STATE COUNCIL OF TECHNICAL EDUCATION AND VOCATIONAL TRAINING, ODISHA
TEACHING AND EVALUATION SCHEME FOR DIPLOMA IN ENGINEERING COURSES

DISCIPLINE: MECHANICAL ENGINEERING						**SEMESTER: 3RD**						
SL NO	**SUBJECT CODE**	**SUBJECT**	**PERIODS**			**EVALUATION SCHEME**						
			L	**T**	**P**	**INTERNAL EXAM**			**END SEM EXAM**	**TERM WORK**	**PRACTICAL EXAM**	**TOTAL MARKS**
						TA	**CT**	**Total**				
THEORY												
1.	BST 301	ENGG. MATH-III	5			10	20	30	70			100
2.	MET 301	STRENGTH OF MATERIAL	5			10	20	30	70			100
3.	MET 302	ENGINEERING MATERIALS	5			10	20	30	70			100
4.	MET 303	THERMAL ENGINEERING-I	5			10	20	30	70			100
PRACTICAL/TERM WORK												
5.	MEP 301	MECHANICAL ENGINEERING DRAWING*			6				100	50	0	150
6.	MEP 302	MECHANICAL ENGINEERING LAB (STRENGTH OF MATERIAL AND THERMAL ENGINEERING)			6					25	75	100
7.	MEP 303	WORKSHOP PRACTICE-II			7					25	75	100
GRAND TOTAL			**20**		**19**	**40**	**80**	**120**	**380**	**100**	**150**	**750**

Total Contact hours per week: 39
Abbreviations: L-Lecture, T-Tutorial, P-Practical, TA- Teacher's Assessment, CT- Class test
Minimum Pass Mark in each Theory Subject is 35% and in Practical subject is 50% * Minimum pass mark in End Sem Exam is 35% & that in term work is 50%

ENGINEERING MATHEMATICS – III
(COMMON TO ELECT/CSE/ETC, AE & I/CP/IT/MECH/AUTO)

Name of the Course: Diploma in **MECHANICAL ENGINEERING**			
Course code:	BST 301	Semester	3rd
Total Period:	60	Examination	3 hrs
Theory periods:	4P / week	Class Test:	20
Tutorial:	1 P/ week	Teacher's Assessment:	10
Maximum marks:	100	End Semester Examination:	70

A. RATIONALE:

The subject Engineering Mathematics-III, is a common paper for Engineering branches. This subject includes Matrices, Laplace Transforms, Fourier Series, Differential Equations and Numerical Methods etc. for solution of Engineering problems.

B. OBJECTIVE:

On completion of study of Engineering Mathematics-III, the students will be able to:

1. Apply matrices in Engineering mechanics, electrical circuits and linear programming.
2. Transform Engineering problems to mathematical models with the help of differential equations and familiarize with the methods of solving by analytical methods, transform method, operator method and numerical methods.
3. Solve algebraic and transcendental equations by Iterative methods easily programmable in computers.
4. Analysis data and develop interpolating polynomials through method of differences.

Topic wise distribution of periods

Sl. No.	Topics	Period
1	Matrices	04
2	Differential equation	12
3	Laplace transform	14
4	Fourier series	14
5	Numerical methods	04
6	Finite difference & Interpolation	12
	Total:	**60**

COURSE CONTENTS

1. MATRICES **04**

1.1 Define rank of a matrix.
1.2 Perform elementary row transformation to determine the rank of a matrix.
1.3 State Rouche's Theorem for consistency of a system of linear equations in 'n' unknowns.
1.4 Solve equations in three unknowns testing consistency.

2. Linear Differential Equations **12**

2.1 Define Homogeneous and non-homogeneous differential equations with constant coefficients with examples.
2.2 Find general solution of linear equations in terms of C.F. and P.I.
2.3 Derive rules of finding C.F. and P.I. in terms of operator D.
2.4 Define Partial Differential equations(P.D.E.)
2.5 Form partial differential equations by eliminating arbitrary constants and arbitrary functions.
2.6 Solve partial differential equations of the form P.p+Q.q=R
2.7 Solve Engineering problems on 2.1-2.6.

