(5FEME05) offered by Mechanical Engineering Department**:**
1) Manufacturing Techniques 2) Ergonomics 3) Production Management4)Project Management

SEMESTER: SIXTH								
Sr. No.	Sub. Code No.	Category	SUBJECT	Teaching Scheme				Examination Scheme-
				L	T	P	Total Hours/ Week	Credits
1.	6ME01	P	Fluid Power-II	4	1		5	5
2.	6ME02	P	Computer Software Applications	3	--		3	3
3.	6ME03	P	Control System Engineering	4	1		5	5
4.	6ME04	P	Theory of Machine –II	4	1		5	5
5.	6FEME05	P	Free Elective-II	3			3	3
6.	6ME06	G	Communication Skills	2	1		3	3
7.	6ME07	P	Fluid Power-II Lab			2	2	1
8.	6ME08	P	Computer Software Applications- II Lab			2	2	1
9.	6ME09	P	Theory of Machine –II Lab			2	2	1
			TOTAL	20	4	6	30	27

GRAND TOTAL: 700

NOTES:
1. Students have to select the Free Elective-II (6FEME05) from the other disciplines, offered by other departments of their institute.
2. List of Free Elective-II (6FEME05) offered by Mechanical Engineering Department**:**
1) Automobile Engineering 2) Non-conventional Energy Systems 3) Energy Management

SEMESTER: SEVENTH								
Sr. No.	Sub. Code No.	Catagory	SUBJECT	Teaching Scheme				Examination Scheme-
				L	T	P	Total Hours/ Week	Credits
1.	7ME01	P	Machine Design & Drawing-II	3	--		3	3
2.	7ME02	P	Energy Conversion – II	3	1		4	4
3.	7ME03	P	Industrial Management and Costing	3	1		4	4
4.	7ME04	P	Automation Engineering	3	1		4	4
5.	7ME05	DE	Elective – I	3	1		4	4
6.	7ME06	P	Project & Seminar	--	--	2	2	4
7.	7ME07	P	Machine Design & Drawing-II Lab			2	2	1
8.	7ME08	P	Energy Conversion – II Lab			2	2	1
9.	7ME09	P	Automation Engineering Lab			2	2	1
	7ME10	P	Elective – I Lab			2	2	1
			Total	15	04	10	29	27

GRAND TOTAL: 750

Note : The Elective will be offered as per the availability of the faculty with the college/Institute & only if the number opting of students for such elective are minimum thirty.

7ME05ELECTIVE –I

1) Nonconventional Energy System 2) Tool Engineering 3)Artificial Intelligence & Expert Systems4) Mechatronics

SEMESTER EIGHTH								
Sr. No.	Sub. Code No.	Catagory	SUBJECT	Teaching Scheme				Examination Scheme-
				L	T	P	Total Hours/ Week	Credits
1.	8ME01	DE	Elective –II	3		--	3	3
2.	8ME02	DE	Elective –III	3			3	3
3.	8ME03	P	I.C. Engines	3			3	3
4.	8ME04	P	Operations Research Techniques	3			3	3
5.	8ME05	P	*Project & Seminar	--	--	6	6	12
6.	8ME06	DE	Elective –III Lab			2	2	1
7.	8ME07	P	I.C. Engines Lab			2	2	1
8.	8ME08	P	Operation Research Techniques Lab			2	2	1
			Total	12		12	24	27

Note:The Elective will be offered as per the availability of the faculty with the college /Institute & only if the number of student opting for such elective are minimum thirty.

8ME01 ELECTIVE –II

1. Automobile Engineering
2. Production Planning & Control
3. Management Information systems
4. Advance Manufacturing Systems

8ME02 ELECTIVE –III

1. Refrigeration & Air Conditioning
2. Machine Tool Design
3. Finite Element Methods
4. Robotics

Summary of Credits						
Category	Sem I&II	Sem III&IV	Sem V&VI	Sem VII&VIII	Total	%
G	6	-	3	-	9	4.25
B	22	5	-	-	27	13
E	21	15	-	-	36	17
P	-	33	47	43	123	58
Open Elective			6		6	2.75
Departmental Elective				11	11	5.00
Total	49	53	56	54	212	100

Syllabus of Mechanical Engineering

Subject Code: 3ME01 ***Subject Name: Mathematics-III***

3ME01	**Mathematics – III**	L	T	P	C
	Total Contact Hours	4	1	-	5
	Prerequisite : Nil				

Purpose:	
To impart analytical ability in solving mathematical problems as applicable to mechanical engineering.	
Course Objectives	
1	Application of mathematics for design, analysis of physical systems & components.
2	To apply advanced matrix knowledge to Engineering problems.
3	To familiarize with the fundamentals and applications of differential equations
4	Ability to find the optimum solutions for the various engineering problems after gaining the knowledge of numerical analysis.

Syllabus:

Section-A

UNIT-I :

Ordinary differential equations:- Complete solution, Operator D, Rules for finding complementary function, the inverse operator, Rules for finding the particular integral, Method of variations of parameters, Cauchy's and Legendre's linear differential equations. (10 Hrs)

UNIT-II

Laplace transforms : Definition, standard forms, properties of Laplace transform, inverse Laplace transform, initial and final value theorem, convolution theorem, Laplace transform of impulse function, Unit step function, Laplace transforms of periodic function.Solution of Linear differential equations. (10 Hrs.)

UNIT-III

a) Partial differential equation of first order of following form- (i) f(p,q)=0; (ii) f(p,q,z)=0; (iii)f(x,p)=g(y,q); (iv)Pp+Qq=R (Lagranges form); (v) z=px+qy+f(p,q) (Clairaut form)

b) Statistics : Curve fitting by method of least squares (Straight and parabola only), Correlation, Regression. (10 Hrs.)

Section-B

UNIT-IV

Complex Analysis :- Functions of complex variables, Analytic function, Cauchy-Reimann conditions, Harmonic function, Harmonic conjugate functions, Milne's method, conformal mappings (translation, rotation, magnification, inversion, bilinear transformation), singular points, expansion of function in Tayler's and

Laurent's series. Cauchy's integral theorm and formula, Residue theorem. (12 Hrs.)

UNIT-V

Numerical Analysis : Solution of algebraic and transcendental equations by Newton-Raphson method & method of false position. Solution of system of linear equations by Gauss-Seidal method, Relaxation method. Solution of first order ordinary differential equations by Picards, modified Euler's, Runge-Kutta and Taylor's method.

UNIT-VI

Vector Calculas :- Scalar and vector point functions, Differentiation of vectors, Gradient of a scalar point function, Directional derivatives, Divergence and curl of a vector point function and their physical meaning, line, surface, volume integrals, irrotational and solenoidal vector fields, Stoke's and Divergence theorem (without proof). (10 Hrs.)

Books Recommended:-

Text Books:

1. Text book on Applied Engineering Mathematics, J.N. Wartikar and P.N. Wartikar,
Pune VidyarthiGrihaPrakashan, Pune.
2. Higher Engineering Mathematics, B.S Grewal, Himalaya Publishing House.

Reference Books:

1. Advanced Engineering Mathematics, Erwin Kreyszig, John Wiley.
2. Engineering Mathematics, Bali, Gupta, Mahalaxmi Publications.
3. A Text Book of Differential Calculus by Gorakh Prasad.

Course Outcomes:

- Students will demonstrate the knowledge to identify and the application of algebraic problems for practical areas.
- The students will be capable of understanding the fundamentals of differential equations.
- The students will demonstrate the knowledge of differential equations to solve engineering problems.
- The students will exhibit to find the optimum solutions for the various engineering problems after gaining the knowledge of numerical analysis.
- The students will find themselves helpful to participate and succeed in competitive examinations for higher studies and research.

3ME01 Mathematics-III												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	G	h	i	j	k
2	Mapping of course outcome with program outcome		*									*
3	Category	General (G)		Basic Science (B)			Engineering Science&tech €			Professional Sub (P)		
				*								

Subject Code: 3ME02 Subject Name: Mechanics of Material

3ME02	**Mechanics of Material**	L	T	P	C
	Total Contact Hours	3	1	-	4
	Prerequisite : Nil				

Purpose:	
To study stress and strain analysis in various mechanical and structural components.	
Course Objectives	
1	To understand the basic concepts of mechanics.
2	To understand the development of stresses and strains in materials.
3	To understand the concept of shear stresses, bending stresses, principal stresses.To understand Laplace transforms
4	To demonstrate the knowledge of various tests like shear test, impact test, hardness test, torsion test, tension test, deflection etc.

Syllabus:

Section-A

Unit-I

Mechanical properties: Concept of direct, bearing and shear stresses and strains, stress-strain relations, Biaxial and triaxial loading, elastic constants and their relationship, stress-strain diagrams and their characteristics for mild steel, and other metals, factor of safety, Uniaxial stresses and strains: Stresses and strains in compound bars in uniaxial tension and compression, temperature stresses in simple restrained bars and compound bars of two metals only.(10 Hrs)

Unit-II

Simple or pure bending theory: Theory of simple bending, section modulus, moment of resistance, bending stresses in solid, hollow and built up section, leaf springs, closed coiled helical spring with axial load. (08 Hrs)

Unit-III

Thin and thick cylinders and thin spherical shells subjected to internal pressures. (06 Hrs)

SECTION - B

Unit-IV

Torsion: Theory of torsion & assumptions, derivation of torsion equation, polar modulus, stresses in solid & hollow circular shaft, power transmitted by shaft. (08 Hrs)

Unit –V

Principal stresses: Biaxial stress system, principal stresses, principal planes, Mohr's circle of stresses, principal strains. (08 Hrs)

Unit-VI

Deflection of beams Deflection in statically determinate (simply supported, cantilever and beams with overhang) beams subjected to point loads, uniformly distributed loads, moments by double integration. (08 Hrs)

Books Recommended:

Text Books:

1. Strength of materials, F. L. Singer, Harper and row publication, New York .
2. Strength of material, Ramamruthm, Danpatrai and Sons New Delhi .

Reference Books:

1. E.P. Popov, Mechanics of Materials: Prentice Hall of India, New Delhi.
2. S. Timoshenko and O.H. Young: Elements of Strength of Materials.East West Press Private Ltd., New Delhi.
3. Shames, I. H., Introduction to solid mechanics: Prentice Hall of India, New Delhi, 1990.
4. Beer and Johston, Mechanics of materials, Mc-Graw Hill.
5. Strength of Material a practical Approach, D. S. Prakash Rao First Edition University Press Hydrabad

3ME06 Mechanics of Material Lab

Practicals:

Minimum Eight out of following:

1. Tension test on metals.
2. Compression test on materials.
3. Shear test on metals.
4. Impact test on metals.

5. Hardness test on metals.
6. Torsion test on metals.
7. Deflection of beams.
8. Modulus of rupture test.
9. Deflection of springs.

Practical examination shall be viva-voce based on above practical and the syllabus of the course.

Course Outcomes:

- Students will demonstrate the knowledge to basic concepts of mechanics.
- The students will be capable of understanding the fundamentals of various stresses and strains.
- The students will demonstrate the application of various tests to identify the material properties.
- The students will exhibit to find the optimum solutions for the various engineering problems after gaining the knowledge of mechanics.
- The students will find themselves helpful to participate and succeed in industry.

Subject Code: 3ME02	**Subject Name: Mechanics of Material**											
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	K
2	Mapping of course outcome with program outcome	*	*	*		*						
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

Subject Code: 3ME03 Fluid Power-I

3ME03	**Fluid Power-I**	L	T	P	C
	Total Contact Hours	4	0	-	4
	Prerequisite : Nil				
Purpose:					
To study basic fundamentals of fluid mechanics principals in designing and analysis of hydraulic machines, turbines of hydro-electric power plants and various fluid systems.					
Course Objectives					
1	To understand the basic concepts of fluid power engineering.				

2	To understand the properties of fluid, kinematics and dynamics of fluid flow.
3	To understand the concept of dimensional analysis.
4	To develop the awareness of motions of fluid and various fluid machinery.
5	To demonstrate the knowledge of volumetric efficiency, hydraulic efficiency, mechanical efficiency etc.

Syllabus:

Section - A

UNIT-I : - 1) Introduction to the study of fluid motion. Mechanical properties of fluids and their influence on flow characteristics.
2) Fluid Statics:- Fluid pressure, pressure variation in fluids, manometers, forces on plane and curved surface buoyancy. (12 Hrs)

UNIT-II:- Buoyancy, stability of floating bodies. Kinematics and dynamics of fluid flow:- Types of flows, Stream lines, potential lines, flow net, continuity equation. One and two dimensional motion, one dimensional method
of flow analysis. Bernoulli's equation. Venturimeter, Momentum equation for steady flow. Vortex motion. (8 Hrs)
UNIT-III:- Dimensional analysis: Dimensional homogeneity and dimension less ratios. Dimensionless parameters. Similitude and model studies (6 Hrs)

Section - B

UNIT-IV:- Motion of viscous fluids:-Introduction to laminar and Turbulent flows. Boundary layer concept. Separation. Drag lift on immersed bodies. Reynolds number and its significance. (7 Hrs)
UNIT V:- Darcy weisbach equation i.e. Equation of pipe flow, friction charts and its use, Minor losses in pipes and fittings, losses due to sudden enlargement and contraction, Hydraulic and energy gradient lines, pipes in series and parallel. Elementary concept of water hammer. (8 Hrs)

UNIT VI:- 1. Principles of fluid machinery: Dynamic action of fluid force exerted by fluid jet on plane, curved, stationary and moving vanes. Velocity diagrams, Work done by impact, pressure due to deviated flow.
2. General Theory of Hydrodynamic Machines:- Eulers equation, Degree of reaction, classification of machines according to degree of reaction. Efficiencies: Volumetric efficiency, Hydraulic efficiency, mechanical efficiency and overall efficiency. (7 Hrs)

Books Recommended :-

Text Books:-
1.CSP Ojha, R. Berndtsson, Fluid mechanics and machinery; Oxford university.
2. Bansal R.K., Fluid mechanics and fluid machines; Laxmi publications.

Reference Books:-
1.R.K.Rajput; Engineering Fluid Mechanics; S. Chand publications.
2. Dr. Mody& Seth; Hydraulics and Fluid Mechanics; Standard book house
3. S. Ramamrutham, Hydraulic, Fluid Mechanics & Fluid Machines, Dhanpatrai publishing company.
4. Strecter, Fluid Mechanics, Tata Mcgraw hill.

Course Outcomes:

- Students will demonstrate the knowledge to basic concepts of fluid power.
- The students will be capable of understanding the fundamentals of kinematics and dynamics of fluid.
- The students will demonstrate the application of dimensional analysis in solving engineering problems.
- The students will demonstrate the calculations of various efficiencies.
- The students will find themselves helpful to participate and succeed in industry.

3ME03 Fluid Power-I												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	K
2	Mapping of course outcome with program outcome	*	*	*	*	*						
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

3ME07 Fluid Power-I Lab

Practical Term Work:-
At least six practical's (study/Trials) based on above syllabus, as given below shall be performed and a report there of submitted by the students.
1. Study of Manometers.
2. Measurement of fluid pressure by manometer.
3. Determination of metacentric height.
4. Verification of Bernoulli's equation.
5. Flow measurement by venturimeter.
6. Study of venturimeter.
7. Determination of Reynolds number.
8. Velocity distribution in Boundary layer & thickness of B.L.
9. Determination of co-efficient of friction for pipes.
10. Determination of head loss due to sudden enlargement.
11. Determination of head loss due to sudden contraction.

12. Determination of losses in bends.
13. Determination of losses in elbows.
14. Study of flow through pipes in series & parallel.
15. Verification of momentum equation.

Note :- Practical examination shall consist of oral or Experimentation based on above term work.

3ME04 Engineering Thermodynamics

3ME04	**Engineering Thermodynamics**	L	T	P	C
	Total Contact Hours	4	1	-	5
	Prerequisite : Nil				

Purpose:	
To study the interrelation between temperature, heat and work in thermodynamic systems. To study the applications of thermodynamic laws and principals that find applications in steam power plant, IC Engines, Gas turbines, RAC etc.	
Course Objectives	
1	To understand the fundamentals of Thermodynamics.
2	To understand the laws of thermodynamics in detail and its applications.
3	Describes the meaning of enthalpy, entropy
4	To understand the properties of steam.
5	Explains the concept of various cycles and its applications and numerical approach.

Syllabus:

SECTION-A

Unit-I Introduction to basic concepts of thermodynamics, Macroscopic and microscopic approaches, properties of system, state and equilibrium, processes and cycle. Temperatures and Zeroth law of thermodynamics, Quasi-static process, Forms of energy and its conversion.

Gas Laws and Ideal gas equation of states, difference between gases and vapours, equation of state, gas constant and universal gas constant. (08 hrs)

Unit-II Work and Heat: Definition of work, thermodynamic work, displacement work and other forms of work, Definition of Heat, Work and heat transfer as path function, comparison of work and heat, work done during various processes, P-V diagrams.

First law of thermodynamics: Energy of a system, classification of energy, law of conservation of energy law applied to closed system under going a cycle, Joules experiment. Energy a property of system, internal energy-a function of temperature, Enthalpy, specific heat at constant volume and constant pressure. Change in internal energy and Heat transfer during various non-flow processes. (10 hrs)

Unit-III First Law applied to flow processes: Steady state, steady flow process, mass balance and energy balance in steady flow process, steady flow

energy equation and its application to nozzles and diffusers, turbine and compressor pumps, heat exchangers, Throttle valve etc. work done and Heat transfer during steady flow processes.

(9Hrs)

SECTION - B

Unit-IV Second Law of thermodynamics: Limitations of Ist law, Thermal energy reservoir, heat engines refrigerator and heat pumps. Kelvin-Plank and Clausious statements, their equivalence, reversible and irreversible processes, Carnot cycle, two propositions regarding the efficiency of Carnot cycles. The thermodynamic temperature scale. Reverse carnot cycle. COP of heat pump and refrigeration. Inequality of Clausius.

(7 Hrs)

Unit-V Entropy: Entropy-a property of system, entropy change for ideal gases, entropy change of a system during irreversible process, lost work. Principle of increase of entropy.

Availability and irreversibility:- Available energy referred to cycle, decrease in available energy with heat transfer through a finite temperature differences. The Helmhltz and Gibbs functions, Availability, Irreversibility and effectiveness.

(8 Hrs)

UnitVI a) Air Standard Cycles: Ottto, diesel, semidiesel, sterling and joule cycles etc., their efficiencies and mean effective pressure.

b) Vapour Cycles:- Rankine and Modified Rankine Cycle. Comparison of Rankine and Carnot cycle, representation on P-V, T-S and H-S diagram. (No numerical on this unit) (8 Hrs)

Books Recommended

Text Books

1. Engineering Thermodynamic - by P.K.Nag.
2. Thermodynamics Volume: I & II; R. Yadav;

Reference Books

1. Basic Engineering Thermodynamics - by Reyner Joel
2. Thermodynamics - by C.P. Arora.
3. Fundamentals of Classical Thermodynamics - by G.J.Vanwylen.
4. Engineering Thermodynamics; P. Chattopadhyay; Oxford
5. Engineering Thermodynamics; Gordon Rogers, Yon Mayhew; Pearson

Course Outcomes:

- Students will exhibit the concept of engineering thermodynamics and its importance to industry.
- Students will be able to handle real time problems of thermal engineering.
- Students will demonstrate the skills for solution of numerical problems based on enthalpy/entropy.
- Students will show the ability to explain the fundamentals of steam.
- Students will understand the concept of thermal cycles and its applications in engineering field.

3ME04 Engineering Thermodynamics												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	F	g	h	i	j	k
2	Mapping of course outcome with program outcome	*	*	*	*	*						
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

3ME05 Manufacturing Processes-I

3ME05	**Manufacturing Processes-I**	L	T	P	C
	Total Contact Hours	4	0	-	4
	Prerequisite : Nil				

Purpose:

To acquire the knowledge of primary manufacturing processes like casting and molding which gives basic form to the product being manufactured.

Course Objectives

1	TO exhibit the concept of different Manfacturing processes and its importance in industry.
2	To be able to handle real time problems of manufacturing engineering.
3	To demonstrate the skills for application of non chipping methods in manufacturing automobile parts, high stress and vibrating parts.
4	To show the ability to explain the fundamentals of welding processes.
5	To understand the concept of complete sand casting process with advance casting methods.
6	To exhibits & apply knowledge related to surface treatments like electroplating, anodizing etc

Syllabus:

Section - A

Unit-I :-

Introduction to manufacturing processes & classification; Introduction to pattern making- Pattern materials, pattern making tools, allowances, Types of patterns, functions of patterns, General properties of moulding sands, Mold hardness. Preparation of sand moulds of different types, Moulding processes, core making, core prints, core boxes. Sand casting Processes - Basic principle and Terminology of sand casting, gating system, types of gate, risers, etc. (9Hrs)

Unit-II:-

Technology of melting and casting - Melting furnaces, crucibles, pit, open hearth, gas fired cupola, cupola operation and electric hearth furnaces, Electric furnaces - Direct Arc, Indirect arc and electric induction furnace.
Defects in castings and its types, Causes and remedies of casting defects. Origin and classification of defects, shaping faults, Inclusion and sand defects, Gas defects, shrinkage defects, contraction defects, dimensional errors. Inspection and testing of castings:- Radiography, ultrasonic, Eddy current testing, fluorescent penetrant test (7 Hrs)
Unit III:-
Casting processes and their principle of operation and applications permanent mold casting, slush casting, shell molding, Investment or lost wax casting, vacuum process, centrifugal casting, continuous casting, Die casting equipment and processes for Gravity, pressure and vacuum casting methods, cleaning of castings, Modernisation&Mechanisation of Foundries. (8 Hrs)

Section - B

Unit IV :-
Mechanical working of metals: Principle of hot and cold working process and its types, Extrusion, piercing, pipe and tube production, manufacture of seamless pipe and tubing. Shearing operations, tube drawing, wire drawing, spinning, embossing and coining, squeezing and bending operations, rotary swaging, Rolling, types of rolling mills, forging operations, upset forging. (8 Hrs)
Unit V:-
Joining processes:- Mechanical joining processes, Mechanical fastening, riveting, soldering, brazing Welding, Types of welding processes-Arc welding: principle and working, Gas welding- principle and working Types and purpose of Electrodes, Electrode coatings(flux). TIG & MIG processes – Working principles and its applications, shielding gases, MIG-Spray transfer and dip transfer processes.
(6 Hrs.)
Unit VI:-
Submerged arc welding & resistance welding :- Heat generation in resistance welding, operational characteristics of resistance welding processes such as spot welding, projection welding, butt welding.
Principle of operation of friction welding, forge welding, plasma arc, thermit welding. Welding defects, Testing and Inspection of welds, Ultrasonic, Electroslag, Electron Beam, laser welding, weldability.
Surface Treatment-Electroplating, electroforming, and iodising, metal spraying, shot peening, polishing, mechanical cleaning. (9 Hrs)

Books Recommended
Text Books:-
1. Workshop Technology Vol. I by Bawa, Tata McGraw Hill Publication.
2. Workshop Technology Vol I by Hajra Chaudhary, DhanpatRai& Sons 2001.
References:-
1. Workshop Technology Vol I by Raghuwanshi.
2. Manufacturing Processes by J.P. Kaushish; PHI
3. Processes and Materials of Manufacture by R.A.Lindberg, PHI Pub 2001.

