SWAMI RAMANAND TEERTH MARATHWADA UNIVERSITY
"DNYANTEERTH", VISHNUPURI, NANDED

PROPOSED CURRICULUM FOR
T.E. (MECHANICAL ENGINEERING)
(CGPA Revised)
w.e.f. 2020-21

Teaching Scheme – B. E. (Third Year) Mechanical Engineering (CGPA Revised)

SEMESTER – V **Effective from 2020 - 2021**

Sr. No.	Category	Sub Code	Subject	Teaching Scheme				Marking Scheme					Theory Total	Semester Total
				TH	P	T	CR	PR	OR	TW	MSE	ESE		
1	Professional Core Course	PCC - ME - 501	Heat Transfer	3	2		4		25 @	25	30	70	100	150
2	Professional Core Course	PCC - ME - 502	Engineering Metallurgy	3	2		4			25	30	70	100	125
3	Professional Core Course	PCC - ME - 503	Manufacturing Process	3	2		4	25 #			30	70	100	125
4	Professional Core Course	PCC - ME - 504	Kinetics and Theory of Machine	3	2		4			25	30	70	100	125
5	Professional Core Course	PCC - ME - 505	Mechanical Measurement and Metrology	3	2		4	25 @		25	30	70	100	150
6	Professional Core Course	PCC – ME - 506	Mechanical Engineering laboratory		4		2	25 #						25
7	Mandatory Course	MC – ME – 507	Indian Constitution/ Indian Tradition Knowledge	2					25 @					25
8	Mandatory Course	MC – ME - 508	Soft skills for Personality Development		2					25				25
9	Mandatory Course	MC – ME - 509	NPTEL Course – I		2		1							
10	Mandatory Course	IT – ME - 510	Industrial Training – I						25 @	25				50
			Semester Total	17	18		23	**75**	**75**	**150**	150	350	**500**	**800**

TH – Theory , P– Practical, T – Tutorial , CR – Credit , PR – Practical OR – Oral , TW – Term work, MSE – Minor Semester Examination, ESE – End Semester Examination, @- Internal Assessment, # - External Assessment.

Dr. V. M. Nandedkar	**Dr. M. K. Rodge**	**Mr. S. S. Deolgaonkar**	**Dr. R. S. Kamble**	**(Chairman)**
S.G.G.S.I.E. & T	**S.G.G.S.I.E. & T**	**GRACE**	**GRACE**	**Dean Engineering**
Vishnupuri, Nanded	**Vishnupuri, Nanded**	**Vishnupuri, Nanded**	**Vishnupuri, Nanded**	**SRTM University Nanded.**

Teaching Scheme –B. E. (Third Year) Mechanical Engineering ((CGPA Revised)

SEMESTER – VI **Effective from 2020 - 2021**

Sr. No.	Category	Sub Code	Subject	Teaching Scheme				Marking Scheme					Theory Total	Semester Total
				TH	P	T	CR	PR	OR	TW	MSE	ESE		
1	Professional Core Course	PCC - ME - 601	Manufacturing Technology	3	2		4	25 #		25	30	70	100	150
2	Professional Core Course	PCC - ME - 602	Design of Machine Elements	3	2		4		25 #	25	30	70	100	150
3	Professional Core Elective Course	PCEC - ME – 603 (A to D)	Elective – I	3	2		4			25	30	70	100	125
4	Professional Core Elective Course	PCEC - ME – 604 (A to D)	Elective – II	3	2		4			25	30	70	100	125
5	Open Elective Course	OEC - ME – 605 (A to B)	Open Elective – I (Humanities)	3			3			25	15	35	50	75
6	Professional Core Course	PCC - ME - 606	Mechanical Engineering Lab (Hypermesh)		4		2	25 #						25
7	Humanities and Social Sciences including Management Course	HSMC – ME - 607	Seminar – II	2			1			25				25
8	Humanities and Social Sciences including Management Course	MC – ME - 608	Technical and Competitive Skills	2					25@					25
9	Mandatory Course	MC – ME - 609	NPTEL Course – II		2		1							
			Semester Total	19	14		23	**50**	**50**	**150**	135	315	**450**	**700**

TH – Theory , P– Practical, T – Tutorial , CR – Credit , PR – Practical, OR – Oral , TW – Term work, MSE – Minor Semester Examination, ESE – End Semester Examination, @- Internal Assessment, # - External Assessment.

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Dean Engineering
SRTM University Nanded

Mechanical Engineering

Fifth Semester

Curriculum Details

Course Name : Third Year Mechanical Engineering

Semester : Fifth

Subject Title : Heat Transfer

Subject Code : PCC-ME-501

Teaching Scheme (in hrs)			Total Credit (TH +T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
3	--	2	4	30	70	25@		25	150

Course Objectives:

The course is designed to address the following:

1. The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
2. Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.
3. The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers.

Contents:

Module 1: Conduction (12 Hrs)

Introduction to three modes of heat transfer, Derivation of heat balance equation- Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, heat transfer through fins- Two dimensional conduction solutions for both steady and unsteady heat transfer

Module 2: Heat convection (10 Hrs)

Basic equations, boundary layers- Forced convection, external and internal flows- Natural convective heat transfer- Dimensionless parameters for forced and free convection heat transfer- Correlations for forced and free convection- Approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow- Estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.

Module 3: Radiation Heat Transfer (8 Hrs)

Fundamental concepts, Basic laws of radiation: Planks law, Kirchoffs law, Stefan Blotzman Law, Wein's displacement law and Lambert's cosine law, Emissivity, Radiosity, Radiation heat exchange between two black bodies, Shape factor for simple geometries, Radiation heat exchange between two infinitely parallel plates & cylinders, Radiation shields, Heat transfer with radiation shields.

Module 4: Heat Exchangers: (8 Hrs)

Heat exchangers classification, Overall Heat transfer coefficient, heat exchanger analysis- use of log mean temperature difference (LMTD) for parallel & counter flow heat exchangers, Special case of condensers & evaporators and heat exchangers where heat capacities of fluids are same, The effectiveness-NTU method for parallel and counter flow heat exchangers.

Module 5: Boiling and Condensation: (8 Hrs)

Boiling heat Transfer, Pool boiling, Forced convection boiling, Condensations heat transfer, Film condensation, drop wise condensation, Introduction mass transfer, Similarity between heat and mass transfer

List of Experiments: - (The Term Work shall consists the record of minimum of **eight** experiments out of the following list)

1. Determination of Thermal conductivity of Insulation Powder.
2. Determination of Thermal conductivity of Metal Rod.
3. Determination of thermal conductivity of composite wall.
4. Determination of heat transfer coefficient in Natural Convection.
5. Determination of heat transfer coefficient in Forced Convection.
6. Determination of heat transfer coefficient in temperature distribution, fin efficiency and
7. Effectiveness in Natural/Forced Convection
8. Determination of Emissivity of a Test surface
9. Determination of heat transfer coefficient in effectiveness of parallel flow and counter flow heat exchanger.
10. To determine heat transfer co-efficient for tube and tube heat exchanger.
11. To determine heat transfer co-efficient for transient heat transfer apparatus.
12. Determination of heat transfer coefficient in Stefan Boltzman constant.
13. Determination of heat transfer coefficient in Emissivity of a grey surface.
14. Determination of Critical thickness of insulation.
15. Thermocouple Calibration
16. Determination of equivalent thermal conductivity of heat pipe
17. Study of boiling and condensation heat transfer.

18. Demonstration of Critical Heat Flux Apparatus.
19. Demonstration of Surface Condenser.
20. To study drop & film wise condensation & determine the film co-efficient.

Course Outcomes:

After learning the course the students should be able to:

CO1 After completing the course, the students will be able to formulate and analyze a heat transfer problem involving any of the three modes of heat transfer

CO2 Illustrate the boundary layer concept, dimensional analysis, forced and free convection under different conditions

CO3 Explain the thermal radiation black body, emissivity and reflectivity and evaluation of view factor and radiation shields.

CO4 Describe the Boiling heat transfer, mass transfer and Evaluate the heat exchanger and examine the LMTD and NTU methods applied to engineering problems

CO5 Understanding the boiling and condensation, difference between heat and mass transfer.

Text Books:

1. Heat Transfer, J.P. Holman, McGraw Hill Book Company, New Delhi.
2. A Text Book of Heat and Mass Transfer, S.P.Sukhatme, Univiesities Press.
3. Heat Transfer – A Practical Apporach, Yunus A Cengel, Tata McGraw Hill Publishing Company, New Delhi.

