RADHA GOVIND UNIVERSITY
RAMGARH, JHARKHAND

Department of Mechanical Engineering

Under Faculty of Engineering and Technology

Choice Based Credit System Curriculum for B.Tech in Mechanical Engineering

(Effective from Academic Session 2025-26)

1st SEMESTER
COURSE CONTENTS

Mechanical Engineering

1st semester course structure

Sl. No.	Category	Course Code	Course Title	Hours Per Week			Credit	Marks		
				L	T	P		IA	ESE	Total
Theory										
1	Basic Science Course	BSC101	Physics I	3	1	0	4	30	70	100
2	Basic Science Course	BSC103	Mathematics – I	3	1	0	4	30	70	100
3	Engineering Science Courses/ Basic Science Course	ESC101/ BSC102	Basic Electrical Engineering/ Chemistry I	3	1	0	4	30	70	100
Total(A)							**12**	**90**	**210**	**300**
Practical/Drawing/Design										
4	Engineering Science Courses	ESC102	Engineering Graphics & Design	1	0	4	3	25	25	50
5	Basic Science Course	BSC101P	Physics Lab	0	0	3	1.5	25	25	50
6	Engineering Science Courses/ Basic Science Course	ESC101P/ BSC102P	Basic Electrical Engineering Lab / Chemistry Lab	0	0	2	1	25	25	50
Total(B)							**5.5**	**75**	**75**	**150**
Grand Total(A+B)							**17.5**	**165**	**285**	**450**

L-Lecture, T-Tutorial, P-Practical

IA- Internal Assessment, ESE-End Semester Examination

29/3/25

2nd SEMESTER
COURSE CONTENTS

Mechanical Engineering

2nd semester course structure

Sl. No.	Category	Course Code	Course Title	Hours Per Week			Credit	Marks		
				L	T	P		IA	ESE	Total
Theory										
1	Basic Science Course	BSC105	Physics -II	3	1	0	4	30	70	100
2	Engineering Science Courses/ Basic Science Course	ESC101/ BSC102	Basic Electrical Engineering/ Chemistry I	3	1	0	4	30	70	100
3	Basic Science Course	BSC104	Mathematics – II	3	1	0	4	30	70	100
4	Engineering Science Courses	ESC103	Programming for Problem Solving	3	1	0	4	30	70	100
5	Humanities and Social Sciences including Management Courses	HSMC101	English	2	0	2	3	30	70	100
Total(A)							**19**	150	350	500
Practical/Drawing/Design										
6	Engineering Science Courses	ESC104	Workshop/ Manufacturing Practices	1	0	4	3	25	25	50
7	Engineering Science Courses/ Basic Science Course	ESC101P/ BSC102P	Basic Electrical Engg. Lab / Chemistry Lab	0	0	2	1	25	25	50
8	Engineering Science Courses	ESC103P	Programming for Problem Solving	0	0	2	1	25	25	50
Total(B)							**5**	**75**	**75**	**150**
Grand Total(A+B)							**24**	**225**	**425**	**650**

L-Lecture, T-Tutorial, P-Practical
IA- Internal Assessment, ESE-End Semester Examination

29/3/25

3rd SEMESTER
COURSE CONTENTS

Mechanical Engineering
3rd semester course structure

Sl. No.	Course Code	Subject	L	T	P	Credit
01	ME301	Thermodynamics	3	1	0	3
02	ME302	Fluid Mechanics	3	1	0	3
03	ME303	Strength Of Materials	3	1	0	3
04	MT301	Materials Engineering	3	1	0	3
05	BSC301	Mathematics-III	3	1	0	4
06	BSC302	Environmental Science	2	0	0	0
01	ME301P	Thermodynamics Lab	0	0	3	1
02	ME302P	Fluid Mechanics Lab	0	0	3	1
03	ME303P	Strength Of Materials Lab	0	0	3	1
04	EX301	Extra Activities (NSO/NSS/NCC/Yoga / Creative Arts/Mini Project)	0	0	2	1
05	HS301	Communication Skill Lab	0	0	2	1
		Total credit				21

29/3/25

4th SEMESTER
COURSE CONTENTS

Mechanical Engineering
4th semester course structure

Sl. No.	Course code.	Subject	L	T	P	Credits
01	ME401	Theory Of Machines	3	1	0	3
02	ME402	Fluid Machines	3	1	0	3
03	ME403	Applied Thermodynamics	3	1	0	3
04	ME404	Manufacturing Process-I	3	1	0	3
05	EC404	Electronics & Instrumentation Engg.	3	1	0	3
06	EN401/ IT402	Engineering Economics / Cyber Security	2	0	0	0
01	ME401P	Theory Of Machines Lab	0	0	3	1
02	ME403P	Applied Thermodynamics Lab	0	0	3	1
03	ME404P	Manufacturing Process-I Lab	0	0	3	1
04	EX401	Extra Activities (NSO/NSS/NCC/Yoga/ Creative Arts/Mini Project)	0	0	2	1
05	IN401	Internship/ Tour & Training/Industrial Training	0	0	0	2
Total credits						**21**

29/3/25

5th SEMESTER
COURSE CONTENTS

Mechanical Engineering
5th semester course structure

S. No.	Course Code	Subject	L	T	P	Credit
		Theory				
1.	MEC501	Heat Transfer	3	1	0	4
2.	MEC502	Design of Machine Elements	2	1	0	3
3.	MEC503	Internal Combustion Engines	2	1	0	3
* 4.	MEP504 MEP505 MEP506	Industrial Robotics Design for Manufacturing Energy System and Management	2	1	0	3
5.**	MEO507 MEO508 MEO509	Project Management Principles of Management Total Quality Management	2	1	0	3
		Laboratory/Sessional				
1.	ME501P	Heat Transfer	0	0	2	1
2.	ME502P	Design of Machine Elements	0	0	2	1
3.	ME503P	Internal Combustion Engines	0	0	2	1
4.	ME506P	Energy System and Management Lab	0	0	2	1
5	ME505G	General Proficiency/Seminar	0	0	2	2
Total Credit						**22**

***Professional Elective I**
**** Open Elective I**

27/3/25

6th SEMESTER
COURSE CONTENTS

Mechanical Engineering
6th semester course structure

S. No.	Course Code	Subject	L	T	P	Credit
		Theory				
1.	MEC601	Solid Mechanics	3	1	0	4
2.	MEC602	Automobile Engineering	2	1	0	3
3.	MEC603	Design of Transmission System	2	1	0	3
4.*	MEP604 MEP605 MEP606	Computer Aided Design Mechatronic Systems Microprocessor in Automation	2	1	0	3
5.**	MEO607 MEO608 MEO609	Operations Research Reliability Engineering Machine Tool Design	2	1	0	3
		Laboratory/Sessionals				
1.	ME601P	Solid Mechanics	0	0	2	1
2.	ME602P	Automobile Engineering	0	0	2	1
3.	ME603P	Manufacturing Lab	0	0	2	1
4.	ME604P	Computer Aided Design	0	0	2	1
5	ME605I	Internship/Tour & Training/Industrial Training	0	0	2	2
Total Credit						**22**

***Professional Elective II**
**** Open Elective II**

3/3/25

7th SEMESTER
COURSE CONTENTS

Mechanical Engineering
7th Semester Course Structure

S.N.	Code	Course Title	Lecture	Tutorial	Practical	Credits
1	MEC701	Automation in Manufacturing	3	0	0	3
2	PEC-III		3	0	0	3
3	PEC-IV		3	0	0	3
4	OEC III		3	0	0	3
5	OEC IV		3	0	0	3
6	ME701P	Lab VII (RAC)	0	0	2	1
7	ME702D	Project-I	0	0	4	2
8	ME703I	Internship Assessment	0	0	2	2
Total credits						20

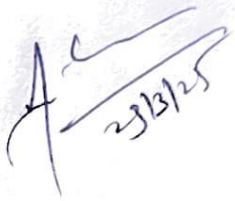
Code	Professional Elective-III (Anyone)	Code	Professional Elective-IV (Any one)
MEP702	Refrigeration and Air Conditioning	MEP705	Power Plant Engineering
MEP703	Cryogenics	MEP706	Finite Element Analysis
MEP704	Gas Dynamics	MEP707	Tool Design

Code	Open Elective-III (Any one)	Code	Open Elective- IV (Any one)
MEO708	Mechanical Vibrations	MEO713	Rapid Prototyping
MEO709	Convective Heat Transfer	MEO714	Industrial Automation
MEO710	Micro and Nano Manufacturing	MEO715	Technology management
MEO711	Energy Systems and Management	MEO716	Computer Aided Manufacturing
MEO712	Condition Monitoring	MEO717	Maintenance Engineering & management

- **PEC-III- Professional Elective-III**
- **OEC III- Open Elective-III**
- **PEC-IV- Professional Elective-IV**
- **OEC IV- Open Elective- IV**

8th SEMESTER
COURSE CONTENTS

S.N.	Code	Course Title	L	T	P	Credits
1	ME801D	Project- II			16	08
				Total Credit		08



Course Code	BSC101				
Category	Basic Science Course				
Course Title	**Physics-I** (i) Introduction to Electromagnetic Theory – For ME (ii) Introduction to Mechanics – For Civil (iii) Oscillation, Waves and Optics - For EEE (iv) Semiconductor Physics – For CSE				
Scheme & Credits	**L**	**T**	**P**	**Credit**	**Semester I**
	3	**1**	**0**	**4**	
Pre-requisites	Mathematics course with vector calculus, High-school education Mathematics course on differential equations and linear algebra				

PHYSICS-I

Course Code- BSC101 **38hrs**

Objectives:

- Understand the fundamental principles of electrostatics in vacuum, including the calculation of electric fields and potentials for various charge distributions, and solve Laplace's and Poisson's equations.
- Apply the principles of electrostatics in linear dielectric media, including the effects of electric polarization, electric displacement, and solve problems involving dielectrics.
- Analyze magnetostatics, including the application of the Bio-Savart law, calculation of static magnetic fields, and understanding the concept of vector potential.
- Understand Faraday's law of electromagnetic induction, including the calculation of EMF produced by changing magnetic flux, and analyze applications of electromagnetic braking.
- Analyze Maxwell's equations, including the derivation of the differential form of Faraday's law

Contents:

Module I: Electrostatics in vacuum **8hrs**

Electric field and electrostatic potential for a charge distribution; Laplace's and Poisson's equations for electrostatic potential and uniqueness of their solution. Boundary conditions of electric field and electrostatic potential; method of images; energy of a charge distribution and itsexpression in terms of electric field.

Module II: Electrostatics in a linear dielectric medium **4hrs**

Electrostatic field and potential of a dipole. Bound charges due to electric polarization; Electric displacement; boundary conditions on displacement; Solving simple electrostatics problems in presence of dielectrics – Point charge at the centre of a dielectric sphere, charge in front of a dielectric slab, dielectric slab and dielectric sphere in uniform electric field.

Module III: Magneto statics **6hrs**

Bio-Savart law, Static magnetic field; vector potential and calculating it for a given magnetic field; the equation for the vector potential and its solution for given current densities.

Module IV: Magneto statics in a linear magnetic medium **4hrs**

Magnetization and associated bound currents; auxiliary magnetic field; Boundary conditions on **B** and **H**. Solving for magnetic field due to simple magnets like a bar magnet; magnetic susceptibility and ferromagnetic, paramagnetic and diamagnetic materials; Qualitative discussionof magnetic field in presence of magnetic materials.

Module V: Faraday's law and Maxwell's equations **8hrs**

Faraday's law in terms of EMF produced by changing magnetic flux; equivalence of Faraday's law and motional EMF; Lenz's law; Electromagnetic breaking and its applications; Differential form of Faraday's law expressing curl of electric field in terms of time-derivative of magnetic field and calculating electric field due to changing magnetic fields in quasi-static approximation; energy stored in a magnetic field.

Continuity equation for current densities; Modifying equation for the curl of magnetic field to satisfy continuity equation; displace current and magnetic field arising from time dependent electric field; calculating magnetic field due to changing electric fields in quasistatic approximation. Maxwell's equation in vacuum and non-conducting medium; Energy in an electromagnetic field; Flow of energy and Poynting.

Module VI: Electromagnetic waves **8hrs**

The wave equation; Plane electromagnetic waves in vacuum, their transverse nature and polarization; relation between electric and magnetic fields of an electromagnetic wave; energy carried by electromagnetic waves. Momentum carried by electromagnetic waves and resultant pressure. Reflection and transmission of electromagnetic waves from a non-conducting medium- vacuum interface for normal incidence.

COURSE OUTCOMES:

1. Understand the basics of electrostatics in vacuum.
2. Understand the basics of electrostatics in material medium.
3. Analyse the basics of magneto statics in vacuum.
4. Apply the basics of magneto in magnetic material medium.
5. familiarized with the Faraday's Law and Maxwell's equation leading to the application of EMW in vacuum and in media.
6. Design and development of engineering system

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L3	3	3	-	-	-	2	1	3	-	-	2		2		
CO2	L2	2	2	2	3	2	2	-	3	-	2	-	-	-	-	-
CO3	L2	2	2	-	3	2	3	2	3	2	3	2	-	-	-	-
CO4	L1	3	3	3	3	2	3	-	-	3	3	2	-	-	-	-
CO5	L5	2	2	-	-	2	3	2	2	2	2	2	-	-	-	-
CO6	L3	3	3	2	-	-	3	2	-	2	-	-	-	-	-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Book:

1. Introduction to Electrodynamics, D.J. Griffiths, 3rd Edn, 1998, Benjamin Cummings.

Reference books:

1. Fundamentals of Physics Electricity and Magnetism, Halliday and Resnick, tenth edition(published 2013).
2. W. Saslow, Electricity, magnetism and light, 1st edition
3. Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, TataMcGraw
4. Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.