3. LAPLACE TRANSFORMS **14**

3.1 Define Gamma function and $\Gamma(n+1) = n!$ and find $\Gamma(1/2) = \sqrt{\pi}$ (No problem)

3.2 Define Laplace transform of a function f(t) and inverse laplace transform.
3.3 Derive L.T. of standard functions and explain existence conditions of L.T.
3.4 Explain linear, shifting and Change of scale property of L.T.
3.5 Formulate L.T. of derivatives, integrals, multiplication by t^n and division by t.
3.6 Derive formula of inverse L.T.
3.7 Solve Linear Differential Equations with constant coefficients associated with initial conditions using Transform Method(upto 2nd order only).
3.8 Solve problems on 3.2- 3.7

4 FOURIER SERIES **14**

4.1 Define periodic functions
4.2 State Dirichlet's conditions for the Fourier expansion of a function and its convergence.
4.3 Express periodic function $f(x)$ satisfying Dirichlet's conditions as a Fourier series.
4.4 State Euler's formulae.
4.5 Define Even and Odd functions and Obtain F.S. in $(0 \le x \le 2\pi$ and $-\pi \le x \le \pi)$
4.6 Obtain F.S. of continuous functions and functions having points of discontinuity in $(0 \le x \le 2\pi$ and $-\pi \le x \le \pi)$.
4.7 Solve problems on 4.1-4.6

5 NUMERICAL METHODS **04**

5.1 Appraise limitations of analytic method of solution of algebraic and transcendental equations.
5.2 Derive Iterative formula for finding the solutions of algebraic and transcendental equations by:
a) Bisection method
b) Newton Raphson method
5.3 Solve problems on 5.2

6 FINITE DIFFERENCE and INTERPOLATION **12**

6.1 Explain finite difference and form table of forward and backward difference.
6.2 Define shift operator(E) and establish relation between E and difference operator(Δ).
6.3 Derive Newton's forward and backward interpolation formula for equal interval.
6.4 State Lagrange's Interpolation formula for unequal intervals.
6.5 Explain numerical integration and state
6.5.1 Newton-Cote's formula(No derivation)
6.5.2 Trapezoidal Rule
6.5.3 Simpson's 1/3rd rule
6.6 Solve Problems on 6.1-6.5

Learning Resources:

Text Books

Sl.No	Name of Authors	Title of the Book	Name of the publisher
1	Dr.B.S. Grewal	Higher Engineering Mathematics	Khanna Publishers

Reference Book

1	Text book of Engineering Mathematics-III	By C.R.Mallick	Kalyani Publication

STRENGTH OF MATERIAL

Name of the Course: Diploma in **MECHANICAL ENGINEERING**			
Course code:	MET 301	Semester	3RD
Total Period:	75	Examination	3 hrs
Theory periods:	5 P/W	Class Test:	20
Tutorial:		Teacher's Assessment:	10
Maximum marks:	100	End Semester Examination:	70

Course objectives

Students will develop ability towards

- Determination of stress, strain under uniaxial loading (due to static or impact load and temperature) in simple and single core composite bars.
- Determination of stress, strain and change in geometrical parameters of cylindrical and spherical shells due to pressure
- Realization of shear stress besides normal stress and computation of resultant stress in two dimensional objects.
- Drawing bending moment and shear force diagram and locating points in a beam where the effect is maximum or minimum.
- Determination of bending stress and torsion stress in simple cases

Determination of critical load in slender columns thus realizing combined effect of axial and bending load.

Chapter ID	Topics ID	Contents	Hours
1.0		**Simple stress& strain**	**15**
	1.1	Types of load, stresses & strains,(Axial and tangential) Hookes law, Young's modulus, bulk modulus, modulus of rigidity, Poisson's ratio, derive the relation between three elastic constants,	
	1.2	Principle of super position, stresses in composite section	
	1.3	Temperature stress, determine the temperature stress in composite bar (single core)	
	1.4	Strain energy and resilience, Stress due to gradually applied, suddenly applied and impact load	
	1.5	Simple problems on above.	
2.0		**Thin cylinder and spherical shell under internal pressure**	**9**
	2.1	Definition of hoop and longitudinal stress, strain	
	2.2	Derivation of hoop stress, longitudinal stress, hoop strain, longitudinal strain and volumetric strain	
	2.3	Computation of the change in length, diameter and volume	
	2.4	Simple problems on above	
3.0		**Two dimensional stress systems**	**12**
	3.1	Determination of normal stress, shear stress and resultant stress on oblique plane	
	3.2	Location of principal plane and computation of principal stress	
	3.3	Location of principal plane and computation of principal stress and maximum shear stress using Mohr's circle	
4.0		**Bending moment& shear force**	**12**
	4.1	Types of beam and load	
	4.2	Concepts of Shear force and bending moment	
	4.3	Shear Force and Bending moment diagram and its salient features illustration in cantilever beam, simply supported beam and over hanging beam under point load and uniformly distributed load	
5.0		**Theory of simple bending**	**12**
	5.1	Assumptions in the theory of bending,	
	5.2	Bending equation, Moment of resistance, Section modulus& neutral axis.	
	5.3	solve simple problems	