Reference Books:

1. Heat and Mass Transfer, P.K. Nag, Tata McGraw Hill Publishing Company, New Delhi.
2. Heat and Mass Transfer, R Yadav, Central Publishing House.
3. Heat and Mass Transfer, Dr. D.S. Kumar, S.K. Kataria and Son Publisher.
4. Heat and Mass Transfer, S.C. Arrora and S. Domkundwar, DhanapatRai and Sons Publication.
5. Fundamentals of Engineering Heat and Mass Transfer, New Age Science

Course Name : Third Year Mechanical Engineering

Semester : Fifth

Subject Title : Engineering Metallurgy

Subject Code : PCC-ME-502

Teaching Scheme (in hrs)			Total Credit (TH +T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
3		2	4	30	70	--	--	25	125

Course Objectives:

The course is designed to address the following:

1. Understanding of the correlation between the internal structure of materials,
2. Different mechanical properties and various methods to quantify their mechanical integrity and failure criteria.
3. To provide a detailed interpretation of equilibrium phase diagrams
4. Learning about different phases and heat treatment methods to tailor the properties of Fe-C alloys.
5. Describe the fundamentals of powder metallurgy

Syllabus:

Module 1: Structure of Materials (6 Hrs)

Crystal Structure: Module cells, Metallic crystal structures, Ceramics. Imperfection in solids: Point, line, interfacial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

Module 2: Mechanical Property measurement (6 Hrs)

Tensile, compression and torsion tests; Young's modulus, relations between true and engineering stress-strain curves, generalized Hooke's law, yielding and yield strength, ductility, resilience, toughness and elastic recovery; Hardness: Rockwell, Brinell and Vickers and their relation to strength.

Module 3: Equilibrium Diagrams **(6 Hrs)**

Definitions of terms, rules of solid-solubility, Hume-rothery's rules of solid solubility, Gibb's phase rule, solidification of a pure metal, plotting of equilibrium diagrams, Iron-iron carbide equilibrium diagram, critical temperatures, solidification and microstructure of slowly cooled steels, non-equilibrium cooling of steels, property variation with microstructures, classification and application of steels, TTT diagram, critical cooling rate

Module 4: Heat treatment of steels **(10 hrs)**

Heat treatment of steels, Annealing, normalizing, tempering hardening and spheroidising, isothermal transformation diagrams for Fe-C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening

Module 5: Engineering Alloy Steels and non-ferrous alloy **(8 Hrs)**

Effect of alloying elements, Classification of alloying elements, properties and uses of allowing elements, Alloy steels like free cutting steel, HSLA steel, maraging steels, Duel phase steel, creep resisting steels, super alloy, low expansion steel, stainless steel and tool steel.

cast irons**;** grey Cast iron , white Cast iron, malleable Cast iron and spheroidal cast iron properties and applications.

Introduction to copper and copper alloys, brasses, bronzes and Aluminum and Aluminum alloy

Module 6: Powder Metallurgy **(8 hrs)**

Introduction, Production of sintered structural component, advantages and limitations of P/M, powder manufacturing, applications like self-lubricated bearing, cemented carbide tool, cermets

List of Experiments: - (The Term Work shall consists the record of minimum of **eight** experiments 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.

Course Outcomes:

After learning the course the students should be able to:

CO1 Study various crystal structures of materials
CO2 Understand mechanical properties of materials and calculations of same using appropriate equations
CO3 Defines the importance of Phase Diagrams in the field of materials science and engineering
CO4 Suggest appropriate heat treatment process for a given application
CO5 Understanding the effect of allowing elements on steel and properties of CI and brass bronze etc.
CO6 Apply use of powder metallurgy in engineering applications.

Text Books:

1. W. D. Callister, 2006, "Materials Science and Engineering-An Introduction", 6th Edition, Wiley India.
2. Kenneth G. Budinski and Michael K. Budinski, "Engineering Materials", Prentice Hall of India Private Limited, 4th Indian Reprint, 2002.
3. V. Raghavan, "Material Science and Engineering', Prentice Hall of India Private Limited, 1999.

Course Name : Third Year Mechanical Engineering

Semester : Fifth

Subject Title : Manufacturing Processes

Subject Code : PCC – ME - 503

Teaching Scheme (in hrs)			Total Credit (TH+T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
3	-----	2	4	30	70	25#	-------	-------	125

Course Objectives:

The course is designed to address the following:

1. Introduce the student to processes and equipment utilized in the manufacturing environment
2. Compare and contrast different material types and their application.
3. Introduce the concepts of production monitoring and control processes.
4. Explain different forms of production logistics in manufacturing processes
5. Explain different unconventional machining process

Module: 1 Conventional Manufacturing processes: (5Hrs)

Casting and moulding: Metal casting processes, Basic of sand casting, solidification, shrinkage, riser design, casting defects and residual stresses.

Module: 2 Introduction to bulk and sheet metal forming (8 Hrs)

plastic deformation and yield criteria; fundamentals of hot and cold working processes such as bulk forming(forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending).

Module: 3 Metal cutting: **(10 hrs)**

Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Turning, Drilling, Milling and grinding processes

Module: 4 Introduction to CNC machining, CNC programming **(8 Hrs)**

Module: 5 Joining Processes: **(6 Hrs)**

Physics of welding, brazing and soldering, design considerations in welding, Solid and liquid state joining processes, arc welding, gas welding, MIG, TIG, submerged arc welding, resistance welding, friction welding

Module: 6 Unconventional Machining Processes: (12 Hrs)

Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters, Electrical Discharge Machining, principle and processes parameters, wire EDM; Electro-chemical machining(ECM), etchant & maskant, process parameters, MRR and surface finish. Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining

List of Experiments: - (The Term Work shall consists the record of minimum of **eight** experiments out of the following list)

1. To study Merchant's circle analysis for calculation of power.
2. To study different machine tools and working principle.
3. One job on drilling machine including all major operations.
4. One job on milling machine including all major operations.
5. One job on broaching machine including all major operations.
6. Study of basics of CNC machining.
7. To study a part programming codes.
8. To study APT language used in CNC programming.
9. One job on CNC milling including all major operations.
10. One industrial visit to industry having CNC set up.
11. To study of Non-conventional machining processes.
12. To study advantages of Non-conventional machining processes.
13. One job on EDM.
14. One job on wire cut EDM.
15. One industrial visit to industry having EDM set up.
16. Assignment on Each Module.

Course Outcomes:

After studying this subject student will be able to:

CO1 Identify the different stages of a manufacturing process.
CO2 Interpret the elements of the product design process.
CO3 Identify the common machines used in a manufacturing process.
CO4 Explain the operations and capabilities of machines used in manufacturing.
CO5 Determine the operations used in finishing manufactured products.
CO6 Explain the operations and capabilities of automated machines used in manufacturing.
CO7 Interpret the functionality of base lining and documentation in a manufacturing process.
CO8 Determine the main elements of quality assurance in a process.
CO9 Identify characteristics of end product logistics.

Reference books:

1. Radhakrishna.K, Manufacturing Process – I, Sapna Book House,
2. Roy Lindberg, Processes and Materials of Manufacture, Pearson Education

Text books:

1. P.N.Rao, Manufacturing Technology – Foundry, Forming and Welding, Tata McGraw Hill, New Delhi,
2. Advanced machining process- Jagdeesha , Pearsons publications ,New Delhi

Course Name : Third Year Mechanical Engineering

Semester : Fifth

Subject Title : Kinetics and theory of machine

Subject Code : PCC-ME-504

Teaching Scheme (in hrs)			Total Credit (TH +T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
3	--	2	4	30	70	--	--	25	125

Course Objectives:

The course is designed to address the following:

1 To understand the kinematics and rigid- body dynamics of kinematically driven machine components

3. To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link
4. To be able to design some linkage mechanisms and cam systems to generate specified output motion

Syllabus:

Module 1: Classification of mechanisms (8 Hrs)

Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains- Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms**.**

Module 2: Velocity, Acceleration of Mechanism: **(10 Hrs)**

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism, Coriolis component of acceleration- introduction to linkage synthesis three position graphical synthesis for motion and path generation**.**

Module 3: CAMS **(10 Hrs)**

Classification of cams and followers- Terminology and definitions- Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers

Module 4: GEARS **(8 Hrs)**

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics

Module: 5 Governor and Flywheel Governors. **(8 Hrs)**

Function of governor, Inertia and centrifugal type of governors, Controlling force analysis, Governor Effort and governor power, Sensitivity, stability, Isochronisms and Hunting, Friction insensitiveness. Flywheel: Turning moment diagram, Fluctuation of energy and speed, Determination of flywheel size for different types of prime movers and machines.