Course Code	BSC103				
Category	Basic Science Course				
Course Title	**Mathematics - I** Calculus and Linear Algebra **(Option 1) for All Branch excluding CSE** Calculus and Linear Algebra **(Option 2) for CSE**				
Scheme & Credits	L	T	P	Credit	Semester I
	3	1	0	4	
Pre-requisites	**Pre-requisites:** High-school education				

MATHEMATICS-I

Course Code- BSC103 **40hrs**

Objectives:

- Understand and apply the concepts of evolutes and involutes, and evaluate definite and improper integrals, including the use of Beta and Gamma functions and their properties.
- Apply calculus techniques such as Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders, and L'Hospital's rule to solve problems related to indeterminate forms and Maxima and minima.
- Analyze sequences and series, including convergence tests, power series, Taylor's series, and Fourier series, and apply them to solve problems involving exponential, trigonometric, and logarithm functions, as well as evaluate surface areas and volumes of revolutions.
- Understand and apply concepts of multivariable calculus, including limit continuity and partial derivatives, directional derivatives, total derivative, tangent planes and normal lines, and solve optimization problems using the method of Lagrange multipliers.
- Analyze matrices, including the calculation of inverse and rank of a matrix, solving systems of linear equations, properties of symmetric, skew symmetric, and orthogonal matrices, determinants, eigenvalues and eigenvectors, diagonalization of matrices, and apply them to solve problems involving orthogonal transformations and the Cayley-Hamilton Theorem.

Contents:

Module I: Calculus-I **6hrs**

Evolutes and involutes; Evaluation of definite and improper integrals; Beta and Gamma functions and their properties; Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Module II: Calculus-II **6hrs**

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

Module III: Sequences and series **10hrs**

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosineseries, Parseval's theorem.

Module IV: Multivariable Calculus (Differentiation) **8hrs**

Limit continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers; Gradient, curl and divergence.

Module V: Matrices **10hrs**

Inverse and rank of a matrix, rank-nullity theorem; System of linear equations; Symmetric, skew symmetric and orthogonal matrices; Determinants; Eigen values and eigenvectors; Diagonalization of matrices; Cayley-Hamilton Theorem, and Orthogonal transformation.

COURSE OUTCOMES:

1. To Understand the idea of applying differential and integral calculus to notions of curvature and to improper integrals.
2. To apply the fallouts of Rolle's Theorem that is fundamental to application of analysis to Engineering problems.
3. To develop the tool of power series and Fourier series for learning advanced Engineering Mathematics.
4. The student will be able to analyze with functions of several variables that is essential in most branches of Engineering.
5. To develop the essential tool of matrices and linear algebra in a comprehensive manner.
6. To solve various engineering problems

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L3	3	3	-	-	-	2	1	3	-	-	2		2		
CO2	L2	2	2	2	3	2	2	-	3	-	2	-	-	-	-	-
CO3	L2	2	2	-	3	2	3	2	3	2	3	2	-	-	-	-
CO4	L1	3	3	3	3	2	3	-	-	3	3	2	-	-	-	-
CO5	L5	2	2	-	-	2	3	2	2	2	2	2	-	-	-	-
CO6	L3	3	3	2	-	-	3	2	-	2	-	-	-	-	-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Textbooks/References:

1. G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson,Reprint, 2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi,2008.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi,11thReprint, 2010.
5. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
7. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course Code	ESC101				
Category	Engineering Science Course				
Course Title	Basic Electrical Engineering				
Scheme & Credits	L	T	P	Credit	Semester I
	3	1	0	4	
Pre-requisites	Intermediate level Electricity				

Basic Electrical Engineering
Course Code- ESC101 **40hrs**

Objectives:

- Understand electrical circuit elements (R, L, and C), voltage and current sources.
- Calculate real power, reactive power, apparent power, and power factor in AC circuits.
- Understand autotransformer and three-phase transformer connections.
- Analyze loss components and efficiency, starting, and speed control of induction motor.
- Describe single-phase and three-phase voltage source inverters, and sinusoidal modulation.
- Describe types of batteries, and important characteristics for batteries.

Contents:

Module I : DC Circuits **7hrs**

Electrical circuit elements (R, L and C), voltage and current sources, Kirchoff current and voltage laws, analysis of simple circuits with dc excitation. Superposition, Thevenin and Norton Theorems. Time-domain analysis of first-order RL and RC circuits.

Module II: AC Circuits **7hrs**

Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase ac circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel), resonance. Three phase balanced circuits, voltage and current relations in star and delta connections.

Module III: Transformers **6hrs**

Magnetic materials, BH characteristics, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency. Auto-transformer and three-phase transformer connections.

Module IV: Electrical Machines **8hrs**

Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic. Loss components and efficiency, starting and speed control of induction motor. Single-phase induction motor. Construction, working, torque- speed characteristic and speed control of separately excited dc motor. Construction and working of synchronous generators.

Module V: Power Converters **6hrs**

DC-DC buck and boost converters, duty ratio control. Single-phase and three-phase voltage source inverters; sinusoidal modulation.

Module VI: Electrical Installations **6hrs**

Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB, Types of Wires and Cables, Earthing. Types of Batteries, Important Characteristics for Batteries. Elementary calculations for energy consumption, power factor improvement and battery backup.

Course Outcomes:

1. To understand and analyze basic electric and magnetic circuits.
2. To Understand the working principles of electrical machines and power converters.
3. To analyse the components of low voltage electrical installations.
4. Apply electric machine for industrial applications
5. Design power converters
6. Design and implementation of electrical installations

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L3	3	3	-	-	-	2	1	3	-	-	2		2		
CO2	L2	2	2	2	3	2	2	-	3	-	2	-	-	-	-	-
CO3	L2	2	2	-	3	2	3	2	3	2	3	2	-	-	-	-
CO4	L1	3	3	3	3	2	3	-	-	3	3	2	-	-	-	-
CO5	L5	2	2	-	-	2	3	2	2	2	2	2	-	-	-	-
CO6	L3	3	3	2	-	-	3	2	-	2	-	-	-	-	-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Suggested Text / Reference Books

1. D. P. Kothari and I. J. Nagrath, "Basic Electrical Engineering", Tata McGraw Hill, 2010.
2. D. C. Kulshreshtha, "Basic Electrical Engineering", McGraw Hill, 2009.
3. L. S. Bobrow, "Fundamentals of Electrical Engineering", Oxford University Press, 2011.
4. E. Hughes, "Electrical and Electronics Technology", Pearson, 2010.
5. V. D. Toro, "Electrical Engineering Fundamentals", Prentice Hall India, 1989.

Course Code	ESC102				
Category	Engineering Science Course				
Course Title	Engineering Graphics & Design (Theory & Lab)				
Scheme & Credits	L	T	P	Credit	Semester I
	1	0	4	3	
Pre-requisites	Basic knowledge of Computer and Solid Geometry				

ENGINEERING GRAPHICS & DESIGN

Course Code- ESC102 **Lecture - 10hrs , Lab – 60hrs**

Objectives:

- Understanding of Traditional Engineering and Computer Graphics concepts.
- Explore principles such as orthographic projection, descriptive geometry, and isometric projections.
- Familiarize students with engineering graphics software and its applications.
- Understanding of ISO and ANSI standards for coordinate dimensioning and tolerancing.
- Proficiency in interpreting technical drawings and utilizing CAD software for design and communication purposes.
- Understanding of engineering graphics principles and their relevance in the field of engineering and design.

Contents:

Traditional Engineering and Computer Graphics: **10hrs**

Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)

(Lab modules also include concurrent teaching)

Lab Module I: Introduction to Engineering Drawing **5hrs**

Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Lab Module II: Orthographic Projections **5hrs**

Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes.

Lab Module III: Projections of Regular Solids **5hrs**

Those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

Lab Module IV: and Sectional Views of Right Angular Solids **5hrs**

Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; Draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only)

Lab Module V: Isometric Projections **6hrs**

Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions.

Lab Module VI: Overview of Computer Graphics **8hrs**

listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids];

Lab Module VII: Customization & CAD Drawing **8hrs**

consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles.

Lab Module VIII: Annotations, layering & other functions **9hrs**

applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command;orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modelling of parts and assemblies. Parametric and non- parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, Multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling.

Lab Module IX: Demonstration of a simple team design project **9hrs**

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modelling software for creating associativemodels at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying colour coding according to building.

Course Outcomes:

1. Introduction to engineering design and its place in society
2. Exposure to the visual aspects of engineering design
3. Exposure to engineering graphics standards
4. Exposure to solid modelling
5. Exposure to computer-aided geometric design
6. Exposure to creating working drawings

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L3	3	3	-	-	-	2	1	3	-	-	2		2		
CO2	L2	2	2	2	3	2	2	-	3	-	2	-	-	-	-	-
CO3	L2	2	2	-	3	2	3	2	3	2	3	2	-	-	-	-
CO4	L1	3	3	3	3	2	3	-	-	3	3	2	-	-	-	-
CO5	L5	2	2	-	-	2	3	2	2	2	2	2	-	-	-	-
CO6	L3	3	3	2	-	-	3	2	-	2	-	-	-	-	-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Suggested Text/Reference Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engg Drawing, Charotar Pub House
2. Shah, M.B. & Rana B.C. (2008), Engg Drawing & Comp. Graphics, Pearson Education
3. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
4. Narayana, K.L. & P Kannaiah (2008), Text book on Engg Drawing, Scitech Publishers
5. Corresponding set of CAD Software Theory and User Manuals

PHYSICS LABORATORY

Course Code: BSC101P

List of Experiments:

1. Experiments on electromagnetic induction and electromagnetic breaking.
2. LC circuit and LCR circuit
3. Resonance phenomena in LCR circuits
4. Magnetic field from Helmholtz coil
5. Measurement of Lorentz force in a vacuum tube
6. Coupled oscillators
7. Experiments on an air-track
8. Experiment on moment of inertia measurement
9. Experiments with gyroscope
10. Resonance phenomena in mechanical oscillators
11. Frank-Hertz experiment
12. Photoelectric effect experiment
13. Recording hydrogen atom Spectrum
14. Diffraction and interference experiments (from ordinary light or laser pointers)
15. measurement of speed of light on a table top using modulation
16. minimum deviation from a prism

BASIC ELECTRICAL ENGINEERING LABORATORY

Course Code: ESC101P

List of experiments:

1. Basic safety precautions. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors.
2. Measuring the steady-state and transient time-response of R-L, R-C, and R-L-C circuits to a step change in voltage (transient may be observed on a storage oscilloscope).Sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage. Resonance in R-L-C circuits.
3. Transformers: Observation of the no-load current waveform on an oscilloscope (non-sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics). Loading of a transformer: measurement of primary and secondary voltages and currents, and power.
4. Three-phase transformers: Star and Delta connections. Voltage and Current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents).Phase-shifts between the primary and secondary side. Cumulative three-phase power in balanced three-phase circuits.
5. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winging - slip ring arrangement) and single-phase induction machine.
6. Torque Speed Characteristic of separately excited dc motor.
7. Synchronous speed of two and four-pole, three-phase induction motors. Direction reversal by change of phase-sequence of connections. Torque-Slip Characteristic of an induction motor. Generator operation of an induction machine driven at super synchronous speed.
8. Synchronous Machine operating as a generator: stand-alone operation with a load. Control of voltage through field excitation.
9. Demonstration of (a) dc-dc converters (b) dc-ac converters – PWM waveform (c) the use of dc-ac converter for speed control of an induction motor and (d) Components of LT switchgear.

Note: 1. At least eight experiments should be performed from the above list.

RADHA GOVIND UNIVERSITY

RAMGARH, JHARKHAND

DEPARTMENT OF MECHANICAL ENGINEERING
B.TECH (2nd) SEMESTER SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

2nd SEMESTER

COURSE CONTENTS

Mechanical Engineering

2nd semester course structure

Sl. No.	Category	Course Code	Course Title	Hours Per Week			Credit	Marks		
				L	T	P		IA	ESE	Total
Theory										
1	Basic Science Course	BSC105	Physics -II	3	1	0	4	30	70	100
2	Engineering Science Courses/ Basic Science Course	ESC101/ BSC102	Basic Electrical Engineering/ Chemistry I	3	1	0	4	30	70	100
3	Basic Science Course	BSC104	Mathematics –II	3	1	0	4	30	70	100
4	Engineering Science Courses	ESC103	Programming for Problem Solving	3	1	0	4	30	70	100
5	Humanities and Social Sciences including Management Courses	HSMC101	English	2	0	2	3	30	70	100
			Total(A)				**19**	150	350	500
Practical/Drawing/Design										
6	Engineering Science Courses	ESC104	Workshop/ Manufacturing Practices	1	0	4	3	25	25	50
7	Engineering Science Courses/ Basic Science Course	ESC101P/ BSC102P	Basic Electrical Engg. Lab / Chemistry Lab	0	0	2	1	25	25	50
8	Engineering Science Courses	ESC103P	Programming for Problem Solving	0	0	2	1	25	25	50
			Total(B)				**5**	**75**	**75**	**150**
			Grand Total(A+B)				**24**	**225**	**425**	**650**

L-Lecture, T-Tutorial, P-Practical

IA- Internal Assessment, ESE-End Semester Examination

Course Code	BSC105				
Category	Basic Science Course				
Course Title	Course contents in Physics-II (i) Introduction to Quantum Mechanics for Engineers – For EEE, CSE (ii) Mechanics of Solid – For Civil, ME				
Scheme & Credits	L	T	P	Credit	Semester II
	2	1	0	3	
Pre-requisites	Mathematics course on differential equations and linear algebra Introduction to Electromagnetic Theory Semiconductor Physics				

PHYSICS-II

Course Code - BSC105 **40hrs**

Objectives:

- Understand and apply free body diagrams for typical supports and joints.
- Understand stress transformation and principal stresses using Mohr's circle.
- Describe one-dimensional material behavior, including concepts of elasticity, plasticity, strain hardening, and failure
- Calculate bending stress, shear stress, and analyze cases of combined stresses.
- Analyze deflection due to bending and integrate the moment-curvature relationship for simple boundary conditions.