4. Foundry Technology by Goel Sinha.

3ME08 Manufacturing Processes-I Lab

Practice:-
1. Study of safety precautions in workshop practices.
2. Foundary:- Any two of the following jobs
Sand preparation and practice in moulding of various types of patterns:- Pattern making 1 job, Moulding 1 job Casting 1 job.
3. Joining Processes:- 2 composite jobs involving electric welding, gas welding and resistance welding process.

A journal should be prepared and submitted on above term work.

The practical examination shall consist of a job preparation and college assessment should be based upon the jobs, termwork and viva examination.

Course Outcomes:

- Students will exhibit the concept of different Manfacturing processes and its importance in industry.
- Students will be able to handle real time problems of manufacturing engineering.
- Students will demonstrate the skills for application of non chipping methods in manufacturing automobile parts, high stress and vibrating parts.
- Students will show the ability to explain the fundamentals of welding processes.
- Students will understand the concept of complete sand casting process with advance casting methods.
- Students will exhibits & apply knowledge related to surface treatments like electroplating, anodizing etc

3ME05 Manufacturing Processes-I												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	F	g	h	i	j	k
2	Mapping of course outcome with program outcome	*		*					*		*	*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

4ME01 Basic Electrical Drives & Control

4ME01	**Basic Electrical Drives & Control**	L	T	P	C
	Total Contact Hours	3	1	-	4
	Prerequisite : Nil				

Purpose:

To study basics of electrical drives and concepts of mechatronics.

Course Objectives	
1	To understand the basic concepts of electric drives theory and principles of power transistor.
2	To know the basic concepts of Mechatronics.
3	Introduction of the concept of D.C. motors and its characteristics.
4	To understand the basic concepts of A.C. motors and the difference between AC and DC motors.
5	To demonstrate the conventional method of speed control of AC & DC motors.
6	To understand the knowledge of sensor & transducers.
7	To develop the awareness of electrical drives for industrial applications.

Syllabus:

Section-A

Unit I :

Concept of general electric drives, classification and comparison of electrical drive system, Cooling and heating of electric motors. Introduction to mechatronics, Theory and principle of Power Transistor, SCR

Unit II :

Basic characteristics of D.C. motor, Torque equation, Modified speed – Torque characteristics. Starting and braking of Electrical D.C. motors, comparison of mechanical and electrical braking methods. Introduction, Principle, construction and working of Servo motors, stepper motors, Brushless D.C. motors.

Unit III :

Classification of A.C. motors, construction, types, principle of working and characteristics of 3 phase Induction motors, applications. Starting and braking of 3 phase induction motors. Classification of single phase induction motors. construction, principle and working and applications. Principle and working of universal motor.

Section-B

Unit IV :

Conventional methods of speed control of A.C. and D.C. motors. Thyristorized stator voltage control of 3 phase induction motor, (v/f) control method, slip-power recovery scheme. Thyristorized armature voltage control of D.C. motors using phase control &Thyristorized chopper.

Unit V :

Basic principle, construction & applications of sensors and transducers, contact - non- contact type, optical proximity sensors. Switches, contact type, magnet type, electromagnetic type, sound, light, pressure, vibration transducers, Hall effect-sensors A.C./D.C. Tachogenerators.

Unit VI:

Industrial applications - classes of duty selection of an electric drive for particular applications such as steel mill, paper mill, cement mill, textile mill, sugar mill, electric traction, coal mining, etc. Induction heating, surface hardening & Dielectric heating.

Books Recommended

Text Books:-

1. A First Course on Electrical Drives - S.K. Pillai.
2. Basic Electrical Technology (Vol. 11) - B.L. Theraja

Reference Books :

1. Drives and Control - N. Dutta
2. Mechatronics - W.Bolton, Addison Wesley, Longman Ltd., 1997.
3. A Course in Electrical, Electronics Measurement and Instrumentation, By A.K.Sawhney, DhanpatRai& Sons, 2006

4ME06 Basic Electrical Drives & Control Lab

List of Experiments

Any eight practicals from the following list:

1.To study the Specification of Various Electrical Machines.
2.To study the D.C. Motor Starters.
3.To study the Running and Reversing of D.C. Motor.
4.Speed Measurements using Magnetic Pick-up.
5.To study the Speed reversal of counter Current Breaking of 3-phase Induction Motor.
6.To control the speed of D.C. Motor by a) Armature Control b) Field Control.
7.To perform Load Test on Induction Motor.
8.To study Dynamic/Rheostatic Breaking of D.C. Motor.
9.To study Characteristics of Thyristor.
10. To study the speed -Torque Characteristic of Servo Motor.

Course outcome:

- Students will demonstrate the knowledge to basic concepts of electrical drives and mechatronics.
- Students will demonstrate the concept of A.C. motors.
- Students will be able to understand the characteristics of D.C. motors.
- Students will exhibit the knowledge of the sensor & transducers.
- Students will demonstrate the conventional method of speed control of AC & DC motors.
- Students will be aware of various electrical drives for industrial applications.

4ME01 Basic Electrical Drives & Control												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	F	g	h	i	j	k
2	Mapping of course outcome with program outcome	*		*					*		*	*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

4ME02 Engineering Metallurgy

4ME02	**Engineering Metallurgy**	L	T	P	C
	Total Contact Hours	4	0	-	4
	Prerequisite : Nil				
Purpose: To acquire knowledge about properties and behavior of metals / materials for their usage during selection and design of a product.					
Course Objectives					
1	To demonstrate the concept of metallurgy, physical metallurgy, mechanical metallurgy, classification of materials.				
2	To understand the Iron-Carbon Equilibrium Diagram (Fe-C), critical temperatures and microstructures of metals.				
3	To know the concept of alloy steel.				
4	The difference between ferrous &non ferrous material.				
5	To study the various heat treatment processes				
6	To understand the concept of powder metallurgy & its applications.				

Syllabus:

Section – A

Unit I : - Introduction to metallurgy: Basic concept of process metallurgy, physical metallurgy, and mechanical metallurgy, Classification of materials & their application, Structure of metals and alloys, formation of Alloys,
Solid solutions, types and their formation, lever rule for phase mixtures. Solidification of pure metals, nucleation and growth, ingot structure, dendritic solidification (8)

Unit II : Study of binary equilibrium diagram and invariant reactions, Construction and study of Iron-carbon Equilibrium Diagram, Critical

temperatures, Microstructure of slowly cooled steel, Estimation of carbon from microstructure, structure property relation, Introduction to composite materials, advantages and applications. (8)

Unit III : Alloy Steels: Purpose of alloying, Classification of alloy steels, classification of alloying elements, Effect of alloying elements on eutectoid composition, Eutectoid temperature, and on the S curve, , alloying elements and their effect on properties of steels, OHNS steels, Hadfield'S Manganese steels, High speed steels, their heat treatments and applications, Ferritic, Austenitic and Martensitic stainless steels, their properties and applications, weld decay in stainless steel. (8)

Section-B

Unit IV : Cast irons : Factors governing condition of carbon in cast iron, Maurer's diagram, Solidification of grey and white cast iron, Malleabalizing, Constitution and properties of white, gray, Nodular and Malleable cast irons, their applications, Alloy cast irons.
Non Ferrous Metals and Alloys : Types, Properties and uses of Brasses and Bronzes. Important alloys of
Aluminium, Lead, Tin and Zinc, their applications. Bearing materials, Season cracking, precipitation hardening. (8)

Unit V : Principles of Heat Treatment: - Annealing, Normalizing, Tempering Iso-thermal transformation diagrams(S-curve), super imposition of continuous cooling curves on 's' Curve, pearlite, bainite and martenste transformation, Quenching media, severity of quench, Austempering, Martempering and patenting, Retained austenite and sub-zero treatment. Hardenability. (8)

Unit VI : Methods of surface hardening: Carburizing, Nitriding, Cyaniding, Flame and Induction Hardening.
Mechanical working of Metals: - Hot and cold working, Relative advantages and disadvantages, study of stress strain curve, Luder's bands, Work hardening, strain Ageing; Recovery, Recrystallization and grain growth.
Metallurgical factors affecting various Mechanical working processes, preferred orientation, Deformation mechanisms-Slip& twining, critical resolved shear stress.
Powder Metallurgy: Concept, Methods of Manufacture of metal powders, compaction Process- Single die and double die, sintering, stages of sintering, Manufacture of porous bearings & cemented carbide tip tools by P.M.T. Advantages, limitations and applications of powder metallurgy. (8)

Book Recommended:-
Text Books:-
1. Introduction to physical metallurgy ;Sidney H Avner, TATA Mc-Graw hill
2. Engineering materials & metallurgy R.K.Rajput, S chand publication
Reference Books:

1. Mechanical Metallurgy, G. E. Dieter, Mc- Graw Hill International, London 3rd Edn. 1999
2. Physical metallurgy for engineers, Clarke and Varney, second Edn.,1987.
3. Power metallurgy, A.K Sinha First Edn. 1991.
4. Material Science and Metallurgy; V.D. Kodgire; Everest Publishing House
5. Engineering physical Metallugrgy, Y Lakhtin, Mir Publications. Second Ed. 1999
6. Material Science and Meallurgy- C Daniel Yesudian, Scitech Publication

4ME07 Engineering Metallurgy Lab

List of Practicals: - (At least eight practicals out of the following list.)

1. Study of metallurgical microscope.
2. Preparation of specimen for micro-examination.
3. Moulding of specimen for micro-examination.
4. Study of micro structures of Annealed and normalized plain carbon steels.
5. Study of micro structures of alloy steels and H.S.S.
6. Study of micro structures of various cast irons.
7. Study of micro structures of non ferrous metals.(brasses, bronzes)
8. Study of micro structures of hardened and tempered steels.
9. Study of Iron carbon Equilibrium diagram & Allotropic forms of iron.
10. Study different Heat Treatment Process for steel.
11. Study of different surface Hardening processes for steels.
12. Study of effect of alloying elements on the properties of steels.
13. Measurement of hardenability by Jominy end quench test apparatus.
14. Study of hardness tester and conversion of Hardness number
15. Industrial visit to study heat treatment plant.
16. Measurement of particle size, grain size, nodularity, coating thickness etc. by using some software like MetzerMicrocam 4.0

Practical Examination:
Practical examination shall consist of viva voce/performance based on the above syllabus and practical work.

Course outcome:

- Students will demonstrate the knowledge to basic concept of metallurgy and classification of materials.
- Students will exhibit the knowledge of Iron-Carbon Equilibrium Diagram and critical temperatures.
- Students will demonstrate the knowledge of alloy steel.
- Students will understand the difference between ferrous &non ferrous material.
- Students will demonstrate the knowledge of various heat treatment processes and industrial applications
- Students will demonstrate the knowledge of powder metallurgy & its applications.

4ME02 Engineering Metallurgy												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	F	g	h	i	j	k
2	Mapping of course outcome with program outcome	*		*		*						*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

4ME03 Energy Conversion-I

4ME03	Energy Conversion-I	L	T	P	C
	Total Contact Hours	4	1	-	5
	Prerequisite : Nil				

Purpose:

To learn the basic fundamentals of a thermal power plant and associated components.

Course Objectives

1	To understand the concept and properties of steam.
2	To understand the general features for steam power plant with basic unit, construction of steam power plant, mounting and accessories.
3	To calculate the efficiency of boiler, and related parameters.
4	To understand the knowledge of fuel & ash handling.
5	To understand the concept of condenser, its application, elementary treatment on it.
6	To understand the concept of steam nozzles.
7	To understand the concept of steam turbine, Analysis of steam turbine.

Syllabus:

Section - A

Unit I

Properties of Steam: Triple point and critical point, Sensible heat, latent heat, superheat and total heat of steam. Wet steam, dryness fraction, Internal energy of steam, External work of evaporation, Specific volume, enthalpy, internal energy and entropy of steam. T-S diagram Mollier chart, Steam tables and their use. Work done and heat transfer during various thermodynamics processes with steam as working fluid. Throttling of steam, determination of dryness fraction using various calorimeters. (8 Hrs)

Unit II

Flow diagram for steam power plant with basic units such as steam generator, turbine, condenser and pump. Boilers: Introduction to water tube boilers used in

thermal power plants, packaged Boilers (fire tube), High pressure boilers; Loeffler, Benson, Lamont Boilers, Boiler mountings and accessories—devices for improving Boiler efficiency. Principle of fluidized bed combustion. Boiler draught; Types of draught, expression for diameter & height of chimney, condition for maximum discharge, efficiency of chimney, reasons for draught loss. (7 Hrs).

Unit III

FUEL & ASH HANDLING : Elementary treatment on coal, coal transportation from mine to site and site to boiler house. Fuel bed firing and suspension firing, Equipments of Mechanical grate firing, pulverised coal firing including crushers &pulverisers and burners. Oil handling system,and burner equipment,Elementary treatment on ash handling. Type of dust collectors and disposal of dust. Boiler performance:- Boiler rating, boiler power, equivalent evaporation, efficiency. Effect of accessories on boiler efficiancy and heat balance. (8 Hrs)

Section - B

Unit IV

Steam power plant: General features, representation of Ranking cycle on phasediagrams. layout,site selection, concept of co-generation. CONDENSERS : Need,Types of condensers, quantity of cooling water required. Dalton's law of partial pressure, condenser and vacuum efficiency. Sources of air in condensers and its effect on performance. Condensate pump and air extraction pumps, air enjectors Cooling water system: cooling ponds, spray tanks, cooling towers: Natural and mechanical wet type cooling tower. (7 Hrs)

UNIT V

Steam nozzles : Flow of steam through nozzles & diffusers, Maximum discharge, critical pressure ratio, Effect of friction. Determination of throat & exit areas, Nozzle efficiency, no nunmerical on concept of super saturated flow &wilson line Steam Turbines:- Principle of working, Types of steam turbines such as impulse, reaction, axial & radial flow, back pressure & condensing turbines. Compounding. Reheat, regenerative cycles, bleeding. Analysis limited to two stages only. (7 Hrs)

UNIT VI

Analysis of steam Turbines : Flow of steam through impulse & impulse reaction turbine blading. Velocity diagrams. Graphical & analytical methods for work & power developed, axial thrust and efficiency. Height of turbine blades. LOSSES IN STEAM TURBINES:- Nozzle losses:- blade friction, partial admission, disc friction, gland leakage losses and velocity losses. Governing of steam turbines. (10 Hrs)

Recommended Books:

Text books

1. Thermal engineering; Mahesh M Rathore; Tata McGraw-Hill
2. Thermal Engineering R.Yadav; Central publication

Reference books:
1. Steam Turbine; Kearton; Oscar Publications
2. Thermal Power Engineering; Mathur Mehta; Tata McGraw-Hill
3. Power Plant Engineeirng; R.K.Rajput; Laxmi Publications
4. Thermal Engineering, P.L.Ballaney; Laxmi Publications

4ME08 Energy Conversion-I Lab

Practical Term Work:-
At least six practicals (Study/trials) based on above syllabus, as given below shall be included in the report by the students.
1. Study of a water tube boiler (Babcock Wilcox boiler)
2. Study of a locomotive boiler.
3. Study of a high pressure boiler.
4. Study of boiler accessories.
5. Trial on a boiler and heat balance sheet.
6. Study of boiler mountings.
7. Study and trial on a steam turbine.
8. Study of condensers.
9. Study of condensate and air extraction pumps.
10. Study of steam power plant.

Practical Examination:- Shall consist of based on above term work and syllabus.

Course outcome:

- Students will study the concept steam and steam power plant, mounting and accessories.
- Students will demonstrate the calculation of various efficiency & related parameters.
- Students will show the adequate knowledge of fuel & ash handling.
- Students will demonstrate the knowledge of condenser & application.
- Students will understand the concepts of steam nozzles & steam turbines.

4ME03 Energy Conversion-I												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome	*		*								*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

4ME04 Manufacturing Process-II

4ME04	**Manufacturing Process-II**	L	T	P	C
	Total Contact Hours	4	0	-	4
	Prerequisite : Nil				

Purpose:	
To acquire the knowledge of various machining processes which give basic form to the product being manufactured.	
Course Objectives	
1	To understand the theory of metal cutting.
2	To understand the construction, operations & accessories of Centre lathe.
3	To understand the knowledge about the drilling, boring and broaching operations.
4	To demonstrate the knowledge of grinding operation and machine.
5	To understand the various unconventional machining processes like EBM, ECM, EDM etc.

Syllabus:

Section – A

UNIT I :- Theory of Metal cutting: Mechanics of Metal cutting, Tool material, Tool Geometry, Cutting tool classification, Tool life, Tool wear, Cutting forces and power consumption, Machinability, Cutting fluids, Machine Tool classification.(8 Hrs)

UNIT II:- Construction, Operations and accessories of centre lathe, introduction of capstan & turret lathe, indexing mechanism, bar feeding mechanism, introduction to Automatic screw machines & Single spindle and multi-spindle automat. (10 Hrs)

UNIT III:- a) Drilling M/cs general purpose, Mass production and special purpose drilling M/cs.

b) Boring M/c :- Horizontal, Vertical and jig Boring M/c.

c) Introduction to Broaching and its types, reaming operation. (8 Hrs)

Section – B

UNIT IV:- a) Milling M/c :- Types, Types of Milling Cutters, Dividing head, Compound and differential indexing.

b) Gear producing M/cs.

c) Study of various parts and operations of power hack saw. (6 Hrs)

UNIT V :- a) Grinding Machines: Bench grinders, surface grinders, centreles grinders, types of bonds & Abrasive modification of grinding wheels.

b) Study of various part & Operation of Shaper, Planer, Sloter. (6 Hrs)

UNIT VI:- Unconventional Machining Processes:-

a) Mechanical Processes:- Ultrasonic Machining - principle and applications. process parameters; Abrasive and water parameters involved.

b) Thermal processes:- Election Beam Machining – Generation of beam, principle and applications : Laser Beam machining applications : Plasma-arc machining- Concept and generation of plasma, principle of PAM, applications.
c) Electro Chemical Machining- Classification, fundamentals: Electro mechanical milling.
d) Electric discharge Machining - Types dis-sie-onking, wire EDM, Mechanism of material removal, process parameters, advantages and applications. (8 Hrs)

Books Recomonded:
Text Books:
1. Manufacturing Technology-Vol 1 & 2; R.L.Timings, S.P. Wilkinson; Pearson Publication.
2. Workshop Technology - By HajraChoudhauryVol II.

References:-
1. Pandya & Shah, Modern Machining process, Tata McGraw Hill 1998.
2. Workshop Technology, O.P. Khanna, Dhanpatrai& Sons.
3. Workshop Technology - By Raghuwanshi. Vol II

4ME09 Manufacturing Process-II Lab

Practicals:-
1. Demonstration of operations related to lathe, shaper, slotter, drilling & grinding m/cs.
2. One job on lathe covering taper turning and threading.
3. One job on shaping covering plane and inclined surfaces.
4. One job on milling machine.

The above jobs should include drilling, grinding, tapping etc.
Term work should be submitted in the form of journal.

N.B. :- The practical examination shall consists of preparation of practical jobs and assessment by external and internal examiner.

Course outcome:

- Students will studythe basic concept of metal cutting and various manufacturing processes.
- Students will know the working of lathe machine for performing various operations.
- Students will study drilling, boring and broaching.
- Students will demonstrate the knowledge of milling &gear production machines.
- Students will demonstrate the knowledge of grinding operations.
- Students will understand the various unconventional machining processes.

4ME04 Manufacturing Process-II												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome		*			*						*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

4ME05 Machine Design & Drawing-I

4ME05	Machine Design & Drawing-I	L	T	P	C
	Total Contact Hours	3	0	-	3
	Prerequisite : Nil				

Purpose:

To acquire the basic knowledge regarding principals and procedures of physical design and development of various machine components.

Course Objectives

1	To study the machine drawing, sectional views, missing views.
2	To understand the concept of development and intersection of cubes, prisms, cylinders, pyramids, cones etc.
3	To study the meaning of design, phases of design and design considerations.
4	To demonstrate the knowledge of design of riveted joints, welded joints etc.
5	To know the design procedure of helical springs, flywheel, power screw etc.