List of Experiments: - (The Term Work shall consists the record of minimum of **eight** experiments out of the following list)

1. Study of simple linkage models/mechanisms
2. Sketch and describe the working of inversions of four bar linkage
3. Sketch and describe the working of inversions of single/double slider crank mechanisms.
4. Calculate the ratio of time of cutting stroke to time of return stroke to understand quick return motion in shaping machine.
5. Sketch and describe the working of Study of Peaucellier Mechanism, Scott Russell Mechanism, and Grasshopper Mechanism.
6. Sketch and describe the working of Study of Davis steering gear mechanism, Ackermann steering gear mechanism.
7. Determine velocity and acceleration analysis using: Vector algebra and Complex algebra and comparison of results.
8. Determine velocity and acceleration analysis using relative velocity and acceleration method.
9. Determine velocity and acceleration analysis using relative velocity and acceleration method involving Coriolis component.
10. Determine velocity and acceleration analysis using Klein’s construction for uniform and non-uniform crank velocity.
11. Determine velocity analysis using ICR method.
12. To draw cam profile for various types of follower motion.

13. To study Turning Moment Diagram for single cylinder & multi-cylinder engine.
14. Draw a schematic diagram of centrifugal governor and describe it's working. Draw a graph between radius of rotation versus speed of governor.
15. Sketch and describe the working of Hartnell, hartung and pickring governor.
16. Determination of Gyroscopic Couple of a Uniform disc.
17. To generate gear tooth profile and to study the effect of under cutting and rack shift using model.
18. Assignment on Each Module.

Course Outcomes:

After learning the course the students should be able to:

CO1 Identify mechanisms in real life applications.

CO2 Perform kinematic analysis of simple mechanisms.

CO3 Understand principles of cam and its terminology

CO4 Evaluate gear tooth geometry and select appropriate gears

CO5 Define governor and select/suggest an appropriate governor

Reference Books:

1. Thomas Beven, "Theory of Machines", CBS Publishers and Distributors, Delhi.
2. J. E. Shigely, J. J. Uicker, "Theory of Machines and Mechanisms", Tata McGraw Hill Publications, New York, International Student Edition, 1995.

Text books

1. S. S. Rattan, "Theory of Machines", Tata McGraw Hill Publications, New Delhi.
2. Kelly, Graham S., "Mechanical Vibrations", Schaum's Outline Series, McGraw Hill, New York, 1996.
3. Rao, J.S., "Introductory Course on Theory and Practice of Mechanical Vibration", New age International (P) Ltd, New Delhi, 2nd edition, 1999.
4. A. Ghosh, A. K. Malik, "Theory of Mechanisms and Machines", Affiliated East-West Press Pvt. Ltd., New Delhi.

Course Name : Third Year Mechanical Engineering

Semester : Fifth

Subject Title : Mechanical Measurement and Metrology

Subject Code : PCC-ME-505

Teaching Scheme (in hrs)			Total Credit (TH +T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
3	--	2	4	30	70	25@	--	25	150

Course Objectives:

The course is designed to address the following:

1. Inspection of engineering parts with various precision instruments.
2. Understand the designing of part, their tolerances and fits.
3. Understand Principles of measuring instruments and gauges and their uses.
4. Evaluation and inspection of surface roughness.
5. Inspection of spur gear and thread elements.
6. Machine tool testing to evaluate machine tool quality.
7. Acquire knowledge of measurement systems and methods with emphasis on different transducers, intermediate modifying and terminating devices.
8. Understand the measurement of Force, Torque, Pressure, Temperature and Strain.

Module 1: Introduction to metrology (4 Hrs)

Metrology Basics Definition of metrology, Categories of metrology, Scientific metrology, Industrial metrology, Legal metrology, Need of inspection, Precision, Accuracy, Sensitivity, Readability, Calibration, Traceability, Reproducibility, Sources of errors, Factors affecting accuracy, Selection of instrument, Precautions while using an instruments for getting higher precision and accuracy.

Module 2: Standards and Comparators (6 Hrs)

Standards and Comparators, Definition and introduction to line standard, end standard, Wavelength standard, Slip gauge and its accessories, Length bars. Definition, Requirement of good comparator, Classification, use of comparators, Working principle of comparators, Dial indicator, Sigma comparator, Pneumatic comparator, Electrical, Electronic

Limits, Fits ,Tolerances and Gauges Concept of Limits, Fits, And Tolerances, Selective Assembly, Interchangeability, Hole And Shaft Basis System, Taylor's Principle, Design of Plug, Ring Gauges, IS919-1993 (Limits, Fits & Tolerances, Gauges IS 3477-1973, concept of multi gauging and inspection

Module 3: Angular Measurement **(4 Hrs)**

Concept, Instruments For Angular, Measurements, Working And Use of Universal Bevel Protractor, Sine Bar, Spirit Level, Principle of Working of Clinometers, Angle Gauges (With Numerical on Setting of Angle Gauges).

Module 4: Threads and Gear Metrology **(06 Hrs)**

Screw thread Measurements ISO grade and fits of thread, Errors in threads, Pitch errors, Measurement of different elements such as major diameter, minor diameter, effective diameter, pitch , Two wire method, Thread gauge micrometer, Working principle of floating carriage dial micrometer.

Gear Measurement and Testing Analytical and functional inspection, Rolling test, Measurement of tooth thickness (constant chord method), gear tooth vernier, Errors in gears such as backlash, run out, composite.

Module 5: Testing Techniques **(08 Hrs)**

Measurement of surface finish Primary and secondary texture, Sampling length, Lay, terminology as per IS 3073-1967, direction of lay, Sources of lay and its significance, CLA, Ra, RMS, Rz values and their interpretation, Symbol for designating surface finish on drawing, Various techniques of qualitative analysis.

Machine tool testing

Parallelism, Straightness, Squareness, Coaxiallity, roundness, run out, alignment testing of machine tools as per IS standard procedure.

Module 6: Measurement systems **(06 Hrs)**

Measurement systems and basic concepts of measurement methods: Definition, significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect, system response-time delay. Errors in measurement, classification of errors. Transducers, transfer efficiency, primary and secondary transducers, electrical, mechanical, electronic transducers, advantages of each type transducers

Module 7: Force, Torque and Pressure Measurement **(06 Hrs)**

Direct methods and indirect method, force measuring inst., Torque measuring inst. Types of dynamometers, Absorption dynamometer, Prony brake and rope brake dynamometer, and power measuring instruments Pressure measurement, principle, use of elastic members, Bridgeman gauge, McLeod gauge, Pirani gauge

Module 8: Measurement of strain and temperature **(04 Hrs)**

Theory of strain gauges, types, electrical resistance strain gauge, preparation and mounting of strain gauges, gauge factor, methods of strain measurement. Temperature Compensation, Wheatstone bridge circuit, orientation of strain gauges for force and torque, Strain gauge based load cells and torque sensors. Resistance thermometers, thermocouple, law of thermocouple, materials used for construction, pyrometer, optical pyrometer

List of Experiments: - (The Term Work shall consists the record of minimum of **eight** experiments out of the following list)

1. Standard use of basic measuring instruments. Surface plate, v-block, sprit level, combination set, filler gauge, screw pitch gauge, radius gauge, vernier caliper, micrometer and slip gauges to measure dimension of given jobs.
2. To find unknown angle of component using sine bar and slip gauges.
3. Study and use of optical flat for flatness testing.
4. Measurement of screw thread elements by using screw thread micrometer, screw pitch gauge.
5. Study and use of dial indicator as a mechanical comparator for run out measurement, roundness comparison.
6. Measurement of gear tooth elements by using gear tooth vernier caliper and verification of gear tooth profile using profile projector,.
7. To measure the pressure using of Pressure Gauge
8. To measure temperature using Thermocouple, temperature measuring devices.
9. To study a Linear Variable Differential Transformer (LVDT) and to measure a small displacement using LVDT
10. To measure load (tensile/compressive) using load cell on a tutor.
11. Assignment on Each Module.

Course Outcomes:

After learning the course the students should be able to:

CO1 Design tolerances and fits for selected product quality.
CO2 They can choose appropriate method and instruments for inspection of various gear elements and thread elements.
CO3 They can understand the standards of length, angles; they can understand the evaluation of surface finish and measure the parts with various comparators.
CO4 The quality of the machine tool with alignment test can also be evaluated by them.
CO5 Describe functioning of force, torque, pressure, strain and temperature measuring devices.