Contents:

Module I: Statics **10hrs**

Free body diagrams on modelling of typical supports and joints; Condition for equilibrium in three- and two- dimensions; Friction: limiting and non-limiting cases; Force displacement relationship; Geometric compatibility for small deformations.

Module II: Stress and Strain at a point **6hrs**

Concept of stress at a point; Planet stress: transformation of stresses at a point, principal stressesand Mohr's circle; Displacement field; Concept of strain at a point; Planet strain:transformation of strain at a point, principal strains and Mohr's circle.

Module III: Material behavior **7hrs**

One- dimensional material behaviour; Concepts of elasticity, plasticity, strain hardening, failure (fracture / yielding); Idealization of one-dimensional stress-strain curve; Generalized Hooke's law with and without thermal strains for isotropic materials.

Module IV: Force analysis **8hrs**

Force analysis — axial force, shear force, bending moment and twisting moment diagrams of slender members (without using singularity functions); Moment curvature relationship for pure bending of beams with symmetric cross-section; Bending stress; Shear stress; Cases of combined stresses.

Module V: Strain energy **9hrs**

Concept of strain energy; Yield criteria; Deflection due to bending; Integration of the moment-curvature relationship for simple boundary conditions; Method of superposition (without using singularity functions); Strain energy and complementary strain energy for simple structural elements (i.e. those under axial load, shear force, bending moment and torsion).

Course Outcomes:

1. To familiarize students of civil and mechanical Engineering with the understanding of the elasticand plastic behavior of solids.
2. To understand the importance of stress and strain at a point on solid.
3. To be able to do force analysis and understand strain energy of solid.
4. Apply force analysis for engineering applications
5. Design sustainable engineering system
6. Implementation of engineering physics into complex system design for industrial applications

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L3	3	3	-	-	-	2	1	3	-	-	2		2		
CO2	L2	2	2	2	3	2	2	-	3	-	2	-	-	-	-	-
CO3	L2	2	2	-	3	2	3	2	3	2	3	2	-	-	-	-
CO4	L1	3	3	3	3	2	3	-	-	3	3	2	-	-	-	-
CO5	L5	2	2	-	-	2	3	2	2	2	2	2	-	-	-	-
CO6	L3	3	3	2	-	-	3	2	-	2	-	-	-	-	-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Reference books:

1. An Introduction to the Mechanics of Solids, 2nd ed. with SI Units - SH Crandall, NC Dahl & TJ Lardner
2. Engineering Mechanics: Statics, 7th ed. — JL Meriam
3. Engineering Mechanics of Solids — EP Popov

Course Code	BSC102				
Category	Basic Science Course				
Course Title	Chemistry-I Contents (i) Chemistry-I (Concepts in chemistry for engineering) (ii) Chemistry Laboratory				
Scheme & Credits	L	T	P	Credit	Semester I
	3	1	0	4	
Pre-requisites	Knowledge of intermediate level chemistry				

CHEMISTRY-I
Course Code- BSC102 42hrs

Objectives:

- Describe the forms of hydrogen atom wave functions and their spatial variations.
- Analyze electronic spectroscopy, fluorescence, and their applications in medicine.
- Explain equations of state of real gases and critical phenomena.
- Estimate entropy and free energies, and their applications in chemical equilibria.
- Describe effective nuclear charge, penetration of orbitals, and variations of s, p, d, and f orbital energies in the periodic table.
- Introduce reactions involving substitution, addition, elimination, oxidation, reduction, cyclization, and ring openings.

Contents:

Module I: Atomic and molecular structure 12hrs

Schrodinger equation. Particle in a box solutions and their applications for conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions toexplore their spatial variations. Molecular orbitals of diatomic molecules and plots of the multicentre orbitals. Equations for atomic and molecular orbitals. Energy level diagrams of diatomics. Pi-molecular orbitals of butadiene and benzene and aromaticity. Crystal field theory and the energy level diagrams for transition metal ions and their magnetic properties. Band structure of solids and the role of doping on band structures.

Module II: Spectroscopic techniques and applications 8hrs

Principles of spectroscopy and selection rules. Electronic spectroscopy. Fluorescence and its applications in medicine. Vibrational and rotational spectroscopy of diatomic molecules. Applications. Nuclear magnetic resonance and magnetic resonance imaging, surface characterisation techniques. Diffraction and scattering.

Module III: Intermolecular forces and potential energy surfaces 4hrs

Ionic, dipolar and van Der Waals interactions. Equations of state of real gases and critical phenomena. Potential energy surfaces of H3, H2F and HCN and trajectories on these surfaces.

Module IV: Use of free energy in chemical equilibria 6hrs

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Cell potentials, the Nernst equation and applications. Acid base, oxidation reduction and solubility equilibria. Water chemistry. Corrosion. Use of free energy considerations in metallurgy through Ellingham diagrams.

Module 5: Periodic properties and Stereochemistry **8hrs**

Effective nuclear charge, penetration of orbitals, variations of s, p, d and f orbital energies of atoms in the periodic table, electronic configurations, atomic and ionic sizes, ionization energies, electron affinity and electronegativity, polarizability, oxidation states, coordination numbers and geometries, hard soft acids and bases, molecular geometries

Representations of 3 dimensional structures, structural isomers and stereoisomers, configurationsand symmetry and chirality, enantiomers, diastereomers, optical activity, absolute configurations and conformational analysis. Isomerism in transitional metal compounds

Module 6: Organic reactions and synthesis of a drug molecule **4hrs**

Introduction to reactions involving substitution, addition, elimination, oxidation, reduction, cyclization and ring openings. Synthesis of a commonly used drug molecule.

Course Outcomes:

1. Analyse microscopic chemistry in terms of atomic and molecular orbitals and intermolecular forces.
2. Rationalise bulk properties and processes using thermodynamic considerations.
3. Distinguish the ranges of the electromagnetic spectrum used for exciting different molecular energy levels in various spectroscopic techniques
4. Rationalise periodic properties such as ionization potential, electronegativity, oxidation states and electronegativity.
5. List major chemical reactions that are used in the synthesis of molecules.
6. Apply chemical reactions in industry applications

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L3	3	2	1	2	2	2	2	1	2	-	-	-	-	-	-
CO2	L3	3	3	2	2	2	2	2	2	2	-	-	-	2	-	-
CO3	L2	2	2	1	2	2	2	3	2	-	-	-	2	-	-	2
CO4	L3	2	1	1	3	3	1	3	-	1	-	-	-	-	-	-
CO5	L1	3	2	3	1	3	3	1	-	2	-	-	-	2	-	-
CO6	L2	3	3	-	-	3	-	1	-	-	-	-	2	-	-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Textbooks:

1. University chemistry, by B. H. Mahan
2. Chemistry: Principles and Applications, by M. J. Sienko and R. A. Plane
3. Fundamentals of Molecular Spectroscopy, by C. N. Banwell
4. Engg Chemistry (NPTEL Web-book), by B. L. Tembe, Kamaluddin and M. S. Krishnan
5. Physical Chemistry, by P. W. Atkins
6 Organic Chemistry: Structure and Function by K. P. C. Volhardt and N. E. Schore, 5thEdition

Course Code	BSC104				
Category	Basic Science Course				
Course Title	**Mathematics – II** **Contents** Calculus, Ordinary Differential Equations and Complex Variable **(Option 1) for All branches excluding CSE** Probability and Statistics **(Option II) for CSE**				
Scheme & Credits	L	T	P	Credit	Semester
	3	1	0	0	II
Pre-requisites	**Elementary Knowledge of calculus, Probability and Statistics**				

Mathematics – II
Course Code- BSC104 **40hrs**

Objectives:

- Understand multiple integration, including double integrals in Cartesian coordinates, change of order of integration, and change of variables to polar coordinates.
- Solve exact, linear, and Bernoulli's equations, as well as Euler's equations.
- Solve Cauchy-Euler equations.
- Understand elementary analytic functions such as exponential, trigonometric, and logarithmic functions and their properties.
- Understand Taylor's series, zeros of analytic functions, singularities, and Laurent's series.

Contents:

Module I: **Multivariable Calculus (Integration):** **10hrs**

Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities);Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds; Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, Theorems of Green, Gauss and Stokes.

Module II: First order ordinary differential equations: **06hrs**

Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Module III: Ordinary differential equations of higher orders: **08hrs**

Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation; Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

Module IV: Complex Variable - Differentiation: **08hrs**

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate; elementary analytic functions (exponential, trigonometric, logarithm) and their properties; Conformal mappings, Mobius transformations and their properties.

Module 5: Complex Variable - Integration: **08 hrs**

Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof); Taylor's series, zeros of analytic functions, singularities, Laurent's series; Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Course Outcomes:

1. To familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables.
2. To equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.
3. Analyze high order ordinary differential equation
4. Apply complex variables for differentiation
5. Apply Integration of complex variables for different problems.
6. Design and implementation of mathematical analysis for problem solving in engineering.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L2	3	2	2	3	2	-	2	-	-	-	-	-	-	-	-
CO2	L3	2	2	3	1	2	1	3	2	-	-	-	-	1	-	-
CO3	L4	1	3	1	2	3	2	2	1	-	-	-	-	-	-	2
CO4	L3	1	3	2	2	3	2	-	2	1		-	-		2	
CO5	L3	3	2	2	2	1	3	-	2	-	1	-	-	1	-	-
CO6	L5	3	1	1	3	1	-	-	-	-		-	-		-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Textbooks/References:

1. G.B. Thomas & R.L. Finney, Calculus & Analytic geometry, Pearson, Reprint, 2002.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,2006.
3. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary ValueProblems, 9th Edn., Wiley India, 2009.
4. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.
5. E. A. Coddington, An Introduction to Ordinary Differential Equations, PHI, 1995.
6. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.
7. J. W. Brown & R. V. Churchill, Complex Variables & Appln, Mc-Graw Hill, 2004.
8. N.P. Bali and Manish Goyal, Engineering Mathematics, Laxmi Pub, Reprint, 2008.
9. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

Course Code	ESC103				
Category	Engineering Science Course				
Course Title	Programming for Problem Solving				
Scheme & Credits	L	T	P	Credit	Semester II
	3	0	0	3	
Pre-requisites	Basic Knowledge of Computer and Mathematics				

PROGRAMMING FOR PROBLEM SOLVING

Course Code- ESC103 **40hrs**

Objective:

- Define an algorithm and its representation using flowcharts or pseudo code.
- Understand conditional branching and loops.
- Define and utilize arrays, including 1-D and 2-D arrays.
- Implement basic sorting algorithms such as Bubble, Insertion, and Selection sort.
- Understand parameter passing in functions, including call by value.
- Define structures and arrays of structures.

Contents:

Module I: Introduction to Programming **6hrs**

Introduction to components of a computer system (disks, memory, processor, where a program isstored and executed, operating system, compilers etc.). Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudo code with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

Module II: Arithmetic expressions and precedence **12hrs**

Conditional Branching and Loops Writing and evaluation of conditionals and consequent branching, Iteration and loops

Module III: Arrays **3hrs**

Arrays (1-D, 2-D), Character arrays and Strings

Module IV: Basic Algorithms, Searching, Basic Sorting Algorithms **4hrs**

(Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

Module V: Function and Pointers **6hrs**

Functions (including using built in libraries), Parameter passing in functions, call by value,Passing arrays to functions: idea of call by reference, Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linkedlist (no implementation).

Module VI: Recursion and Structure **9hrs**

Recursion, as a different way of solving problems. Example programs, such as Finding, Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort. Structures, Defining structures and Array of Structures.

Course Outcomes:

1. Able to formulate simple algorithms for arithmetic and logical problems
2. Able to translate the algorithms to programs (in C language).
3. Able to apply test and execute the programs and correct syntax and logical errors.
4. Able to implement conditional branching, iteration and recursion.
5. To use arrays, pointers and structures to formulate algorithms and programs.
6. To apply programming to solve matrix addition and multiplication problems and searching andsorting problems.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L3	3	3	-	-	-	2	1	3	-	-	2		2		
CO2	L2	2	2	2	3	2	2	-	3	-	2	-	-	-	-	-
CO3	L2	2	2	-	3	2	3	2	3	2	3	2	-	-	-	-
CO4	L1	3	3	3	3	2	3	-	-	3	3	2	-	-	-	-
CO5	L5	2	2	-	-	2	3	2	2	2	2	2	-	-	-	-
CO6	L3	3	3	2	-	-	3	2	-	2	-	-	-	-	-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Suggested Text Books

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill

Suggested Reference Books

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, PrenticeHall of India.

Course Code	HSMC101				
Category	Humanities and Social Sciences including Management Courses				
Course Title	English				
Scheme & Credits	L	T	P	Credit	Semester II
	2	0	2	3	
Pre-requisites	Basic Knowledge of English grammar and composition				

ENGLISH
Course Code- HSMC101 38hrs

Objectives:

- Learn synonyms, antonyms, and standard abbreviations.
- Understand sentence structures and the use of phrases and clauses.
- Identify and correct errors in subject-verb agreement, noun-pronoun agreement, misplaced modifiers, articles, prepositions, redundancies, and clichés.
- Learn techniques for describing, defining, classifying, providing examples or evidence in writing.
- Learn the art of précis writing and essay writing.
- Improve pronunciation, intonation, stress, and rhythm in oral communication.

Contents:

Module 1: Vocabulary Building 6hrs

The concept of Word Formation, Root words from foreign languages and their use in English, Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives, Synonyms, antonyms and standard abbreviations.

Module 2: Basic Writing Skills 6hrs

Sentence Structures, Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely.

Module 3: Identifying Common Errors in Writing 7hrs

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies, Clichés.