Syllabus:

Section - A

Unit I- a)Sectional Views
Conversion of pictorial view in to sectional orthographic projections, Sectional viewswith different types of projections, Missing views (12 Hrs)

Unit II- a)Development of surfaces, Development of surfaces of cubes, prisms, cylinders, pyramids, cones & their cut sections
b) Intersection of solids-prism and prism, cylinder and cylinder, cylinder and prism, cone and cylinder, cone and prism. (12 Hrs)

Section B

Unit III- a) Meaning of Design, Phases of Design, Design considerations
b) Simple stresses, Thermal stresses, Torsional Stress, stresses in straight & curved beams and its application- hooks, c- clamps

c) Design & drawing of riveted joints- Caulking &fullering, failures, strength & efficiency of riveted joints
d) Welded joints- Symbolic representation, Strength of transverse & parallel fillet welded section
e) Design & drawing of Knuckle Joints (12 hrs)

Unit IV-a) Design of Helical springs- Types of springs, stresses in helical springs, Wahl's stress factor, Buckling & surge, tension spring b)spiral & leaf springs
c)Design of power screw-Torque required to raise loads, efficiency & helix angle, overhauling &self locking of screw, acme threads, stresses in power screw.
d) Design of flywheel-Design problems of flywheel for punching machine and for otto cycle. (12 hrs)

Books Recommended

Text Books
1)Machine Drawing by N. D. Bhatt, Charator Publication
2)Machine Design by R. S. Khurmi& J. K. Gupta ,S Chand publication
References
1)Machine Design by Dr. P. C. Sharma & Dr. D. K. Agrawal, Katsons Books publication
2)Design of Machine elements by C. S. Sharma, KamleshPurohit, PHI publication
3)Design of Machine elements by V. B. Bhandari, Tata McGraw Hill Publication
4)Machine Design, Jindal, Pearson publications
5)Design Data Book by- P.S.G. Koimbatore
6)Design Data Book by Mahadevan,
(Use of any data book from the above will be permitted during the examination).

4ME10 Machine Design & Drawing-I Lab

List of Practical's
Any Six of the following

1)Sectional views & missing views of objects
2)Development of surfaces
3)Intersection of Solids
4)Conventions for various components like bearing, gears, springs, key & key ways, threads, tap holes and materials, Surface roughness etc
5)Design & Drawing of cotter joint
6)Design & drawing of screw jack
7)Design & drawing of flywheel
8)Design & drawing of helical spring
Any one practical from the above list should be done using software

Course Outcomes:

- Students will demonstrate the concept of machine drawing, sectional and missing views.
- Students will exhibit the skills of development and interaction of cube, prism, cylinder, pyramid cone etc.
- Students will study the fundamentals of machine design and will be able to use design considerations in design process.
- Students will exhibit the knowledge design procedure of riveted joints, welded joints, knuckle joint etc.
- Students will be able to apply design procedure to helical springs, flywheel and power screw.
- Students will be benefitted by utilizing the course concepts in project work and show confidence in industry.

4ME05 Machine Design & Drawing-I												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome	*		*		*						
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

5ME01 Production Technology

5ME01	**Production Technology**	L	T	P	C
	Total Contact Hours	4	0	-	4
	Prerequisite : Nil				
Purpose:					
To make the students aware about metrological and quality concepts in inspection and manufacturing of products in industry.					
Course Objectives					
1	To understand the fundamentals quality, quality control and related issues in detail.				
2	To know the various methods of quality control like, sampling inspection, control charts and other techniques of SQC.				
3	Students will learn the fundamentals of work study and its details like, time study and motion study.				
4	Students will study various methods of motion study and time study to optimize productivity.				
5	To understand the importance of various standards used in measurement.				
6	The students will learn linear measurement, angular measurement, thread measurement, gear measurement etc.				

Syllabus:

Seciton– A

UNIT I : Concept of quality and quality control, quality of design and quality of conformance, Quality characteristics, Cost of quality & Value of quality, Specification of quality, quality control & inspection.Concept of TQM & Quality assurance,

Concept of variation, variable and attribute data, Frequency distribution, Measures of Central tendency-
Mean, mode & median, Measures of dispersion. -Range, std. deviation & variance. (8)

UNIT II : Concept of universe and population, Normal distribution curve; Control charts for variables, process capability, Control charts for attributes; comparison between variable charts and attribute charts; precision & accuracy, Sampling plans, Operating Characteristic curve, Quality circle. (8)

UNIT III : Basic principles of work study : definition, method study, introduction, objective, procedure, process charts, flow process charts, operation process chart, principles of motion economy, work place layout, multiple activity chart, two handed process chart, simo chat. Work measurement : definition, techniques, time study, rating system, allowances, std, time estimation, PMTS, MTM. (7)

Section – B

UNIT IV : Standards of measurements: line standards, end standard, wave length standard. Limits, fits and gauges : terminology of limits, Fits and gauges, concept of interchangeability, allowance tolerance, Indian Standard Specification for limits, fits and gauges, B.S. System. Limit gauging - design of Go, No Go gauges. (8 Hrs)

UNIT V : Linear measurement: various comparators such as mechanical, electrical, optical, pneumatic comparators, their principle, operations and applications.
Angular measurements: vernier, optical, bevel protractor universal bevel protector, Sine bar level clinometers, taper gauges.
Thread measurement: screw thread limit and fit limits gauging of screw threads (8 Hrs)

UNIT VI : Gear measurement : alignment error, master gear, Parkinson tester. Study and use of optical dividing head, auto collimator, tool makers microscope. Interferometry, flatnesstesting, squareness testing. Surface texture testing Coordinate measuring machine- types, role and application. (7Hrs)

Books Recommended:
Text Books:
1. Engineering Metrology – R.K.Jain - Khanna Publishers.

2.Statistical Quality Control- M. Mahajan – Dhanpatrai& Com. Pvt. Ltd.
3.Work Study; ILO
Reference Books:
1.Quality Control - By Juran - Mc. Graw Hill Pub. Company.
2.Statistical Quality Control- By Grant E.L. – R.S.L.Leavgen Worth-. Mc. Graw Hill Pub. Company
3.Statistical Quality Control- By Gupta - Dhanpatrai& Com. Pvt. Ltd

5ME06 Production Technology Lab

Practicals : At least six from the below list.
Minimum Six experiments from the following list:
1. Determination of Linear/Angular dimensions of a given specimen/part using Precision/Non-Precision
Measuring instruments.
2. Precision Angular Measurement using Sine Bar/Sine Centre, Autocollimator/Angle Dekkor.
3. Measurement of Gear Tooth Thickness by Gear Tooth Vernier Caliper/Constant Chord/Span
Micrometer.
4. Measurement of Circularity/Roundness of a given specimen.
5. Measurement of Screw Thread Element by Floating Carriage Micrometer.
6. Testing of Surfaces by using Optical Flat.
7. Measurements of various angles of single point cutting tool by using Profile Projector and Tool
Maker's Microscope.
8. Preparation of X and R chart for the given lot of sample.
9. Preparation of process chart.

Practical Examination :¬
The practical examination shall consist of oral on term work and syllabus taken jointly by Internal and External examiner.

Course Outcomes:

- Students will exhibit the concept of inspection,quality control and its importance to industry.
- Students will demonstrate the skills of controlling various out of control processes using statistical quality control tools.
- Students will reveal the importance of improving production and productivity using work study approach.
- Students will exhibit the knowledge of various measurement standards and techniques in the industry.
- Students will be able to measure various parameters related to metrology.

5ME01 Production Technology

Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome	*		*					*		*	*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

5ME02 Heat Transfer

5ME02	**Heat Transfer**	L	T	P	C
	Total Contact Hours	4	1	-	5
	Prerequisite : Nil				

Purpose:	
To understand the basic modes and laws of heat transfer i.e. conduction, convection and radiation and its application in various engineering devices.	
Course Objectives	
1	To understand the basic concepts of heat transfer, laws of heat transfer and various modes of heat transfer.
2	Students will learn to determine thermal conductivity of various materials.
3	To understand the heat transfer through conduction, convection, and radiation. Students will learn the concept of black and grey body.
4	To understand the laws of radiation.
	To understand the numerical approach to find the efficiency of heat exchanger.

Syllabus:

Section - A

UNIT - I :-

Introduction, heat transfer in engineering, modes of heat transfer, basic laws of heat transfer and their basic equations. Conduction- thermal conductivity and thermal diffusivity effect of phase & temperature on thermal conductivity, one dimensional steady state heat conduction through slab, cylinder & sphere-simple and composite. Combined conduction- convection, overall heat transfer coefficient. General heat conduction differential equation. One dimensional steady state conduction with internal heat generation for infinite slab, wire & cylinder. (8 Hrs)

UNIT II :-

Insulations, critical radius of insulation, Conduction through extended surfaces, analysis of a uniform C.S. fin, fin efficiency, fin effectiveness, Biot number. Introduction to unsteady state heat conduction, Newton's law of cooling, lumped heat capacity analysis. (8 Hrs)

UNIT III :-

Radiation- general concepts and definitions, black body & grey body concept. Laws of radiation- Kirchoff's, Plank's, Stefan-Boltzman's, Wien's law. Concept of shape factor, emissivity factor and radiation heat transfer equation. (No numericals). Radiation errors in temperature, measurement, radiation shield. (7 Hrs)

Section - B

UNIT IV :-

Forced convection- heat convection, forced and natural convection, boundary layer theory, hydrodynamic & thermal boundary layers, boundary layer thickness. Laminar & turbulent flow over flat plate and through pipes & tubes (only concept, no derivation & analytical treatment). Dimensionless number and their physical significance Reynold, Prandtl, Nusselt, Grashoff number, empirical correlations for forced convection for flow over flat plate, through pipes & tubes & their applications in problem solving. (8 Hrs)

UNIT V :-

Free convection- velocity and thermal boundary layers for vertical plate, free convection over vertical cylinder and
horizontal plate/cylinder (only concept, no derivation & analytical treatment). Use of empirical correlations in problem solving. Condensation & Boiling - introduction to condensation heat transfer, film & drop condensation. Boiling heat transfer, pool boiling curves. (7 Hrs)

UNIT VI :-

Heat exchanger - applications, classification, overall heat transfer coefficient, fouling. L.M.T.D. & E.N.T.U. methods, temperature profiles, selection of heat exchangers. Introduction to working of heat pipe with and without wick (7 Hrs)

Text Books:-

1. Heat and Mass Transfer; R.K Rajput; S. Chand, New Delhi
2. Heat and Mass Transfer; V.M. Domkundwar; DhanpatRai& Co. Delhi

Reference Books:-

1. Heat Transfer; J.P. Holman; McGraw Hill
2. Heat Transfer; P.S. Ghoshdastidar; Oxford University Press, Mumbai
3. Heat Transfer; P.K. Nag; TMH.

5ME07 Heat Transfer Lab

List of Practicals (Any six of the following):-

1. Determination of thermal conductivity of a metal bar.
2. Determination of thermal conductivity of insulating powder.
3. Study of heat transfer through composite wall.
4. Study of heat transfer through composite cylinders.
5. Determination of fin efficiency.
6. Verification of Stefan-Boltzman's law.
7. Determination of emissivity of grey body.
8. Determination of heat transfer coefficient for forced convection.
9. Determination of heat transfer coefficient for natural convection.

10. Study of pool & nucleate boiling.
11. Trial on double pipe heat exchanger.
12. Determination of efficiency of cross flow heat exchanger.
13. To write a computer program for conduction heat transfer problem.

Practical Examination:- The practical examination shall consist of oral on the term work and syllabus.

Course Outcomes:

- Students will exhibit the concept of heat transfer, laws of heat transfer and various mathematical equations.
- Students will demonstrate the knowledge of determining the thermal conductivity of various materials.
- Students will exhibit the skills of understanding and verifying various laws of radiation.
- Students will reveal the concept of black and grey body.
- Students will be able to explain the concept of heat exchanger and demonstrate the calculations of efficiency.

5ME02 Heat Transfer												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome	*	*			*						*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	

5ME03 Measurement Systems

5ME03	**Measurement Systems**	L	T	P	C
	Total Contact Hours	4	0	-	4
	Prerequisite : Nil				
Purpose:					
To make the students aware about various measuring instruments required in engineering applications.					
Course Objectives					
1	To understand the basic concepts of measurement system, its applications and measuring instruments.				
2	To know the general configuration and functional elements of measuring instruments.				

3	To understand the methods of strain gauge measurement and pressure measurement.
4	To know the concept of flow measurement, torque and force measurement methods.
5	To understand the methods of vibration, temperature and liquid level measurement.

Syllabus:

Section – A

UNIT I :1. Generalized Measurement system: Significance of measurement, generalized systems. application of measuring instruments. Types of measuring instruments.
2. General configuration and functional elements of measuring instruments, types of inputs, various methods of correction for interferings and modifying inputs. (6 Hrs)

UNIT II :General performance Characteristics:¬
1. Static characteristics, different types of errors, combination of component errors in overall systems.
2.Dynamic characteristics : General mathematical model of zero order, first order and second order instruments, response of first and second order instruments to following inputs step, ramp, impulse and frequency. (10 Hrs)
UNIT III : Strain Measurement :
1.Types of strain gauges, strain gauge circuits, calibration, Temperature compensation, use of strain gauges on rotating shafts, selection and installation of strain gauges.
2. Pressure Measurements:¬
Basic methods of pressure measurement, manometers, Transducers-elastic, gravitational. elastic : draph, strain gauge pressure cell, High pressure measurement Bridgeman type, low pressure Measurement - Mcleod, Krudsen, ionisation, Thermal conductivity gauges. (8Hrs)

Section – B

UNIT IV : 1.Force Measurement:Various mechanical. Hydraulic, pneumatic and electrical methods.
2.Torque and Power Measurements : Various mechanical, hydraulic & electric methods.
3. Flow Measurements : Construction- Venturi, orifice, Dall tube, Rota meter. Pressure probes- Pitot static tube, yaw tube anemometer, positive displacement flow meters, turbine meter, electro-magnetic flow meter. (8 Hrs)
UNIT V : 1. Temperature Measurements : Standards, Various temperature measuring devices, Bimetallic strip, liquid in glass thermometer, pressure thermometers, thermo couples, electrical resistance thermometers, Thermistors, radiation Thermometors.

2.Liquid Level Measurements : Various methods such as¬ single flot, displacement or force transducers. Pressure sensitivity, bubbler or Page system, capacitance variation type (for both conducting and non conducting type liquids) Resistance variation type, Radioisotope. (8 Hrs)

UNIT VI :1. Speed Measurements : Various mechanical type techometers, electrical types tachometers, stroboscope etc.

2. Vibration Measurements : Seismic, Strain gauge and peizoelectic accelerometers.

3. Displacement measurements : Linear and angular displacement measurements, LVDT, LDR, Capacitive & inductive pick ups. (8 Hrs)

Text Books:-

1. Measurement Systems : - By Erenest O. Doebelins - MC Graw Hill.
2. Mechanical Measurement & Control: By D.S.Kumar.

References Book:-

1. Mechanical Measurements :- By T.G.Beckwith&N.L.Bulk - Addison Werllv.
2. Instrumental Measurement & Analysis : By NakraChoudhari Tata McGraw Hill.
3. Mechanical Measurement & Instrumentation :By R.K.Rajput,Katsons Books

5ME08 Measurement Systems Lab

List Of Practicals :

Atleast of eight practicals from the following list.

1. Measurement of strain using strain gauges.
2. Calibration of pressure gauge with pressure gauge tester.
3. Measurement of linear displacement by LDR and inductive pick-up transducers.
4. Performance of capacitance transducer as a angular displacement measuring device.
5. Performance of inductive Transducers.
6. Flow measurement.
7. Speed measurement by a stroboscope.
8. Speed measurement by magnetic pick up or phot electric pick up tachometer.
9. Pressure measurement by strains gauge type transducer.
10. Vibration measurement.
11. Liquid level measurement.
12. Temperature measurement.

The practical examination shall consist of viva-voce on the above syllabus & practical work.

Course Outcomes:

- Students will exhibit the concept of measurement system and will know its importance related to the industry.
- Students will demonstrate the ability to measure various parameters like pressure, flow, speed, vibration etc.
- Students will show the ability to use various measuring instruments.
- Students will exhibit the practical approach of engineering and will be confident in industry.
- Students will be benefited by using various instruments and will demonstrate good skills in project work.

5ME03 Measurement Systems												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome	*										*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

5ME04 Theory of Machines-I

5ME04	**Theory of Machines-I**	L	T	P	C
	Total Contact Hours	3	1	-	4
	Prerequisite : Nil				

Purpose:	
To study the basics of mechanisms used in machines.	
Course Objectives	
1	To understand the basic concepts of links, mechanisms and machines.
2	To understand the kinematic analysis of mechanisms.
3	To know the concepts of velocity and acceleration analysis, their methods and calculations.
4	To understand the synthesis of mechanisms and methods
5	To know the frictional torque in various components like brake, clutch etc.
6	To understand general terminology of gear and gear train.

Syllabus:

Section - A

UNIT I :-

1. Introduction to study of mechanisms, machines, basic definitions, different types of links, kinematic pairs. Grashof's law- class-I and class -II mechanisms. Grubler's criterion, Kutrbach's theory. Inversions of four bar, single slider, double slider mechanisms,.
2. Kinematic analysis of mechanisms:- Transmission angle, Mechanical Advantage, coupler curve and their properties, radius of curvature of coupler curves.. (8 Hrs)

UNIT II :-

1. Velocity analysis:- Relative velocity method, method of equivalent mechanisms, Instantaneous centre of rotation method, body and space centroids,.
2. Acceleration analysis:- Relative acceleration method, analytical method and, Klein's construction for slider crank mechanism. (10 Hrs)

UNIT III :-

Synthesis of Mechanisms:- Introduction to type, number and dimensional synthesis, graphical method of two position, three position and four position synthesis for input output co-ordination, Overlay method, Freudenstien's equation, Blosch's method. (7 Hrs)

Section - B

UNIT IV :-

Frictional torque in pivot and collar bearing. Brakes, Clutches, and Dynamometers: types, constructional details, operation & calculation of leading dimensions. (8 Hrs)

UNIT V :-

Special purpose mechanisms:- Steering mechanisms, Geneva wheel mechanism.

Cams:- Introduction, types of cam & follower, different motions of followers, graphical layout of cam profiles, cam with specified contours. (8 Hrs)

UNIT VI :-

I) Gear :- Introduction, terminology, gear tooth profiles, involumetry, interference, spur, gears, spiral gears, and its efficiency,

II) Gear Trains:- Types of gear trains, speed ratio applications. (8 Hrs)

Books Recommended:

Text Books:

1)Theory of Machines, S.S.Ratan, Published by Tata McGraw Hill.

2)Theory of Machines and Mechanisms, J.E.Shigley, Uicker and Gordon, Published by Oxford University press-New York.

3)Theory of Machine, R.S.Khurmi and Gupta J.K., Published by Eurasia Publishing house-N Delhi.

Reference Books:

1)Theory of Machines, V.P.Singh, Published by DhanpatRai-N Delhi.

2)Theory of Machines, P.L.Ballaney, Published by DhanpatRai and sons-N Delhi.

3)Theory of Machines and Mechanisms, Rao J.S. and Gupta K.N., Published by Wiley Eastern-N Delhi.

4) Machines and Mechanisms (applied kinematic analysis), David H. Myszka, Published by Pearson Education –Asia.

5)Mechanisms Design (analysis and synthesis), Arthur G.Erdman and George N.Sandoor, Published by Prentice Hall Inc.

6)Theory of Machines and Mechanisms,Ghosh and Amitabh,Published Affiliated East West Press N-Delhi.

5ME09 Theory of Machines-I Lab

PRACTICALS:- At least eight practicals from the below list shall be performed.

1. Study of inversion of four bar mechanism.
2. Study of inversion of slider crank mechanism.
3. Study of inversion of double slider crank mechanism.
4. Study of velocity analysis by relative velocity method/ pole technique.(2 Prob)
5. Study of acceleration analysis by relative acc. method. (2 Prob)

6. Study of brakes.
7. Study of clutches.
8. Study of dynamometer.
9. Study of Graphical layout of cam profile. (3 Prob.)
10. Study of gear trains
11. Problem in position synthesis.
12. Problem in input/output coordination
13. Computer aided synthesis of four bar mechanism.

The practical examination shall consist of viva-voce on the above syllabus & practical work.

Course Outcomes:

- Students will exhibit the concept and its applications of link, mechanisms and machines.
- Students will demonstrate the ability to analyze the mechanisms and machines on the basis of velocity and acceleration and they will show the ability to solve analytical methods.
- Students will show the ability to use graphical and analytical methods for synthesis of mechanisms.
- Students will exhibit the practical for study of brake, clutch, dynamometer, gear train etc.
- Students will show the ability to develop mini projects in the course duration.

5ME04 Theory of Machines-I												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	D	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome	*				*						*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	

5FEME05 Manufacturing Techniques (Free Elective 1)

5FEME05	**Manufacturing Techniques (Free Elective 1)**	L	T	P	C
	Total Contact Hours	3	0	-	3
	Prerequisite : Nil				

Purpose:

To aware about various manufacturing techniques to students of disciplines other than mechanical engineering (being free elective) in order to assist them in selection and planning of the processes.

Course Objectives

1	To understand the basic manufacturing processes, properties of ferrous and non-ferrous metals.
2	To understand the various machining operations like, turning, drilling, milling, shaping grinding etc.
3	To know the concepts of metal; forming and sheet metal working. To know few commonly used sheet metal processes like, bending, forming drawing, coining, embossing etc.,
4	To understand the cutting processes like, punching, blanking, shearing etc.
5	To know the various casting processes, joining processes particularly welding, soldering, brazing etc.
6	To understand the importance of powder metallurgy in manufacturing.