TEXT BOOKS:

1. Engineering Metrology by R.K.Jain / Khanna Publishers
2. Engineering Metrology by Mahajan / DhanpatRai Publishers

REFERENCE BOOKS:

1. Dimensional Metrology, Connie Dotson, Cengage Learning.
2. Engineering Metrology by I.C.Gupta / DhanpatRai Publishers.
3. Precision Engineering in Manufacturing by R.L.Murthy / New Age.
4. Engineering Metrology and Measurements by NV Raghavendra, L Krishna murthy, Oxford publishers. 5. Engineering Metrology by KL Narayana, Scitech publishers.
5. Mechanical measurement and Control, by Dr. D.S. kumar, Metropolitan Book Co. (P) Ltd. (2012)

Course Name : Third Year Mechanical Engineering

Semester : Fifth

Subject Title : Mechanical Engineering Laboratory

Subject Code : PCC-ME-506

Teaching Scheme (in hrs)			Total Credit (TH +T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
	--	4	2	--	--	25#	--	--	25

Course contents

Module 1 - Sketcher – (4 Hrs)

Sketcher Geometry Management Sketcher Constraints Management Sketching simple profiles sketching predefined profiles Sketch Analysis Tools

Module 2: Part Design (6 Hrs)

Sketched features: Pad Pocket Shaft Groove

Placed features: Hole Fillet Chamfer Thickness

Transformation features: Translate Rotation Mirror Pattern Scaling

Dress up features:

Modifying parts

Module 3: Assembly Design (8 Hrs)

Assembling components

Positioning components using constraints

Analyzing assembly

Editing parts in assembly

Exploding the assembly

Module 4: Generative Design (6 Hrs)

Starting a Drawing View Generation

Additional View Generation

Editing Views Layout and Properties

Automatic Dimensioning a Part

Finalizing the Drawing and Printing

Setting Drafting Standards and Visualization

List of Practical's:

1. Creation of minimum 4 different 2 D sketches
2. Creation of at least 5 solid models using solid modeling features.
3. Creation of 2 assembly drawings each of at least 5 components.
4. Generation of orthographic projections front view, top view, side view, isometric view.
5. Generation of sectional view.
6. Generation of auxiliary view.
7. Intersection of solids (at least 2 assignments)
8. Plotting of above drawings on A2/A3 size sheet.

Course Name : Third Year Mechanical Engineering

Semester : Fifth

Subject Title : Indian Constitution /Indian Tradition Knowledge

Subject Code : MC - ME - 507

Teaching Scheme (in hrs)			Total Credit (TH +T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
2	--	--	--	--	--	--	25@	--	25

Module 1: Introduction Constitution (4 Hrs)

Meaning of the term,, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive Principles of State Policy.

Module 2: Union Government and its Administration (4 Hrs)

Structure of the Indian Union: Federalism, Centre- State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha (2)

Module 3: State Government and its Administration (2 Hrs)

Governor: Role and Position, CM and Council of ministers, State Secretariat: Organization, Structure and Functions.

Module 4: Local Administration (2 Hrs)

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

Module 5: Election Commission (4 Hrs)

Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women

Module 6: Astronomy, Chemistry, Mathematics and Metallurgy in India (4 Hrs)

Siddhantik and Post siddhantik development of Astronomy, Early Chemical Techniques, Atomism in Vaiśeṣika, Chemistry in Early Literature, First Steps, Early Historical Period, The Classical Period, The Classical Period, post-Āryabhaṭa, The Kerala School of Mathematics, Features of Indian Mathematics, Metallurgy before and during the Harappan Civilization, After the Harappans, iron metallurgy, wootz steel, other iron pillars and beams, zinc, social context.

Module 7: Medical Sciences in India (2 Hrs)

The Principles of Ayurvedic Healing, Treating diseases to restore health.

Module 8: Music, Theater and Drama in India (4 Hrs)

Origin, classification accompanied instrument, Bharata's Nāṭyaśāstra, New era, Medieval period, modern era, aesthetics of Indian classical music, forms of composition: Dhrupada, thumari, gazal, tarana, tappa, folk music, film music, Theater and Dram Its Beginnings, Classical Period, Major Indian Dramatists: Bhāsa, Kālidāsa, Bhavabhūti, Medieval Period, Kuṭiyaṭṭam, Yakṣagāna, Bhavāī, Jātrā, Nautaṅkī, Swāṅg, Rāmalīlā, Tamāśā, Nāchā, Pāṇḍavānī, Modern Era.

References

1. 'Indian Polity' by M. Laxmikanth, Mc Graw Hill Publications.

2. 'Our Constitution' by Subhash C Kashyap, www.bookmandelhi.com.

3. 'Indian Constitution' by D.D. Basu, Lexis Nexis Publications.

Course Name : Third Year Mechanical Engineering

Semester : Fifth

Subject Title : Soft Skills for Personality Development

Subject Code : MC – ME - 508

Teaching Scheme (in hrs)			Total Credit (TH +T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
--	--	2	--	--	--	--	--	25	25

Module 1: Soft Skills (4 Hrs)

What are soft skills? – Importance of soft skills , Attributes regarded as soft skills – Soft skills – Social - Soft skills – Thinking - Soft skills – Negotiating – Exhibiting your soft skills – Identifying your soft skills – Improving your soft skills –Exercise : Measure your soft skills

Module 2: Self-Discovery (2 Hrs)

Importance of knowing yourself - Process of knowing yourself - SWOT analysis - Benefits of SWOT analysis - Using SWOT analysis - SWOT analysis.

Module 3: Developing Positive Attitude (4 Hrs)

Meaning of attitude - Features of attitudes - Attitude and behaviour - Formation of attitudes - Change of attitudes - What can you do to change attitude? - Ways of changing attitude in a person - Attitude in a workplace - The power of positive attitude - Developing positive attitude - Obstacles in developing positive attitude - Staying positive - Examples of positive attitudes - Positive attitude and its results - Staying negative - Examples of negative attitude - Overcoming negative attitude - Negative attitude and its results. Exercise : Measure your attitude.

Module 4: Forming Values (4 Hrs)

Meaning of value, A core of values - Values relating to education - Values relating to self and others - Values relating to civic.

Module 5: Improving Perception (2 Hrs)

Factors influencing perception - Perceptual process - Improving perception - Perception and its application in organizations. Exercise : Test your perception.

Module 6: Body Language (4 Hrs)

Body talk - Voluntary and involuntary body language - Forms of body language - Parts of body language - Origin of body language - Uses of body language - Body language in building interpersonal relations - Body language in building industrial relations - Reasons to study body language - Improving your body language - Types of body language - Gender differences - Female interest and body .

Module 7: Team Building and Teamwork **(4 Hrs)**

Aspects of team building - Skills needed for teamwork - A model of team building - Team Vs Group - Characteristics of effective team - Role of a team leader - Role of team members - Nine persons a successful team should have - Inter-group collaboration - Advantages of inter-group collaboration.

Module 8: Time Management: **(2 Hrs)**

Examination of Work, Sense of Time Management, Features of Time, Time Management Matrix, Difficulties in time management, Ideal way of spending a day/

Module 9: Stress Management: **(2 Hrs)**

Meaning of stress, type of stress, effect of stress, Sources of stress, identifying existence of stress, Sign of stress and stress management.

Reference Books

1. Soft Skills – Know yourself and Know your world by Dr.K.Alex – S.Chand and Publications, New Delhi
2. Presonality development and soft skills –by Barun K Mishra – Oxford University Press.- 2011

Course Name : Third Year Mechanical Engineering

Semester : Fifth

Subject Title : NPTEL Course - I

Subject Code : MC – ME - 509

Teaching Scheme (in hrs)			Total Credit (TH +T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
--	--	02	01	--	--	--	--	--	--

Every Student has to complete minimum four weeks NPTEL web and video course from mechanical engineering department which is available on portal nptel.ac.in. It is preferred that student should attend any one course related to subjects of Fifth semester.

Certification courses are offered twice a year (Jan-Jun, Jul-Dec). Joining a course is free. Learning can be done by watching videos and this is tested by the weekly assignments, which are to be submitted online within the prescribed deadline.

There is a certification examination that the student can take for a nominal fee at the end of the course to earn certificates from the IITs.

To earn credits of this course the students need to produce the NPTEL course completion certificate and online submitted assignments to the department before end semester practical examination.

Course Name : Third Year Mechanical Engineering

Semester : Fifth

Subject Title : Industrial Training - I

Subject Code : IT - ME - 510

Teaching Scheme (in hrs)			Total Credit (TH +T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
--	--	--	--	--	--	--	25@	25	50

Every Student has to undergo 4 weeks industrial training after completion of Fourth Semester Examination. The performance of training will be assessed in the fifth semester. The student has to submit continuous assessment and report of training to the Department. Similarly, the student should represent his work to the department in the form of power point presentation.

