PANDIT DEENDAYAL PETROLEUM UNIVERSITY
SCHOOL OF TECHNOLOGY
COURSE STRUCTURE FOR B.TECH. INDUSTRIAL ENGINEERING

SEMESTER III			B.TECH. MECHANICAL ENGINEERING											
Sr. No	Course Code	Course Name	Teaching Scheme					Exam Scheme						
			L	T	P	C	Hrs/wk	Theory			Practical		Total Marks
								MS	ES	IA	LW	LE/Viva	
1	MA 201T	Mathematics-III	3	1	0	7	4	30	60	10	--	--	100
2	ME/IE 201T	Thermodynamics	3	0	--	6	3	30	60	10	--	--	100
	ME/IE 201P		--	--	2	1	2	--	--	--	25	25	50
3	EE 212T	Electrical Technology	2	0	--	4	2	30	60	10	--	--	100
	EE 212P		--	--	2	1	2	--	--	--	25	25	50
4	ME/IE 205T	Mechanical Measurements & Metrology	3	0	--	6	3	30	60	10	--	--	100
	ME/IE 205P		--	--	2	1	2	--	--	--	25	25	50
5	ME/IE203T	Strength of Materials	3	0	--	6	3	30	60	10	--	--	100
	ME/IE203P		--	--	2	1	2	--	--	--	25	25	50
6	ME/IE204T	Fluid Mechanics	3	0	--	6	3	30	60	10	--	--	100
	ME/IE 204P		--	--	2	1	2	--	--	--	25	25	50
7		CSSI	--	--	--	3	--	--	--	--	--	--	100
		Total	**17**	**1**	**10**	**43**	**28**						950

MS = Mid Semester, ES = End Semester; IA = Internal assessment (like quiz, assignments etc)

LW = Laboratory work; LE = Laboratory Exam

MA 201T MATHAMETICS-III										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	--	7	3	30	60	10	--	--	100

UNIT I **10**

Systems of linear equations : Matrices , Matrix Operations, Special matrices, Elementary transformation, Rank, Introduction to systems of Linear Equations, Solution by Gauss and Gauss Jordan Elimination Method, Solving system of equation using inverse of a Matrix and Cramer's rule, Conditions for consistency of the system.

UNIT II **10**

Vector spaces: Euclidean n - space, Linear Transformations from R^n to R^m; Properties Linear Transformations from R^n to R^m, Matrices of General Linear Transformations, Similarity; Isomorphisim, Vector space and Subspaces, Linear dependence and Independence; Basis Dimension, Row space; null space; column space and rank of a matrix, Rank and Nullity, Dimension Theorem, Inner product spaces, Eigen values and Eigen vectors, Inner products , Angle and Orthogonality in Inner Product Spaces, Orthonormal Bases; Gram-Schmidt process;Least squares approximation, Orthogonal Matrices, Eigen values and Eigen vectors, Diagonalization.

UNIT III **10**

Fourier Series: Periodic functions, Euler's formulae, Dirichlet's conditions, expansion of even and odd functions, half range Fourier series, Perseval's formula, complex form of Fourier series.

Special Functions: Power series method to solve the equation, Frobenius method for solution near regular singular points, Legendre's equation, Legendre polynomials, Rodrigue's formula, Bessel's equation and orthogonality.

UNIT IV **09**

Partial Differential Equations and its Applications: Classification of partial differential equations, solutions of one dimensional wave equation, one dimensional unsteady heat flow equation and two dimensional steady heat flow equation in Cartesian and polar coordinates by variable separable method with reference to Fourier trigonometric series and by Laplace transform technique

APPROXIMATE TOTAL 39 Hours

Texts and References

1. R. K. Jain & S. R. K. Iyernagar, Higher Engineering Mathematics,
2. E.Kreyszig, Advanced engineering mathematics , John Wiley Publication
3 M.D. Raisinghania, Ordinary and Partial Differential Equations S. Chand Publication
4. H.Anton, Elementary linear algebra with applications, John Wiley Publication
5. G.Strang, Linear algebra and its applications , Thomson Publication

ME/IE 201T THERMODYNAMICS										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	--	6	3	30	60	10	--	--	100

UNIT I **10**

Review of the basics of Thermodynamics: Introduction to thermodynamics,First Law of Thermodynamics (Law of conservation of energy), Second Law of Thermodynamics (law of degradation of energy), Concept of Reversibility & reversible cycle. Entropy as a property, Clausius inequality, principle of increase of Entropyand its numerical problems