Syllabus:

Section A

Unit I Overview of manufacturing: Manufacturing science, Introduction to various activities in manufacturing, Properties and application of common ferrous and non-ferrous metals, Common methods of manufacturing, Selection of manufacturing process, Selection of material. (6Hrs)

Unit II Various Machining operations – Turning, planning, shaper, milling, drilling, boring and grinding process. Introduction to tools and equipments required to perform various operations. (8Hrs)

Unit III Introduction to metal forming and sheet metal process: Forming process- Forging, rolling, extrusion, wire drawing. Sheet metal processes- Forming, bending, drawing, coining, embossing. Cutting process: Punching, blanking, shearing, lancing. (7Hrs)

Section B

Unit IV Casting: Steps involved in casting, advantages of casting, pattern, difference between pattern and casting, pattern allowances, material used for patterns, molding sand, sand mould making core, types of cores, defects of castings, melting furnace(Cupola), casting process and its applications. (6Hrs)

Unit V Joining process with its types, advantages and disadvantages of riveting, soldering, brazing. Arc welding, gas welding, resistance welding, friction welding. (6Hrs)

Unit VI Powder metallurgy: Methods of production of metal powder, steps in powder metallurgy, mixing and blending, compaction, sintering and finishing. Plastic part manufacturing: Process of extrusion, injection molding, blow molding, compression molding, transfer molding, advantages and disadvantages. (7Hrs)

Books Recommended:

Text Books:

1. Manufacturing processes –Workshop practice, R.A. Khan, Ali Hassan, Scitech Pub.
2. Workshop Technology -Hajra Chaudhary, DhanpatRai and Sons.

References:

1. Processes and materials of manufacture E.P. Degarmo, Prentice Hall of India (PHI)
2. Material and processes in manufacturing Lindberg, Tata McGraw Hill Pub.

Course Outcomes:

- Students will exhibit the knowledge of various manufacturing techniques and its applications in engineering.
- Students will exhibit the knowledge of machining operations, sheet metal working and processes.
- Students will show the ability to apply various joining methods in practice.
- Students will exhibit the knowledge of powder metallurgy.
- Students will demonstrate the applications of various techniques in development of project work.

5FEME05 Manufacturing Techniques (Free Elective 1)												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	D	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome	*				*	*					*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	

5FEME05 Ergonomics (Free Elective-I)

5FEME05	**Ergonomics (Free Elective-I)**	L	T	P	C
	Total Contact Hours	3	0	-	3
	Prerequisite : Nil				

Purpose:	
To aware about various manufacturing techniques to students of disciplines other than mechanical engineering (being free elective) in order to assist them in understanding human interaction with the environment and understand the law of work.	
Course Objectives	
1	To understand the fundamentals of ergonomics and its importance in design process.
2	To find out the differences in various anthropometric parameters of individuals.
3	To know the various problems related to posture, seating and standing stature.
4	To design the ergonomically suitable work place using anthropometry.
5	To design the control tools.
6	To understand the applications of ergonomics and the problems related to safety.

Syllabus:

Section – A

Unit I –

Introduction to Ergonomics , Man machine system, brief history of ergonomics, introduction to human anatomy, posture and body mechanics, musculoskeletal problems in seating and standing (8)

Unit II -
Anthropometry and Work Place Design, Anthropometric data, applying engineering anthropometry to work station design, work place design for standing and seated workers (7)

Unit III -
Design of Manual Handling Task , Assessment of Work Load, Anatomy and biomechanics of manual handling & design of manual handling task , lifting , lowering and carrying, grasping and pinching, physiology , workload and work capacity (7)

Section – B

Unit IV -
Environmental Factors, Auditory environment- basic principles, Noise & vibration, measurement of sound, noise exposure and hearing loss, annoyance & distraction, interference with communication, structure of ear, Thermal environment-basic principle, factors affecting the human comfort, physical work and heat stress, visual environment-basic principle, main factors in visual environment, illumination and color, lighting, glare Whole body vibration , segmental vibration, sources of vibration, discomfort (8)

Unit V -
Design of controls and tools, Design of controls, symbols, labels, visual displays of dynamic information, design and selection of tools (7)

Unit VI -
Applications of ergonomics in various fields, Human errors, accidents & safety (7)

Books recommended

Text books –
1. Introduction to Ergonomics by R S Bridger, Edition 1995, McGraw Hill International.

Reference books –
1. Human Factors in Engineering & Design by Mark S Sanders and Ernest J. McCormick, Seventh Edition, McGraw Hill International
2. Ergonomics in manufacturing , Edited by WaldermarKarwowski&GavrielSalvendy, Engineering Management Press (EMP), Georgia
3. Industrial Ergonomics; M.I. Khan; PHI

Course Outcomes:

- Students will exhibit the better understanding of ergonomics and its applications in day to day life as well as in industry.
- Students will demonstrate how to measure different anthropometric parameters.

- Students will show the ability to apply various ergonomic concepts in solving work place related problems.
- Students will be able to design work place for manual handling tasks.
- Students will demonstrate the importance and applications of ergonomics and consider safety in designing work place.
- Students will help society in general by designing "fit-to-all tools.

5FEME05	**Ergonomics (Free Elective-I)**											
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	D	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome	*		*		*	*				*	*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

5FEME05 Production Management (Free elective-I)

5FEME05	**Production Management (Free elective-I)**	L	T	P	C
	Total Contact Hours	3	1	-	4
	Prerequisite : Nil				

Purpose:

To make the engineering students aware about basic management concepts associated with production and processing of work parts.

Course Objectives

1	To understand the evolution of production and operations management.
2	To understand the concepts of flexible manufacturing systems, computer integrated manufacturing etc.
3	To know the various forecasting methods and facility planning.
4	To know the importance of job design and capacity planning
5	To understand the concept of loading, scheduling, priority sequencing etc.
6	To understand the basics of inventory control, JIT, and quality management.

Syllabus:

Section –A

UNIT I Designing products, services and processes; Historical evolution of productions and operations management, new product designs, manufacturing process technology.

Flexible manufacturing systems(FMS) and computer integrated manufacturing(CIM), design ofservices and service processes, tools for product development.Standardization, simplification, specialization, diversification, product analysis.

UNIT II Forecasting & Facility Location: Types of forecasting models, selection of the forecasting model, need for facility location planning, procedures for facility location planning, facility location planning, facility location models & facility payout planning.
UNIT III Job Design & Capacity Planning: effective job design, production and operations standards, method study, work measurement, capacity measuring , capacity planning modeling, capacity strategies.

Section –B

UNIT IV Aggregate Planning for Production & Scheduling: Operation planning and scheduling systems, the aggregate planning process, strategies for developing aggregate planning, master scheduling and rough cut capacity planning, aggregate planning for service organizations,loading sequencing, expediting.
UNIT V Inventory Control: Demand and control system characteristics, inventory concepts, costsModeling , Deterministic inventory models, stochastic inventory models, inventory control application, just-in-time manufacturing.
UNIT VI Quality Management: Quality and quality related costs, quality function deployment(QFD), Taguchi's off-line quality control methods, managerial responsibility in managing for quality products & services. TQM. Failure analysis, bath tub curve, Reliability of system, Maintainability and availability.

Text Books:

1. Production and operations management- concepts models and Behaviour by Everett E. Adam,Jr., & Ronald J. Ebert (Prentice- Hall of India)
2. Production and operations management – Total Quality and responsiveness by Hamid Noori& Russell Radfort (McGraw Hill, Inc.)

References Books

1. Industrial engineering & production Management by M. Mahajan (DhanpatRai& Co.)
2. Industrial engineering & management by O.P.Khanna (DhanpatRai& Co.)
3. Production and Operations Management; J.P. Saxena; McGraw Hill

Contribution to Outcomes:

- Students will exhibit the knowledge of operations management and its applications in industrial environment.
- Students will demonstrate the knowledge of advanced manufacturing technologies and philosophies.
- Students will show the analytical ability to know the sales forecasts and use of facility planning.
- Students will be able to use loading and scheduling concept in industry.
- Students will demonstrate the importance of inventory control, JIT in manufacturing.
- Students will reveal the basic concept of quality management, TQM etc.

5FEME05	**Production Management (Free elective)**											
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	D	e	f	g	h	i	j	k

2	Mapping of course outcome with program outcome	*	*				*					*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

5FEME05 Project Management (Free elective-I)

5FEME05	**Project Management (Free elective-I)**	L	T	P	C
	Total Contact Hours	3	0	-	3
	Prerequisite : Nil				

Purpose:

To make the students aware about various project management techniques to students of disciplines other than mechanical engineering (being free elective).

Course Objectives

1	To understand the concept of project, project selection and various constraints in developing project.
2	To understand the types of project models and project proposals.
3	To know the procedure of project organization and coordination.
4	To understand the various scheduling techniques and resource allocation management.
5	To understand the concept of MIS and project audit.
6	To understand the issues in project management and its remedies.

Syllabus:

Section -A

UNIT I Concepts of Project & Project Selection : Project & development, concept of a project, external causes of delay, Internal constraints, criteria for project selection models, Types of project selection models, Analysis under high uncertainty, project proposals.

UNIT II Project organization and planning: organizational form, strategic variables, need for planning, project coordination, negotiation and conflict resolution.

UNIT III Budgeting and Cost Estimation: estimating project budgets, improving the process of cost estimation, Life-cycle-costing, project cost reduction methods.

Section -B

UNIT IV Scheduling and resource allocation ; Network Techniques CPM and PERT, Gantt Charts, resource constraints, resource loading, resource leveling, integrated resource management.

UNIT V Project Control: monitoring and information systems MIS, purposes of control, types of control processes, project cost overruns and cost control, project audit.

UNIT VI Issues in project Management: Multicultural, issues, project cost escalation, conflict zones inproject management, appraisal processes, concepts and techniques, managing project resources flow, project feasibility study.

Text Books:

1.Text Book of Project Management by P. Gopalkrishnan& VE Rama Moorthy(MacMillan India Ltd)
2.Project Management – A Managerial Approach by Jack R. Meredith & Samuel J. Mantel, Jr.(John Wiley & Sons Inc.)

Reference Books:
1.Project Management by Clifford F. Gray/Erik W. Larson (McGraw Hill).
2.Project Management by Prassana Chandra.

Course Outcomes:

- Students will exhibit the knowledge of project and project selection.
- Students will demonstrate the knowledge of various project models and proposals.
- Students will show the ability to organize the project proposals and other managerial skills required.
- Students will demonstrate the scheduling techniques and its applications in industry.
- Students will understand the concept of MIS and project audit.
- Students will reveal the solution for the problem issues in project management.

5FEME05 Project Management (Free elective-I)												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	D	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome	*				*	*				*	*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

5ME10 Computer Software Applications-I Lab

5ME10	**Computer Software Applications-I Lab**	L	T	P	C
	Total Contact Hours	0	0	2	2
	Prerequisite : Nil				
Purpose:					
To make students conversant with various modeling and designing softwares.					
Course Objectives					
1	To understand the concept of computer aided drafting and designing.				
2	To know the basic commands used in various CAD software like, AutoCAD, CATIA, ProE, Solidedge etc				

3	To understand the procedure of creating 2D, 3D drawings of various machine components
4	To understand the commands used for creating assembly drawing.
5	To create the animation of mechanism using modeling software.

1. 2D & 3D CAD modeling methodology using packages like AutoCAD, CATIA, Pro-E, Solidedge, Unigrpahics, etc..
2. Creation of 2D Drawing (Sketching module) of any three mechanical machine component using any modeling /drafting software.
3. Creation of 3D drawing (part Module) of any three mechanical machine parts using any modeling software.
4. Creation of an assembly using (assembly module) various machine 3D parts using any modeling software.
5. Creation of 3D detailed part for any sheet metal components using 3D Product modeling software.
6. Creation of any one mechanism/animation using any modeling software.

At least five practicals from the above list should be performed.

Practical Examination:-
It shall consist of viva-voce based on term work and syllabus to be examined by internal and external examiner.

Course Outcomes:

- Students will exhibit the knowledge engineering drawing.
- Students will demonstrate the knowledge of various commands used for drafting.
- Students will show the ability to use various CAD software for drafting of components.
- Students will demonstrate the procedure of creating 2D, 3D drawing.
- Students will understand the commands of drafting softwares for fcreating assembly drawing.
- Students will show the ability to develop animation of mechanisms.

ME10 Computer Software Applications-I Lab												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome			*	*	*					*	*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

6ME01 Fluid Power-II

6ME01	**Fluid Power-II**	L	T	P	C
	Total Contact Hours	4	1	-	5
	Prerequisite : Nil				

Purpose:	
To apply basic fundamentals of fluid mechanics principals in designing and analysis of hydraulic machines, turbines of hydro-electric power plants and various fluid systems.	
Course Objectives	
1	To understand the basic concept of prime movers and turbines
2	To understand the knowledge of centrifugal pump.
3	To demonstrate the knowledge of axial flow pump, water lifting devices and CFD.
4	To understand the concept of positive displacement pumps.
5	To solve the elementary treatment on compressible fluid flow.
6	To understand the concept of hydrostatic system and hydrokinetic system.

Syllabus:

Section – A

Unit I : 1. Prime Movers :- Theory of impulse and reaction machines. Pelton, Francis and Kaplan turbines, their construction, classification, analysis, characteristics and governing, draft tube, unit quantities. (8hrs)

Unit II : Centrifugal pumps :- Basic Theory, classification, construction, operation, characteristics, multistage, NPSH and cavitations in pumps. (7)

Unit III : 1. Axial flow pump :- Basic theory, construction, operation, and characteristics. 2. Other water lifting devices :-
(a) Air lift pump.
(b) Jet Pump.
(c) Hydraulic Ram.
3. Computational Fluid Dynamics (CFD): Basic Definition, Applications of CFD in the area of research & Industry.
Comparison of Experimental Fluid Dynamics and Computational Fluid Dynamics, Importance of GoverningEquations and the physical meaning of the involved terms. Equation of continuity, equation of motion & energybalance equation in Cartesian & cylindrical polar coordinates. (10)

Section – B

Unit IV : Positive displacement Pumps :-1. Reciprocating Pumps :- Basic theory, types, construction,installation and characteristics. 2. Rotary Pumps :- Basic theory, types, construction and variable delivery pumps. (9)

Unit V : Compressible fluid flow :- Perfect gas relationship, speed of sound wave, mach number, Isothermal and isotropic flows, shock waves, fanno and Rayliegh lines. (8)

Unit VI : 1. Hydrostatic systems, their function, components and application such as Hydraulic press, lift, crane and fluid drive for machine tools. Intensifier and accumulator
2. Hydrokinetic systems : Fluid couplings and torque converter. (8)

Books Recommended :-
Text Books:-
1.CSP Ojha, R. Berndtsson, Fluid mechanics and machinery; Oxford university.
2. Bansal R.K., Fluid mechanics and fluid machines; Laxmi publications.

Reference Books:-

1.Jagdish Lal, Hydraulic machines; Metropolitan Book Co. Pvt. Ltd.
2. Dr. Mody& Seth, Hydraulics and Fluid Mechanics; Standard house book.
3. Sengupta, Computational fluid dynamics; Pearson Publishers.
4. Sameer sheikh, Iliyas Khan, Treaties on Hydraulics; Pneumatics, R.K. Publication.

6ME07 Fluid Power-II Lab

Practical Term Work :
At least seven exercises based on the following.
1) Trial/study of Pelton turbine.
2) Trial/study of Francis turbine.
3) Trial/study of Kaplan Turbine.
4) Trial/study of centrifugal pump.
5) Trial/study of reciprocating pump.
6) Trial/study of Axial flow pump.
7) Study of multistage pump.
8) Trial/study of Hydraulic Ram.
9) Study of Hydrostatic components systems.
10) Study of Hydrostatic systems.
11) Study of Hydrokinetic systems.
12) Study of Cavitation phenomena.
13) Study of governing of Impulse Turbines.
14) Study of governing of reaction turbines.
15) Study of Special pumps (Air lift pump/jet pump)
16) Formulation of problem concerning the fluid flow in the vessel with any commercial code available like CFX, FLUENT, PHOENIX.
Practical examination shall consist of oral/and or experimentation based on above term work.

Contribution to outcomes:

- Students will demonstrate basic concept of prime movers and turbines.

- Students will develop the knowledge of centrifugal pump.
- Students will reveal the importance of axial flow pump, water lifting devices and CFD.
- Students will understand the concept of positive displacement pumps.
- Students will capable to solve the elementary treatment on compressible fluid flow.
- Students will understand the concept of hydrostatic system and hydrokinetic system.

	6ME01 Fluid Power-I											
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome	*	*	*	*	*						*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

6ME02 Computer Software Applications

6ME02	**Computer Software Applications**	L	T	P	C
	Total Contact Hours	3	0	-	3
	Prerequisite : Nil				

Purpose:

To impart the knowledge of DBMS and modeling simulation softwares.

Course Objectives

1	To understand the concept of Database Management System in context to Mechanical Engineering.
2	To know the basic requirements of DBMS, importance of DBMS, Data base administrator and his role.
3	To understand the concept of relational database, structure of relational database.
4	To design the database and E-R Model.
5	To create the syntax in structured query language (SQL).
6	To study the concept of modeling and simulation, its importance, applications and various packages.

Syllabus:

Section -A

Unit I

Introduction to data base management system (DBMS): Database system application, purpose of database systems, view of data, database languages, relational databases, database design, object based and semi structured databases, data storage and

querying, transaction management, data mining and analysis, database architecture, database users and administrators. (6 Hrs)

Unit II
Relational Databases: Structure of relational database, Fundamental relational algebra operation, Additional relational algebra operation, extended relational algebra operation, Null values, Modification of the database.
(6 Hrs)

Unit III
Database design and the E-R model: Overview of the database process, The entity-relational model, Constraints, Entity- relationship diagrams, Entity- relationship design issues, Weak entity sets, Extended E-R features, Database design of banking enterprise, reduction to relational schemas, other aspects of database design the unified modeling languages. (8 Hrs)

Section-B

Unit IV
Structured Query Language(SQL) : Introduction, data definition, basic structure of SQL queries, set operations, Aggregate functions, null values, nested sub queries, complex queries, view, modification of the database, joined relations, SQL data types and schemas, integrity constraints. (8 Hrs)

Unit V
Relational Database design: Features of good relational design, atomic domains and first normal forms, decomposition using functional dependencies, functional-dependency theory, decomposition using functional dependencies, decomposition using multi valued dependencies, more normal forms, database design process, modeling temporal data. (8 Hrs)

Unit VI
Modeling and Simulation : Model, Types of model, advantages of modeling, need of system modeling, system approach to modeling, Introduction to simulation, modeling of simulation, environment, component of system, steps in simulation, advantages and disadvantages of simulation, simulation Languages and packages. (6 Hrs)

Books Recommended:
Text Books:
1. Database system concepts –A. Silberschatz, H. Korth, Mc-Graw-Hill, 5th Edition.
2. System Simulation –G. Gordon, Prentis Hall international publication
3. Database Management systems; Raghu Ramkrishnan, Johannes Gehrke; McGra Hill International

Reference Books:
1. An Introduction to Database system –C. J. Date, Addison Wesley publication
2. System Simulation with digital computer – NarsinghDeo, Prentis Hall international

6ME08 Computer Software Applications–II Lab

Practicals:
1. At least four practical's using SQL for mechanical applications.
2. Demonstration of simulation packages

Practical examination shall consist of oral based on above term work and syllabus.

Course Outcomes:

- Students will understand the basics of DBMS.
- Students will understand various data Models.
- Students will show the ability of designing MRP and ERP models.
- Students will understand Relational Database design.
- Students will exhibit the knowledge of modeling and simulation.

	6ME02 Computer Software Applications											
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome			*	*	*		*			*	*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

6ME03 Control System Engineering

6ME03	**Control System Engineering**	L	T	P	C
	Total Contact Hours	4	1	-	5
	Prerequisite : Nil				
Purpose:					
To understand the basic and different types of control system numerically and analytically.					
Course Objectives					
1	To know the fundamentals of various types of systems.				
2	To understand the knowledge basic control action and industrial controllers.				
3	To understand the concept Transient- Response analysis and numerical approach.				
4	To understand the concept of Stability, root locus concept, Rauths stability criterion.				
5	To understand the concept of Frequency Response method and bode diagram.				
6	To understand various speed control systems and analysis of performance characteristics.				

Syllabus:

Section – A

Unit I :- Introduction system concept, open & closed loop systems, Mathematical models of physical systems, transfer functions.Block diagrams reduction and signal flow graphs.
Unit II :- Basic control actions and Industrial controllers :-Classification of industrial automatic controllers, control
actions, proportional controllers, obtaining derivative and integral control action, effects of integral and derivative
control action on systems performance.
Unit III :- Transient Response Analysis :- Introduction Std. Test signals, steady state response of first and second order systems for stop, ramp and impulse input, transient response specifications, steady state error & error constants.

Section – B

Unit IV :- Concept stability, necessary condition for stability, Rauths stability criterion, Root locus concept, construction of Root loci, systems with transporation lag.
Unit V :- Frequency Response methods :-Introduction, concept of Bode diagrams.
Unit VI :- Study of important automatic speed control systems in machine tools, Prime movers, system generators, etc. Analysis of performance characteristics.

BOOKS RECOMMENDED:-

TEXT BOOK :
1. Modern Control System by Richard C. Dorf, Robert H. Bishop, 9th Edition 2007
2. Automatic Control Enginering by F. H. RavanMc-Graw-Hill

REFERENCE BOOK :

1) Modern Control Engg. - by Katsuhiko Ogata, PHI, 4th Edition 2006.
2) Automatic Control Engg. - by Kuo B.C. & F. Golnaraghi, 10th edition 2008
3) Control System Engg. - by Nagrath&Gopal, 5th Edition 2006

Contribution to outcomes:

- Students will demonstrate basic system concept and study different types of systems.
- Students will demonstrate the knowledge of basic control action and industrial controllers.
- Students will demonstrate concept Transient- Response analysis and will apply in numerical methods.
- Students will understand the concept of Stability, and exhibit the knowledge of root locus concept.
- Students will understand the concept of Frequency Response method and use bode diagram in solving analytical problems.

- Students will understand the concept automatic speed control.

	6ME03 Control System Engineering											
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome	*		*							*	*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

6ME04 Theory of Machines-II

6ME04	**Theory of Machines-II**	L	T	P	C
	Total Contact Hours	4	1	-	5
	Prerequisite : Nil				

Purpose:

To study the static and dynamic force analysis including inertia effect.