Module 4: Nature and Style of sensible Writing 6hrs

Describing, Defining, Classifying, Providing examples or evidence, Writing introduction and conclusion

Module 5: Writing Practices 6hrs

Comprehension, Précis Writing, Essay Writing,

Module 6: Oral Communication 7hrs

(This unit involves interactive practice sessions in Language Lab)

Listening Comprehension, Pronunciation, Intonation, Stress and Rhythm, Common Every day, Situations: Conversations and Dialogues, Communication at Workplace, Interviews, Formal Presentations.

COURSE OUTCOMES:

1. The student will acquire basic proficiency in English
2. Apply proficiency in English for enhancing basic writing skills
3. Apply proficiency in English for identify common errors in writing.
4. Analyze different nature and style of writing.
5. Development of writing skill in individuals
6. Enhance communication lead to draft engineering project proposals.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L3	3	3	-	-	-	2	1	3	-	-	2		2		
CO2	L2	2	2	2	3	2	2	-	3	-	2	-	-	-	-	-
CO3	L2	2	2	-	3	2	3	2	3	2	3	2	-	-	-	-
CO4	L1	3	3	3	3	2	3	-	-	3	3	2	-	-	-	-
CO5	L5	2	2	-	-	2	3	2	2	2	2	2	-	-	-	-
CO6	L3	3	3	2	-	-	3	2	-	2	-	-	-	-	-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Suggested Textbooks:

1. Practical English Usage. Michael Swan. OUP. 1995.
2. Remedial English Grammar. F.T. Wood. Macmillan.2007
3. On Writing Well. William Zinsser. Harper Resource Book. 2001
4. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
5. Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

Course Code	ESC104				
Category	Engineering Science Course				
Course Title	Workshop/Manufacturing Practices (Theory & Lab)				
Scheme & Credits	L	T	P	Credit	Semester II
	1	0	4	3	
Pre-requisites	Basic Knowledge of Physics, Chemistry and Mathematics				

WORKSHOP/MANUFACTURING PRACTICES

Course Code- ESC104 **Theory-10hrs**

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods **(3 hrs)**
2. CNC machining, Additive manufacturing **(1 hrs)**
3. Fitting operations & power tools **(1 hrs)**
4. Electrical & Electronics **(1 hrs)**
5. Carpentry **(1 hrs)**
6. Plastic Moulding, glass cutting **(1 hrs)**
7. Metal casting **(1 hrs)**
8. Welding (arc welding & gas welding), brazing **(1 hrs)**

WORKSHOP PRACTICE

Lab-60hrs

1. Machine shop **(10 hrs)**
2. Fitting shop **(8 hrs)**
3. Carpentry **(6 hrs)**
4. Electrical & Electronics **(8 hrs)**
5. Welding shop **(8 hrs (Arc welding 4 hrs + gas welding 4 hrs))**
6. Casting **(8 hrs)**
7. Smithy **(6 hrs)**
8. Plastic Moulding & Glass Cutting **(6 hrs)**

Suggested Text/Reference Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
2. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
3. Gowri P. Hariharan & A. Suresh Babu, "Mfg. Tech- I" Pearson Education, 2008.
4. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, PHl, 1998.
5. Rao P.N., "Manufacturing Technology", Vol. I & Vol. II, Tata McGrawHill House, 2017.

CHEMISTRY LABORATORY
Course Code- BSC102P

List of Experiments:

1. Determination of surface tension and viscosity
2. Thin layer chromatography
3. Ion exchange column for removal of hardness of water
4. Determination of chloride content of water
5. Colligative properties using freezing point depression
6. Determination of the rate constant of a reaction
7. Determination of cell constant and conductance of solutions
8. Potentiometry - determination of redox potentials and emfs
9. Synthesis of a polymer/drug
10. Saponification/acid value of an oil
11. Chemical analysis of a salt
12. Lattice structures and packing of spheres
13. Models of potential energy surfaces
14. Chemical oscillations- Iodine clock reaction
15. Determination of the partition coefficient of a substance between two immiscible liquids
16. Adsorption of acetic acid by charcoal
17. Use of the capillary visco meters to the demonstrate of the isoelectric point as the pH of minimum viscosity for gelatin sols and/or coagulation of the white part of egg.

Note: 1. At least eight experiments should be performed from the above list.

PROGRAMMING FOR PROBLEM SOLVING
Course Code: ESC103P

List of Experiments:

Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment

Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions

Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures

Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series

Tutorial 5: 1D Arrays: searching, sorting:
Lab 5: 1D Array manipulation

Tutorial 6: 2D arrays and Strings
Lab 6: Matrix problems, String operations

Tutorial 7: Functions, call by value:
Lab 7: Simple functions

Tutorial 8 & 9: Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab 8 and 9: Programming for solving Numerical methods problems

Tutorial 10: Recursion, structure of recursive calls
Lab 10: Recursive functions

Tutorial 11: Pointers, structures and dynamic memory allocation
Lab 11: Pointers and structures

Tutorial 12: File handling:
Lab 12: File operations

Note: 1. At least eight experiments should be performed from the above list.

RADHA GOVIND UNIVERSITY

RAMGARH, JHARKHAND

DEPARTMENT OF MECHANICAL ENGINEERING
B. TECH (3rd) SEMESTER SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

3rd SEMESTER

COURSE CONTENTS

Mechanical Engineering

3rd semester course structure

Sl. No.	Course Code	Subject	L	T	P	Credit
01	ME301	Thermodynamics	3	1	0	3
02	ME302	Fluid Mechanics	3	1	0	3
03	ME303	Strength Of Materials	3	1	0	3
04	MT301	Materials Engineering	3	1	0	3
05	BSC301	Mathematics-III	3	1	0	4
06	BSC302	Environmental Science	2	0	0	0
01	ME301P	Thermodynamics Lab	0	0	3	1
02	ME302P	Fluid Mechanics Lab	0	0	3	1
03	ME303P	Strength Of Materials Lab	0	0	3	1
04	EX301	Extra Activities (NSO/NSS/NCC/Yoga / Creative Arts/Mini Project)	0	0	2	1
05	HS301	Communication Skill Lab	0	0	2	1
		Total credit				21

THERMODYNAMICS

Course code -ME301 **40hrs**

Objectives:

- To learn about work and heat interactions, and balance of energy between system and its Surroundings.
- To learn about application of I law of various energy conversion devices.
- To evaluate the changes in properties of substances in various processes.
- To understand the difference between high grade and low- grade energies and II law limitations on energy conversion.
- To develop an intuitive understanding of thermodynamics by emphasizing the engineering and engineering arguments.

Contents:

Module-I **5hrs**

Fundaments- system and control volume; property; state and process; Exact & inexact differentials; Work-thermodynamic definition of work; examples; displacement work; path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work.

Module – II **5hrs**

Temperature, definition of thermal equilibrium and zeroth law; Temperature scales; various thermometers-definition of heat; examples of heat/work interaction in systems-first law for cycle & non-cyclic processes; concept of total energy E; Demonstration that E is a property; Various modes of energy; internal energy and enthalpy**.**

Module – III **8hrs**

Definition of pure substance, ideal gases and ideal gas mixture, real gases and real gas mixtures, compressibility charts-Properties of two-phase system-const. temperature and const. pressure heating of water; Definitions of standard states; PV-T surface; use of steam tables and R134a tables; saturation tables; superheated tables; identification of states and determination of properties, Mollier's chart.

Module – IV **5hrs**

First law of flow processes-Derivation of general energy equation for a control volume; Steady state flow processes including throttling; Examples of steady flow devices; unsteady processes; Examples of steady and unsteady I law applications for system and control volume.

Module -V **5hrs**

Second law- Definitions of direct and reverse heat engines; Definitions of thermal efficiency and C O P Kelvin-plank and Clausius statements Definition of reversible process; internal and external irreversibility; Carnot cycle; Absolute Temperature Scale.

Module-VI **8hrs**

Clausius inequality; Definition of energy S; Demonstration that entropy S is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of S from steam tables-Principle of increase of entropy; Illustration of processes in T-S co-ordinates; Definition of Isentropic efficiency for compressors, turbines and nozzles-Irreversibility and availability, availability function for systems and control volume undergoing different processes, Lost work. Second law analysis for a control volume. Energy balance equation and Energy analysis.

Module -VII **4hrs**

Thermodynamic cycles- Basic Rankine cycle; Basic Brayton cycle; Basic vapour compression cycle and comparison with Carton cycle.

Course Outcomes:

1. To apply energy balance to systems and control volumes, in situations involving heat and work interactions.
2. Evaluate changes in thermodynamic properties of substances.
3. Evaluate the performance of energy conversion devices.
4. To differentiate between high grade and low-grade energies.
5. Apply the first law of thermodynamics to analyze non-flow and steady flow systems.
6. Apply the second law of thermodynamics to evaluate the performance of cyclic devices.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO2	L 3	2	2	3	-	-	-	-	-	-	-	-	-	2	-	-
CO3	L 4	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO4	L 4	3	2	3	-	-	-	-	-	-	-	-	-	2	-	-
CO5	L 3	2	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO6	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	2	1

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Sonntag R.E., Borgnakke C. and Van wylen G. J., 2003- 6th edition, *Fundamentals of thermodynamics*, John Wiley and sons.
2. Jones, J.B. and Duggan R.E., 1996, *Engineering Thermodynamics*, Prentice Hall of India.
3. Morgan, M.J and Shapiro, H.N., 1999, *Fundamentals of Engineering Thermodynamics*, John Wiley and Sons.
4. Nag P.K.,1995, *Engineering Thermodynamics* Tata McGraw-Hill Publishing Co. Ltd.

FLUID MECHANICS

Course Code-ME302 **40hrs**

Objective:

- To introduce the students about properties of the fluids, behavior of fluids under static conditions.
- To impart basic knowledge of the dynamics of fluids and boundary layer concept.
- To expose to the applications of the conservation laws to a) flow measurements b) flow through pipes (both laminar and turbulent) and c) forces on pipe bends.
- To exposure to the significance of boundary layer theory and its thicknesses.

Contents:

Module I **5hrs**

Fluids and Their Properties: Introduction of fluid, fluid classifications, hypothesis of continuum, Shear stress in a moving fluid, molecular structure of material, fluid density, viscosity, causes of viscosity in gases and liquids, surface tension, capillary effect, vapor pressure, cavitation, compressibility and the bulk modulus

Module II **5hrs**

Pressures and Head: Types of Pressure, Pascal's law of pressure at a point, variation of pressure vertically in a fluid under gravity, equality of pressure at the same level in a static fluid, general equation for the variation of pressure due to gravity from a point to point in a static fluid, pressure and head, the hydrostatic paradox, pressure measurements using Elastic Pressure Transducers, Force Balance Pressure gauge, Electrical Pressure Transducers

Module III **8hrs**

Static Forces on Surface and Buoyancy: Fluid static, action of fluid pressure on surface, resultant force and centre of pressure on a plane surface under uniform pressure, resultant force and centre of pressure on a plane surface immersed in a liquid, pressure diagrams, forces on a curved surface due to hydrostatic pressure, buoyancy, equilibrium of floating bodies, stability of a submerged body, stability of floating bodies, determination of the metacentric height, determination of the position of the meta centre relative to the centre of buoyancy

Module IV **8hrs**

The Energy Equation and its Application: Momentum and fluid flow, Momentum equation for 2D and 3-D flow along a stream line, momentum correction factor, Euler's equation of motion along a stream line, Mechanical energy of a flowing fluid – Bernoulli's theorem, kinetic energy correction factor, pitot tube, determination of volumetric flow rate via pitot tube, changes of pressure in tapering pipe, principle of venturi meter, pipe orifices, theory of small orifices discharging to atmosphere, theory of large orifices, Rotameter, elementary theory of notches and weirs, flow in a curved path

Module V **5hrs**

Dimensional Analysis and Similarities: Dimension reasoning, dimensional homogeneity, dimensional analysis using Rayleigh's method, Buckingham π-theorem, significance of dimensionless, use of dimensionless numbers in experimental investigation, geometric similarity, dynamic similarity, Kinematic similarity, model testing-Model laws, Undistorted and Distorted models.

Module VI **4hrs**

Viscous Flow: Reynolds number and Reynolds experiment, flow of viscous fluid through circular pipe- Hagen Poiseuille formula, Flow of viscous fluid between two parallel fixed plates, power absorbed in viscous flow through - journal, foot step and collar bearing, movement of piston in dash pot, methods of measurement of viscosity Turbulent Flow: Expression for coefficient of friction - Darchy Weishbach Equation, Moody diagram resistance of smooth and rough pipes shear stress and velocity distribution in turbulent flow through pipes.

Module VII **5hrs**

Flow through pipes: Major energy losses, Minor energy losses, Hydraulic gradient and total energy lines, Pipes in series and parallel, Equivalent pipes, Siphon, power transmission through pipe, Flow through nozzle at end of pipe, Water hammer in pipes Compressible Flow: Basic equations for one dimensional compression, Pressure wave propagation, sound velocity in fluid, Mach number, Stagnation properties

Course Outcome:

1. Understand the basic concept of fluid mechanics.
2. Understand statics, dynamics and various approaches to fluid mechanics.
3. Understand fundamentals of flow through pipes
4. Understand basics of compressible flow
5. Estimate losses in pipelines for both laminar and turbulent conditions and analysis of pipes connected in series and parallel.
6. To understand the concept of boundary layer and its thickness on the flat solid surface.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 3	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-
CO2	L 4	3	3	1	-	-	-	-	-	-	-	-	-	3	-	-
CO3	L 3	3	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO4	L 3	3	3	1	-	-	-	-	-	-	-	-	-	2	1	-
CO5	L 4	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-
CO6	L 3	2	3	1	-	-	-	-	-	-	-	-	-	3	1	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Reference Books:

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, S.K. Kataria & Sons
2. Fluid Mechanics and Hydraulic Machines by R.K. Bansal, Laxmi Publications
3. Fluid Mechanics and Hydraulic Machines by R.K. Rajput, S. Chand & Co.
4. Fluid Mechanics by Frank.M. White, McGraw Hill Publishing Company Ltd.
5. Fundamentals of Fluid Mechanics by Munson, Wiley India Pvt. Ltd
6. Fluid Mechanics by A. K. Mohanty, PHI Learning Pvt. Ltd.
7. Laboratory Manual Hydraulics and Hydraulic Machines by R V Raikar

STRENGTH OF MATERIALS

Course code -ME 303 **40hrs**

Objectives:

- To understand the concepts of stress, strain, principal stresses and principal planes.
- To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To determine stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.