UNIT II **09**

Availability: Available and unavailable energy, concept of availability, availability of heat source at constant temperature and variable temperature (Numerical) Availability of non flow and steady flow systems, Helmholtz and Gibbs function, irreversibility and second law efficiency

Thermodynamic Relations: Different relationship for systems of constant composition, Helmholz and Gibb's function, variable specific heat, Joule-Kelvin coefficient, Clausius- Clapeyron equation

Ideal Gas mixtures: Composition of a gas mixtures, P-v-T behavior of ideal gas mixtures, properties of ideal gas mixtures, psychometrics of gas-vapor mixtures

UNIT III **11**

Properties of Steam and Vapor Processes: Formation of steam, Phase changes, Properties of steam, Use of Steam Tables, Study of P-V, T-S and Mollier diagram for steam, Dryness fraction and its determination, Study of steam calorimeters (Separating, Throttling and combined) Non-flow and Steady flow vapour processes, Change of properties, Work and heat transfer

Vapour Power Cycles: Carnot cycle, Rankine cycle, Comparision of Carnot cycle and Rankine cycle, Efficiency of Rankine cycle , Relative efficiency, Effect of superheat, boiler and condenser pressure on performance of Rankine cycle. Reheat & Regenerative cycle (no numerical, for reheat & regenerative)

Gas power cycles: Introduction toCarnot cycle,Otto cycle,Diesel cycle, Dual cycle, Brayton cycle, Ericssion Cycle, Stirling cycle

UNIT IV **09**

Fuels and Combustion: Combustion theory, Combustion Equations Theoretical, excess air and equivalence ratio. Analysis of products of combustion Calorific value – HCV & LCV., Enthalpy of formation and enthalpy of combustion, first law analysis of reacting systems, adiabatic flame temperature, entropy change of reacting systems, second law analysis of reacting systems

Use of EES for solving the numerical problems

Approximate Total: 39Hrs

Texts and References

1. Yunus A Cengel& Bole, Thermodynamics- An Engineering Approach, Tata Mcgraw Hill, New Delhi
2. P. K. Nag, Engineering Thermodynamics, Tata Mcgraw Hill, New Delhi
3. RJoel , Engineering Thermodynamics, ELBS Longman.
4. R.Yadav , Fundamentals of Engineering Thermodynamics by, Central Publishing House, Allahabad

ME/IE 201P THERMODYNAMICS										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
--	--	2	1	2	--	--	--	25	25	50

List of Experiments:

1.To calculate the calorific value of a liquid fuel by bomb calorimeter.

2.Tostudy the working of single cylinder diesel engine.

3. To perform the constant speed load test on single cylinder diesel engine and to calculate various performance parameters

4.To measure the flue gas emissions from a diesel engine through a flue gas analyzer.

5. Tostudy the working of single stage and two stage air compressors.

6. To perform the load test on single stage air compressor and to calculate various performance parameters.

7. Junker gas calorimeter

8. Flash point and fire point apparatus

9. Exergy analysis of a operating power plant.

ME/IE 205T Mechanical Measurement & Metrology										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	--	6	3	30	60	10	--	--	100

UNIT I **08**

Generalized Measurement Systems: Selection of methods, need for measurements

Introduction, description of stages in measurement, calibration, accuracy, precision and error, error of classification, treatment of test data, uncertainty analysis. Gage repeatability & Reproducibility

UNIT II **12**

Measurement of force, torque and pressure standards: Measuring methods, comparative study of different types of forces and torque measuring systems, description and working principle of different types of transducers for measuring pressure, measurements of high pressure and low pressure, calibration method.

Measurement of humidity: Introduction, different types of transducers for measurement of humidity their performance characteristic and limitations.

UNIT III **12**

Flow measurement: Introduction, principle of operation of various obstruction meters for compressible and incompressible fluid flow measurement, variable area meter and other important flow meters and visualization methods.

Temperature measurements: Different types of transducer of low and medium temperature pyrometers, temperature indicators, problem in temperature measurement.

Measurement of speed and vibration: Velocity acceleration, speedometers, velocity measurement, accelerometers, encoders, calibration and users, different pickups and their limitations.

Measurement of radio isotopes: measurement of radio activity.

UNIT IV **07**

Metrology: Introduction to metrology and its relevance, standardization, dimensional measurement, limits, fits and tolerance, limit gauging, linear and angular measurement and their applications, surface roughness quantifications and measurement, alignment testing of machine tools, feature inspection and computer aided inspection. GD & T.