Course Objectives

1	To understand the basic concept of Static force Analysis and Hydrodynamic lubrication.
2	To understand the knowledge of Dynamic force Analysis.
3	To demonstrate the knowledge of Space mechanism and vehicle dynamics.
4	To understand the concept of free vibration and force vibration.
5	To understand the concept of Torsional vibration.
6	To understand the concept of balancing of machinery.

Syllabus:

Section – A

UNIT I :-

1. Static equilibrium, superstition principle, Static force analysis applied to plane motion mechanisms, virtual work method, static force analysis without and with friction.
2. Theory of hydrodynamic lubrication, boundary lubrication, film lubrication, rolling friction, performance of bearing. (9 Hrs)

UNIT II :-

1. D'Alemberts Principle. Engine force analysis-piston effort, thrust along connecting rod, side of cylinder, on the bearings, crank effort and turning moment on the crank shaft.

2. Dynamic equivalent system of connecting rod. Inertia of the connecting rod. Inertia force in reciprocating engines (graphical method).
3. Turning moment diagrams for two stroke, four stroke and multi cylinder engines, fluctuations of speed & energy, Flywheel requirements. (8 Hrs)

UNIT III :-
1. Space mechanism:- Gyroscope, gyroscopic effect as applied to ship, aeroplane, 4 wheeler, 2 wheeler, universal joint.
2. Vehical dynamics :- Coefficient of adhesion, resistance to vehicle motion, relative drive effectiveness, braking of vehicles. (7 Hrs)

Section - B

UNIT IV :-
Concept and basic terms of vibratory motions, types of vibrations, basic features or elements of vibrating systems, degree of freedom in mechanical vibratory system.
1. Longitudinal vibrations- Natural frequency of free longitudinal vibrations by equilibrium, energy and Rayleigh method. Effect of inertia constraint in longitudinal vibrations. Damped vibrations with mass, spring and dash pot. Definitions of logarithmic decrement, magnification factor, transmissibility, vibration isolation.
2. Transverse vibrations- natural frequency of free transverse vibrations. Effect of inertia constraints in transverse vibrations. Natural frequency of free transverse vibrations due to point load and uniform distributed load acting over a simply supported shaft. Frequency of free transverse vibrations of a shaft subject to a number of point loads by energy and Dunkerley's method (9 Hrs)

UNIT V :-
1. Torsional vibration, single rotor systems, Two Rotor system, three rotor system, geared systems, Graphical method for multi rotor system.
2. Whirling of shaft & critical speeds. (6 Hrs)

UNIT VI :-
Balancing of Machinery:- Static, & dynamic unbalance, balancing of rotating masses in same and different transverse planes, Balancing of single cylinder, multi-cylinder V and radial engines. Partial balancing of reciprocating masses. Balancing of linkages & machine. (9 Hrs)

Books Recommended:
Text Books:
1) Theory of Machines, S.S.Ratan, Published by Tata McGraw Hill.
2) Theory of Machines and Mechanisms, J.E.Shigley, Uicker and Gordon, Published by Oxford University press-New York.
3) Theory of Machine, R.S.Khurmi and Gupta J.K., Published by Eurasia Publishing house-N Delhi.

Reference Books:
1) Theory of Machines, V.P.Singh, Published by DhanpatRai-N Delhi.
2) Theory of Machines, P.L.Ballaney, Published by DhanpatRai and sons-N Delhi.

3) Theory of Machines and Mechanisms, Rao J.S. and Gupta K.N., Published by Wiley Eastern-N Delhi.
4) Mechanisms Design (analysis and synthesis), Arthur G.Erdman and George N.Sandoor, Published by Prentice Hall Inc.
5) Theory of Machines and Mechanisms,Ghosh and Amitabh,Published Affiliated East West Press N-Delhi.

6ME09 Theory of Machines-II Lab

Practicals:-
At least eight practical from the following list
1) Determination of intertia of simple pendulum.
2) Determination of inertia of compound pendulum.
3) Determination of inertia of irregular bodies.
4) Experiment on state balancing of rotating masses.
5) Experiment on dynamic balancing of rotating masses.
6) Determination of gyroscopic couple.
7) Experiment on whirling speed of shaft.
8) Determining the interrtia force of connecting rod by
9) Dynamic force analysis of four bar mechanism
10) Experiment on free and damped vibration of systems with one degree of freedom.
11) Experiment on forced damped vibration of systems with one degree of freedom.
12) Experiment on free damped torsional vibration
13) Study of universal point.
14) Study of vehicle dynamics.

Practical Examination :-
It shall consist of Viva-voce on the above syllabus & Practical work.

Course outcomes:

- Students will exhibit the basic concept of static force analysis and hydrodynamic lubrication.
- Students will understand the knowledge of dynamic force analysis and use graphical methods to solve problems.
- Students will exhibit knowledge of space mechanism and vehicle dynamics.
- Students will understand concept of free vibration and force vibration.
- Students will understand concept of Torsionalvibration
- Students will understand the concept of balancing of machinery.

	6ME04 Theory of Machines-II											
	Department of Mechanical Engineering, PRMIT&R											
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k

2	Mapping of course outcome with program outcome	*		*	*	*							
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)		
								*					

6FEME05 Automobile Engineering (Free Elective-II)

6FEME05	**Automobile Engineering (Free Elective-II)**	L	T	P	C
		3	0	-	3
	Prerequisite : Nil				

Purpose:	
To understand the functioning of basic components and various systems in automobiles.	
Course Objectives	
1	To understand the basic concept of automobile engineering and its components.
2	To understand the knowledge of fuel feed system (such as MPFI and CRDI) and cooling system.
3	To understand the basic concept of electrical system and ignition system.
4	To understand the concept of transmission system and types of gears box.
5	To understand the concept of braking system and steering system.
6	To understand the concept of suspension and lubrication.

Syllabus:

SECTION - A

UNIT I :-

Classification of automobiles, chassis types, Power Unit- Functions, basic working of SI and CI engines, engine parts-types, construction and functions, Multiple cylinder engines, Firing order (7 Hrs)

UNIT II :-

Fuel feed systems- fuel feed systems for petrol and diesel engines, Fuel pumps, fuel filters, Air filters, Basic principles of MPFI and CRDI. Multipoint Fuel Injection Systems (MPFI), Common Rail Diesel Injection Systems(CRDI). Cooling system: purpose, types of cooling system, liquid cooling system-water jacket and ports, water pump and radiators, by pass recirculation system, temperature indicator, antifreeze mixtures. (7 Hrs)

UNIT III :-

The electrical system. Battery Capacity, standard capacity ratings, starter motor drive-Bendix drive. Ignition system:- Battery coil ignition system, Electronic ignition system (7 Hrs)

SECTION - B

UNIT IV :-

Transmission system:- Layout, single plate friction clutch and multiplate clutch, clutch troubles and remedies. Gear Boxes:- Sliding mesh, constant mesh gear box, Propeller shaft, Hotchkiss drive, torque tube drive, differential. (8 Hrs)

UNIT V :-

Braking system:- Mechanical, hydraulic brakes, power brakes, and vacuum brakes Steering system:- Function, types of linkages, steering gears, steering gear ratio, wheel balancing, wheel alignment, camber, castor, king pin inclination, toe-in & toe-out & their effects, Introduction to power steering. (7 Hrs)

UNIT VI :-

Suspensions :- Rigid axle and independent suspension system, shock absorbers. Auto lubrication :- Types of lubricants, their tests and ratings, multi viscosity oils. Engine lubrication:- types of lubricating systems, full pressure system, dry sump system, oil pump, crankcase ventilation. (6 Hrs)

Books Recommended

Text Books:-

1. Automobile Engineering- Vol. I & II; Kirpal Singh; Standard Publishers Distributors
2. Automobile Engineering; R.K. Rajput; Laxmi Publications, New Delhi

Reference Books:-

1. Automotive Mechanics; Crouse &Anglin; TMH.
2. Automotive Mechanics; J.Heitner; East West Press
3. Automotive Mechanics; S. Srinivasan; TMH.

Course Outcomes:

- Students will understand the basics of automobile engineering and its components.
- Students will develop about the cooling system and its function.
- Students will exhibit basic concept of electrical system and ignition system.
- Students will demonstrate the knowledge of braking system and steering system.
- Students will understand basic concept of transmission system and types of gears box.
- Students will exhibit the knowledge of suspension and lubrication.

Automobile Engineering (Free Elective-II)												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	J	k
2	Mapping of course outcome with program outcome	*	*	*							*	*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	

6FEME05 Non-Conventional Energy Systems (Free Elective-II)

3ME02	**Mechanics of Material**	L	T	P	C
	Total Contact Hours	3	0	-	3
	Prerequisite : Nil				

Purpose:	
To study various renewable energy resources.	
Course Objectives	
1	To understand the basic concept of renewable and non-renewable sources and solar radiation.
2	To understand the knowledge of radiation transmission through covers and solar energy collections.
3	To understand the basic concept of solar energy utilization and storage.
4	To understand the concept of energy from ocean and wind.
5	To understand the concept of bio-mass energy resources.
6	To understand the concept of direct energy conversion and fuel cell.

Syllabus:

Section - A

UNIT I :-

Introduction :- Renewable & Nonrenewable sources. Solar Radiation :- Solar constant, basic earth-sun angles. Spectral distribution of extra terrestrial radiations & its variation. Solar time, Direction of beam radiation, computation of radiation on inclined surfaces. (7 Hrs)

UNIT - II :-

Radiation Transmission through covers:- Reflection and absorption of radiation, optical properties of cover systems transmittance effects of surface layers on transmittance, transmittance absorptance product. Solar Energy collections:- Heat transfer for solar energy utilization, flat plate collectors such as liquid & air collector. Introduction to various systems of concentrating collectors. (7 Hrs)

UNIT III :-

Solar energy Utilization:- Application of solar energy in heating, cooling, pumping, power production, distillation, drying, solar cookers, solar pond, solar furnace. Solar Energy Storage :- Methods of storage such as sensible, latent heat & thermo-chemical storage, selection of method of storage, properties of storage materials and different arrangements of storages. (No analytical treatment) (7 Hrs)

Section - B

UNIT IV :-

Energy from Ocean:- Tidal Power:- types of tidal plants such as single and two basin plants, power developed & operation of tidal power plant. Ocean thermal energy

conversion system. Oceamtemp. profile, OTE power plant development, controlled flash evaporation, indirect vapour cycle. Wind Power:- Wind speed data, power in the wind, wind power development, types of wind mills, application for pumping and power generation. (No numerical) (7 Hrs)

UNIT V :-
Biomass Energy Resources: Mechanism of green plant photosynthesis. efficiency of conversion, solar energy plantation, biogas – Types of biogas plants, factors affecting production rates. Pyrolysis, Gasifiess : Types & classification. Straight vegetable oils as a liquid fuels and their properties. Introduction to bio-diesel as a diesel engine fuel. (7 Hrs)

UNIT VI :
Direct Energy Conversion:- Photo voltaic cells : Principle, concept of energy conversion, conversion efficiency, power output and performance, storage. Fuel Cells: Principles types of fuel cells, conversion efficiency. Geothermal Energy Resources, power generation methods like vapour dominated. water dominated, flash steam, binary fluid and total flow concept of power generation. (7 Hrs)

Books Recommended:
Text Books:-
1. Solar Energy; S.P. Sukhatme; TMH
2. Non-Conventional Energy Sources; G.D. Rai; Khanna Publications

Reference Books:-
1. Treatise on Solar Energy; H.P. Garg; John Wiley & Sons.
2. Renewable Energy Conversion, Transmission and Storage; Bent Sorensen; Elsevier Publication
3. Renewable Energy; Godfrey Boyle; Oxford University Press, Mumbai
4. Renewable Energy Sources and Emerging Technology; D.P. Kothari, K.C. Singal, RakeshRanjan; PHI

Course outcomes:

- Students will understand concept of renewable and non-renewable sources.
- Students will understand the basic concept of radiation transmission through covers and solar energy collections.
- Students will demonstrate the basic concept of Solar energy utilization and storage.
- Students will be able to demonstrate the concept of energy from ocean and wind.
- Students will understand the concept of bio-mass energy resources.
- Students will understand the concept of direct energy conversion and fuel cell.

6FEME05	**Non-Conventional Energy Systems (Free Elective-II)**											
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	C	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome	*		*							*	*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

6FEME05 Energy Management (Free Elective-II)

3ME02	**Mechanics of Material**	L	T	P	C
	Total Contact Hours	3	0	-	3
	Prerequisite : Nil				

Purpose:	
Course Objectives	
1	To understand the basic concept of energy, sources of energy, forms of energy.
2	To understand the need and importance of energy conservation and management.
3	To understand the basic concept energy audit, energy audit-methods, analysis.
4	To study the energy conservation in supply system. Calculation of boiler performance and efficiency.
5	To study the energy conservation in process industries.
6	To understand the government rules and economy in energy.

Syllabus:

Section-A

UNIT-1

Introduction to energy, Sources of energy, Forms of energy, Energy reserves, renewable energy sources, Units of energy. Energy consumption and GDP. Need and importance of energy conservation and management (7 Hrs)

UNIT-2

Energy audit concepts, Mass and Energy balances, Energy Auditing-methodology, analysis and reporting, Evaluation of energy conserving opportunities, Economic analysis and life cycle costing. (7 Hrs)

UNIT-3

Energy conservation in steam generation and supply system. Boiler performance, Boiler efficiency (direct and indirect method), excess air, flue-gas monitoring. (7 Hrs)

Section-B

UNIT-4

Energy conservation Energy conservation in compressed air systems, refrigeration and air-conditioning systems and water systems. Elementary coverage of energy conservation in pumps and fans. Opportunities in Process Industries for Energy conservation.

UNIT-5

Electrical energy conservation in building lighting, heating, ventilating and air conditioning, Energy efficient motor, power factor improvement in power systems, (9Hrs)

UNIT-6

Energy environment interaction, Environmental issues, Global warning, Carbon dioxide emissions, Depletion of ozone layer, Government's regulations, Energy economy interaction. (7 Hrs)

Books Recommended

Text Books:

1. P.H. Henderson; India – The Energy Sector; Oxford University Press.
2. D. A. Ray; Industrial Energy Conservation; Pergamon Press.

Reference Books:

1. W.S. Turner; Energy Management Handbook (Wiley)..
2. Rajan; Optimizing Energy Efficiency in the Industry, Tata McGraw Hill Publishers.
3. C.L Capehart; Guide to Energy Management, Fairmont Press

Course outcomes:

- Students will understand concept of energy, sources of energy and forms of energy.
- Students will study theneed and importance of energy conservation and management.
- Students will exhibit basic concept energy audit, energy audit-methods, analysis.
- Students will demonstrate the ability to calculate of boiler performance and efficiency.
- Students will study the energy conservation in process industries.
- Students will understand the government rules and economy in energy.

	6FEME05 Energy Management (Free Elective-II)											
	Department of Mechanical Engineering, PRMIT&R											
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome	*	*			*	*				*	*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

7ME01 Machine Design and Drawing-II

7ME01	**Machine Design and Drawing-II**	L	T	P	C
	Total Contact Hours	3	0	-	3
	Prerequisite : Nil				

Purpose:	
To acquire the basic knowledge regarding principals and procedures of physical design and development of various machine components.	
Course Objectives	
1	To study the various types of shaft, key, coupling, flywheel, bearings, belt drives, gear drives etc.
2	To study various stresses and failure theories of shaft, key, coupling, flywheel, bearings, belt drives, gear drives etc.
3	To make the competent in design and drawings of shaft, key, coupling, flywheel, bearings, belt drives, gear drives etc.
4	To understand the design and drawing of IC engines parts and Hartnell's governor.

Syllabus:

Section-A

Unit I :- a) Design of Shaft : Material, Design on the basis of strength considering shaft subjected to
- Twisting moment only
- Bending moment only
- Combine twisting and bending moment
- Design on the basis of rigidity.

b) Design of Key - types, strength of key

c) Design of coupling - types, requirements of good couplings, design of sleeve coupling, clamp or compression coupling, rigid flange coupling, flexible flange coupling.

d) Design of fly-wheel : Function, coefficients of fluctuation of speed and energy, energy stored in fly wheel, construction, stresses in fly wheel arms and rim, Design of fly wheel based on T-Mdiagram, fly wheel for Otto cycle engines and punching machines. (12Hrs)

Unit II :- a)Antifriction Bearings: Types of bearing, construction, designations, standard load
ratings by AFBMA for static and dynamic loads, life of bearings, selection of bearings, lubrication, mounting and enclosure.

b) Journal bearings: lubrication of bearings, stable lubrication, Thick film lubrication, pressure distribution, minimum film thickness, relations of variables-viscosity, coefficient of friction, speed, pressure, length and diameter, bearing modulus, viscosity-Temperature chart, Sommerfeld number, selection of lubricant, design procedure and numericals.

c) Design of belts-

Flat belts -types, material and construction of belt, types of drives, slip, creep, Design of belt. V-Belts -Construction and types, design of V belts.

d) Wire Rope -Selection ,Construction, classification ,designations, stresses in wire rope, selection of wire rope for given loads. (12Hrs)

Section-B

Unit III :- Design of Gears Classification, law of gearing, forms and system of teeth, interference, beam strength of teeth, dynamic tooth load, wear tooth load, tooth failure.

a) Spur gear –Design of gear

b) Helical gear -Classification face width, formative teeth number, strength of gear Design of gear

c) Bevel gear- Classification, pitch angles, strength of gear, Design of gear

d) Worm gear -Types, efficiency of gear, Design of gear. (12 Hrs)

Unit IV

a)Design of I.C.Engine parts: Design of Cylinder, Piston, Piston rings, Piston pin, Connecting rod and Crank.

b)Design and Drawing of Governor (Parts and Assembly): Types of Governors. Design procedure and problem of Hartnell'sgoverner (including design of Spring, spindle, lever and balls). (12 Hrs)

Books Recommended:

Text Books

1) Machine Design fundamentals –Mechanical designer workbook , J.E.Shigley, Published by McGraw hill .

2) Machine Design, R.S.Khurmi and Gupta J.K., Published by Eurasia Publisher's-N Delhi.

3) Machine Drawing, N.D. Bhat, Charotar Publication

Reference Books

1) Machine Design, Maleev and Hartman., Published by C.B.S. Publication-N Delhi.

2) Machine Component Design ,WillianOrthwein,Published by Jaico publishing House-Bombay.

3) Machine Elements in Mechanical M.F. Spotts

4) Machine Design, Black P.H., Published by McGraw Hill.

5) CAD CAM Concepts & applications, ChennaKesava, PHI Publications

6) Design Data Book by- P.S.G. Koimbatore

7) Design Data Book by Mahadevan,

(Use of any data book from the above will be permitted during the examination).

7ME07 Machine Design and Drawing-II Lab

List Of Exercises For Term Work

1) Sheet 1 : Design of shaft

2) Sheet 2: Design of coupling or any one type of gears.

3) Sheet 3: Design of I.C.Engine part(any one based on syllabus)

4) Sheet 4 : Preparation of detail drawing of simple machine assembly
(Pedastal bearing, Plummer block, Simple eccentric, Stuffing box, Cross head, Tail stock, Tool post, C-clamp, Screw jack, Boiler safety valve - Any one of these)
5) Sheet 5 : Preparation of Assembly drawing of simple machine assembly
(Any one machine from practical 4)

Note: -
Any one from the above list should be done using Computer Programming/software.

Course Outcomes:

- Students will be able to select types of shafts, keys, couplings for various machines and industrial applications.
- Students will know the bearing design parameters, heat balance etc.
- Students will select the types of drives for specific industrial applications.
- Students will be able to find approximate dimensions of IC engine parts and Hartnell's governor.
-

7ME01	**Machine Design and Drawing-II**											
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome	*		*		*						
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

7ME02 Energy Conversion-II

7ME02	**Energy Conversion-II**	L	T	P	C
	Total Contact Hours	3	1	-	4
	Prerequisite : Nil				
Purpose:					
To acquire knowledge of various conventional and renewable fuel driven devices required in heat engines and refrigeration systems.					
Course Objectives					
1	To get acquainted with different types of air compressors.				
2	To study the working of rotary compressor, reciprocating compressor and centrifugal compressor.				
3	To study the working of refrigeration system and refrigeration cycles.				

4	To study the air conditioning and its applications
5	To study the working of gas turbines, its classification and related issues.
6	To study the working of nuclear power plant, its working, reactor types.
7	Introduction to renewable energy sources, viz. wind, solar, biogas etc.

Syllabus:

Section – A

UNIT I :- Reciprocating Air Compressors:- Industrial uses of compressed air, Methods of compression and efficiencies of compression, Methods of reducing losses during compression single and multistaging of compressors, clearance volume and its effect on work done and volumetric efficiency, condition for minimum work in tow stage compression, Intercooling and its effects. Overall, isothermal and adiabatic efficiencies, IHP,BHP, requirements and after cooler.
(7 Hrs)

UNIT II :- Rotary compressors:- Comparison between reciprocating and rotary compressors, difference between fans, blowers and compressors, general equations for rotary machines. Vane, Roots blower, construction, working and velocity diagrams of centrifugal and axial flow compressors, Performance characteristics of blowers and compressors.
(8 Hrs)

UNIT III :- Definitions, classifications of refrigeration system; Air refrigeration, Bell-colman cycle, reversed cannot cycle, reversed Brayton cycle, vapour compression refrigeration, vapour absorption refrigeration based on solar and waste heat recovery. Analysis of simple saturated vapor compression cycle, representation on T-s, Ph diagrams, Problem on simple saturation cycle, Need for CFC free refrigerants.
Air conditioning:- Definitions, classification and applications. Psychrometric properties, psychrometric charts.
(8Hrs)

Section – B

UNIT IV:- Classification of gas turbines, construction and working Gas turbine ideal and actual cycles constant volume, constant pressure, (Open and closed) cycle analysis. Inter cooling, Regeneration and reheating application. Optimum and maximum pressure ratios, work ratios. Performance characteristics. Fields of application of gas turbine power plant. Introduction to jet propulsion, Ram jet, turbo jet. (No numerical treatment for Jet Propulsion.)
(8 Hrs)

UNIT V: NUCLEAR POWER : Fusion, fission, Chain reaction, conversion and breeding in nuclear fission, components of reactor, coolants, moderators etc. Different type of reactors such as boiling water, pressurised
water, gas cooled, liquidized metal cooled thermal reactors.
(6 Hrs)

UNIT VI:- Introduction to renewable energy: Wind energy, solar, fuel cell, bio-gas, MHD, basic requirements, Advantages, Disadvantages and applications.
(7Hrs)

Recommended Books:-

Text Books:
1. Steam and gas turbine; R.Yadao; Central Publication Allahabad,
2. Thermal Engineering; Domkundwar, Kothandarawar; DhanpatRai& Co.
3. Power Plant Engineering; R.K. Rajput; Laxmi Publication
4. Solar energy by S. P. Sukhatme; Tata McGraw-Hill in New Delhi .