Contents:

Module-1 **8hrs**

Deformation in solids-Hooks law, stress and strain-tension, compression and shear stresses –elastic constants and their relations-volumetric, linear and shear strains principal stresses and principal planes-Mohr's circle.

Module-II **8hrs**

Beams and types transverse loading on beams-shear force and bending moment diagrams-Types of beams supports, simply supported and over hanging beams, cantilevers. Theory of bending of beam, bending stresses distribution and neutral axis, shear stress distribution, point and distributed loads.

Module-III **8hrs**

Moment of inertia about the axis and polar moment of inertia, deflection of beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorem.

Module-IV **8hrs**

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical spring.

Module -V **8hrs**

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure.

Course Outcomes:

1. Understand the concepts of stress and strain in simple and compound bars, the importance of principal stresses and principal planes.
2. Understand the load transferring mechanism in beams and stress distribution due to shearing force and bending moment.
3. Apply basic equation of torsion in designing of shafts and helical springs
4. Calculate slope and deflection in beams using different methods.
5. Analyze thin and thick shells for applied pressures.
6. To study the stresses and deformations induced in thin and thick shells

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	-
CO3	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	1
CO4	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	1
CO5	L 4	2	2	1	-	-	-	-	-	-	-	-	-	3	-	1
CO6	L 4	3	3	2	-	-	-	-	-	-	-	-	-	2	-	2

3-High, 2- Moderate, 1- Low, '-' for No correlation

Test Books:

1. Egor P. Popov, Engineering Mechanics of solids, Prentice Hall of India, New Delhi,2001.
2. R. Subramanian, Strength of Materials, Oxford University Press,2007.
3. Ferdinand P. Been, Russel Johnson Jr and Jhon J. Dewole, Mechanism of materials, Tata McGraw-Hill Publication Co. Ltd., New Delhi 2005.

MATERIAL ENGINEERING

Course code -MT 301 **42hrs**

Objectives:

- To increasing demand of the available materials, coupled with new applications and requirements has brought about many changes in the style of their uses.
- To develop the basic knowledge of metals, polymers composites and ceramics other than conventional metals and alloys to apply them to advance engineering applications.

Contents:

Module – I **5hrs**

Introduction – Crystalline and Non crystalline solids, Classification of Engineering materials and their selections, Bonding in solids: Ionic, Covalent and Metallic bonding.

Module – II **12hrs**

Crystal Structure- Space lattices, Bravais lattices, Crystal system, Unit Cell, Metallic crystal structures: SC, BCC, FCC, HCP structures, Miller notations of planes and directions, Imperfections in crystal: Point defects, Line surface defects. Dislocations: Edge and Screw dislocation, Burgers vectors.

Module – III **10hrs**

Metallic Materials – Metals and alloys, ferrous materials- introduction to Iron carbon Diagram, steel and their Heat treatment, Properties and applications. Different types of heat treatment processes. Non-ferrous alloys: - Copper based alloys. Al based alloys, other important nonferrous alloys, properties and applications.

Module – IV **5hrs**

Polymers- Basic concepts of Polymers Science, polymer classifications. Crystallinity of polymers, Copolymers, Thermoplastic and Thermosetting polymers, Elastomers, Properties and Applications.

Module – V **5hrs**

Ceramics- Basic concepts of ceramics science, traditional and new ceramics. Oxide and Non- Oxide ceramics, Ceramics for high temperature applications. Glass, applications of ceramics, and glass.

Module -VI **5hrs**

Composite materials- Definition, general characteristics. Particles reinforced and fiber reinforced composite materials, MMC, CMC, PMC, properties and applications.

Course Outcomes:

1. Classify various engineering materials and their selections
2. To learn about various crystal structures.
3. Analyse Iron-Carbon diagram in different structures.
4. To understand different types of heat treatment processes.
5. To understand the basic knowledge of Ceramics and Polymers and their properties & applications.
6. To learn about Composite materials.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 3	3	3	1	-	-	-	-	-	-	-	-	-	-	2	-
CO2	L 2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	L 3	2	2	1	-	-	-	-	-	-	-	-	-	-	2	-
CO4	L 5	3	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO5	L 5	3	2	1	-	-	-	-	-	-	-	-	-	-	-	1
CO6	L 6	3	2	2	-	-	-	-	-	-	-	-	-	3	-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Elements of Material Science by Van Vlack
2. Material Science by O.P. Khanna
3. Material Science and Engineering by V. Raghavan 4. Material Science by R. K. Sharma and R.S. Sedha

Reference Books:

1. Material Science and Engineering by Wiliam D. Callister

MATHEMATICS-III

Course code: BSC301 **40hrs**

Objective:

- Learn the technique of inverse Laplace transformation and the convolution theorem
- Learn numerical differentiation, integration methods such as Newton-Cotes quadrature formula, and numerical techniques for solving differential equations
- Understanding of Z-Transform and Difference Equations
- Learn about the properties of Fourier series, Fourier transformation, and inverse Fourier transformation

Module-I **8hrs**

Laplace Transformation: Laplace Transformation and its properties, Periodic function, Unit step function and impulse function .Inverse Laplace Transformation, Convolution Theorem, Applications of Laplace transforms in solving certain initial value problems & simultaneous differential equations.

Module-II **10hrs**

Numerical Method: Finite difference, Symbolic relations, Interpolation and Extrapolation, Newton-Gregory forward and backward formula, Lagrange's formula, Inverse Interpolation by Lagrange's formula. Numerical Differentiation and Numerical Integration, Newton Cotes Quadrature formula, Trapezoidal rule, Simpson's 1/3"rule, Simpson's3/8"rule.

Module-III **6hrs**

Z-Transform & Inverse Z-Transform- Properties - Initial and Final value theorems, Convolution theorem- Difference equations. Solution of difference equations using Z-Transformation.

Module-IV **8hrs**

Fourier Series &Fourier Transform: Expansion of- Algebraic, Exponential & Trigonometric functions in Fourier series, Change of interval, Even and odd function, half ranges in e and cosine series, Complex form of Fourier series. Fourier Transformation and inverse Fourier Transformation, Fourier sine & cosine transforms. Convolution theorem for Fourier transforms with simple illustrations.

Module-V **8hrs**

Partial Differential Equations: Formation of partial differential equations, Linear partial differential equations of first order, Lagrange's linear equation, Non-linear equations of first order, Charpit's method Solution of one-dimensional Wave equation & Heat equation by the method of separation of variables and its applications.

Course Outcomes:

1. Intuitive meaning and Methods of finding integration definite integration and its properties.
2. Application of Integration in finding Area, volume of irregular shapes.
3. Methods of solving differential equation of first order and first degree.
4. Methods for finding approximate roots by using bisection, Regula -falsi, Newton-Raphson method, Gauss elimination, Jacobi and Gauss-Seidal methods.
5. Use of Binomial, Normal and Poisson distributions for solving different examples.
6. Use of Laplace transform for solving problems of Differential Equations.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO 1	L 3	3	2	--	--	--	--	3	1	--	--	--	1	3	2	2
CO 2	L 4	3	2	1	1	--	--	1	1	--	--	--	1	3	1	1
CO 3	L 5	3	2	1	1	--	--	1	1	--	--	--	1	3	1	1
CO 4	L 4	3	2	1	1	--	--	1	1	--	--	--	1	3	3	2
CO 5	L 3	3	2	1	--	--	--	1	1	--	--	--	1	3	2	2

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books

1. Irwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons,
2. Ramana R.V, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 2010.
3. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition,

Reference Books

1. R.J. Beerends. H. G. TerMorsche, J. C. Van Den Berg. L. M. Van De Vrie, Fourier and Laplace Transforms, Cambridge University Press.
2. Sastry S.S. Introductory Methods of Numerical Analysis, PHI

ENVIRONMENTAL SCIENCE

Course code –BSC 302 **24hrs**

Objectives:

- To develop basic knowledge of ecological principles and their applications in environment.
- To analyse, how the environment is getting contaminated and probable control mechanisms for them.
- To generate awareness and become a sensitive citizen towards the changing environment.

Contents:

Module-1 **2hrs**

Concept and scope of Environment science, components of environment, environmental segment and their importance.

Module-II **4hrs**

Ecology: Ecosystem and its characteristics features, structure and function of forest ecosystem, grassland ecosystem, desert ecosystem and aquatic ecosystem, ecological balance and consequences of imbalance.

Module-III **4hrs**

Atmosphere: Atmospheric composition, energy balance, climate, weather, depletion of ozone layer, greenhouse effect, acid rain, particles, ions and radicals in the atmosphere, chemical and photochemical reactions in the atmosphere.

Module-IV **4hrs**

Air pollution and control: Air pollutants, sources and effect of air pollutants, primary and secondary pollutants, photochemical smog, fly ash, inorganic and organic particulate matter. Air quality standards, sampling, monitoring and control measures for pollutants.

Module-V **4hrs**

Water pollution and control: Aquatic environment, water pollution, sources and their effect, lake and ground water pollution, eutrophication, water quality standard and water pollution control measures, waste water treatment.

Module-VI **4hrs**

Land pollution; Lithosphere, composition of soil, acid base and ion exchange reactions in soil, soil erosion, landslides, desertification, pollutants (municipal, industrial, commercial, agricultural, hazardous solid wastes), origin and effects, collection and disposal of solid wastes, recovery and conversion methods.

Module-VII **2hrs**

Noise pollution; Noise classification and its sources, effects and measurement, noise pollution hazards, standards and noise pollution control.

Course Outcomes:

1. Understanding of issues related to environment and their impact on the human life.
2. Understanding on the solutions related to the environmental problems.
3. Understanding of different component of environment and their function and sustainable development.
4. Able to identify the sources, causes, impacts and control of air pollution.
5. Able to judge the importance of soil.
6. To learn about causes of contamination and need of solid waste management.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 3	3	3	1	-	-	-	-	-	-	-	-	-	-	2	-
CO2	L 2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	L 3	2	2	1	-	-	-	-	-	-	-	-	-	-	2	-
CO4	L 5	3	2	1	-	-	-	-	-	-	-	-	-	2	-	-
CO5	L 5	3	2	1	-	-	-	-	-	-	-	-	-	-	-	1
CO6	L 6	3	2	2	-	-	-	-	-	-	-	-	-	3	-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Books and References:

1. Master, G.M Introduction to environment engineering and science, Pearson Education.
2. Nebel, B.J., Environment science, Prentice Hall Inc.
3. Odum, E.P. Ecology: The link between the natural and social sciences. IBH Publishing Company Delhi
4. De, A.K. Environmental Chemistry, Merrut.
5. Sharma B.K Environmental Chemistry, Krishna Prakashan Media Merrut.
6. Kaushik, A and Kaushik, C.P. Perspectives in Environmental studies, New Age International Publication.
7. Menon, S.E. Environmental Chemistry.

THERMODYNAMICS LAB

Course Code - ME301P

List of Experiments:

1. To study low pressure boilers and their accessories and mountings.
2. To study high pressure boilers and their accessories and mountings.
3. To prepare heat balance sheet for given boiler.
4. To study the working of impulse and reaction steam turbines.
5. To find dryness fraction
6. Efficiency of a steam turbine.
7. To find the condenser efficiencies.
8. To study and find volumetric efficiency of a reciprocating air compressor.
9. To study cooling tower and find its efficiency.
10. To find calorific value of a sample of fuel using Bomb calorimeter.
11. Calibration of Thermometers and pressure gauges.

Note: 1. At least eight experiments should be performed from the above list.

FLUID MECHANICS LAB

Course Code-ME302P

List of Experiments:

1. To determine the coefficient of impact for vanes.
2. To determine coefficient of discharge of an orifice meter.
3. To determine the coefficient of discharge of Notch (V and Rectangular types).
4. To determine the friction factor for the pipes.
5. To determine the coefficient of discharge of venturi meter.
6. To determine the coefficient of discharge, contraction & velocity of an orifice.
7. To verify the Bernoulli's Theorem.
8. To find critical Reynolds number for a pipe flow.
9. To determine the meta-centric height of a floating body.
10. To determine the minor losses due to sudden enlargement, sudden contraction and bends.
11. To show the velocity and pressure variation with radius in a forced vertex flow.
12. Verification of momentum theory by impact of Jet.
13. To study the performance characteristics of a Pelton Turbine.
14. Determine the operating characteristic of a reaction turbine.
15. Determine the operating characteristic of a reciprocating pump.
16. Verification of momentum theory by impact of Jet.

Note: 1. At least eight experiments should be performed from the above list.

STRENGTH OF MATERIAL LAB

Course Code - ME303P

List of Experiments:

1. Tensile test: To prepare the tensile test upon the given specimen (Mild Steel)
2. Compression test: To determine the compressive strength of the given specimen
3. Torsion test: To perform the Torsion test on the given specimen.
4. Impact test: To determine the Impact toughness of the given material
5. Brinell hardness test: To determine the hardness of the given specimen
6. Vicker's Hardness test: To determine the hardness of the given specimen
7. Rockwell Hardness test: To determine the hardness of the given specimen.
8. To determine the shear strength of a mild steel specimen by Double Shear Test
9. To determine the modulus of rigidity of a solid circular rod by conducting Torsion Test.
10. To obtain tensile strength, modulus of elasticity, percentage elongation and percentage reduction in area. of cross-section.