Mechanical Engineering

Sixth Semester

Curriculum Details

Course Name : Third Year Mechanical Engineering

Semester : Sixth

Subject Title : Manufacturing Technology

Subject Code : PCC - ME - 601

Teaching Scheme (in hrs)			Total Credit (TH +T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
3	--	2	4	30	70	25#	--	25	150

Course Objectives:

The course is designed to address the following:

1. To provide knowledge on machines and related tools for manufacturing various components.
2. To understand the relationship between process and system in manufacturing domain.
3. To identify the techniques for the quality assurance of the products and the optimality of the process in terms of resources and time management.
4. To understand the techniques material handling, transportation and inventory

Course Contents:

Module 1: Tooling for conventional and non-conventional machining process (12 Hrs)

Mould and die design, Press tools, Cutting tools; Holding tools: Jigs and fixtures, principles, applications and design; press tools – configuration, design of die and punch; principles of forging die design.

Module 2: Metrology: (12 Hrs)

Dimensions, forms and surface measurements, comparators; gauge design; interferometry Metrology in tool wear and part quality including surface integrity, alignment and testing methods; tolerance analysis in manufacturing and assembly. Process metrology for emerging machining processes such as micro-scale machining, Inspection and work piece quality

Module 3: Assembly practices: **(08 Hrs)**

Manufacturing and assembly, process planning, selective assembly, Material handling and devices.

Module 4: Linear programming **(12 Hrs)**

Objective function and constraints, graphical method, Simplex and duplex algorithms, transportation assignment, Traveling Salesman problem; Network models: shortest route, minimal spanning tree, maximum flow model- Project networks: CPM and PERT, critical path scheduling; Production planning & control: Forecasting models, aggregate production planning, materials requirement planning. Inventory Models Simple queuing theory models.

List of Experiments: - (The Term Work shall consists the record of minimum of **eight** experiments out of the following list)

1. To study different Moulding process & Perform floor moulding.
2. To study bench moulding& and perform bench moulding.
3. To perform a sample mould& Creates gate, runner, riser in it.
4. To study centrifugal casting process on demo model
5. To create a sample solid piece pattern by carpentry work.
6. To study a sample smithy operation & analysis different smithy tools (forging process)
7. To study various models for rolling process like 2 high ,4 high& cluster rolling mills.
8. To study wire drawing machine model in a lab.
9. To study various welding process, like gas welding, MIG welding, TIG welding, ete.
10. To prepare edge preparation on sample metal plates & perform arc welding operation.
11. To study spot welding machine on lab model.
12. To study seam, projection welding on lab model.
13. To study solid state welding process & understand application of each process.
14. To study basic press machine & understand each part of machine.
15. To study various press working process &study application of each process.
16. To study a sample die sets on a lab model.
17. To study types of plastics materials & understand application of each material.
18. To study various plastic moulding processes on lab models.
19. Assignment on Each Module.

Course Outcomes:

After completion of this course, students will be able to understand

CO1 The designs of different molds

CO2 The tooling needed for manufacturing

CO3 The dimensional accuracy and tolerances of products

CO4 Assembly of different components and the application of optimization methods in manufacturing.

CO5 The handling, transportation and inventory of material

Text Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014.
2. Taha H. A., Operations Research, 6th Edition, Prentice Hall of India, 2003.
3. *Metrology And Quality Control*" by Dr A M Badadhe S G Shilwant and Dr B Anand

Reference books:

1. Radhakrishna.K, Manufacturing Process – I, Sapna Book House
2. Roy Lindberg, Processes and Materials of Manufacture, Pearson Education
3. Shenoy G.V. and Shrivastava U.K., Operations Research for Management, Wiley Eastern, 1994.

Course Name : Third Year Mechanical Engineering

Semester : Sixth

Subject Title : Design of Machine Element

Subject Code : PCC - ME -602

Teaching Scheme (in hrs)			Total Credit (TH +T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
3	--	2	4	30	70		25#	25	150

Course Objectives:

The course is designed to address the following:

1. An introduction to the design of machine elements commonly encountered in mechanical engineering practice, through
2. A strong background in mechanics of materials based failure criteria underpinning the safety-critical design of machine components
3. An understanding of the origins, nature and applicability of empirical design principles, based on safety considerations
4. An overview of codes, standards and design guidelines for different elements
5. An appreciation of parameter optimization and design iteration
6. An appreciation of the relationships between component level design and overall machine system design and performance

Course Contents:

Module 1: Introduction: (6 Hrs)

Steps of design, Basic requirements of machine element, Design of machine elements, Design consideration for dynamic and static load, Selection of materials, Designation of material as per ISI, Various codes and standards. FO and Factors affecting FOS.

Module 2: Design against static load: **(6 Hrs)**

Static Load, Modes of failure, Failure of ductile materials, Failure of brittle materials, Stress due to bending moment, Stress due to torsional moment, Eccentric axial loading, Design of machine parts subjected to combined direct and bending stress.

Design of simple machine parts Cotter Joint, Knuckle Joint, Turnbuckle Design of Levers:- Hand/Foot Lever & Bell Crank Lever, Design of C – Clamp, Off-set links

Module 3: Design against fluctuating load: **(6 Hrs)**

Definition, Stress concentration, Fluctuating stress, Fatigue failure, Endurance limit, S-N curve, Low cycle and High cycle fatigue. Endurance Limit: Approximate estimation, Reversed stresses-Design for finite and infinite life, Cumulative damage in fatigue, Soderberg and Goodman lines, Modified Goodman diagrams, Gerber equation, Fatigue design under combined stresses.

Module 4: Design of shafts, Keys & Couplings: **(8 Hrs)**

Shaft design on strength basis, Shaft design on torsional rigidity basis.Keys: Definition, Types of keys and their design, Splines and their design. Couplings: Definition, Muff coupling, Rigid flange coupling, Bushed pin flexible coupling, Design for lateral rigidity, Castigliano's theorem, Area moment method, Critical speed of shaft.

Module 5: Threaded, Riveted and Welded Joints: **(6 Hrs)**

Introduction, Basic types of screw fastening, Bolt of uniform strength, eccentrically loaded bolted joints in shear, Bolted joint under fluctuating load, Bolted joints with combined stresses. Riveted Joint: Methods of riveting, Types of rivet heads, Types of riveted joints, Strength of joint, Eccentric loaded riveted joint. Welded Joint: Introduction, Types, Stresses in Butt and fillet joints, Strength of welded joints, eccentrically loaded joints.

Module 6: Sliding contact bearings **(6 Hrs)**

Introduction, Classification of bearing, Modes of Lubrication, Viscosity, Bearing materials, Petroff'seqn, McKee's investigation, Hydrostatic step bearing, Sommerfeld number, Heat generated in journal bearing, Raimondi and boyd method, Bearing design, Thrust bearing.

Rolling contact bearings: Types of rolling contact Bearings, Static and dynamic load carrying capacities, Stribeck's equation, Equivalent bearing load, Load-life relationship, Selection of bearing from manufacture's catalogue, Design for cyclic loads and speeds.

Module 7: Spur Gears **(4 Hrs)**

Introduction, Gear terminology, Gear tooth failure, Selection of gear material, Gear blank design, Beam strength (Lewis) equation, Velocity factor, Service factor, Load concentration factor,

Effective load on gear tooth, Estimation of Dynamic and Static tooth load, Wear strength (Buckingham's) equation, Design of spur gear.

Module 8: Helical, Worm and Bevel Gear (4 Hrs)

Helical Gears: Terminology, Tooth proportions, Force analysis, Strength analysis and Effective load on gear tooth. Bevel Gears: Terminology, Force analysis, Strength analysis and Effective load on gear tooth. Worm Gear: Terminology, Tooth proportions, Force analysis, Strength analysis.

Tem Work:

Assignments consisting of Theoretical questions and full imperial size sheets with the design problems on following

1. Assignment on selection of materials for given applications [at least fiveapplications should be covered] using design data book. List the mechanicalproperties of material selected.

2. Problems on design of simple machine parts like Cotter Joint, Knuckle Joint, Bell Crank Lever, Turn Buckle, Off – Set link, Arm of Pulley (One example on eachcomponent) with free hand sketches

3. CAD Drawing for project No 1 or 2 should be prepared in practical and print out should be attached along with respective drawing sheets.

4. Assignment on Each Module.

Course Outcomes:

CO1	Ability to identify and understand failure modes for mechanical elements and design of machine elements based on strength.
CO2	Ability to design Shafts, Keys and Coupling for industrial applications.
CO3	Ability to design machine elements subjected to fluctuating loads.
CO4	Ability to design bearings, machine element that constrains relative motion to only the desired motion, and reduces friction between moving parts
CO5	Ability to design fasteners and welded joints subjected to different loading conditions.
CO6	Ability to design various gears which mesh with another toothed part to transmit torque

Text Books:

[1] Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw-Hill International; 1989.

[2] Deutschman, D., Michels, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.

[3] V.B. Bhandari, Design of Machine Elements. McGraw-Hill companies, 2002.