6.0	**Combined direct & Bending stresses**		**9**
	6.1	Define column	
	6.2	Axial load, Eccentric load on column,	
	6.3	Direct stresses, Bending stresses, Maximum& Minimum stresses. Numerical problems on above.	
	6.4	Buckling load computation using Euler's formula (no derivation) in columns with various end conditions	
7.0	**Torsion**		**6**
	7.1	Assumption of pure torsion	
	7.2	The torsion equation for solid and hollow circular shaft	
	7.3	Comparison between solid and hollow shaft subjected to pure torsion	

Learning Resources:

TEXT BOOKS:	**1.** S Ramamrutham	Strength of Materials
	2. R K Rajput	Strength of Materials
	3.R Subramanian	Strength of Materials
Reference Books:	1. G H Rhyder	Strength of Materials
	2. R C Hibbler	Mechanics of Materials

ENGINEERING MATERIALS

Name of the Course: Diploma in **MECHANICAL ENGINEERING**			
Course code:	MET 302	Semester	3rd
Total Period:	75	Examination	3 hrs
Theory periods:	5 P/week	Class Test:	20
Tutorial:		Teacher's Assessment:	10
Maximum marks:	100	End Semester Examination:	70

Course Objectives

Students will develop ability towards

- Realizing material requirements
- Realizing application area of ferrous, non ferrous and alloys
- Comprehending micro-structural changes during iron-carbon phase transformation process
- Comprehending effect of heat treatment and its effect towards change in material properties
- Comprehending continuity during evolution in engineering materials and development of modern engineering materials

Chapter ID	Topics ID	Contents	Hours
1.0		**Engineering materials and their properties**	**8**
	1.1	Material classification into ferrous and non ferrous category and alloys	
	1.2	Properties of Materials: Physical and Chemical	
	1.3	Performance requirements	
	1.4	Material reliability and safety	
2.0		**Ferrous Materials and alloys**	**8**
	2.1	Characteristics and application of ferrous materials	
	2.2	Classification, composition and application of low carbon steel, medium carbon stell and High carbon steel	
	2.3	Alloy steel: Low alloy steel, high alloy steel, tool steel and stainless steel	
	2.4	Tool steel: Effect of various alloying elements such as Cr, Mn, Ni, V, Mo, W	
3.0		**Iron – Carbon system**	**8**
	3.1	Concept of phase diagram and cooling curves	
	3.2	Features of Iron-Carbon diagram with salient micro-constituents of Iron and Steel	
4.0		**Crystal imperfections**	**10**
	4.1	Crystal defines, classification of crystals, ideal crystal and crystal imperfections	
	4.2	Classification of imperfection: Point defects, line defects, surface defects and volume defects	
	4.3	Types and causes of point defects: Vacancies, Interstitials and impurities	
	4.4	Types and causes of line defects: Edge dislocation and screw dislocation	
	4.5	Effect of imperfection on material properties	
	4.6	Deformation by slip and twinning	
	4.7	Effect of deformation on material properties	
5.0		**Heat Treatment**	**12**
	5.1	Purpose of Heat treatment	
	5.2	Process of heat treatment: Annealing, normalizing, hardening, tampering, stress relieving measures	
	5.3	Surface hardening: Carburizing and Nitriding	
	5.4	Effect of heat treatment on properties of steel	
	5.5	Hardenability of steel	
6.0		**Non-ferrous alloys**	**10**
	6.1	Aluminium alloys: Composition, property and usage of Duralmin, y-alloy	