Approximate Total: 39Hrs

Texts and References

1. Beckwidth, Lienhard, Marangoni, Mechanical Measurements, Pearson Education Asia
2. Doeblin , Measurement systems, application and design, Tata McGraw-Hill, New Delhi
3. Adams l. F., Engineering Measurement and analysis, University Press, London
4. Nakra B. C. , Choudhary K.K., Instrumentation measurement and analysis, Tata McGraw-Hill, New Delhi
5. Mikell P. Groover, Automation, production system & computer integrated manufacturing, Pearson Education Asia.
6. Bently J. P., Principle of measurement systems, Pearson Education Asia.

ME/IE 205P Mechanical Measurement & Metrology										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
--	--	2	1	2	--	--	--	25	25	50

List of Experiments:

1. Study of static and dynamic instrument characteristic, general structure.
2. Experiment design leading to understanding of measurement system, standard, accuracy, error, uncertainty, data handling.
3. Experiment on linear and rotary measurement using LVDT & potentiometer.
4. Experiment using strain gauge & load cell for force and torque/moment measurement.
5. Experiment to measure temperature using thermocouple, RTD, NTC, Mercury Thermometer and Bimetallic Thermometer and pyrometer.
6. Calibration of Micrometer, Vernier Caliper using Gauge Blocks / Slip Gauges
7. Measurement of circularity using Comparator/Dial combination.
8. Measurement of inner diameter of a cylindrical piece with the help of Height gauge
9. Measurements of surface finish using Subtonic tester.
10. Measurement related to fit, feature detection.
11. Measurement of gear tooth parameters, screw thread parameters on Profile Projector.
12. Experiment design: gas geyser, piston cylinder or ball bearing/bush bearing fit

EE 212T ELECTRICAL TECHNOLOGY											
Teaching Scheme					Examination Scheme						
L	T	P	C	Hrs/Week	Theory			Tutorial	Term Work	Practical /Viva	Total Marks
					MS	ES	IE				
2	0	0	4	2	30	60	10	--	--	--	100

UNIT-I **06**

Single phase transformer: - Types, KVA rating, approximate equivalent circuit, voltage regulation and efficiency of transformer, condition for maximum efficiency.

Three phase transformers: Types of transformer connection (star/star, star/delta, delta/star, and delta/delta) and applications based on connections. (Theoretical Treatment only) Introduction of power transformer, distribution transformer.

UNIT-II **08**

Three phase Induction Motor:-Constructional feature, working principle of three phase induction motors, types; torque equation, torque slip characteristics; power stages; efficiency; types of starters; methods of speed control & Industrial applications.

Single phase induction motors: Types, construction, working principle of split phase and shaded pole type induction motors, applications. Specifications of induction motors (KW rating, rated voltage, current rating, frequency, speed, class of insulation)

UNIT-III **06**

Synchronous Generator: Constructional features (Salient and non- salient),working principle, e m f equation, synchronous speed of an alternator, concept of synchronous reactance and impedance, phasor diagram of loaded alternator, voltage regulation of alternator by direct loading method and synchronous impedance method. Specifications of synchronous generator.

UNIT-IV **06**

Construction, working principle of D.C. generator, emf equation of D C generator. (Theoretical concept only). Working principle of D.C. motor. Types of D. C. motor, back emf , torque equation for D.C. motor, characteristics of D. C. motor (series, shunt and compound), starters of D.C. shunt and series motor, methods for speed control of D.C shunt and series motors, Industrial applications.

Approximate Total : 26 Hrs

References / Books:

1. B. L.Theraja,Electrical Technology, S Chand Publication Co Ltd.
2. Ashfaq Husain, Fundamentals of Electrical Engineering, DhanpatRai& Co.
3. D P Kothari and I J Nagrath, Electrical machines Tata McGraw Hill
4. S.K. Bhattacharya Electrical Machinery ,TTTI Chandigad
5. Edward Hughes ,Electrical Technology, Pearson Education
6. H Pratap, Art and Science of Utilization of Electrical Energy, DhanpatRai and Co ,Third Edition
7. Dr. P.S. Bhimbra, Power Electronics, Khanna Publication

EE 212P ELECTRICAL TECHNOLOGY										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Term Work	Practical /Viva	Total Marks
					MS	ES	IA			
0	0	2	1	2	--	--	--	25	25	50