Reference Books:
1. Thermal engineering By Mahesh M. Rathore; Tata McGraw-Hill in New Delhi ,
2. Gas Turbines Theory - By Cohen &C.F.Rogers.F; H. I. H. Saravanamuttoo Heritage Publishers,
3. Gas Turbines and Rotary Compressors; Khajuria&Dubey, DhanpatRai& Co,
4. Thermal Engineering; R.K. Rajput, Laxmi Publication.
5. Renewable energy; Godfrey Boyle; Oxford University Press

7ME08 Energy Conversion-II Lab

List of Experiments:

Any six of the following-.
1. Trial on reciprocating compressor.
2. Trial on centrifugal blower.
3. Studies of domestic refrigerator.
4. COP calculation of vapour compression system.
5. Study of room air conditioner.
6. Study of gas turbine with the help of models.
7. Study of Pyrheliometer and measurement of direct radiation
8. Study & testing of a flat plate collector.
9. Study of solar still and trial on it.
10. Study of a photovoltaic system.

Practical Examination shall consist of viva voice based on above term work.

Course Outcomes:

- Students will exhibit the working of different types of compressors.
- Students will be able to handle and resolve the problems related to working of air compressor.
- Students will understand the principle of working of refrigeration systems.
- Students will able to exhibit the concept of air conditioning and its applications.
- Students will be able to demonstrate the use of gas turbines in power plants.
- Students will understand various nuclear reactions and issues related to working and maintenance of nuclear power generation.
- Students will be able to apply the knowledge in order to develop various renewable energy systems.

7ME02	**Energy Conversion-II**
Department of Mechanical Engineering, PRMIT&R	

1	Program Outcome	a	b	c	d	e	f	g	H	i	j	k
2	Mapping of course outcome with program outcome		*			*						*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	

7ME03 Industrial Management & Costing

7ME03	Industrial Management & Costing	L	T	P	C
	Total Contact Hours	3	1	-	4
	Prerequisite : Nil				

Purpose:

To make engineering students aware about basic managerial and economics skills required in an organization.

Course Objectives

1	To understand the working of business environment.
2	To study the process of evolution of management thoughts, management principles and their functions.
3	To study the importance of marketing and sales management and understanding the need of international marketing.
4	To acquire knowledge about human resources management and its importance.
5	To study materials management and its various activities.
6	To understand the procedure for cost estimation, fabrication work.
7	To study different financial statements and depreciation methods.

Syllabus:

Section – A

UNIT I :- Concept ,Principles and Techniques of Management. Evolution of management thoughts, Functions of management, organization structure & relationship (8 Hrs)

UNIT - II :- Marketing & sales Management :- Marketing strategy, market re¬search, buying, motives, types of market, New product develop¬ment, Product life cycle. Sales organization, advertising, methods of selling, consumer behaviour (7 Hrs)

UNIT III :- a) Functions of personnel management, Human resource planning, Recruitment, training and development, work¬ers participation in management, joint consultation, collective bargaining.

b) Materials management, classes of materials, scope of material control, scope and function of purchasing department, purchasing procedure, inventory

control, ordering procedure, material iden¬tification, store function. (8 Hrs)

Section – B

UNIT IV :- Objectives, functions, principle factors of estimating and estimating procedure. Estimation of weights and materials, Esti¬mation of machining time, estimation of fabrication cost, forg¬ing cost, foundry cost. (8 Hrs)

UNIT V :- a) Introduction to costing and costing Techniques:- Definitions, objectives, elements of costs, components of cost, job costing, simple process costing, normal and abnormal losses in process, waste, scrap. (8 Hrs)

UNIT VI :- a) Financing of business :- Basis of business finance, need of finance, Kinds of capital, sources of fixed & Working capital.
b) Financial statements :- Profit and loss statement , balance sheet
c) Depreciation Analysis:- Causes & significance, methods of calculation of depreciation. (7 Hrs)

Text Books :-
1. Management- principles, processes and practices; Anil Bhat, Aryakumar; Oxford University Press
2. Management Accounting; Paresh Shah; Oxford University Press
3. Estimating and Costing; TTTI Madras.
Reference Books:
1. Essentials of Management; Koontz, Harold; McGraw-Hill Education(India)
2. Cost Accounting; JawaharLal; Tata McGraw-Hill Publishing
3. Cost Accounting by Bhar

Course Outcomes:

- Students will be able to understand the working of business environment.
- Students will be familiar with the management thoughts, its evolution and functions.
- Students will demonstrate the marketing skills and knowledge related to international marketing.
- Students will be able to handle human resources and plan according to requirements.
- Students will be able to exhibit standard and scientific techniques in materials management.
- Students will demonstrate to calculate time, costs, cost sheet and depreciation of industry.

7ME03	**Industrial Management & Costing**											
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k

2	Mapping of course outcome with program outcome	*							*		*	*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
											*	

7ME04 Automation Engineering

7ME04	**Automation Engineering**	L	T	P	C
	Total Contact Hours	3	1	-	4
	Prerequisite : Nil				

Purpose:

To develop an ability to use the techniques, skills and modern engineering tools necessary for engineering practice and to demonstrate the use of modern Computer aided Manufacturing concepts.

Course Objectives

1	Describe functions of different types of automated systems
2	To find out the importance of various automated systems, partial automation and line balancing.
3	Describe NC/DNC/CNC systems in detail, its applications and advantages
4	Prepare manual part program for lathe, milling and drilling operations.
5	Describe various robot configurations and components of robot.
6	Explain the concept of Flexible Manufacturing System and application of Group Technology in FMS.
7	Demonstrate the use of Computer Aided Process Plan and its application in FMS
8	Describe the importance of Computer Integrated Manufacturing, components of CIM, and automation in inspection.

Section – A

UNIT I :- Automation & Types, Automation for mass manufacturing and assem¬bly. Automation of continuous processing systems. Detroit type automation, Automated flow lines. Methods of workpart transport, transfer mechanisms, control function. General terminology and analysis of automated flow line, partial automation, assembly systems and Line balancing. (09 Hrs)

UNIT II :- NC/CNC:- Basic concept. N.C. controls- Point to point, straight-cut and continuous path control., machine control units, closed system, NC machine components, tooling. CNC & DNCs. Manual part programming formats, programming languages-APT, ADAPT, EXAPT etc..NC/CNC Programming- Various programming

codes, Manual part programming for drilling, Milling and turning operations. Examples in APT. Sensors and adaptive control in machining. Applications and economics of CNC. (12 Hrs)

UNIT III :- ROBOTICS :- Introduction to cybernetics, Evolution of Industrial robots, Robots anatomy, Arm geometry, drive system and end effectors, sensors. Evolution of geometrical configurations for robots Programming techniques of Robots.

Application of Robots in manufacturing- casting, welding, painting, m/c loading, handling, heat treatment, assembly, inspection etc. Technical Specifications of a Robot. Robot economics. (09 Hrs)

Section – B

UNIT IV :- GROUP TECHNOLOGY AND PROCESS PLANNING: Introduction-Part families, part classification and coding systems, Group technolo¬gy machine cells, advantage of group technology, The planning function, retrieval type process planning system. Generative process planning systems, Benefits of CAPP, Expert systems and expert system approach to CAPP. (09 Hrs)

UNIT V :- FMS : Introduction, schematic of FMS, FMS cells, Components of FMS. Relation of Group Technology with FMS. Planning, Simulation and analysis of FMS. Applications of FMS.Material handling: Automated storage and Retrieval System (ASRS), Automated Guided Vehicles (AGV) etc.
(08 Hrs)

UNIT VI :- Computer Integrated Manufacturing: Introduction, Integration. Sequence of functions in CIM, elements of CIM system. CIM wheel, structure of CIM database system. Guidelines for CIM development, benefits of CIM shop floor control and process monitoring.

Automated inspection and testing: Introduction to automated inspection. Advantages over traditional method. On-line & off-line inspection, CMM construction, types & working. (09 Hrs)

Text Books:

1. Production System, Automation and CIM; MikhalGroover; Pearson Publications.
2. CNC Machines; M. Adithan&B.S.Pabla; New Age International

Reference Books:

1. Robotics; YaremKoren; McGraw Hill
2. Computer Aided Manufacturing; P.N.Rao, N.K.Tiwari&T.K.Kundra; Tata McGraw Hill.
3. Machine Tool Design; N.K.Mehta; Tata McGraw Hill
4. Computer Control of Manufacturing; YaremKoren; Tata McGraw Hill
5. CAD/CAM/CIM; Radhakrishnan&Subramaniam; New Age International

7ME09 Automation Engineering Lab

PRACTICALS :-

At least six practical's will be based on the following topics.

1. Preparation of Manual part program for Point-to-Point control. Ex.: Drilling operation.
2. Preparation of Manual Part program for two-axis CNC turning operation.
3. Study of working & Programming of XY Plotter.
4. Programming Examples on APT.
5. Study of Performance of Robots.
6. Simulation of CNC Machining.
7. Case study on CAPP.
8. Case study on GT.
9. Performance on NC and CNC m/c.
10. Study of Computer aided quality control(CAQC).

PRACTICAL EXAMINATION:-

The practical examination shall consist of viva-voce and or practical based on the termwork and syllabus.

Course Outcomes:

- Students will exhibit the concept of automation and its importance to industry and society.
- Students will be able to handle real time problems of automated flow lines like line balancing.
- Students will demonstrate the skills of development of NC/CNC programs and its application/simulation through the software.
- Students will show the ability to develop the working model of robots.
- Students will understand the concept of group technology and its applications in Flexible Manufacturing Systems
- Explain the concept of Flexible Manufacturing System and application of Group Technology in FMS.
- Students will demonstrate the use of Computer Aided Process Plan and its application in FMS
- Students will exhibit the fundamentals of Computer Integrated Manufacturing, components of CIM, and automation in inspection.

7ME04 Automation Engineering												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome	*		*							*	*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

7ME05 Non-Conventional Energy Systems (Elective-I)

7ME05	**Non-Conventional Energy Systems (Elective-I)**	L	T	P	C
	Total Contact Hours	3	1	-	4
	Prerequisite : Nil				

Purpose:

To make students aware about various renewable energy systems and technologies.

Course Objectives

1	To understand the basic concept of renewable and non-renewable sources and solar radiation.
2	To understand the knowledge of radiation transmission through covers and solar energy collections.
3	To understand the basic concept of solar energy utilization and storage.
4	To understand the concept of energy from ocean and wind.
5	To understand the concept of bio-mass energy resources.
6	To understand the concept of direct energy conversion and fuel cell.

Syllabus:

Section - A

UNIT I :-

Introduction :- Renewable & Nonrenewable sources. Solar Radiation :- Solar constant, basic earth-sun angles. Spectral distribution of extra terrestrial radiations & its variation. Solar time, Direction of beam radiation, computation of radiation on inclined surfaces, solar charts, measurements of diffuse & global & direct radiations, duration of sunshine hours, computation of radiation data, Altention of solar radiation by the atmosphere. (8 Hrs)

UNIT - II :-

Radiation Transmission through covers:- Reflection and absorption of radiation, optical properties of cover systems transmittance effects of surface layers on transmittance, transmittance absorptance product. Solar Energy collections:- Heat transfer for solar energy utilization, flat plate collectors such as liquid & air collector, collector overall heat transfer coefficient, temperature distribution between the tubes & the collector efficiency factor useful heat gain, heat removal & flow factors, Testing of collectors & effects of various parameters on the performance. Introduction to various systems of concentrating collectors. (8 Hrs)

UNIT III :-

Solar energy Utilisation:- Application of solar energy in heating, cooling, pumping, power production, distillation, drying, solar cookers, solar pond, solar furnace. Solar Energy Storage :- Methods of storage such as sensible, latent heat & thermo-chemical storage, selection of method of storage, properties of storage materials and different arrangements of storages. (No analytical treatment) (6 Hrs)

SECTION - B

UNIT IV :-

Energy from Ocean:- Tidal Power:- types of tidal plants such as single and two basin plants, power developed & operation of tidal power plant. Ocean thermal energy conversion system. Oceam temp. profile, OTE power plant development, controlled flash evaporation, indirect vapour cycle. Salinity differences conversion of salinity gradient resources, osmotic pump, dialytic battery, etc. Wind Power:- Wind speed data, power in the wind, wind power development, types of wind mills, application for pumping and power generation. (8 Hrs)

UNIT V :-

Biomass Energy Resources : Mechanism of green plant photosynthesis. efficiency of conversion, solar energy plantation, biogas – Types of biogas plants, factors affecting production rates. Pyrolysis, Gasifiess : Types & classification. Straight vegetable oils as a liquid fuels and their properties, esterification process, formation of Biodiesel, Biodiesel and its properties, suitable species for Biodiesel formation and its cultivation, byproduct formation during esterification, Biodiesel economics. (8 Hrs)

UNIT VI :

Direct Energy Conversion:- Photo voltaic cells : Principle, concept of energy conversion, conversion efficiency, power output and performance, storage. Fuel Cells : Principles types of fuel cells, conversion efficiency. Geothermal Energy Resources, power generation methods like vapour dominated. water dominated, flash steam, binary fluid and total flow concept of power generation. (7 Hrs)

Text Books:-

1. Solar Energy; S.P. Sukhatme; TMH
2. Non-Conventional Energy Sources; G.D. Rai; Khanna Publications

Reference Books:-

1. Treatise on Solar Energy; H.P. Garg; John Wiley & Sons
2. Renewable Energy Conversion, Transmission and Storage; Bent Sorensen; Elsevier Publication
3. Renewable Energy; Godfrey Boyle; Oxford University Press, Mumbai

7ME10 Non-Conventional Energy Systems (Elective-I) Lab

List of Practicals:-

Any six practical will be based on the following topics.

1. Study of Pyrheliometer and measurement of direct radiation.
2. Study of a pyranometer and measurement of global & diffuse radiation.
3. Study of a sunshine recorder and measurement of sunshine hours.
4. Study & Testing of a flat plate collector.
5. Study of various concentrating collectors.
6. Study of a solar absorption refrigerating system.

7. Study of a solar dryer.
8. Study of wind mill, and trial on it.
9. Study of a biogas plant.
10. Study of sterling cycle engine and a trial on it.
11. Study of solar still and trial on it.
12. Study of a gasifier and trial on it.
13. Study of a photovoltaic system & trial on it.

Practical Examination :

It shall consist of viva-voce based on the term-work and syllabus.

Course Outcomes:

- Students will understand concept of renewable and non-renewable sources.
- Students will understand the basic concept of radiation transmission through covers and solar energy collections.
- Students will demonstrate the basic concept of Solar energy utilization and storage.
- Students will be able to demonstrate the concept of energy from ocean and wind.
- Students will understand the concept of bio-mass energy resources.
- Students will understand the concept of direct energy conversion and fuel cell.
- Students will exhibit the knowledge of NES in development of project work.

7ME05 Non-Conventional Energy Systems (Elective-I)												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome	*		*							*	*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
											*	

7ME05 Tool Engineering (Elective I)

7ME05	**Tool Engineering (Elective I)**	L	T	P	C
	Total Contact Hours	3	1	-	4
	Prerequisite : Nil				
Purpose:					
To make the students conversant with design of various manufacturing tools like forming, cutting tools etc.					
Course Objectives					
1	To study the basic principles of metal cutting.				

2	To understand various issues related to machining like, tool wear, tool life, machinability etc.
3	To study the design procedure for design of single point and multipoint cutting tools.
4	To know the use and working of special tools like broach, die cutting, thread cutting and gear cutting tools.
5	To understand the working of various processes used in sheet metal working.
6	To get acquainted with various types of press working operations and die design concepts.
7	To study the construction and working of work holding devices like jigs and fixtures.
8	To study the concept of process planning and its applications.

Syllabus:

Section – A

UNIT I :- Theory of metal cutting: Chip formation, shear angle, shear strain-velocity relations, un-deformed chip thickness. Force relations. Merchant circle, energy consideration in metal cutting. Tool wear & tool life, Tool life criterion, mach inability, tool materials, properties & types, Newly invented tool material and their types, cutting fluids. (08 Hrs)

UNIT II :- Single point cutting tools-classification and nomenclature, various systems of nomenclature, single point cutting tool design, recommended speed, feed and tool angles determination, clamping arrangements. Form tools.
Twist drills & Reamers - Geometry types, cutting forces. Numerical on Power & torque. (09 Hrs)

UNIT III:- i) Broaches - Geometric elements of broach teeth, classification of broaches, design of broaches, cutting forces.
ii) Milling cutters - Geometry of plain milling cutter, face milling cutters and end milling cutters, milling process &cut¬ting variables, forces acting on plane milling cutters, cutters for VMC and HMC
iii) Thread cutting tools :- Geometry of taps and dies.
iv) Gear cutting tools :- Geometry of gear shaper cutter, gear hobs. (09 Hrs)

SECTION – B

UNIT IV :- Jigs & Fixtures : Design economics, principles of locations, types of locators, prevention of jamming, problems of chip and dust in location, use of dowels, Redundant location. Principles of clamping, types of clamps, power clamping, Tool guiding & tool setting, types of drill bushes, types of drill jigs & their designs, Turning, Milling, Grinding, Broaching and Assembly fixtures. Indexing devices in jigs and fixtures.(10 Hrs)
UNIT V :- Press tools:- Classification of presses, Theory of sheet metal cutting, clearance, cutting force calculations, Methods of reducing cutting forces, centre of pressure & its significance, classification of press working operations, Theory of bending, spring back action in metals, drawing fundamentals, calculation of bending &

drawing forces, plan¬ning for cupping operation, stock layout.
(09 Hrs)

UNIT VI :- Design of Press working tools: , Types of die construc¬tion, function & nomenclature of die components, Cutting Dies-Blanking & Punching. Forming Dies-Forming, Drawing and Bending etc. Design of - Compound, Combination and Progressive dies. Miscellaneous dies- Horn die, cam-action die, rubber & bulging die, sub-press die.
(09 Hrs)

Text Books:
1. Fundamentals of Tool Design -A. Kumar (Dhanpatrai& Sons)
2. A text book of Production Engineering. -P.C. Sharma (S.Chand Publication)

Reference Books:-
1. Tool Design - Cyril Donaldson(Tata McGraw Hill)
2. Jigs & Fixtures -P.H.Joshi(Tata McGraw Hill)
3. Metal Cutting Theory & Cutting Tool Design-Arshinov (Mir publications)
4. Tool Design -ASTME(ASTME)
5. Fundamentals of Metal Cutting & M/c Tools-Juneja (Age International).

7ME10 Tool Engineering (Elective I) Lab

TERM WORK: ANY EIGHT OF THE FOLLOWING.
1. Design & drawing of single point cutting tool.
2. Design & drawing of form tools.
3. Design & drawing of drill.
4. Design & drawing of broach.
5. Design and drawing of milling cutter.
6. Study of geometry of reamer.
7. Study of geometry of gear cutting tools.
8. Measurement of forces in orthogonal cutting by Dynamometer.
9. Study of geometry of taps & dies.
10. Design & drawing of press tools.
11. Design & drawing of jigs.
12. Design and drawing of fixtures.

Practical Examination :-
It shall consist of viva-voce based on the term work and syllabus.

Course Outcomes:

- Students will be able to design single and multi point cutting tools.
- Students will be able to identify the basic tool geometry.
- Students will exhibit their knowledge related to machining in order to estimate tool life and selection of cutting fluids.

- Students will demonstrate their skills in designing multipoint tools like twist drills, reamers, broach and milling cutters.
- Students will show the ability to design press working dies like punching, blanking and drawing.
- Students will handle the real time problems of work holding by designing jigs and fixtures.

7ME05 Tool Engineering (Elective I)												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome					*						*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
											*	

7ME05 Artificial Intelligence & Expert Systems (Elective-I)

7ME05	**Artificial Intelligence & Expert Systems (Elective-I)**	L	T	P	C
	Total Contact Hours	3	1	-	4
	Prerequisite : Nil				

Purpose:	
To study the basic concepts of artificial intelligence and its architecture.	
Course Objectives	
1	To study the basic concept of artificial intelligence, knowledge, and knowledge base.
2	To understand the concept and architecture of expert system.
3	To study expert system tools and build the expert system using software shell.
4	To study the concept of fuzzy logic and its applications.
5	To study the concept of process planning and its applications.