	6.2	Copper alloys: Composition, property and usage of Copper-Aluminium, Copper-Tin, Babbit, Phosperous bronze, brass, Copper-Nickel	
	6.3	Predominating elements of lead alloys, Zinc alloys and Nickel alloys	
	6.4	Low alloy materials like P-91, P-22 for power plants and other high temperature services. High alloy materials like stainless steel grades of duplex, super duplex materials etc.	
7.0	**Bearing Material**		**5**
	7.1	Classification, composition, properties and uses of Copper base, Tin Base, Lead base, Cd base bearing materials	
8.0	**Spring materials**		**4**
	8.1	Classification, composition, properties and uses of Iron-base and Copper base spring material	
9.0	**Polymers**		**4**
	9.1	Properties and application of thermosetting and thermoplastic polymers	
	9.2	Properties of elastomers	
10.0	**Composites and Ceramics**		**4**
	10.1	Classification, composition, properties and uses of particulate based and fiber reinforced composites	
	10.2	Classification and uses of ceramics	
11.0	**Surface preparation and Industrial painting**		**2**
	11.1	Reasons of corrosion and surface wear	
	11.2	Purpose of painting and methods of industrial painting	

Learning Resources:

	Sl.No	**Author**	**Title of Book**	**Publisher**
Text books	1.	O P Khanna	A Textbook of Material Science and Metallurgy	
	2.	R K Rajput	Engineering materials and metallurgy	
Reference book	1.	S K Hazrachoudhry	Material science& process	

THERMAL ENGINEERING-I

Name of the Course: Diploma in **MECHANICAL ENGINEERING**			
Course code:	MET 303	Semester	3rd
Total Period:	75	Examination	3 hrs
Theory periods:	5 P/week	Class Test:	20
Tutorial:		Teacher's Assessment:	10
Maximum marks:	100	End Semester Examination:	70

Course Objectives:

Students will develop an ability towards

- Comprehending significance of thermodynamic properties in order to analyze a thermodynamic system from macroscopic view point
- Computing work and heat transfers across system boundaries
- Comprehending and applying first and second law of thermodynamics in closed and open systems involving steady flow
- Determining thermodynamic properties of water-vapor-steam using steam tables and Mollier chart
- Comprehending and applying gas laws applicable to ideal gas in order to determine thermodynamic properties as well realizing differences in real gases

Chapter ID	Topics ID	Contents	Hours
1.		**Concepts and terminology**	8
	1.1	Thermodynamic systems	
	1.2	Macroscopic and microscopic views of study, concept of continuum	
	1.3	Thermodynamic properties of a system (Pressure, volume, temperature and units of measurement)	
	1.4	Intensive and extensive properties	
	1.5	State and Process	
	1.6	Thermodynamic equilibrium	
	1.7	Quasistatic process	
2		**Energy and Work Transfer**	10
	2.1	Conceptual explanation of energy, work and heat	
	2.2	Work transfer, Displacement work, forms of work transfer	
	2.3	Modes of heat transfer (Introductory concepts of conduction, convection and radiation)	
	2.4	Sensible and latent heat, specific heat	
	2.5	Energy and its sources	
3		**First Law of thermodynamics**	15
	3.1	First Law of thermodynamics	
	3.2	Energy as system property, forms of stored energy	
	3.3	First law for a closed system undergoing a cyclic process	
	3.4	First law for a closed system undergoing change of state	
	3.5	Concept of enthalpy	
	3.6	First law applied to steady flow processes Steady Flow Energy Equation and its application to nozzle, turbine and compressor	
	3.7	Perpetual motion machine of first kind	
4		**Second Law of Thermodynamics**	15
	4.1	Limitations of first law	
	4.2	Thermal reservoir	
	4.3	Concept of heat engine, heat pump and refrigerator	
	4.4	Statement of Second law of thermodynamics (Clausius and Kelvin Planck), Perpetual motion machine of second kind	
	4.5	Carnot cycle	
	4.6	Application of second law in heat engine, heat pump, refrigerator and determination of efficiencies and COP	

	4.7	Clausius inequality	
	4.8	Defining entropy, entropy and disorder	
	4.9	Principle of increase in entropy	
5	**Working substances**		15
	5.1	Pure substance, what it is	
	5.2	Phase change phenomenon of pure substance and associated terminology	
	5.3	p-v, p-h and T-s diagrams	
	5.4	Specific heats	
	5.5	Dryness fraction and its measurement	
	5.6	Steam table and its use to determine unknown properties	
	5.7	Use of Mollier chart to determine unknown properties	
6	**Ideal gases and real gases**		12
	6.1	Boyle's law, Charles' law, Avogadro's law, Dalton's law of partial pressure, Guy Lussac equation, Equations of state, Characteristic Gas constant and Universal Gas constant	
	6.2	Work transfer equations for ideal gases: Constant pressure, constant volume, isothermal, polytropic, isentropic processes	
	6.3	Van der wal equation of state for real gases, Difference between ideal and real gases	