Note: 1. At least eight experiments should be performed from the above list.

COMMUNICATION SKILL LAB

Course code - HS301

This lab paper involves interactive practice sessions in Language Lab along with some class lectures to enable the students to be confident enough in language and professional sphere of life.

Module I: Listening Comprehension

1. To comprehend spoken material in standard Indian English/ British English & American English
2. Current situation in India regarding English American English Vs. British English

Module II: Phonetics & Phonology

1. Introduction to Phonetics & Phonology
2. Organs of Speech/ Speech Mechanism
3. Pronunciation, Intonation, Stress and Rhythm, Syllable Division
   Consonants/Vowels/Diphthongs/Classification.

Module III: Common Everyday Situations: Conversations and Dialogues

Module IV: Communication at Workplace

Module V: Telephonic Conversation

1. Introduction
2. Listening/Speaking
3. Telephonic Skills Required
4. Problems of Telephonic Conversation
5. Intensive Listening

Module VI: Interviews

1. The Interview Process
2. Purpose/Planning/Two-way Interaction/Informality
3. Pre-interview Preparation Techniques
4. Projecting a Positive Image
5. Answering strategies

Module VII: Formal Presentations

1. Introduction
2. Nature/Importance of Presentation
3. Planning
4. Objective with central idea, main ideas, role of supporting materials
   Handling Stage Fright

Module VIII: Forms of Technical Communication

Technical Report: Definition & importance; Thesis/Project writing: structure & importance; synopsis writing: Methods; Technical research Paper writing: Methods & style; Seminar & Conference paper writing; Expert Technical Lecture: Theme clarity; Analysis & Findings; C.V./Resume writing; Technical Proposal: Types, Structure & Draft

Module IX: Technical Presentation

Strategies & Techniques Presentation: Forms; interpersonal Communication; Class room presentation; style; method; Individual conferencing: essentials: Public Speaking: method; Techniques: Clarity of substance; emotion; Humour; Modes of Presentation; Overcoming Stage Fear; Audience Analysis & retention of audience interest; Methods of Presentation: Interpersonal; Impersonal; Audience Participation: Quizzes & Interjections.

Module X: Technical Communication Skills

Interview skills; Group Discussion: Objective & Method; Seminar/Conferences Presentation skills: Focus; Content; Style; Argumentation skills: Devices: Analysis; Cohesion & Emphasis; Critical thinking; Nuances: Exposition narration & Description; effective business communication competence: Grammatical; Discourse competence: combination of expression & conclusion; Socio-linguistic competence: Strategic competence: Solution of communication problems with verbal and nonverbal means.

RADHA GOVIND UNIVERSITY

RAMGARH, JHARKHAND

DEPARTMENT OF MECHANICAL ENGINEERING

B. TECH (4th) SEMESTER SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

4th SEMESTER

COURSE CONTENTS

Mechanical Engineering

4th semester course structure

Sl. No.	Course code.	Subject	L	T	P	Credit s
01	ME401	Theory Of Machines	3	1	0	3
02	ME402	Fluid Machines	3	1	0	3
03	ME403	Applied Thermodynamics	3	1	0	3
04	ME404	Manufacturing Process-I	3	1	0	3
05	EC404	Electronics & Instrumentation Engg.	3	1	0	3
06	EN401/ IT402	Engineering Economics / Cyber Security	2	0	0	0
01	ME401P	Theory Of Machines Lab	0	0	3	1
02	ME403P	Applied Thermodynamics Lab	0	0	3	1
03	ME404P	Manufacturing Process-I Lab	0	0	3	1
04	EX401	Extra Activities (NSO/NSS/NCC/Yoga/ Creative Arts/Mini Project)	0	0	2	1
05	IN401	Internship/ Tour & Training/Industrial Training	0	0	0	2
Total credits						**21**

THEORY OF MACHINE

Course code -ME 401 **40hrs.**

Objective:

- To study the basic components of mechanisms, analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism and design cam mechanisms for specified output motions.
- To study the basic concepts of toothed gearing and kinematics of gear trains
- To Analyzing the effects of friction in machine elements
- To Analyzing the force-motion relationship in components subjected to external forces and analyzing of standard mechanisms.
- To Analyzing the undesirable effects of unbalances resulting from prescribed motions in mechanism and the effect of dynamics of undesirable vibrations.

Contents:

Module -1 **8hrs**

Classification of mechanisms- Basic kinematic concepts and definition – Degree of freedom, mobility-Grashof's law, Kinematic inversions of four bar chain and slider crank chains-Limit Proportions-Mechanical Advantage-Transmission angle – Description of some common mechanisms-Quick return mechanism, Straight line generators-Universal Joint- Rocker mechanism.

Module-II **8hrs**

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

Module-III **8hrs**

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

Module – IV **8hrs**

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 – V **8hrs**

Surface contacts-sliding and rolling friction, friction drives- bearings and lubrication-friction clutches-belt and rope drives-friction in brakes.

Course outcomes:

1. Evaluate the velocity & acceleration of links in a mechanism or machine.
2. Explain the working principle of different machines.
3. Design linkages & gear mechanisms for a given motion or a given input/output motion relationship.
4. Apply the laws of friction in applications of mechanisms and machines.
5. Understand constructional and working features of important machine elements.
6. Design belt, rope and chain drives for transmission of motion from one shaft to another.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 3	3	2	2	-	-	-	-	-	-	-	-	-	1	-	-
CO2	L 3	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
CO3	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	-
CO4	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
CO5	L 4	3	3	3	-	-	-	-	-	-	-	-	-	3	2	-
CO6	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	2

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Thomas Bevan, Theory of machines,3rd edition, CBS Publishers & Distributors,2005.
2. Cleghorn W.L., Mechanisms of Machines, Oxford University Press,2005.
3. Robert L. Norton, Kinematics and Dynamics of machinery, Tata McGrawHill,2009.
4. Ghosh A. And Mallick A. K, Theory of Mechanism and Machines, Affiliated East- West Pvt.Ltd, New Delhi,1988.

FLUID MACHINE

Course code -ME 402 **40hrs**

Objectives:

- To develop a strong foundation in the fundamentals of fluid mechanics.
- The basic conservation equations are derived for a compressible viscous fluid and then are specialized for applications in potential flow, viscous flow, and gas dynamics.
- To solve fluid mechanics problems by reading the problem and restate it with a summary of the results desired, gather the needed property data, make a detailed, labeled sketch of the system or control volume needed,

Contents:

Module I

Introduction: Impulse of Jet and Impulse Turbines **8hrs**

Classification of Fluid Machines & Devices, Application of momentum and moment of momentum equation to flow through hydraulic machinery, Euler's fundamental equation. Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat & curve), Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Governing of Pelton wheel.

Module II

Reaction Turbine **8hrs**

Francis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Degree of reaction, Draft tube, Cavitation in turbines, Principles of similarity, Unit and specific speed, Performance characteristics, Selection of water turbines.

Module III

Centrifugal Pumps **8hrs**

Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, specific speed, Cavitation & separation, Performance characteristics.

Module IV

Positive Displacement and other Pumps **8hrs**

Reciprocating pump theory, slip, Indicator diagram, Effect of acceleration, air vessels, Comparison of centrifugal and reciprocating pumps, Performance characteristics.

Module V **8hrs**

Hydraulic accumulator, Hydraulic intensifier, Hydraulic Press, hydraulic crane, hydraulic lift, hydraulic RAM, Hydraulic coupling, Hydraulic torque converter, air lift pump, jet pump.

Course outcome:

1. Understanding of the basic concepts of fluid mechanics.
2. Knowledge of the different types of fluid machines.
3. Understanding of the working principle of different types of fluid machines.
4. Ability to analyze the performance of different types of fluid machines.
5. Knowledge of the selection criteria for different types of fluid machines.
6. Ability to design different types of fluid machines.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 4	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	L 3	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO3	L 5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	L 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO5	L 3	2	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO6	L 3	3	-	-	-	-	-	-	-	-	-	-	-	-	2	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

TEXT BOOKS:

1. Hydraulic Machines by Jagdish Lal, Metropolitan book co. pvt. Ltd.
2. Hydraulic Machines by K Subramanya, Tata McGraw Hill
3. Fluid Mechanics and Machinery by C.S.P. Ojha, R. Berndtsson, P.N. Chandramouli, Oxford University Press.
4. Fluid Mechanics and Fluid Power Engineering by D S Kumar, S K Kataria & Sons
5. Fluid Mechanics and Turbo machines by Das, PHI
6. Fluid Power with Applications, by Esposito, Pearson
7. Fluid Mechanics and hydraulic machines by Modi & Seth, Standard Book House
8. Fundamentals of Turbomachinery by Venkanna B.K., PHI
9. Hydraulic Machines: Theory & Design, V.P. Vasandhani, Khanna Pub.
10. Fluid Mechanics and Hydraulic Machines by Sukumar Pati, Tata McGrew Hill.

APPLIED THERMODYNAMICS

Course Code-ME 403 **40hrs**

Objectives:

- To understand various practical power cycles and heat pump cycles.
- To analyse energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors
- To understand phenomena occurring in highspeed compressible flows.

Contents:

Module-1 **8hrs**

Introduction to solid, liquid and gaseous fuels- Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations using free energy.

Module -II **12hrs**

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, energy analysis Super-critical and ultra-super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual cycles- Air standard Brayton cycle, effect of reheat, regeneration and intercooling – Combined gas and vapor power cycles- vapor compression refrigeration cycles, refrigerants and their properties.

Module-III **4hrs**

properties of dry and wet air, use of psychrometric chart, processes involving heating/cooling and humidification/ dehumidification, dew point.

Module-IV **8hrs**

Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, chocked flow, subsonic and supersonic flows- normal shocks-use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, super saturation-compressible flow in diffusers, efficiency of nozzle and diffuser.

Module-V **5hrs**

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.

Module-VI **3hrs**

Analysis of steam turbines, velocity and pressure compounding of steam turbine.

Course outcomes:

1. To learn about of 1st law for reacting systems and heating value of fuels.
2. To learn about gas and vapor cycles and their first law and second law efficiencies.
3. To understand about the properties of dry and wet air and the principles of psychometry.
4. To learn about gas dynamics of air flow and steam through nozzles.
5. To learn the about reciprocating compressors with and without intercooling.
6. To analyse the performance of steam turbines.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO2	L 3	2	2	3	-	-	-	-	-	-	-	-	-	2	-	-
CO3	L 4	3	3	2	-		-	-	-	-	-	-	-	3	-	-
CO4	L 4	3	2	3	-	-	-	-	-	-	-	-	-	2	-	-
CO5	L 3	2	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO6	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	2	1

3-High, 2- Moderate, 1- Low, '-' for No correlation

MANUFACTURING PROCESSES I

Course Code-ME 404 **43hrs**

Objectives:

- Examine the technical aspect related to basic manufacturing processes.
- Get acquainted with different methods of manufacturing used.
- Analyse different aspects of a manufacturing process along with their appropriate usage and scope.
- Derive relationship and use empirical relations to study the effects of manufacturing parameters on a process
- Develop an understanding of existing and emerging manufacturing processes.

Contents:

Module-I **5hrs**

Conventional Manufacturing Processes: Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses.

Module-II **8hrs**

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy. Metal Cutting: 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 coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.

Module-III **3hrs**

Additive manufacturing: Rapid prototyping and rapid tooling.

Module-IV **3hrs**

Joining/ fastening processes: Physics of welding, brazing and soldering; design considerations in welding. Solid and liquid state joining processes; Adhesive bonding.

Module-V **5hrs**

Unconventional Machining Processes: Abrasive Jet Machining, Water Jet Machining Abrasive Water Jet Machining, Ultrasonic Machining principles and process parameters.

Module-VI **8hrs**

Electrical Discharge Machining principle and processes parameters, MRR, surface finish tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant & maskant, process parameters, MRR and surface finish.

Module-VII **3hrs**

Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining.

Course Outcomes:

1. Explain the basic principles behind different Casting, Welding, Forming and machining processes
2. Select appropriate manufacturing process for a given component design
3. Identify advantages and limitations of various casting, welding, machining and forming techniques
4. Correctly explain and construct mathematical relationships existing amongst various parameters in different manufacturing processes
5. Select appropriate welding process for a given joint.
6. Knowledge of advanced manufacturing process.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	-	2	1	1	1		-	-	-	-	3	2	-	-
CO2	L 2	3	-	-	-	-	1	1	-	-	-	-	-	-	-	1
CO3	L 2	3	-	2	1	1	-	1	-	-	-	-	-	2	2	-
CO4	L 2	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO5	L 3	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO6	L 3	3	-	2	-	1	-	-	-	-	-	-	-	2	2	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Books and References:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014.
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems.
3. Manufacturing Technology by P.N. Rao., MCGRAW HILL INDIA.
4. Materials and Manufacturing by Paul Degarmo.
5. Manufacturing Processes by Kaushish, PHI.
6. Principles of Foundry Technology, Jain, MCGRAW HILL INDIA
7. Production Technology by RK Jain.
8. Degarmo, Black & Kohser, Materials and Processes in Manufacturing.

ELECTRONICS AND INSTRUMENTATION ENGINEERING

Course code – EC404 **40hrs**

Objectives:

- To design various instruments for different sectors.
- To ensure that systems and processes work safely and efficiently.
- To create, build, and maintain measuring and control devices and systems found in manufacturing plants and research institutions.

Contents:

Module I: Basic Electronic Components **8hrs**

Active and Passive Components, Types of resistors and Color coding, Capacitors, Inductors applications of Resistor, Capacitor and Inductor, Relay, LDR, Basic Integrated Circuits (IC 7805, 7809, 7812, 555 etc.). Measuring Instruments like CRO, Power supply, multi-meters etc.