Syllabus:

SECTION -A

Unit I - Introduction to Artificial Intelligence (AI) – Overview of AI, definition and importance of knowledge, knowledge based systems, representation of knowledge, knowledge organization, knowledge manipulation, acquisition of knowledge. (6)

Unit II - Introduction to Expert Systems – Features of expert systems, knowledge engineering, basic expert system terminology, human experts and artificial experts,

algorithmic and heuristic methods, difference between conventional programs and expert systems, Architecture of expert systems (8)

Unit III - Knowledge Representation – Rule based methods, rule execution, forward chaining and backward chaining, knowledge representation using semantic nets, structure of semantic nets, Frame-based methods (8)

SECTION -B

Unit IV - Expert System Tools – Types of tools for expert system building, system building aids, support facilities, debugging aids, I/O facilities, explanation facilities, knowledge base editors, stages in the development of expert system tools, procedure oriented methods, object-oriented methods, logic-based methods, access-oriented methods
(7)

Unit V - Building an Expert System – Development phases in expert system building, development constraints, reliability, maintainability, examples of expert systems, difficulties in development of expert systems

(7)

Unit VI - Fuzzy Engineering – Fuzzy logic, fuzzy expert systems, fuzzy sets, membership functions, fuzzy rules for approximate reasoning, fuzzy inference generation, defuzzification, development of rule matrix, applications of fuzzy expert systems for design of industrial controllers. (8)

Recommended Books :
Text Book :
1) A Guide to Expert Systems By Donald A. Waterman, Pearson
2) Introduction to Artificial Intelligence & Expert Systems By Dan W. Patterson, PHI
3) Fuzzy Logic By John Yen, Reza Langari, Pearson

Reference Books :
1) Expert Systems – Theory & Practice, By Ermine, Jean Louis, PHI
2) Expert System in Engineering, By D. T. Pham, JFS Pub.
3) Expert System Applications By SumitVadera, Sigma Press
4) Artificial Intelligence By Winston P.H., Pearson

7ME10 Artificial Intelligence & Expert Systems (Elective-I)

Practical : The students are expected to perform five practical based on the above syllabus.

Course Outcomes:

- Students will be able to interact with interdisciplinary course.
- Students will be able to understand the concept of knowledge and knowledge base.

- Students will demonstrate the skills of development of expert system for industrial problems.
- Students will know the design pre-requisites and design procedure of expert system.
- Students will understand the concept of fuzzy logic and will try to implement in project work.

7ME05 Artificial Intelligence & Expert Systems (Elective-I)												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome	*	*			*					*	
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
											*	

7ME05 Mechatronics (Elective-I)

7ME05	Mechatronics (Elective-I)	L	T	P	C
	Total Contact Hours	3	1	-	4
	Prerequisite : Nil				

Purpose:	
To study the applications of electrical and electronic components in mechanical systems.	
Course Objectives	
1	To study the scope of mechatronics and working of basic components such as sensors, transducers, actuators etc.
2	To study the basics of process control using computers.
3	To study the details in designing of mechatronics system viz. tool monitoring, servo drive, diagnostic etc.
4	To study the various handling devices useful in automatic loading and unloading system.
5	To understand the working and construction of pneumatic and hydraulic systems.

Syllabus:

Section-A

Unit I : Introduction to Mechatronics

Defination, Block diagram & Example, Basics of Sensors, Position & Speed Sensors, Proximity Sensors & Switches, LVDT,Digital optical Encoder, Temperature Sensors

Actuators- Functions. Electromagnetic principles, Solenoids and Relays, working of DC motors and stepper motors, hydraulic and pneumatic actuators.
(6 Hrs.)

Unit II :Data Acquisition

Analog signal processing using operational amplifier- Introduction, types of amplifiers, sample and hold circuits, Intrduction to data acquisition, sampling thermo, Quantizing theory, Analog to digital conversion, Analog to digital convertor, Digital to analog conversion, Multiplexer.
(6 Hrs.)

Unit III :Mechatronic systems- Control architectures

Introduction, Control architectures, Analog circuits, digital circuits, Design of logic networks, sequential logic, flip-flops, application of flip-flops, micro-controllers, Programmable logic controller.

(6 Hrs.)

Section-B

Unit IV :Control Valves

Study of different control components of pneumatic & hydraulic system- Construction, Working and function of Directional control valve, Flow control valves, Pressure relief valves, pressure reducing valve, Sequence valve with symbols.

(6 Hrs.)

Unit V : Pneumatic System

Design and analysis of Pneumatic circuits- Synchronizing, Power chucking operations, controlling the rate of speed of piston, circuit to move work piece around a corner, circuit to move a work piece at a constant speed.

(6 Hrs.)

Unit VI : Hydraulic System

Design and analysis of Hydraulic circuits-Sequencing, synchronizing, Pneumohydralic, regeneration circuit, circuit to control tool movements on lathes, grinders, etc(6Hrs.)

Text Books

1. Introduction to Mechatronics and Measurement systems- 2/e by Alciatore and M.B. Histand, Tata McGraw Hill edition,
2. Pneumatics and Hydraulics by H.L. Stewart.

Reference Books:

1)Introduction to Mechatronics by AppuuKuttan K.K.- Oxford University press.
2)Mechatronics- A multidisciplinary approach 4/e by W. Bolton- Pearson Publication.
3)Automation, Production systems and CIM by M.P. Groover- Pearson Publication.

7ME10 Mechatronics (Elective-I) Lab

PRACTICALS :

Practical based on above syllabus (Total 6 practicals.)

Practical Examination :

It shall consist of viva-voce based on the term-work and syllabus.

Course Outcomes:

- Students will be able to understand the concept of computer process control.
- Students will be able to develop the working models for various mechatronics system for industrial applications.
- Students will be able to undertake mini projects on material handling systems like pick and place type robot, machine loading system etc.
- Students will be able to develop pneumatic and hydraulic circuits for various industrial applications.

- Students will understand the concept of fuzzy logic and will try to implement in project work.

7ME05 Mechatronics (Elective-I)												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome	*	*	*		*					*	*
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
											*	

8ME01 Automobile Engineering (Elective-II)

3ME02	**Mechanics of Material**	L	T	P	C
	Total Contact Hours	3	0	-	3
	Prerequisite : Nil				
Purpose:					
To understand the functioning of basic components and various systems in automobiles.					
Course Objectives					
1	To understand the basic concept of automobile engineering and its components.				
	To understand the knowledge of fuel feed system (such as MPFI and CRDI) and cooling system.				
2	To understand the basic concept of electrical system and ignition system.				
3	To understand the concept of transmission system and types of gears box.				
4	To understand the concept of braking system and steering system.				
5	To understand the concept of suspension and lubrication.				

Section - A

UNIT I :-

Classification of automobiles, chasis types, Power Unit- Functions and locations power for propulsion, engine mounting, engine parts-types, construction and functions, Multiple cylinder engines. General considerations of engine balancing, firing order. (7 Hrs)

UNIT II :-
Fuel feed systems- fuel feed systems for petrol engines. Fuel pumps, fuel filters, Air filters, Basic principles of MPFI and CRDI. Multipoint Fuel Injection Systems (MPFI), Common Rail Diesel Injection Systems(CRDI) Cooling system : purpose, types of cooling system, liquid cooling system-water jacket and ports, water pump and radiators, by pass recirculation system, temperature indicator, antifreeze mixtures, troubles and remedies of cooling system. (7 Hrs)

UNIT III :-
The electrical system. Battery Capacity, standard capacity ratings, starter motor drive-Bendix drive, over running clutch drive, solenoid switch and shift. Ignition system:-Battery coil ignition system, Ignition timing and its effect on engine performance, Ignition advance mechanisms, Electronic ignition system (7 Hrs)

Section - B

UNIT IV :-
Transmission system:- Layout, types of clutches, single plate friction clutch and multiplate clutch, clutch adjustments, clutch troubles and remedies. Gear Boxes:-Sliding mesh, constant mesh and synchromesh gear box, function of over drive, trouble shooting and remedies, torque convertor, automatic transmission, Propeller shaft, hotchkiss drive, torque tube drive, differential. (8 Hrs)

UNIT V :-
Braking system:- Mechanical, hydraulic brakes, power brakes, and vacuum brakes Fault finding and maintenance of brakes. Steering system:- Function, types of linkages, steering gears, steering gear ratio, wheel balancing, wheel alignment, camber, castor, king pin inclination, toe-in & toe-out & their effects, Introduction to power steering. (7 Hrs)

UNIT VI :-
Suspensions :- Rigid axle and independent suspension system, shock absorbers. Auto lubrication :- Types of lubricants, their tests and ratings, multi-viscosity oils, chassis lubrication. Engine lubrication:- types of lubricating systems, full pressure system, dry sump system, oil pump, oil filters system-by pass system, full flow system, oil breather, crankcase ventilation, Engine lubrication troubles and remedies. (6 Hrs)

Text Books:-
1. Automobile Engineering- Vol. I & II; Kirpal Singh; Standard Publishers Distributors
2. Automobile Engineering; R.K. Rajput; Laxmi Publications, New Delhi

Reference Books:-
1. Automotive Mechanics; Crouse &Anglin; TMH.

2. Automotive Mechanics; J.Heitner; East West Press
3. Automotive Mechanics; S. Srinivasan; TMH.

Course Outcomes:

- Students will understand the basics of automobile engineering and its components.
- Students will develop about the cooling system and its function.
- Students will exhibit basic concept of electrical system and ignition system.
- Students will demonstrate the knowledge of braking system and steering system.
- Students will understand basic concept of transmission system and types of gears box.
- Students will exhibit the knowledge of suspension and lubrication.
- Students will demonstrate the knowledge in delivering seminars and development of project work.

8ME01 Automobile Engineering (Elective-II)												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome											
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
											*	

8ME01 Production Planning and Control (Elective-II)

8ME01	**Production Planning and Control (Elective-II)**	L	T	P	C
	Total Contact Hours	3	0	-	3
	Prerequisite : Nil				

Purpose:	
To study various advanced management techniques and tools for planning, scheduling and controlling of organizational activities.	
Course Objectives	
1	To understand the importance of production planning and control, its functions, advantages.
2	To demonstrate the skills of calculating sales forecasts using various forecasting methods.
3	To understand the different ways/criteria of batch size determination and numerical based on the course topic.
4	To study the concept of machine capacity, loading of machines and man machine activity charts.
5	To calculate the size of inventory and analytical methods to solve inventory problems.
6	To understand the concept of modern techniques/philosophies of management like CIM, JIT, MRP-I and MRP-II.

Section – A

UNIT I :- INTRODUCTION

Objectives and Advantages of PPC, Production Procedure, functions of PPC, production consumption cycle, centralised and decentra¬lised PPC, Pre-requisites of PPC.

Scheduling:- Introduction, Inputs of scheduling, loading and scheduling devices, factors influencing scheduling, procedure for scheduling, Techniques of scheduling. (8 Hrs)

UNIT II :- PRODUCTION FORCASTING:-

Introduction, definition and importance of forecasts. Qualitative model: Delphi techniques, Quantitative models- Simple moving average, weighted moving average, simple exponential smoothing.

Forecasting error and selection of forecasting model. Types of forecasts: Constant, linear, cyclic forecasts. Verification and Controlling, The moving range chart, Average MR, out of control conditions. (8 Hrs)

UNIT III :- PRODUCTION PLANNING :- The production order, Procedure for formulating Production order, Master Program, Basic prob¬lems in production planning, Quantities in Batch production, criteria for batch size determination, minimum cost batch size, Production Range, Maximum profit Batch size, Maximum return, Maximum Rate of return, Economic Batch size.

(8 Hrs)

SECTION – B

UNIT IV :- MACHINE OUTPUT:- Machine output, multi machine supervision by one operator, Machine Interference, Ashcroft tables, average number of consecutive servicing task, the Ashcroft Number. (8 Hrs)

UNIT V :- ANALYTICAL STRUCTURE OF INVENTORY :- Definition of Inventory, Types of inventory and its classification, structure of inventory problems and its analysis, the relevant cost, objectives of carrying inventories, selective inventory analysis.

Static Model:- General characteristic, incremental analysis, opportunity cost, cost of risk, decision criteria under uncertainty.

(8 Hrs)

UNIT VI :- A) DYNAMIC MODEL:- CERTAINITY CASE:- General characteristic, optimum lot size model with constant demand, Quantity discounts.

Risk Case:- General characteristic, P-system and Q-system.

B) Material Requirement planning (MRP):- Introduction to MRP, Manufacturing Resource Planning (MRP-II), Just-in-Time (JIT), compari¬son of MRP, MRP-II, Entrepreneurship Resource Planning (ERP). (8 Hrs)

Text Books:-

1. Elements of Production Planning and Control by SimuelEilon – Universal Publishing Corporation ltd. Mumbai
2. Production Control- John E.Biegal - Prentice Hall of India
3. Inventory control, Theory & Practice - Starr & Miller.

Reference Books:-

1. Production planning and Control and Management - K.C.Jain&L.N.Agrawal.
2. Production & operation Mgt. - E.E.Adam, Jr.R.J.Ebert , Pre¬ntice Hall of India.
3. Industrial Engineering and Production Management- M. Mahajan- DhanpatRai

Course Outcomes:

- Students will understand the importance of production planning and control, its functions, advantages.
- Students will skills of calculating sales forecasts using various forecasting methods.
- Students will demonstrate different ways/criteria of batch size determination and numerical based on the course topic.
- Students will know concept of machine capacity, loading of machines and man machine activity charts.
- Students will understand concept of inventory control and various cases of inventory system.
- Students will exhibit the knowledge of suspension and lubrication.
- Students will understand the concept of modern techniques/philosophies of management like CIM, JIT, MRP-I and MRP-II.
- Students will be confident enough to work in industrial environment.

8ME01 Production Planning and Control (Elective-II)												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome											
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
											*	

8ME01 Management Information System (Elective-II)

3ME02	**Mechanics of Material**	L	T	P	C
	Total Contact Hours	3	0	-	3
	Prerequisite : Nil				
Purpose:					
To understand the basics of MIS and its application.					
Course Objectives					

1	To understand the basic of MIS.
2	To understand the knowledge of system analysis and design.
3	To understand the concept of development of MIS.
4	To understand the concept of information system technology, design performance monitoring and security.
5	To understand the knowledge of decision support system, enterprise management system and business process re-engineering.
6	To understand use of application of MIS in service sector and manufacturing sector.

Section-A

Unit I :BASIS OF MIS :

What is a system, what is information and data, necessity of prompt, accurate & relevant information for effective decision making, decision tables. Types of information, Organisational structure and types of information within them, Fact gathering techniques. (8 Hrs)

Unit II : System Analysis & Design :

Phases of system development procedure, project request form system proposal, cost/benefit analysis, functional specifica¬tions, detailed system description, system acceptance criteria, audit and control requirements, structured system devel¬opment, data flow diagram, context analysis diagram, exploding a process, structured analysis, structured design, structure charts, coding schemes, input form design, system protection.

(8 Hrs)

Unit - III : A) Development of MIS

Long Range plans of MIS, Class of Information, information re¬quirement, implementation of MIS, Management of Quality in the MIS, Organisation for the development of MIS, Factors of success & failure of MIS.

B) Choice of Information Technology

Nature of IT decision, Strategic decision, Configuration design, Evaluation, IT implementation plan, (8 Hrs)

Section-B

Unit-IV :Introduction to MIS

Preliminaries of Information System Technology Data base Manage¬ment System : Concepts, Models, Design, Performance monitoring& Tuning, Security in the database environment MIS & RDBMS.

DBMS Software ORACLE (8 Hrs)

Unit V:a) Decision Support Systems (DSS):

Concept & Philosophy AI, Knowledge based expert system. MIS & Role of DSS

b) Enterprise Management System (EMS):

Introduction to ERP, basic feature, benefits, selection and implementation EMS & MIS.

c) Business Process Re-engineering (BPR): Introduction, Business Process, Process model of Organisation and value stream model of organization, MIS & BPR.
(8 Hrs)

Unit VI :- Application of MIS

A) Application in Manufacturing Sector:-
Personnel Management, Materials Management, Marketing Management.

B) Application in Service Sector like Hospitals, Airlines, Ho¬tels, Banks, Insurance. (8 Hrs)

Text Books:

1) Management Information System- W.S.Jawadekar (TMH, 2010)
2) Data Processing System Analysis- and Design Robert J Vondon

Reference Books:-

1) Computers and Information System - Madrvin R Gore & W Stubbe.
2) Information systems for operation and Management - Voichdan, Homer.
3) Management Information Systems - Ross.

Course Outcomes:

- Students will develop the knowledge of MIS.
- Students will exhibit the knowledge of system analysis and design.
- Students will understand basic concept of development of MIS.
- Students will study information system technology, design performance monitoring and security.
- Students will demonstrate the knowledge of decision support system, enterprise management system and business process re-engineering.
- Students will be able todevelop the application of MIS in service sector and manufacturing sector.

8ME01 Management Information System (Elective-II)												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	D	e	f	g	h	I	j	k
2	Mapping of course outcome with program outcome											
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
											*	

8ME01 Advanced Manufacturing Systems (Elective-II)

8ME01	**Advanced Manufacturing Systems (Elective-II)**	L	T	P	C
	Total Contact Hours	3	0	-	3
	Prerequisite : Nil				

Purpose:	
Course Objectives	
1	To understand the basic concept of total quality control (TQM), case study of performance measures and implementation of TQM.
2	To understand the knowledge of total productive maintenance (TPM).
3	To understand the concept business process re- engineering (BPR).
4	To understand the concept of value engineering and its application in industry.
5	To understand the concept of concurrent engineering and rapid prototyping.
6	To understand the concept of just in time (JIT), design, development and implementation of JIT.

Section-A

Unit I

Total Quality Management (TQM) : Understanding quality, commitment & leadership Customer satisfaction Employee involvement Performance measures - Case Study Implementation of TQM Case Study (10)

Unit II

Total Productive Maintenance (TPM) : Introduction outline of TPM Concepts of "Kobetsu-Kaizen", "Jishu-Hozen" Planned Maintenance Systems Operation & Maintenance skill upgrade training initial control, "Hinshitsu - Hozen" concept. (10)

Unit III

Business Process Re-Engineering (BPR) : Introduction, Reengg., Rethinking The new world of work Who will Re-Engineer ?, Succeeding at Re-Engg.- case study (10)

Section-B

Unit IV

Value Engineering (VE) Introduction Value Orientation The various phases of VE like orientation phase, Information phase, function phase .... etc. How to manage the VE programme
Case Study (10)

Unit V

Concurrent Engineering (CE) Introduction to CE & need of CE CE tools Advances in design & manufacturing engg. Design for manufacture, design for assembly Rapid prototyping Concurrent approaches to design, manufacturing and other aspects of engg. (10)

Unit VI
Just In Time (JIT) Introduction to JIT What is Toyota Production System Design, Development & Management of JIT manufacturing systems Implementation of JIT (10)

Books Recommended

Text Books:
1) Besterfield D.H. et.al, "Total Quality Management", PHI, New Jersey, 1995.
2) Johan S. Okland, "TQM : Text with Cases", Butterworth einemann, Oxford, 1995.
3) "TPM Edited Notes" by Japan Institution of Plant Maintenance.
4) Michel Hammer &JomesChampy, "Re-Engineering the Corporation, Nicholas Brealely, London, 1994.
5) G.Jogannathan, "Getting More at Less Cost : The Value Engineering Way", Tata McGraw Hill, 1992.

Reference Books :
1) Andrew Kusiak, "Concurrent Engineering : Automation, Tools & Techniques", John Willey & Sons.
2) Chanan S. Syan&UnnyMenon, "Concurrent Engineering : Concept, Implementation & Practice", Chapman & Hall.
3) M.G.Korgaonkar, "Just in Time Manufacturing", Macmillan India Ltd., New Delhi, 1992.

Course Outcomes:

- Students will understand basics of total quality control (TQM), case study of performance measures and implementation of TQM.
- Students will exhibit the knowledge of total productive maintenance (TPM).
- Students will understand concept business process re-engineering (BPR).
- Students will understand the concept of value engineering.
- Students will understand concept of concurrent engineering and rapid prototyping.
- Students will show design, develop and implement the concept of JIT in practice.

8ME01 Advanced Manufacturing Systems (Elective-II)												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome											
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
											*	

8ME02 Refrigeration & Air Conditioning (Elective-III)

8ME02	**Refrigeration & Air Conditioning (Elective-III)**	L	T	P	C
	Total Contact Hours	3	0	-	3
	Prerequisite : Nil				
Purpose:					
To study different refrigeration and air condition systems, their basic working cycles, components and controls.					
Course Objectives					
1	To understand the fundamental basic of simple vapour compression system, types of refrigerant used in refrigeration system .				
2	To understand the multistage pressure system and its types.				
3	To study the refrigeration system components and its controls, defrosting systems.				
4	To understand the concept psychrometric properties and psychometric processes, human comfort and its related issues.				
5	To understand the concept air conditioning system as winter, summer air conditioning system applications and its related issues.				
6	Elementary treatment on load calculation and applied psychrometry.				

Syllabus:

Section - A

UNIT I

Introduction to automotive air conditioning:- Vapour compression system:- Analysis of simple vapour compression system. Use of pressure enthalpy, Temperature entropy charts. Effect of operating conditions such as evaporation and condenser pressure, superheating and sub cooling. Actual vapour compression system. Refrigerants:- Classification: primary and secondary refrigeratns, desirable properties of refrigerants, merits and demerits of commonly used refrigerants such as Ammonia R-12, R-22 and their
selections and eco friendlyrefrgeration 134a, HFC

UNIT II

Multi stage pressure systems:- Multistage compression: choice of Intermediate pressure, complete multistage compression. Multi-evaporator system; single compressor individual expansion valve, single
compressor multi expansion valves, individual compressor multi- expansion valves, Cascade systems, its application to cryogenics Air liqulification processes- Linde-Hampson (No numerical treatment to air liquifaction system) (10 Hrs)

UNIT III

Refrigation system components and controls:- Brief study of refrigerant compressors, condensers, evaporators, expansion valves, dryer, fillers, selection criteria for the compoonents of vapour compression systems flow controls, temperature controls,

pressure controls and safety devices. Defrosting systems, testing and charging of refrigeration systems, leak detection. (No Analytical treatment is expected) (8 Hrs)

Section - B

UNIT IV

Psychrometric properties of moisairpsychrometric chart, concept of thermo-dynamic wet-bulb temperature,

Representation of psychrometric process on psychrometric charts, mixing of air, evaporating cooling, Air washers. Human Comfort:- Metabolism of human body, factors influencing comfort, conceptof effective temperature, optimum effective temperature and comfort charts. (7 Hrs)

UNIT V

Classification of air-conditioning system & applications. Unitary system package, window type and split type airconditioning. Central system :- System components, types:- Direct expansion system, All water system and all air system. Winter, summers and year round air-conditioning. Transmission and distribution. Types of supply air ducts, considerations for selection and location of outlet, distribution patterns of outlets, location of return air opening and introduction to duct design. (No numerical treatment is expected) (9 Hrs)

UNIT VI

Load calculation and applied psychrometyr-Basic considerations and heat gains/losses senssible and latent,

heat due to occupancy lighting, appliances, products, process, air conditioning systems, safty factor cooling load estimates, heating load estimates. Sensible heat factor By pass factor, apparatus dew point, effective sensible heat factor. (8 Hrs)

Books Recommended:-

Text books:

1. Refrigeration and Air Conditioning; C.P.Arora; Tata McGraw Hill Publication
2. Refrigeration and Air conditioning; Arora, Domkundwar; DhanpatRai Publication

Reference Books:

1. Principles of Refrigeration; J. Dossat; Pearson Education Asia Publication
2. Refrigeration and Air Conditioning- P.L.Balaney
3. Refrigeration and Air conditioning- Manohar Prasad

8ME06 Refrigeration & Air Conditioning (Elective-III) Lab

List of Practicals:-

Any six of the following should be conducted and a report there of should be submitted.