Learning Resources:

Text Books:
1. P. Chattopadhyay — Engineering Thermodynamics
2. Domkundwar — A text book of thermal Engineering

Reference Books:
1. P K Nag — Engineering Thermodynamics,
2. M Rathore , Mahesh — Thermal Engineering,

MECHANICAL ENGINEERING DRAWING

Name of the Course: Diploma in **MECHANICAL ENGINEERING**			
Course code:	MEP 301	Semester	3rd
Total Period:	90	Examination	4 hrs
Theory periods:	6 P/week	Term Work:	50
Tutorial:		Teacher's Assessment:	
Maximum marks:	150	End Semester Examination:	100

Course objectives

Students will develop ability towards

- Recognizing significance of standardized representations
- Comprehending role of various fastening elements and offer engineering drawing thereof in manual mode
- Comprehending geometrical constraints and function of components in assemblies such as bearings and screw jack
- Comprehending functional requirement of major components and offer engineering drawing in manual mode thereof

Chapter	Contents	Hours
1.0	**Conventional representations**	6
	1.1 Standard convention (SP-46): Materials (CI, MS, Brass, Bronze, Aluminium, Wood, Glass, Concrete and rubber) Tapers Surface roughness Geometrical tolerances General welding	
2.0	**Engineering drawing of Fastening elements in first angle orthographic projection**	**30**
	2.1 Bolt, nut and threads 2.2 Screws and rivets 2.3 Cotter joint 2.4 Knuckle joints	
3.0	**Details to assembly**	**24**
	3.1 Rigid pedestal bearing 3.2 Foot step bearing 3.3 Simple Screw jack	
4.0	**Assembly to details**	**30**
	4.1 Connecting rod of IC Engine 4.2 Boiler safety valve 4.3 Spring loaded valve 4.4 Hydraulic non return valve 4.5 Flat belt pulley	

Learning Resources:

Text Books:

N D Bhatt — Machine Drawing
T Jones — Machine Drawing
R K Dhawan — Machine Drawing

MECHANICAL ENGINEERING LABORTORY

Name of the Course: Diploma in **MECHANICAL ENGINEERING**			
Course code:	MEP 302	Semester	3rd
Total Period:	90	Examination	4 hrs
Lab. periods:	6 P/week	Term Work	25
Maximum marks:	100	End Semester Examination:	75

Course Objectives

Students will develop an ability towards

- Conducting experimentations to determine properties of a solid material subject to uni axial loading and impact
- Conducting experimentations towards determining characteristics of a fuel
- Study of equipment employing using fuels

1. Strength of Materials Laboratory

1.1 Determine end reactions in a beam

1.2 Determination of Young's modulus using Searl's apparatus

1.3 Determination of torsional rigidity of the shaft using torsion testing machine

1.4 Determination of salient points (Young's modulus, yield point, fracture point) from stress-strain curve using Universal Testing Machine

1.5 Determination of hardness number by Rockwell/Vickers hardness testing machine

1.6 Determination of toughness using Impact testing machine (Charpy/Izod)

2. Thermal Engineering Laboratory

2.1 Study of 2-S, 4-S petrol engine

2.2 Study of 2-S, 4-S diesel engine

2.3 Determination of Flash point and fire point

2.4 Joule's experiment

2.5 Study of boilers (Fire tube, water tube)

2.6 Study of steam engine

WORKSHOP PRACTICE-II

Name of the Course: Diploma in **MECHANICAL ENGINEERING**			
Course code:	MEP 303	Semester	3rd
Total Period:	105	Examination	4 hrs
Lab. periods:	7 P/week	Term Work	25
Maximum marks:	100	End Semester Examination:	75

Course Objectives

Students will develop an ability towards

- Practicing fitting, carpentry, smithy and machining
- Understanding the tools and equipment used in the practices
- Realize the time and resource utilization in the practices

1. Fitting practices

1.1 Preparation of caliper
1.2 Preparation of try square
1.3 Preparation of hammer
1.4 Preparation of male-female joint

2. Smithy Practices

2.1 Preparation of door ring with hook
2.2 Preparation of hexagonal head bolt
2.3 Preparation of octagonal flat chisel

3 Carpentry Practices

3.1 Cutting of slot, botch, mortise and Tenon
3.2 Preparation of single dove tail joint

4 Metal Machining practices

4.1 Plain turning
4.2 Step turning
4.3 Taper turning
4.4 Grooving
4.5 Chamfering
4.6 External threading