Course Name : Third Year Mechanical Engineering
Semester : Sixth

Subject Title : Mechatronic System

Subject Code : PCEC–ME-603/604 (A)

Teaching Scheme (in hrs)			Total Credit (TH +T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
3	--	2	4	30	70	--	--	25	125

COURSE OBJECTIVES:

The course is designed to address the following:

1. Understand the key elements of Mechatronic system, representation into block diagram.
2. Understand principles of Sensors, their characteristics
3. Understand Mathematical modeling of systems.
4. Study various actuators applicable to Mechatronic systems.
5. Study of Interfacing of different electronic and electro - mechanical devices

Course Contents:

Module 1: Introduction (6 Hrs)

Introduction to control system and Mechatronics system, Basic building blocks of Mechatronic system, Block Diagram Representation of Open and Closed loop control system. Mechatronics key elements, Mechatronics in home, office and industry automation, Scope of Mechatronics, Advantages of Mechatronics, pre-requisites for Mechatronics

Module 2: (6 Hrs)

Mathematical Modeling of Systems Introduction to transfer function ,properties ,Mathematical Modeling of Electrical, Mechanical, Fluid and Thermal systems, Grounded chair representation, Block diagram algebra, rules and Numeric

Module 3: Sensors & Actuators (8 Hrs)

Sensors & Actuators: Introduction to Mechatronics, Measurement characteristics: - Static and Dynamic Sensors: Position Sensors: - Potentiometer, LVDT, Encoders; Proximity sensors:-

Optical, Inductive, Capacitive; Motion Sensors:- Variable Reluctance; Temperature Sensor: RTD, Thermocouples; Force / Pressure Sensors:- Strain gauges; Flow sensors: - Actuators: Stepper motor, Servo motor, Solenoids,DC motors : Principles of operation of DC motor, Modelling of DC, AC motors ,relays and types, Hydraulic and Pneumatic DC Valves cylinders symbols

Module 4: **(8 Hrs)**

System Interfacing and Data Acquisition Data Acquisition systems (DAQs), data loggers, supervisory control and data acquisition, interfacing requirements, buffers, handshaking, polling and interrupt, digital communication, parallel communication, serial communication interface, universal asynchronous receiver and transmitter (UART), peripheral interface device (PIA), analog interfacing, Component interconnection and impedance matching, interfacing sensors and motor drives with microcomputer system

Module 5: **(8 Hrs)**

Controllers Time response analysis of first and second order systems, Inputs and responses, standard Test signals, steady state errors Analysis of first and second order , Controllers: P, I, D, PD, PI, and PID control systems. Controller turning (Auto and manual) Ziglar Nicholas method, Digital Controllers – Velocity Control – Adaptive Control – Digital Logic Control – Microprocessor Control

Module 6: **(08 Hrs)**

Mechatronics and Studies: Autonomous Mobile Robot, Wireless Surveillance Balloon, Firefighting robots, Cantilever beam vibration control using piezo sensors and actuators, Car engine management, pick and place robot, automatic camera, CNC Machine

List of Experiments: - (The Term Work shall consists the record of minimum of **eight** experiments out of the following list)

1. Study of basic principles of sensing and actuation techniques used in Mechatronics systems
2. Study of Electro-pneumatic Logic Trainer kit, and experiments on Electro-pneumatic circuits
3. Study of Electro-hydraulic Logic Trainer kit, and experiments on Electro-hydraulic circuits
4. Experiments on Ladder programming for Mechatronics system (e.g. bottle filling plant)
5. Experiments on interfacing of mechanical system
6. Experiment based on waveform generation, interfacing and control of motors etc.
7. System Identification of any one of the actuator
8. Experimental Identification by frequency response approach of Mechanical, Electrical, Chemical system
9. Interfacing analog actuators such as motors, speakers, and pumps using IC-based and resistive ladder network-based D2A converters including linear/pulse-width-modulation (PWM) power amplification

10. Measurement, data logging, automation, and control(Design based experiments shall be encouraged using standard National Instrument/ texas instrument/ dSPACEGmbh/ Arduino or any other platform).
11. Assignment on Each Module.

COURSE OUTCOMES

After completion of this course the students should be able to:

CO1	Develop the skill to identify the suitable sensor and actuator for a Mechatronic system.
CO2	Develop the skill required for interfacing the electronic and electro-mechanical systems.
CO3	Develop the skill to indigenously design and develop a Mechatronic system
CO4	Develop the skill to model a complete automated electro-mechanical system
CO5	Understand the working and use of hydraulic and pneumatic actuator

Reference Books:

1. Mechatronics by W Bolton Pearson Publishers K.P. Ramchandran, G.K. Vijyaraghavan, M.S. Balasundaram,
2. Mechatronic Sourcebook by Newton C Braga CENGAGE Learning
3. Mechatronics: Integrated Mechanical Electronic Systems, Willey Publication, 2008
4. Mechatronics by M D Singh and J G Joshi Prentice-Hall
5. Mechatronics Systemsby S R Mujumdar McGraw Hill

Course Name : Third Year Mechanical Engineering

Semester : Sixth

Subject Title : Microprocessor in Automation

Subject Code : PCEC–ME-603/604 (B)

Teaching Scheme (in hrs)			Total Credit (TH +T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
3	--	2	4	30	70	--	--	25	125

Course Objectives:

The course is designed to address the following:

1. To introduce the basic concepts of Digital circuits, Microprocessor system and digital controller
2. Understand the assembly language programming
3. Study of Interfacing peripherals 8255
4. Understand the function of 8085 working system
5. Study of digital control system and signal

Course Contents:

Module 1: Introduction to number system and logic gates: (6 Hrs)

Number Systems, codes, and digital electronics: Logic Gates, combinational circuits design, Flip-flops,

Module 2: Sequential logic circuits design: **(8 Hrs)**

Counters, Shift registers. Introduction to 8085 Functional Block Diagram, Registers, ALU, Bus systems, Timing and control signals. Machine cycles, instruction and timing states, instruction timing diagrams, Memory interfacing.

Module 3: Assembly Language Programming: **(8 Hrs)**

Addressing modes, Instruction set simple programs in 8085; Concept of Interrupt, Need for Interrupts, Interrupt structure, Multiple Interrupt requests and their handling, Programmable interrupt controller

Module 4: Interfacing peripherals (8255) (10 Hrs)

Programmable peripheral interface (8255). Interfacing Analog to Digital Converter & Digital to Analog converter, Multiplexed seven segments LED display systems,

Stepper Motor Control,

Module 5: Data Communication: (6 Hrs)

Serial Data communication (8251), Programmable Timers (8253);

8086/8088 Microprocessor and its advanced features

Module 6: Introduction to Digital Control (6 Hrs)

Sampling theorem, Signal conversion and Processing, Z-Transform, Digital Filters, Implementation of Digital Algorithm

Course outcomes:

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

CO1 USE NUMBER system and codes for interpreting working of digital system

CO2 Use Boolean expression to realize logic circuit

CO3 Describe the general architecture of a microcomputer system and architecture &organization of 8085 Microprocessor and understand the difference between 8085 and advanced microprocessor

CO4 Understand and realize the Interfacing of memory & various I/O devices with 8085 microprocessor

CO5 Understand and classify the instruction set of 8085 microprocessor and distinguish the use of different instructions and apply it in assembly language programming

CO6 Understand the architecture and operation of Programmable Interface Devices and realize the programming & interfacing of it with 8085 microprocessor

TERM WORK

It shall consist of Minimum two questions from theory part of each module as assignments/ exercises.

Text book

1. Digital Electronics: An Introduction to Theory and Practice, William H. Gothmann, PHI Learning Private Limited
2. Digital Computer Electronics: An Introduction to Microcomputers, Albert Paul Malvino, Tata McGraw-Hill Publishing Company Ltd.
3. Microprocessor Architecture, Programming, and Applications with the 8085, Ramesh Gaonkar, PENRAM International Publishers
4. Microcomputer Experimentation with the Intel SDK-85, Lance A. Leventhal, Prentice H

Course Name : Third Year Mechanical Engineering

Semester : Sixth

Subject Title : Computer Aided Design

Subject Code : PCEC- ME 603/604 (C)

Teaching Scheme (in hrs)			Total Credit (TH +T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
3	--	2	4	30	70	--	--	25	125

Course Objectives:

The course is designed to address the following:

1. To introduce field of Intelligent CAD/CAM with particular focus on engineering product design and manufacturing.
2. To develop a holistic view of initial competency in engineering design by modern computational methods.
3. To understand concepts of geometric modeling.
4. Provide theoretical background of CAD/CAM.
5. Introduce Rapid Prototyping techniques.

Contents:

Module 1: Introduction to CAD/CAM (4 Hrs)

CAD/CAM concepts, the product cycle and CAD/CAM, mathematical model of CAD/CAM, Automation and CAD/CAM, Benefits of CAD.