List of Experiment:-

1. Excitation characteristic of dc machines
2. O.C. / S.C. Test on single Phase Transformer
3. Polarity & Voltage ratio Test on Single Phase Transformer
4. Load Test on Single Phase Transformer
5. Speed Control Methods of D C shunt motors
6. Speed Control Methods of D C series motors
7. Swinburns Test for D C Machine
8. Hopkinsons Test for D C Machine
9. Parallel operation of Single Phase Transformer
10. Sumpners Test on Single Phase Transformer

ME/IE 203T STRENGTH OF MATERIALS										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	--	6	3	30	60	10	--	--	100

UNIT I **12**

Mechanics Fundamentals: Load/Force, Types of forces (Static, Dynamic, Impact, Impulse etc., external vs. internal), free body diagram. **Stress:** Definition of stress, Normal and shear stress, Stress at a point – matrix of stress / stress tensor, Symmetry of stress tensor, Different states of stress – uniaxial, biaxial, plane stress, etc., Transformation ofplane stress; extension to 3-D, Principal stresses and maximum shear stress, Mohr's circle for plane stress.

Strain: Definition of strain – shear and normal strains, Strain at a point – matrix of strain / strain tensor, Symmetry of strain tensor, Different states of strain – uniaxial, plane strain, etc., Transformation of plane strain; extension to 3-D, Principal strains, Mohr's circle for plane strain, Strain energy.

UNIT II **04**

Mechanical properties: Testing of Materials, Tension Test, Load-deflection and Stress-Strain diagrams, Elasticity, Engineering vs. True stress, Young's Modulus, Yield point, Proportional limit, Plasticity, Strain hardening, Ultimate strength, Percentage elongation, Lateral strain, Poisson's ratio, Relationship between different elastic constants.

Equilibrium Equations: Equilibrium of a body – differential equations of equilibrium, Hooke's law, Generalized Hooke's law.

Design Considerations: Stress concentration factor, Factor of safety, thermally induced stress and strain.

UNIT III **11**

Fixed Beams: Deflections, reactions and fixing moments with SF & BM calculations & diagrams for fixed beams under (i) concentrated loads, (ii) uniformly distributed load and (iii) a combination of concentrated loads & uniformly distributed load. Bars of varying cross-section, Composite sections under compression and tension.

Slope & Deflection: Relationship between bending moment, slope & deflection, Mohr's theorem, moment area method, method of integration, Macaulay's method, calculations for slope and deflection of (i) cantilevers and (ii) simply supported beams with or without overhang under concentrated load, Uniformly distributed loads or combination of concentrated and uniformly distributed loads.

UNIT IV **12**

Torsion: Torque, Derivation and use of torque equation, Shear stress diagram for solid and hollow circular shafts, Comparison between solid and hollow shaft with regard to their strength and weight, Power transmitted by shaft, Concept of mean and maximum torque.

Columns & Struts: Column under axial load, concept of instability and buckling, slenderness ratio, derivation of Euler's formulae for the elastic buckling load, Euler's, Rankine, Gordon's formulae, Johnson's empirical formula for axial loading columns and their applications, eccentric compression of a short strut of rectangular & circular sections.

Approximate Total : 39Hrs

Texts and References

1. Ferdinand P. Beer & E. Russel Johnston, "Mechanics of Materials", McGraw Hill Publications.
2. G. H. Ryder, "Strength of Materials", Macmillan, India.
3. R. C. Hibbeler, "Mechanics of Materials", Prentice Hall, Pearson, India.
4. Andrew Pytel& Ferdinand L. Singer, "Strength of Materials", Addison-Wesley.
5. TimoShenko, "Strength of Materials", CBS Publisher, New Delhi.
6. Popov, "Strength of Materials", PHI, New Delhi.
7. M. A. Jayaram, "Strength of Materials A Rudimentary Approach", Sapna Book House, Bangalore.
8. Kazmi, "Book of Solid Mechanics", Tata McGraw Hill.
9. N. Krishan Raju & D. R. Gururaje, "Advanced Mechanics of Solid and Structures" Narosa Publishing House.
10. S. S. Rattan, "Strength of Materials", McGraw Hill Publications.