Module II: Semiconductors, Diode and Transistors **8hrs**

Difference between Insulators, Semiconductors and Conductors, Mobility and Conductivity, Intrinsic and Extrinsic Semiconductors, Fermi Level, Energy band, P-N Junction Diode, construction, working, characteristics and diode equation Application of Diode, Rectifier: Half Wave, Full Wave and Bridge Rectifier, Zener Diode and its Applications, Varactor Diode, Schottky Diode, Regulated Power Supply using Zener Diode and Regulated ICs, LED, Photodetector, Construction, Working, Modes and Configuration of BJT, Input and Output Characteristics of all Configurations, Comparison of all Configuration & Modes, BJT as a Switch and as an Amplifier. JFET Construction, working and characteristics. MOSFET Construction, working and Characteristics, Types of MOSFET.

Module III: Digital Electronics Fundamentals **8hrs**

Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters, Block diagram of microprocessor/microcontroller and their applications.

Module IV: Electronic Instruments **8hrs**

Measurement of Temperature, RTD, Thermistors, LVDT, Strain Gauge, Piezoelectric Transducers, Digital Shaft Encoders, Tachometer, Hall effect sensors. Sensors and Transducers for physical parameters: temperature, pressure, torque, flow. Speed and Position Sensors. Electronic Display Device, Digital Voltmeters, Digital Energy meter, CRO, measurement of voltage and frequency, Lissajous Patterns, Plotting B-H curve of a magnetic material, Wave Analyzers, Harmonic Distortion Analyzer. Digital Energy Meter. Measurements of R, L and C Digital Multi-meter, True RMS meters, Clamp-on meters, Meggers. Digital Storage Oscilloscope.

Module V: Electronic Communication Systems **8hrs**

The elements of communication system, IEEE frequency spectrum and Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system, Ultrasonic wave & its application in distance measurement.

Course outcomes:

1. Understanding of the basic concepts of electronics and instrumentation engineering.
2. Knowledge of the different types of electronic devices and their applications.
3. Understanding of the working principle of different types of electronic devices.
4. Ability to analyze the performance of different types of electronic devices.
5. Knowledge of the selection criteria for different types of electronic devices.
6. Ability to design different types of electronic devices.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	L 2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO 2	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	-
CO 3	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	1
CO 4	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	1
CO 5	L 4	2	2	1	-	-	-	-	-	-	-	-	-	3	-	1
CO 6	L 4	3	3	2	-	-	-	-	-	-	-	-	-	2	-	2

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Basic Electronics and Linear Circuits by N. N. Bhargava, D. C. Kulshreshtha and S. C. Gupta, TMH Publications.
2. Op-Amps and Linear Integrated Circuits by Ramakant A. Gayakwad, PHI Publications.
3. Electronic Devices and Circuits by Godse and Bakshi Technical, Vol-1 Technical Publication Pune.
4. Floyd," Electronic Devices" Pearson Education 9th edition, 2012.
5. R.P. Jain, "Modern Digital Electronics", Tata Mc Graw Hill, 3rd Edition, 2007.
6. Frenzel, "Communication Electronics: Principles and Applications", Tata Mc Graw Hill, 3rd Edition, 2001

Reference Books:

1. Integrated Devices & Circuits by Millman & Halkias, TMH Publications.
2. Electronics Devices and Circuit Theory by R. Boylestad & L. Nashelsky, Pearson Publication
3. Electronic Communication System by G. Kennedy, TMH Publications.
4. Basic Electronics by Sanjeev Kumar & Vandana Sachdeva, Paragaon International Publication

ENGINEERING ECONOMICS

Course code –EN 401 **40hrs**

Objective:

The basic purpose of this course is to provide a sound understanding of concepts and principles of engineering economy and to develop proficiency with methods for making rational decisions regarding problems likely to be encountered in professional practice.

Contents:

Module -I **10hrs**

Meaning and nature of Economics, Relation between science, engineering, technology and economics; Nature of Economic problem, Production possibility curve, Concepts and measurement of utility, Law of Diminishing Marginal Utility, Law of equi-marginal utility – its practical application and importance.

Module -II **10hrs**

Meaning of production and factors of production; Law of variable proportions, Returns to scale, Internal and External economics and diseconomies of scale. Various concepts of cost – Fixed cost, variable cost, average cost, marginal cost, money cost, real cost, opportunity cost. Shape of average cost, marginal cost, total cost, Cost curves.

Module III **10hrs**

Meaning of Market, Types of Market Perfect Competition, Monopoly, Oligopoly, Monopolistic Competition (Main features of these markets)

Pricing Policies- Entry Deterring policies, Predatory Pricing, Peak load Pricing. Product Life cycle Firm as an organization- Objective of the Firm, Type of the Firm, Vertical and Horizontal Integration, Diversification, Mergers and Takeovers.

Module -IV **10hrs**

Nature and characteristics of Indian economy (brief and elementary introduction), Privatization – meaning, merits and demerits. Globalization of Indian economy – merits and demerits. Elementary Concepts of VAT, WTO, GATT & TRIPS agreement, Business cycle, Inflation.

Course Outcomes:

1. Understanding of the basic concepts of engineering economics.
2. Knowledge of the different types of costs and their applications.
3. Understanding of the working principle of different types of costs.
4. Ability to analyze the performance of different types of costs.
5. Knowledge of the selection criteria for different types of costs.
6. Ability to design different types of costs

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	B L	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	L 3	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	L 2	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO4	L 3	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	L 4	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO6	L 3	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

RECOMMENDED BOOKS: -

1. R. Paneer Seelvan: Engineering Economics, PHI
2. Managerial Economics, D.N. Dwivedi, Vikash Publication
3. Managerial Economics, H.L. Ahuja, S. Chand and Co. Ltd.
4. Managerial Economics, Suma Damodaran, Oxford.
5. R. molrishnd Ro T.V S 'Theory of firms: Economics and Managerial Aspects'. Affiliated East West Press Pvt Ltd New Delhi.

THEORY OF MACHINE LAB

Course Code - ME401P

List of Experiments:

1. To draw velocity diagram of four bar mechanism
2. To draw velocity diagram of slider crank mechanism.
3. To draw acceleration diagram of four bar mechanism
4. To draw acceleration diagram of slider crank mechanism
5. To study Different types of Cam profile
6. To draw displacement diagram, velocity diagram & acceleration diagram of cam follower
7. To draw a cam profile
8. To study Different types of Gears
9. To draw Involute gear profile.
10. To draw Cycloidal gear profile

Note: 1. At least eight experiments should be performed from the above list.

APPLIED THERMODYNAMICS LAB

Course Code-ME 403P

List of Experiments:

1. Study of Fire Tube boiler.
2. Study of Water Tube boiler.
3. Study and working of Two stroke petrol Engine.
4. Study and working of Four stroke petrol Engine.
5. Determination of Indicated H.P. of I.C. Engine by Morse Test.
6. Prepare the heat balance sheet for Diesel Engine test rig.
7. Prepare the heat balance sheet for Petrol Engine test rig.
8. Study and working of two stroke Diesel Engine.
9. Study and working of four stroke Diesel Engine.
10. Study of Velocity compounded steam turbine.
11. Study of Pressure compounded steam turbine.
12. Study of Impulse & Reaction turbine.
13. Study of steam Engine model.
14. Study of Gas Turbine Model.

Note: 1. At least eight experiments should be performed from the above list.

MANUFACTURING PROCESS LAB

Course Code-ME404P

List of Experiments:

1. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine.
2. Bolt (thread) making on Lathe machine.
3. Tool grinding (to provide tool angles) on tool-grinder machine.
4. Gear cutting on Milling machine
5. Machining a block on shaper machine.
6. Finishing of a surface on surface-grinding machine.
7. Drilling holes on drilling machine and study of twist-drill
8. Study of different types of tools and its angles & materials.
9. Experiment on tool wear and tool life.
10. Experiment on jigs/Fixtures and its uses.
11. Gas welding experiment.
12. Arc welding experiment.
13. Resistance welding experiment.
14. Soldering & Brazing experiment.
15. Study and understanding of limits, fits & tolerances.
16. Study of temperature measuring equipment's.
17. Measurement using Strain gauge.
18. Experiment on dynamometers.
19. To study the displacement using LVDT.

Note: 1. At least eight experiments should be performed from the above list.

RADHA GOVIND UNIVERSITY

RAMGARH, JHARKHAND

DEPARTMENT OF MECHANICAL ENGINEERING
B.TECH (5th) SEMESTER SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

5th SEMESTER

COURSE CONTENTS

Mechanical Engineering

5th semester course structure

S. No.	Course Code	Subject	L	T	P	Credit
		Theory				
1.	MEC501	Heat Transfer	3	1	0	4
2.	MEC502	Design of Machine Elements	2	1	0	3
3.	MEC503	Internal Combustion Engines	2	1	0	3
4.*	MEP504 MEP505 MEP506	Industrial Robotics Design for Manufacturing Energy System and Management	2	1	0	3
5.**	MEO507 MEO508 MEO509	Project Management Principles of Management Total Quality Management	2	1	0	3
		Laboratory/Sessional				
1.	ME501P	Heat Transfer	0	0	2	1
2.	ME502P	Design of Machine Elements	0	0	2	1
3.	ME503P	Internal Combustion Engines	0	0	2	1
4.	ME506P	Energy System and Management Lab	0	0	2	1
5	ME505G	General Proficiency/Seminar	0	0	2	2
Total Credit						**22**

***Professional Elective I**

**** Open Elective I**

HEAT TRANSFER

Course Code -MEC501 **42hrs**

Objective:

- Classify innumerable cases under heat transfer process.
- To learn about various laws and its application.
- Illustrate and solve mathematically the relations under various heat transfer modes.
- Classify, solve and correlate heat and mass transfer problems.

Contents:

Module I **12hrs**

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 thickness of insulation, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer-approximate solution to unsteady conduction, heat transfer by the use of Heissler charts.

Module II **10hrs**

Heat convection 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 III **8hrs**

Interaction of radiation with materials, definitions of radiative properties, Stefan Boltzmann's law, black and Gray body radiation, Calculation of radiation heat transfer between the surfaces using radiative properties, view factors and the radiosity method.

Module IV **6hrs**

Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and ε-NTU methods. Exposure of numerical technique of heat transfer.

Module V **3hrs**

Boiling and Condensation heat transfer, Pool boiling curve.

Module VI **3hrs**

Introduction mass of transfer, Fick's law, Similarity between heat and mass transfer.

Course Outcomes:

1. Formulate and analyze a heat transfer problem involving any of the three modes of heat transfer.
2. Evaluate exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer.
3. To design devices such as heat exchangers.
4. Estimate the insulation needed to reduce heat losses where necessary.
5. Analyze the heat transfer by use of fins and radiation surfaces.
6. Estimate and illustrate mass transfer problems.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	B L	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	L 3	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	L 2	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO4	L 3	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	L 4	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO6	L 3	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1.P. K. Nag, Heat and Mass Transfer

2.Yunus A Cengel, Heat Transfer: A Practical Approach, McGraw Hill, 2002

3.Frank Kreith, Raj M. Manglik, Mark S. Bohn: Principles of Heat Transfer, Cengage Learning

References Books:

1. A. Bejan, Heat Transfer John Wiley, 1993
2. J.P. Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
3. F.P. Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, Sixth Edition, 2007.
4. Massoud Kaviany, Principles of Heat Transfer, John Wiley, 2002

DESIGN OF MACHINE ELEMENTS

Course Code - MEC502 **43hrs**

Objectives:

- A strong background in mechanics of materials-based failure criteria underpinning the safety-critical design of machine components
- An understanding of the origins, nature and applicability of empirical design principles, based on safety considerations
- An overview of codes, standards and design guidelines for different elements
- An appreciation of parameter optimization and design iteration
- An appreciation of the relationships between component level design and overall machine system design and performance

Contents:

Module I **6hrs**

Philosophy of engineering Design, Mechanical engineering design, Design process, Design considerations, Factor of safety Codes and Standards. Material selection.

Module II **8hrs**

Design of shafts under static and fatigue loadings, Analysis and design of sliding and rolling contact bearings.

Module III **8hrs**

Design of transmission elements: spur, helical, bevel and worm gears; belt and chain drives.

Module IV **6hrs**

Design of springs: helical compression, tension, torsional and leaf springs

Module V **6hrs**

Design of joints: threaded fasteners, pre-loaded bolts and welded joints,

Module VI **9hrs**

Analysis and applications of power screws and couplings, Analysis of clutches and brakes, Engine Components.

Course Outcomes:

1. Understanding of the basic concepts of machine design.
2. Knowledge of the different types of machine elements.
3. Understanding of the working principle of different types of machine elements.
4. Ability to analyze the performance of different types of machine elements.
5. Knowledge of the selection criteria for different types of machine elements.
6. Ability to design different types of machine elements.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	B L	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	-	2	1	1	1		-	-	-	-	3	2	-	-
CO2	L 2	3	-	-	-	-	1	1	-	-	-	-	-	-	-	1
CO3	L 2	3	-	2	1	1	-	1	-	-	-	-	-	2	2	-
CO4	L 2	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO5	L 3	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO6	L 3	3	-	2		1	-	-	-	-	-	-	-	2	2	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Shigley, J.E. and Mischke, C.R., Mechanical Engineering Design, Fifth Edition, McGraw- Hill International; 1989.
2. Deutschman, D. Michel's, W.J. and Wilson, C.E., Machine Design Theory and Practice, Macmillan, 1992.
3. Juvinal, R.C., Fundamentals of Machine Component Design, John Wiley, 1994.
4. Spottes, M.F., Design of Machine elements, Prentice-Hall India, 1994.
5. R. L. Norton, Mechanical Design – An Integrated Approach, Prentice Hall, 1998

INTERNAL COMBUSTION ENGINES

Course Code - MEC503 **42hrs**

Objectives:

- To familiarize with the terminology associated with IC Engines.
- To understand the basics of IC Engines.
- To understand Combustion and various parameters and variables affecting it in various types of IC Engines.
- To learn about various systems used in IC Engine required for various applications.