Module 2: Geometric modeling (6 hrs)

Need of solid modeling, study of different representation schemes in solid modeling, Wire frame modeling, surface modeling, and solid modeling, feature based modeling (FBM), hybrid modeling, their merits and demerits. Generalized sweeps, boundary representation, constructive solid geometry (CSG)

Module 3: Curves (8 Hrs)

Introduction, Analytic Curves, Line, Circle, Parabolas, Hyperbolas, Ellipses, Conics, Synthetic Curves, Hermite, Cubic Spline, Bezier Curve, B-Spline Curve, Surfaces:-Introduction, Surface

Representation, Analytic Surfaces, Synthetic Surfaces, Hermitebicubic Surface, Bezier surfaces, B-spline Surfaces, Coons Surface.

Module 4: Transformations (8 Hrs)

Introduction, 2D and 3D transformations, Formulation, Translation, Rotation, Scaling, Reflection, Homogenous Representation, Concatenated Transformation. Projections: Orthographic, Isometric

Module 5: Introduction to NC/CNC (6 hrs)

NC/CNC applications, benefits, basic components, classification of NC/CNC machine tools, reference points, component dimensioning in NC/CNC. NC motion control modes, types of interpolation, axis designation in NC/CNC. Manual data input, use of subroutines and canned cycles, NC words, NC procedure, DNC.

Module 6: Part programming (8 Hrs)

CNC programming using G and M codes adoptable to FANUC controller for lathe and milling, Part programmers job, functions of a post processor, APT.

Module 7: Rapid Prototyping (4 Hrs)

Introduction to RP, Technology Description, Overview of RP, Benefits and Application. RP Processes

TERM WORK

It shall consists of assignments/ exercises on,

1. Study of any one CAD software, like AUTOCAD, SOLIDWORKS, IDEAS, PRO-E, UNIGRAPHICS, CATIA etc.
2. Sketching
3. Part modeling.
4. Drafting.
5. Assembly modeling.
6. Assignment on 3D transformations.
7. NC part programming
8. APT programming

List of Practical

1. Minimum two questions from theory part of each module should be solved as a home work in A-3 size sketch book.
2. A-3 size Printouts/plots of the problems solved in practical class from the practical part of each module. Problems from practical parts of each module should be solved using any standard CAD packages like IDEAS, PRO-E, CATIA, Solid Works, and Inventor etc.

3. Assignment on 2-D sketching with geometrical and dimensional constraints using any commercially used solid modeling software like AutoCAD/ UniGraphics/ Catia/ ProE, etc
4. Assignment on parametric solid modeling of a machine component using various commands and features of the software.
5. Assignment on solid modeling of the parts of a machine (min. 5 components)
6. Assignment on assembly modeling of the parts modeled in assignment 3 using proper mating conditions.
7. Assignment on Each Module.

Course Outcome:

After completion of this subject the learners will be able to:

CO1 Apply benefits of CAD/CAM and automation in industries.
CO2 Identify proper computer graphics techniques for geometric modeling.
CO3 Understanding the different curves and surfaces in CAD
CO4 Transform, manipulate objects, store and manage data.
CO5 Prepare computer assisted part program and post process.
CO6 Prepare part programming applicable to CNC machines.
CO7 Use rapid prototyping and tooling concepts in any real life applications

Text Books:

1. Groover M. P. & Zimmer E. W.-CAD/CAM – Pearson Education
2. P.N. Rao -CAD/CAM, Principles & Applications-Tata McGraw Hill
3. T.K. Kundra- Numerical Control& Computer aided Manufacturing –TMH
4. P. Radhakrishnan - CAD/CAM/CIM –New Age International Ltd.Publishers New Delhi

Reference Books:

1. Mathematical elements of computer graphics- Rogers, Adams- Tata McGraw Hill
2. CNC machines-B.S. Pabla, M. Adithan- Willey Eastern Ltd
3. "CAD/ CAM, Theory & Practice" by Ibrahim Zeid, R. Sivasubramanian, Tata McGraw Hill Publications
4. "CNC Machines" by B.S. Pabla and M. Adithan, New Age International Publishers.
5. "Numerical Control and Computer Aided Manufacturing" , T.K. Kundra, P.N. Rao, N.K. Tiwari, Tata McGraw Hill
6. "CNC Technology and Programming", Krar, S., and Gill, A., McGraw Hill publishers

Course Name : Third Year Mechanical Engineering
Semester : Sixth

Subject Title : Composite Material

Subject Code : PCEC–ME - 603/604 (D)

Teaching Scheme (in hrs)			Total Credit (TH +T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
3	--	2	4	30	70	--	--	25	125

Course Objectives:

The course is designed to address the following:

1. To understand the mechanical behavior of composite materials
2. To get an overview of the methods of manufacturing composite materials
3. To understand various types of composite material and stresses
4. To know different joining methods for different composite materials
5. To understand the use of composite materials

Contents:

Module 1: Introduction (6 Hrs)

Definitions, Composites, Reinforcements and matrices, Types of reinforcements, Types of matrices, Types of composites, Carbon Fibre composites, Properties of composites in comparison with standard materials, Applications of metal, ceramic and polymer matrix composites.

Module 2: Manufacturing methods (10 Hrs)

Hand and spray lay - up, injection molding, resin injection, filament winding, pultrusion, centrifugal casting, Fiber/Matrix Interface, mechanical, Characterization of systems; carbon fibre/epoxy, glass fiber/polyester

Module 3: Mechanical Properties (8 Hrs)

-Stiffness and Strength: Geometrical aspects – volume and weight fraction. Unidirectional continuous fibre, discontinuous fibers, Short fiber systems, woven reinforcements –Mechanical Testing: Determination of stiffness and strengths of unidirectional composites; tension, compression, flexure and shear.

Module 4: Laminates **(10 Hrs)**

Plate Stiffness and Compliance, Assumptions, Strains, Stress Resultants, Plate Stiffness and Compliance, Computation of Stresses, Types of Laminates -, Symmetric Laminates, Antisymmetric Laminate, Balanced Laminate, Quasi-isotropic Laminates, Cross-ply Laminate, Angleply Laminate. Orthotropic Laminate

Module 5: Joining Methods and Failure Theories **(8 Hrs)**

Joining –Advantages and disadvantages of adhesive and mechanically fastened joints. Typical bond strengths and test procedures.

Course Outcomes:

After completion of this subject the learners will be able to:

CO1 To know the composite material and its types
CO2 Understand the manufacturing methods of composite material
CO3 Understand the mechanical behavior and application of composite materials
CO4 Analyze the stresses in the composite material
CO5 Understand the joining methods of composite materials and their failures

TERM WORK

It shall consist of Minimum two questions from theory part of each module as assignments/ exercises.

Text Books:

1. Gibson R.F. Principles of Composite Material Mechanics, second edition, McGraw Hill, 1994.
2. Hyer M.W., Stress Analysis of Fiber- Reinforced Composite Materials, McGraw Hill, 1998.

Reference books:

1. Introduction to composite material by J. Barbero
2. Design and Analysis of composite structure by Christos Kassapoglou

Course Name : Third Year Mechanical Engineering

Semester : Sixth

Subject Title : Energy Conservation and Audit (Open Elective –I (Humanities)

Subject Code : OEC – ME - 605 A

Teaching Scheme (in hrs)			Total Credit (TH+T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
3	-----	--------	3	15	35	-------	-------	25	75

Course Objective:

The course is designed to address the following:

1. To impart basic knowledge to the students about current energy scenario, energy conservation, audit and management.

2. To inculcate among the students systematic knowledge and skill about assessing the energy efficiency, energy auditing and energy management

3. To know about analysis of the energy data of industries, energy accounting and balancing

4. To know energy audit and methodologies for energy savings

5. To understand utilization of the available resources in optimal ways

Module 1: Energy Scenario (04 Hr)

Commercial and Non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, restructuring of the energy supply sector, energy strategy for the future, air pollution, climate change. Energy Conservation Act-2001 and its features.

Module 2: Basics of Energy and its various forms (06 Hrs)

Electricity tariff, load management and maximum demand control, power factor improvement, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion.

Module 3: Energy Management & Audit (06 Hrs)

Definition, energy audit, need, types of energy audit. Energy management (audit) approach understanding energy costs, bench marking, energy performance, matching energy use to

requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments. Material and Energy balance: Facility as an energy system, methods for preparing process flow, material and energy balance diagrams.

Module 4: Energy Efficiency in Electrical Systems (06 Hrs)

Electrical system: Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, performance assessment of PF capacitors, distribution and transformer losses. Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors.