1. Trial on vapour compression system.
2. Trial on Air-conditioning system.
3. Study of Electrolux system.
4. Study of Water cooler.

5. Study of window Air conditioner.
6. Study of household refrigerator.
7. Study of desert cooler.
8. Study of cold storage plant.
9. Testing and changing of referigeration system.
10. Study of defrosting system.
11. Study/ trial of ice plant.
12. Study of various refrigeration and air-conditioning controls

Practical Examination:-
It shall consist of viva-voce based on term work and syllabus.

Course Outcomes:

- Students will exhibits the fundamental basic of simple vapour compression system, types of refrigerant used in refrigeration system
- Students will understand the multistage pressure system, its types and elementary treatment of refrigeration system.
- Students will exhibit the knowledge of refrigeration system and its controls, defrosting.
- Students will understand the concept psychrometric properties and psychrometric processes, human comfort and its related issues.
- Students will understand the concept air conditioning system as winter, summer air conditioning system applications and its related issues.
- Students will be able to demonstrateelementary treatment on load calculation and applied psychrometry.

8ME02 Refrigeration & Air Conditioning (Elective-III)												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome											
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
											*	

8ME02 Machine Tool Design (Elective-III)

8ME02	**Machine Tool Design (Elective-III)**	L	T	P	C
	Total Contact Hours	3	0	-	3
	Prerequisite : Nil				

Purpose:	
To make the students conversant with design of various manufacturing tools like forming, cutting tools etc.	
Course Objectives	
1	To understand the general requirements of machine tool design, kinematics of machine tool, basic design considerations.
2	To understand the mechanical, electrical, hydraulic step-less regulation of speeds.
3	To study the machine tool structure.
4	To understand the concept static and dynamic rigidity, methods of increasing rigidity.
5	To study the concept of vibrations in machine tool and related issues.
6	To study the machine tool parts like, guideways and slideways.
7	To study the design procedure of machine tool spindle and bearings.

Syllabus:

Section - A

UNIT - I

General requirement of machine tool design kinematics of m/c tool :- Various driving systems used in machine tools, basic design consideration in the design of variable speed range in the machine tools, layout of speed in geometric, logarithmic and earthmatic progression saw diagram, range ratio, Graphical representation of speed on structural and ray diagram, design of speed and feed boxes and their classification. (11 Hrs)

UNIT II

a) Mechanical electrical, Hydraulticstepless regulation of speeds.

b) Machine tool structure (bed, column, cross-rail) functions & their requirements design criterion for machine tool structure design procedured factors efftecting stiffness fo machine tool structure & their profile. (8 Hrs)

UNIT III

Static & dynamic rigidity, methods of increasing rigidity of structure, machine tool clasfic system, procedure for assessing dynamic stability, dynamic charactostics, single degree &multidegree of ferrdom systems, Experimental determination of dynamic charactorstics of m/c tool, dynamic characteristics of cutting process, statrility analysis, single degree, multidegree. (8 Hrs)

Section - B

UNIT IV

Vibrations of machine tools:- Effects of vibration on m/c tool on cutting condns, workpiece, tool life. Sources of cibrations, types of vibrations (forced, chatter, sticksup vibrations) and its minimisation. Shock absorber, isolalid tool bloder, chatter in milling lathe, grinding, reduction of chatter in design & production stages. (8 Hrs)

UNIT V

a) Machine tool guideways&slideways :- Functions, shapes of guidaway, materials, methods of adjusting clearance inguideways, design of slideways for wear resistance, determination of miximum and average pressure, on slide way. Hydraulic guidway, antifriction guideay, protecting devices for slideway. (8 Hrs)

UNIT VI
Machine tool spindle and bearings:- Functions, requirement, types and materials of spindle, machine tool compliance, design of spindle, antifriction bearing, performance indices, Hydrostatic journal bearing, hydrodynamic bearing. (7 Hrs)

Books Recommended:
Text books:
1. Principles of Machine Tools - Base & Pal
2. M/c Tool Design - N.K.Mehta

Reference Books :-
1. Machine Tool Design Vol. I, II, III, IV; N. Acherkar (Mir Pub)
2. Principles of M/c Tools - Sen& Bhattacharya
3. Design Principles of Metal – Kondsberger Cutting Machine Tools
4. Machine Tool Desing Vol. I to VI - CMIT, Banglore

8ME06 Machine Tool Design (Elective-III) Lab

PRACTICALS:-
1. Design of speed box.
2. Design of feed box.
3. Design of combination guideway.
4. Design of combination guideway
5. Acceptance lists.
6. Pneumetic trainer.
7. Hydraulic trainer.
8. Design of laths bed.
Note:- At least six practical from above list should be done.

Practical Examination:-
It shall consist of viva-voce based on term work and syllabus.

Course Outcomes:

- Students will exhibits knowledge of general requirements of machine tool design, kinematics of machine tool, basic design considerations.
- Students will study the mechanical, electrical, hydraulic step-less regulation of speeds.
- Students will demonstrate the knowledge of machine tool structure.
- Students will be able to study and demonstrate the concept if rigidity, static and dynamic conditions.

- Students will understand the vibrations in machine tool and will take care of in designing the machine tool.
- Students will exhibit the knowledge of design considerations of guideways, slideways, machine tool spindle and selection of bearings.

8ME02 Machine Tool Design (Elective-III)												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome											
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
											*	

8ME02 Finite Element Method (Elective-III)

8ME02	Finite Element Method (Elective-III)	L	T	P	C
	Total Contact Hours	3	0	-	3
	Prerequisite : Nil				

Purpose:	
Course Objectives	
1	To understand the concept of finite elements, finite element method and steps of FEM, advantages and applications.
2	To demonstrate the mathematical understanding required for FEA and finite difference techniques.
3	To understand the concept of finite element modeling, shape functions and boundary conditions.
4	To study the development of beam equation, truss equation, treatment of body and surface forces.
5	To understand the knowledge of application of FEA, stresses on beams, three dimensional frames, heat transfer, flow through pipe and its related issues.

Syllabus:

Section –A

Unit I

Introduction: Application, Advantages, Steps of FEM, Stress and Equilibrium, Boundary conditions, Strain Displacement Relations, Stress-strain Relations, Von mises stress, Temperature effect, Potential Energy and Equilibrium, Galerkin's Method, stiffness (Displacement) method. (7 Hrs)

Unit II

Matrix Algebra And Gaussian Elimination: Matrix Multiplication, Transposition, Diagonal Matrix, Symmetric Matrix, Upper Triangular Matrix, Determinant of matrix, Matrix Inversions, Eigen values & Eigenvectors, Gaussian elimination. (7 Hrs)

Unit III

1D Problems : Finite Element modeling, coordinate Shape function, The potential Energy approach, The Galerkin's Approach, assemblies of the global Stiffness matrix and load vectors, Properties of stiffness matrix, Treatment of boundary conditions, quadratic Shape Functions, Temperature Effects. (7 Hrs)

Section -B

Unit IV

2D Problems for CST: Constant strain Triangle, isoperimetric Representation, potential energy approach, element stiffness, galaerkin's approach, temperature effects, Problem modeling and boundary conditions.(7 Hrs)

Unit V

Development of Equations: Truss equations, derivation of the stiffness matrix for a bar element in local coordinate, global stiffness matrix, Beam Equation, Beam Stiffness, example assemblage of beam stiffness matrix, plain Stress and plain Stress stiffness equations, basic concept of plain stress and plain strain, derivation of the CST stiffness matrix and equations. Treatment of body and surface forces. (7 Hrs)

Unit VI

Heat Transfer ;Derivation of the basic differential equations, Heat transfer with convection, conduction, radiation, 1D Formulation using variational method

Fluid Flow: Derivation of the basic differential equations, 1D Finite Element formulation, Computer implementation (prepossessing, post processing, input data file, mesh generation). (7 Hrs)

Books Recommended:

Text Book:-

1. Introduction to Finite Element Engineering- T.R. Chandrupatla, Belegunda; PHI
2. A First course in Finite Element Method –Darya Logon, Thompson Learning (TL Publisher).

Reference Books:

1. The Finite Element Method in Engineering- S.S. Rao, Elsvier Publication, 4th edition
2. Fundamentals of Finite Element Analysis – D.V. Huttan, Tata Mcgraw Hill,
3. Concept and Applications of Finite Element Analysis - Robert D.Cook
4. Finite and Boundary Element Method in Engineering - O. P. Gupta
5. An Introduction to Finite Element Method -J.N. Reddy, Tata Mcgraw Hill, 2nd Edition 2005.

8ME06 Finite Element Method (Elective-III) Lab

List of Practicals

1. To study the computational design procedure for solving problem using FEM.
2. To study the application of FEM packages to mechanical engineering problems.
3. At least four case studies based on above syllabus using any Analysis software.

Practical Examination:-
It shall consist of viva-voce based on term work and syllabus.

Course Outcomes:

- Students will exhibits knowledge of principal of FEA, its types, governing equation, fundamental concept of solid mechanics.
- Students will demonstrate the mathematical understanding required for FEA and finite difference techniques.
- Students will concept of finite element modeling, shape functions and boundary conditions.
- Students will understand the knowledge of application of FEA such as related to stress on beams, three dimensional frames, heat transfer, flow through pipe and its related issues and analysis of application.
- Students will exhibit the knowledge of using FEA software for analysis of industrial application
- Students will demonstrate the use of FEA in their project work.

8ME02 Finite Element Method (Elective-III)												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome											
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
											*	

8ME02 Robotics (Elective-III)

8ME02	**Robotics (Elective-III)**	L	T	P	C
	Total Contact Hours	3	0	-	3
	Prerequisite : Nil				
Purpose:					
To study basic concepts of robots, their types, anatomy, configuration, programming and applications of robots.					
Course Objectives					
1	To understand the concept of robotics, evolution of robots, and relation				

	between automation and robotics.
2	To study the robot anatomy, configuration of robot, end effectors and different types of manipulator.
3	To understand various robot drives and controls.
4	To understand the concept of kinematic analysis of robots.
5	To study the concept robot sensors.
6	To understand the concept robot programming, its methods and programming languages.
7	Application of robots used in various field and is related issues.
8	Quantitative approach to find out robot economy.

Syllabus:

SECTION- A

Unit I - Fundamentals of Robotics – Introduction, Automation and Robotics, robot applications, robotic systems, robot anatomy and robot configurations, joint types used in robots, robot wrists, joint notation schemes, work volumes for various robot anatomies, robot specifications

(8)

Unit II - Robot end-effectors – Classification of end-effectors, mechanical grippers, hooking or lifting grippers, grippers for molten metals, plastics, vacuum cups, magnetic grippers, electrostatic grippers, multiple grippers, internal and external grippers, drive systems for grippers, active and passive grippers

(7)

Unit III - Robot drives and controls - Pneumatic power drives, hydraulic systems, electric drives, robot controllers – servo and non-servo systems, motion control of robots, point to point and continuous path control, teaching of robots, robot programming methods

(7)

SECTION-B

Unit IV - Robot sensors – Scheme of robotic sensors, contact type sensors, force, torque, touch, position, velocity sensors, non-contact type sensors, electro-optical imaging sensors, proximity sensors, range imaging sensors, robot environment and robot input/output interfaces, machine intelligence, safety measures in robots

(7)

Unit V - Robot Kinematics – Forward and reverse kinematics, forward and reverse transformation of two DOF and three DOF 2-D manipulator, homogeneous transformations

(7)

Unit VI - Quantitative Techniques for economic performance of robots – Robot investment costs, robot operating expenses, methods of economic evaluation, method of pay-back period, return on investment method, discounted cash flow method, equivalent uniform annual cost method

(8)

Recommended Books :
Text Book :
1) Robotics Technology & Flexible Automation By S. R. Deb, Tata McGraw Hill
2) Industrial Robotics By M. P. Groover, McGraw Hill

Reference Books :
1) Robotics for Engineers, KorenYoram, McGraw Hill
2) Robots and Manufacturing Automation, By Asfahl, C. Ray, John Wiley
3) Robotic Engineering By Richard D. Klafter, PHI.

8ME06 Robotics (Elective-III) Lab

Practical : The students are expected to perform five practical based on the above syllabus.

Course Outcomes:

- Students will exhibits understand the concept of robotics, its history.
- Students will be able to know robot anatomy, and various configurations for different industrial applications
- Students will exhibit the knowledge of end effectors and different types of manipulator.
- Students will understand the concept of kinematic analysis of robots.
- Students willunderstand the applications ofrobot sensors.
- Students will understand the concept robot programming, its methods and programming languages.
- Students will knowledge of application of robots used in various field and is related issues.
- Students will be able to solve analytical problems for selection of robots.

8ME02 Robotics (Elective-III)												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	F	g	h	i	j	k
2	Mapping of course outcome with program outcome											
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
											*	

8ME03 I. C. Engines

8ME03	**I. C. Engines**	L	T	P	C
	Total Contact Hours	3	0	-	3

	Prerequisite : Nil				

Purpose:	
To acquire knowledge of IC Engines and their types and to study fuels and their properties.	
Course Objectives	
1	To study the fundamental of I.C. engines, their types and cycle analysis
2	To understand the knowledge of fuels and alternative fuels, study of fuel injection pump.
3	To study the concept of combustion of SI engine, stages of combustion.
4	To understand the concept of combustion of CI engine.
5	Performance testing of IC engine and including heat balance sheet, excess air calculations.
6	To understand the basics of supercharging, objectives, advantages and limitations.
7	To study the basics of emissions from IC engines, study of emission norms.

Section - A

UNIT I :-

Introduction to IC Engines and cycle analysis: Basics of I.C. Engines, Details of two stroke and four stroke engines, Air standard cycles, Fuel air cycle and actual cycle. Variation in specific heat, Dissociation and their effect on engine performance. Review of other losses in IC engines .

(7 Hrs)

UNIT II :-

Fuels and alternative fuels: Conventional fuels for IC engines, requirement, properties, fuel additives, limitations of fossil fuels. Review of various alternative/ non-conventional fuels

Studies of fuel injection systems : Fuel pump and their working, different types of fuel feed systems, studies of injectors, nozzles, Bosch type fuel pump.

(8 Hrs)

UNIT III :-

Combustion SI Engine:- Stages of combustion, factors influencing various stages, Normal and abnormal combustion, Detonation, Factors responsible for detonation. Effect of detonation. Octane rating of fuel, Requirement of combustion chambers for SI engines, important types, relative advantages and disadvantages and application.

(8 Hrs)

Section - B

UNIT IV:-

Combustion in CI Engine :- Stages of combustion in CI Engine, delay period, factor affecting delay period. Diesel knock, Cetane rating. Requirements of combustion chamber for CI Engine. Methods of generating turbulence in combustion chamber. Types of combustion chambers for CI engine. (8 Hrs)

UNIT V :-

Performance testing of IC engines: Evaluation of various performance parameters of IC engines including heat balance sheet and excess air calculations. Methods of determination of friction power.
Supercharging: basic principle, Objectives, Arrangements for supercharging, Advantages and limitations of supercharging.
(8 Hrs)

UNIT VI :-
Emissions form IC engines: Review, Their effect on human health, Causes of formation and approaches to control these pollutants. Study of BIS, EURO emission norms,
IC Engines: Recent trends : Microprocessor based engine management, Multipoint fuel injection engines, Common rail direct injection engines, variable valve timing engines.
(8 Hrs)

Text Books.
1. Internal Combustion Engines - M.L.Mathur and Sharma, Dhanpatrai and soms
2. Internal Combustion Engines – V Ganeshan, Tata MacGraw Hills

Reference Books
1. Internal Combustion Engines Fundamentals - John B. Heywood, MacGraw Hills
2. Internal Combustion Engines & Air Pollution - Obert E.F. Intext Educational

8ME07 I. C. Engines Lab

List of Experiments :
Any six of the following practical should be performed and
1. Performance test on a single cylinder diesel engine.
2. Performance test on a single cylinder petrol engine.
3. Evaluation of the heat balance for single cylinder diesel engine.
4. Performance test on a multi-cylinder petrol engine.
5. Morse test on multi-cylinder petrol engine.
6. Trial on petrol/ diesel engine to plot P-θ and P-V diagram
7. Measurement of exhaust gas emission from S. I . Engine.
8. Measurement of smoke density of CI engine exhaust.
9. Study of Bosch type single plunger fuel pump.
10. Study of various types of fuel injectors and nozzles.

Practical Examination shall consists of viva voice based on above termwork and syllabus

Course Outcomes:

- Students will understand fundamentals of I.C. engines, their types and cycle analysis.
- Students will exhibits the knowledge of fuels and alternative fuels, study of fuel injection pump.
- Students will understand basic concept of combustion of SI engine.

- Students will know the concept of combustion of CI engine.
- Students will be able to apply the performance test on IC engine and heat balance sheet.
- Students will understand the concept of supercharging its objectives, advantages and limitations.
- Students will be able to understand BIS, EURO emission norms.

8ME03 I. C. Engines												
Department of Mechanical Engineering, PRMIT&R												
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome											
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				

8ME04 Operations Research Techniques

8ME04	**Operations Research Techniques**	L	T	P	C
	Total Contact Hours	3	0	-	3
	Prerequisite : Nil				
Purpose:					
To make students aware about tools of optimization of resources and decision making.					
Course Objectives					
1	To understand the concept of operation research with OR models.				
2	To solve transportation problems, assignment problems and related issues.				
3	To understand the network models, CPM and PERT analysis.				
4	To understand the concept waiting line theory, sequencing and related issues.				
5	To understand the applications of replacement models and simulation.				
6	To understand the concept of dynamic programming and applications.				

Syllabus:

Section – A

Unit I

Operations Research: Introduction, Characteristics, Phases, Limitations, Models and Classification of O.R. models.

Linear Programming: Formulation, Standard Form, Graphical and Simplex methods, Primal-Dual relationship. (8 Hrs)

Unit II

Transportation Models: Introduction, LP formulation of transportation problems, Methods for finding initial solution, MODI method.
Assignment Models: Introduction, Mathematical statement and solution methods of assignment problems, Variations of assignment problems. (6 Hrs)

Unit III
Network Models: Network construction, PERT analysis, CPM analysis, Cost analysis and crashing the network, Updating- resource smoothing and leveling. (6 Hrs)

Section – B

Unit IV
Waiting line models: Introduction, Characteristics, Classification, Analysis of M/M/1 and M/M/s models.
Sequencing: Processing of n jobs through 2 machines, n jobs through m machines, 2 jobs through m machines. (7 Hrs)

Unit V
Replacement models: Introduction, Value of money, Individual and group replacement policies.
Simulation: Introduction, Monte Carlo simulation, Advantages and limitations, Applications of simulation to- Queuing models, Inventory models, Maintenance models, etc. (7 Hrs)

Unit VI
Dynamic Programming : Introduction, Characteristics, Applications of dynamic programming to- Capital budgeting, Production scheduling, Travelling salesman, Cargo loading problems, etc. (6 Hrs)

Books Recommended:
Text Books:
1. Operations Research Theory And Applications- Second Edition; J. K. Sharma; Macmilan Business Books.
2. Operations Research; Prem Kumar Gupta, D.S. Hira; S. Chand & Co. Ltd.

Reference Books:
1. Introduction To Operations Research, Seventh Edition; Hiller / Lieberman; Tata McGraw-Hill.
2. Operations Research: An Introduction, Seventh Edition H. A. Taha; Phi.
3. Operations Research: Principles And Practice, Second Edition: Ravindran, Phillips, Solberg: John Wiley & Sons
4. Operations Research; Kapoor

8ME08 Operations Research Techniques Lab

List of Practicals: ¬
At least 6 Practicals from following:¬
1. Formulation of LPP from real life situation.

2. Solution of LPP by using MS Excel.
3. Case study on transportation problems.
4. Case study on assignment problems.
5. Case study on project network.
6. Case study on sequencing problems.
7. Constructing and solving the simulation model from real life situationsg
8. Study of Replacement model through different problem.
9. Case study on dynamic programming problems.

External Practical Examination -Viva voce on the term work and syllabus

Course Outcomes:

- Students will exhibits the knowledge of OR and OR models.
- Students will be able to solve transportation problems and related issues.
- Students will understand the concept network models, CPM and PERT analysis.
- Students will understand the concept waiting line model, and sequencing and its related issues.
- Students will understand the concept replacement models and solve the problem on simulation techniques.
- Students will understand the concept of dynamic programming and applications.

	8ME04 Operations Research Techniques											
	Department of Mechanical Engineering, PRMIT&R											
1	Program Outcome	a	b	c	d	e	f	g	h	i	j	k
2	Mapping of course outcome with program outcome											
3	Category	General (G)			Basic Science (B)			Engineering Science&tech (E)			Professional Sub (P)	
								*				