ME/IE 203P STRENGTH OF MATERIALS

Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
--	--	2	1	2	--	--	--	25	25	50

List of Experiments:

1. To study the Brinell hardness testing machine & perform the Brinell hardness test.
2. To study the Rockwell hardness testing machine & perform the Rockwell hardness test.
3. To study the Vickers hardness testing machine & perform the Vickers hardness test.
4. To study the Impact testing machine and perform the Impact tests (Izod&Charpy).
5. To study the Universal testing machine and perform the tensile test
6. To perform compression test.
7. To perform bending tests.
8. To study the torsion testing machine and perform the torsion test.
9. To study the shear testing machine and perform the shear test.

ME/IE 204T FLUID MECHANICS										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	--	6	3	30	60	10	--	--	100

UNIT I09

Introduction: Continuum, Force, Stress, Strain, Solids vs. Fluids, Types of fluids, Fluid Properties, Newton's law of viscosity, Stokes' theorem, Compressibility and vapor pressure

Fundamental Concepts: Fluid flow definition (Eulerian vs. Langrangian), System vs. Control Volume, Reynolds' transport theorem

Fluid Statics: Hydrostatic law, Pascal's law, Pressure at a point, Total Pressure, Centre of pressure, Pressure on a plane(Horizontal, Vertical, Inclined) & Curved surfaces, Archimedes Principle , Buoyancy and stability of floating and submerged bodies, Meta-centric height

UNIT II12

Fluid Kinematics: Types of flow (steady vs. unsteady, uniform vs. non-uniform, laminar vs. turbulent, One, Two and Three dimensional, compressible vs. incompressible, rotational vs. Irrotational), Stream lines, path lines, streak lines, velocity components, convective, local and total acceleration, velocity potential, stream function, continuity equation in Cartesian co-ordinates

Fluid Dynamics: Introduction to Navier-Stokes'equation, Euler's equation of motion along a stream line, Bernoulli's equation, Application of Bernoulli's equation to Pitot tube, Venturi meter, Orifices, Orifice meter, Triangular Notch & Rectangular Notch

Dimensional Analysis: Dimensions of physical quantities, dimensional homogeneity, Buckingham pi Theorem, important dimensionless numbers, Model analysis (Reynolds, Froude and Mach)

UNIT III10

Laminar Flow: Definition, relation between pressure and shear stresses, laminar flow through round pipe, fixed parallel plates

Boundary Layer Theory: Development of Boundary Layer on a flat plate, Laminar and Turbulent Boundary Layers, Laminar sub layer, Separation of Boundary Layer and Methods of Controlling, Flow around Immersed Bodies, Lift and Drag, Classification of Drag, Flow around circular cylinder and Aerofoil, Development of lift on Aerofoil

UNIT VI08

Flow Through Pipes: Total energy line, Hydraulic grade line, Energy losses through pipe, Darcy-Weisbach equation, Moody diagram, Minor losses in pipes, pipes in series and parallel, Siphons, Transmission of power, Turbulent Flow, Velocity Distribution

Compressible fluid flow:Ideal gas relations, mach number, speed of sound. Isentropic flow of ideal gas.

Introduction to Computational Fluid Dynamics: Introduction to CFD Methodology (Elementary Treatment); Use of EES for problem solving; Flow visualization tapes

Approximate Total: 39Hrs

Texts and References

1. S. Gupta, Fluid Mechanics and Hydraulic Machines, Pearson Publishers.
2. Cengel and Cimbala, Fluid Mechanics, Tata-McGraw Hill Publishers.
3. F. White, Fluid Mechanics, Tata-McGraw Hill publishers.
4. R. Fox and A. McDonald, Fluid Mechanics, John Wiley Publishers.
5. J. Douglas, J. Gasiorek, J. Swaffield, and L. Jack, Fluid Mechanics, Pearson Publishers.
6. C. Ojha, P. Bernstein and P. Chandramouli, Fluid Mechanics and Machinery, Oxford University Press.

ME/IE 204P FLUID MECHANICS										
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
--	--	2	1	2	--	--	--	25	25	50

List of Experiments:

1. Reynolds apparatus
2. Verification of Bernoulli's principle
3. Viscosity by efflux time measurement
4. Friction in circular pipe
5. Discharge coefficient of venturimeter
6. Discharge coefficient of orificemeter
7. Calibration of rotameter
8. Studies on pitot tube
9. Discharge coefficient of open channel
10. Determination of Equivalent pipe length of various pipe fittings

CSSI							
Teaching Scheme					Examination Scheme		
L	T	P	C	Hrs/Week	Report Writing	V/V	Total
--	--	--	3	--	80	20	100

Duration: three weeks after second semester
Examination of CSSI will be conducted in III semester.