Module 5: Energy Efficiency in Industrial Systems (06 Hrs)

Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test, factors affecting the performance and savings opportunities in HVAC, Fans and blowers: Types, performance evaluation, efficient system operation, flow control strategies and energy conservation opportunities.

Module 6: Energy Efficient Technologies in Electrical Systems (06 Hr)

Maximum demand controllers, automatic power factor controllers, energy efficient motors, soft starters with energy saver, variable speed drives, energy efficient transformers, electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

CO1 Understand the current energy scenario and importance of energy conservation.

CO2 Understand the concepts of energy management.

CO3 Understand the methods of improving energy efficiency in different electricalSystems.

CO4 Understand the concepts of different energy efficient devices.

TERM WORK

It shall consist of Minimum two questions from theory part of each module as assignments/ exercises.

Text Books:

1. W. F. Kenny, Energy Conservation In Process Industry.
2. AmlanChakrabarti, Energy Engineering and Management, Prentice hall India 2011
3. CB Smith, Energy Management Principles , Pergamon Press, New York

Reference Books

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online)

2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3, Electrical Utilities (available online)

3. S. C. Tripathy, “Utilization of Electrical Energy and Conservation”, McGraw Hill, 1991.

4. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

Course Name : Third Year Mechanical Engineering

Semester : Sixth

Subject Title : Wind Energy and solar energy Open Elective –I (Humanities)

Subject Code : OEC-ME - 605 B

Teaching Scheme (in hrs)			Total Credit (TH +T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
3	--	--	3	15	35	--	--	25	75

Course Objective:

This course is designed to address the following:

1. An introduction to energy systems and renewable energy resources, with a scientific examination of the energy field
2. An emphasis on alternate energy sources their technology and application.
3. The class will explore society's present needs and future energy demands, examine conventional energy sources and systems, including fossil fuels and nuclear energy
4. Focus on alternate, renewable energy sources such as solar, wind power, conservation methods will be emphasized.

Module 1: Physics of Wind Power (6 Hrs)

History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Module 2: Wind generator topologies (8 Hrs)

Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent- Magnet Synchronous Generators, Power electronics converters

Module 3: The Solar Resource (6 Hrs)

Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Module 4: Solar photovoltaic (6 Hrs)

Technologies-Amorphous, monocrystalline, polycrystalline; V-I characteristics of a PV cell, PV module, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms

Module 5: Solar thermal power generation (6 Hrs)

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, elementary analysis.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

CO1 Understand the energy scenario and the consequent growth of the power generation from

CO2 Renewable energy sources.

CO3 Understand the basic physics of wind and solar power generation.

CO4 Understand the power electronic interfaces for wind and solar generation.

CO5 Understand the issues related to the grid-integration of solar and wind energy systems.

TERM WORK

It shall consist of Minimum two questions from theory part of each module as assignments/ exercises.

Text Books:

1. Wind Power Technology Earnest , Joshua PHI Learning, New Delhi, 2014
2. Solar Photovoltaic: A Lab Training Module Solanki, Chetan Singh, Arora, Brij M., VasiJuzer, Patil, Mahesh B. Cambridge University Press, New Delhi, 2009
3. Solar Photovoltaic: Fundamentals, Technologies and Application Solanki, Chetan Singh PHI Learning, New Delhi, 2009
4. Wind Power Plants and Project Development Earnest , Joshua and Wizelius, Tore PHI Learning, New Delhi, 2011

Reference Books

1. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005.
2. G. M. Masters, “Renewable and Efficient Electric Power Systems**”,** John Wiley and Sons, 2004.
3. S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, McGraw Hill, 1984.
4. G. N. Tiwari and M. K. Ghosal, “Renewable Energy Applications”, Narosa Publications, 2004.

Course Name : Third Year Mechanical Engineering

Semester : Sixth

Subject Title : Mechanical Engineering Lab (Hypermesh)

Subject Code : PCC–ME-606

Teaching Scheme (in hrs)			Total Credit (TH +T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
	--	4	2	--	--	25#	--	--	25

Course Objectives:

Hypermesh training course enables participants

1. To work on Hypermesh software which is a computer aided engineering (CAE) simulations software platform.
2. To create finite element models for analysis and prepare high-quality meshes in an efficient manner.
3. To offer the skills needed to work with geometry editing tools for preparing CAD models for the meshing process.
4. To mesh several files in the background to match the standards set by users.

Course Content:

1. Finite Element Analysis (FEA)
2. Shell, Tetra, and Hypermeshing
3. Creating hexa and penta mesh
4. Assemblies: Welding and Swapping Parts
5. Topography and Topology
6. Thermal, Static and Normal Mode analysis
7. Preparing models for analysis and geometry for meshing
8. Normal mode analysis
9. Inertial relief analysis
10. Dynamic analysis
11. Frequency response analysis
12. Self weight gravity analysis
13. Coupled linear analysis
14. Composite analysis

15. Defining manufacturing constraints
16. 2D and 3D shape optimization
17. 1D and 2D size optimization
18. Post processing Results interpretation and Report Generation

Course Name : Third Year Mechanical Engineering

Semester : Sixth

Subject Title : Seminar-II

Subject Code : HSMC- ME - 607

Teaching Scheme (in hrs)			Total Credit (TH +T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
2	--	--	1	--	--	--	--	25	25

Course Objectives:

This course is designed to address the following:

1. The seminar learning objectives is to increase competency of the students.
2. Understand more vital issues of basic science.
3. To improve communication skills and stage courage of the students.
4. To understand the ethics of presentation and to get a scope of self improvement.

Seminar Topics:

Students have to prepare a research paper in prescribed format of any peer review journal. They also deliver seminar on recent advancements in one of the following area and prepare PPT and Seminar report and power point presentation to the department.

1. CAD / CAE / CIM
2. Lean and green manufacturing
3. Non-conventional manufacturing
4. Sheet metal forming
5. Hybrid vehicle
6. Robot Design
7. Quality Management
8. Rapid Prototyping
9. Technology Management

10. Nanotechnology
11. Impact and Crash analysis
12. Knowledge based expert system
13. Bio diesel
14. Nanotechnology applications in Mechanical Engineering
15. Tribology
16. Composite Materials
17. Design Optimization
18. CFD

Course Name : Third Year Mechanical Engineering

Semester : Sixth

Subject Title : Technical and Competitive Skills

Subject Code : MC- ME - 608

Teaching Scheme (in hrs)			Total Credit (TH +T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
2	--	--	--	--	--	--	25@	--	25

Course Content:

Module 1: Gate Exam Preparation: (4 Hrs)

Orientation of GATE Curriculum for Mechanical Engineering, Providing information regarding literature of GATE Examination. Solving some sample question papers of GATE Examination. Giving information for Use of GATE for Job in PSU, Direct recruitment to Group A level posts in Central government and state Government.

Module 2: Preparation of Engineering Mathematics and General Aptitude (4 Hrs)

Preparation of Engineering Mathematics and General Aptitude (GA) with Language and Analytical Skills for GATE examination.

Module 3: Information (4 Hrs)

Information regarding IES Examination and Recruitment procedure of Graduate Engineering students with detail curriculum, Literature and Guidance.

Module 4: Information (2 Hrs)

Information regarding Technical MPSC Examination and Recruitment procedure of Graduate Engineering students with detail curriculum, Literature and Guidance.

Module 5: Technical Post (2 Hrs)

Curriculum and authentic literature of RRB, BSRB examination

Module 6: **Higher Studies (6 Hrs)**

Information Regarding Higher Education in Foreign Universities, Preparation of Pre requirements like SAT, PTE, LSAT, ACT, CAE, CPE GMAT, GRE, IELTS and the TOEFL. Preparation for PG entrance examination, Curriculum and information of entrance examination to IIM and other MBA collages. Information regarding different Scholarship offered For Higher Studies abroad to the Indian students.

Course Name : Third Year Mechanical Engineering

Semester : Sixth

Subject Title : NPTEL Course - II

Subject Code : MC - ME - 609

Teaching Scheme (in hrs)			Total Credit (TH +T+P)	Examination Scheme					
				Theory		Practical			Total
TH	T	P	CR	MSE	ESE	PR	OR	TW	
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Every Student has to complete minimum four weeks NPTEL web and video course from mechanical engineering department which is available on portal nptel.ac.in. It is preferred that student should attend any one course related to subjects of Sixth semester.

Certification courses are offered twice a year (Jan-Jun, Jul-Dec). Joining a course is free. Learning can be done by watching videos and this is tested by the weekly assignments, which are to be submitted online within the prescribed deadline.

There is a certification examination that the student can take for a nominal fee at the end of the course to earn certificates from the IITs.

To earn credits of this course the students need to produce the NPTEL course completion certificate and online submitted assignments to the department before end semester practical examination.