Contents:

Module I **6hrs**

Introduction: Internal and external combustion engines, classification and nomenclature of I. C. Engines, Air standard Otto, diesel and dual combustion cycles, deviation of actual engine cycle from ideal cycle.

Module II **8hrs**

Combustion in I.C. Engines: Stages of combustion in S.I. Engines, factor influencing the ignition lag and flame speed, detonation and its effects on engine performance, influence of engine variables on detonation, pre-ignition, Stages of combustion in C.I. Engines, delay period, variables affecting delay period, knock in C.I. engines, Lubrication and Cooling Systems.

Module III **7hrs**

Carburetion and fuel Injection: Mixture requirements for various operating conditions in S.I. Engines; elementary carburettor, single-point and multi-point fuel injection systems; Diesel injection system

Module IV **7hrs**

Ignition systems: Types of ignition systems, advancing ignition timing; spark plugs

Module V **7hrs**

Supercharging: Objectives of supercharging, its advantages and applications; Turbocharging and supercharging of SI and CI Engines; limitations of supercharging**.**

Module VI **7hrs**

Testing of IC Engines, Engine emissions and control, advanced IC engine concepts

Course Outcomes:

1. To learn about basics of IC engines.
2. To learn about the knowledge of different parameters influence the operational characteristics of IC Engine.
3. To learn about different operational parts of IC Engines.
4. To understand the functions of fuel combustion of IC Engines.
5. To learn about designing and modifying the IC engines.
6. To learn about ignition system, lubrication and cooling systems.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	-	2	1	1	1		-	-	-	-	3	2	-	-
CO2	L 2	3	-	-	-	-	1	1	-	-	-	-	-	-	-	1
CO3	L 2	3	-	2	1	1	-	1	-	-	-	-	-	2	2	-
CO4	L 2	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO5	L 3	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO6	L 3	3	-	2		1	-	-	-	-	-	-	-	2	2	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text books:

1. Obert E. F. "Internal combustion engines and air pollution " Harper and Row Publication Inc. NY,1973.

2. Heisler H. " Advanced Engine technology " Edward Arnold 1995.

3. Heywood J.B. " Internal combustion Engine fundamentals ", McGraw Hill Book Co. NY, 1989.

4. Heidt P.M. " High combustion Engines ", Oxford &IBH Publishing Co. India, 1985.

5. Stockel M.W. Stockel TS and Johnson C, " Auto Fundamentals ", The Goodheart, Wilcox Co.Inc. Illinois, 1996.

INDUSTRIAL ROBOTICS

Course code-MEP504 **40hrs**

Objective:

- To Gain knowledge of Robotics and automation.
- To Understand the working methodology of robotics and automation.
- Write the program for robot for various applications

Contents:

Module-I **6hrs**

Robotics-classification, Sensors-Position sensors, Velocity sensors, Proximity sensors, Touch and Slip Sensors, Force and Torque sensors.

Module-II **8hrs**

Grippers and Manipulators- Gripper joints, Gripper force, Serial manipulator, Parallel Manipulator, selection of Robot-Selection based on the Application

Module-III **8hrs**

Kinematics-Manipulators Kinematics, Rotation Matrix, Homogenous Transformation Matrix, Direct and Inverse Kinematics for industrial robots for Position and orientation.

Module-IV **6hrs**

Differential Kinematics and static-Dynamics-Lagrangian Formulation, Newton-Euler Formulation for RR & RP Manipulators.

Module-V **6hrs**

Trajectory planning-Motion Control- Interaction control, Rigid Body mechanics, Control architecture-position, path velocity and force control systems, computed torque control, adaptive control, and Servo system for robot control.

Module-VI **4hrs**

Programming of Robots and Vision System- overview of various programming languages.

Module-VII **2hrs**

Application of Robots in production systems- Application of robot in welding, machine tools, material handling, and assembly operations parts sorting and parts inspection.

Course Outcomes:

1. Understand the basic components of robots.
2. Differentiate types of robots and robot grippers.
3. Model forward and inverse kinematics of robot manipulators.
4. Analyze forces in links and joints of a robot.
5. Programme a robot to perform tasks in industrial applications.
6. Design intelligent robots using sensors.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	-
CO3	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	1
CO4	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	1
CO5	L 4	2	2	1	-	-	-	-	-	-	-	-	-	3	-	1
CO6	L 4	3	3	2	-	-	-	-	-	-	-	-	-	2	-	2

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Fu, K.S., Gonzalez, R.C., and Lee, C.S.G., Robotics control, Sensing, Vision and Intelligence, McGraw-Hill Publishing company, New Delhi, 2003.
2. Klafter, R.D., Chmielewski, T.A., and Negin. M, Robot Engineering-An Integrated Approach, Prentice Hall of India, New Delhi, 2002.
3. Craig, J.J., Introduction to Robotics Mechanics and Control, Addison Wesley, 1999.

DESIGN FOR MANUFACTURING

Course code-MEP505 **42hrs**

Objectives:

- To educate students on factors to be considered in designing parts and components with focus on manufacturability.
- To impart the knowledge on design considerations for designing components produced using various machining operations.

Contents:

Module-I **4hrs**

Introduction: Overview of the course, Design for manufacturing, Typical Case studies, Innovative product and service designs.

Module-II **4hrs**

Material Selection: Requirements for material selection, systematic selection of processes and materials, ASHBY charts.

Module-III **8hrs**

Design for Casting: Basic characteristics and Mould preparation, Sand casting alloys, Design rules for sand castings, Example calculations, Investment casting overview, Cost estimation, Number of parts per cluster, Ready to pour liquid metal cost, Design guidelines for Investment casting, Die casting cycle, Determination of optimum number of cavities, appropriate machine size, Die cost estimation, Design principles.

Module-IV **5hrs**

Design for Injection moulding: Injection moulding systems, Moulds, moulding cycle time, mould cost estimation, estimation of optimum number of cavities, Assembly techniques, Design Guidelines.

Module-V **5hrs**

Design for Hot Forging: Characteristics of the forging process, forging allowances, flash removal, die cost estimation, die life and tool replacement costs.

Module-VI **2hrs**

Design for Sheet metal working: Press selection, press brake operations, Design rules.

Module-VII **10hrs**

Design for Powder Metal processing: Powder metallurgy, tooling and presses for Compaction, Sintering, materials, heat treatments, Design guidelines. Design for machining: Machining using single point cutting tools, multipoint cutting tools, abrasive wheels, Assembly, cost estimation for machined components, Design guidelines.

Module-VIII **4hrs**

Design for Assembly: Design guidelines for manual assembly, large assemblies, analysis of an assembly, rules for product design for automation, design for robot assembly, Design for manufacture and Computer aided design.

Course Outcomes:

1. Understand the design principles of design for manufacturing processes
2. Estimates the cost of dies, moulds and machined components based on die life.
3. Understand the design for manual assembly and automated assembly.
4. Design typical assemblies using principles of design for X concepts.
5. Understand the design rules for machining with single point and multi point cutting tools.
6. To understand the design for sheet metal working.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	-	2	1	1	1		-	-	-	-	3	2	-	-
CO2	L 2	3	-	-	-	-	1	1	-	-	-	-	-	-	-	1
CO3	L 2	3	-	2	1	1	-	1	-	-	-	-	-	2	2	-
CO4	L 2	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO5	L 3	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO6	L 3	3	-	2		1	-	-	-	-	-	-	-	2	2	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Geoffrey Boothroyd, Dewhurst.P, Knight.W, product design for manufacture and assembly, CRC press, 2002

3. George E Dieter, Engineering Design- A material processing approach, 5/E. Mc Graw hill international, 2003.

4. ASM Handbook, Design for manufacture, 2000.

ENERGY SYSTEM AND MANAGEMENT

Course code-MEP506 **42hrs**

Objectives:

- To understand the basics of Energy Resources.
- To understand the Energy Conversion Systems and Management.
- To learn about basic concept of Power Systems Engineering.

Contents:

Module- I **7hrs**

Energy Resources: Energy and Development, Units and Measurements, Conventional and Non-Conventional Sources of Energy, Fossil and Mineral Energy Resources, Details of Coal, Peat, Oil, Natural Gas and Nuclear Resources, Recovery of Fossil Fuels, Classification and Characterization of Fossil fuels, Basic of Solar, Wind, Bio, Hydro, Tidal, Ocean Thermal and other Renewable Energy Sources, Impact of Energy on Environment, Flow of Energy in Ecological System, Environmental Degradation due to energy, Control of Pollution from Energy.

Module- II **7hrs**

Energy Conversion Systems I: Energy, Conversion routes, Direct and indirect way of Energy Conversion, Principles of heat and mass transfer, Thermodynamics, Fluid static and dynamics, Electricity generation, distribution and use, Basic of Solar Thermal Conversion, Technology of Selective Coating, Fundamentals of Flat Plate Collector and Evacuated Collector, Basic of Wind Energy Conversion, Wind machine, Wind electric generator, Wind pump.

Module- III **7hrs**

Energy Conversion Systems II: Basics of Photovoltaic Conversion technology and PV systems, PV system design methodologies, Basics of Bio-energy conversion, bio methanation technology, Thermochemical Conversion through Pyrolysis, Gasification and Esterification, Bio Oil, Application of Ocean Thermal Gradient and Geothermal gradient for power generation, Basics of hydropower, Tidal and Wave power, Basics of Hydrogen fuel, Fundamentals of Fuel Cells, Basics of Fusion power, Energy Storage Technologies, Mechanical storage, Chemical storage and Electrical storage, Details of Pb-acid battery, Ni-Cd-alkaline battery, Ni-iron and Na-S batteries, battery maintenance and safety precautions.

Module- IV **7hrs**

Energy Management: Fundamental of Energy conservation, Energy Management and Audit, Basics of Energy Demand and Supply, Principles of Economic analysis in the Energy Management and Audit Programme, Supply side and demand side energy management, Boilers and Firing System, Steam, Condensation Systems, Energy Conservation and Management in power plant, Energy conservation in Buildings, Heating, Ventilation and Air Conditioning System, Degree day in energy use monitoring, Energy Conservation Opportunities, in chemical industries, Waste heat recovery, Co-generation, Energy Conservation in Agricultural Sector, Energy conservation in illumination engineering, Combustion stoichiometry, air-fuel ratio, optimum loading in boilers, etc

Module- V **7hrs**

Industrial Energy Analysis: Materials and energy balance in the industries, Products and the process, industrial demand and supply networking, Optimization techniques, efficiency analysis, methods, Energy monitoring and ongoing information dissertation in terms of energy consumption, production and cumulative sum of differences. Energy efficiency analysis in various conversion systems like boilers, furnaces, compression systems, controlling systems, etc. Case studies for large scale, medium scale and small-scale industries, efficiency integration methodologies.

Module- VI **7hrs**

Power Systems Engineering Basic concept of power plants, types of power plants, thermal power stations, various components of thermal power stations, power plant cycles, fuel handling, combustion, waste disposal methodologies, economizers, turbo alternators, heat balance and efficiencies, hydroelectric power plant, various components, capacity calculation, design methodologies, operation and maintenance methodologies, elements of nuclear power stations, reactor design, fuel, moderator, coolant control and safety, waste disposal.

Course Outcomes:

1. Understand the distinction between conventional and non-conventional energy sources, including their classification, characterization, and impact on the environment.
2. Acquire detail Knowledge of fundamentals of solar, wind, bio, hydro, tidal, ocean thermal, and other renewable energy sources, including their technologies and applications.
3. Learn the fundamentals of energy conservation, energy management.
4. Analyze materials and energy balances in industries, apply optimization techniques.
5. Understand the basic concepts of power plants, types, components, and operation methodologies of thermal, hydroelectric, and nuclear power stations.
6. Learn about safety protocols, waste disposal methodologies, and the importance of sustainable practices in power plant operations.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L2	3	-	2	1	1	1		-	-	-	-	3	2	-	-
CO2	L2	3	-	-	-	-	1	1	-	-	-	-	-	-	-	1
CO3	L2	3	-	2	1	1	-	1	-	-	-	-	-	2	2	-
CO4	L2	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO5	L3	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO6	L3	3	-	2		1	-	-	-	-	-	-	-	2	2	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

TEXT BOOKS:

1. Albert Thumann, Handbook of Energy Audits, The Fairmont Press Inc., Atlanta gergia, 1979.
2. Murphy W.R and Mckay G, Energy Management, Butterworths, London, 1982.
3. Albert Thumann, Plant Engineer and Management guide to Energy Conservation, Van Nost and Reinhold Co. New York.
4. Energy Audits, E.E.O.-Book-lets, U.K. 1988.
5. Craig B. Smith, "Energy Management Principles", Pergamon Press.
6. The role of Energy Manager, E.E.O., U.K.
7. The Energy conservation Design Resource Hand Book-The Royal architectural Institute of Canada.
8. Non-Conventional Energy Resources by B H Khan, Tata McGraw Hill

PROJECT MANAGEMENT

Course code- MEO507 **42hrs**

Objectives:

- To facilitate the understanding of project management principles and processes.
- To provide ability to successfully manage and deliver engineering projects by applying a professional, systematic approach.

Contents:

Module- I **4hrs**

Introduction: Introduction to Project Management, definitions, History of Project Management, project identifications, establishing a project, Project Life Cycle.

Module- II **7hrs**

Project Analysis: Facets of Project Analysis, Resource Allocation, Market Analysis, Technical Analysis, Economic and Ecological Analysis.

Module- III **8hrs**

Financial Analysis: Financial Estimates and Projections, Investment Criteria, Financing of Projects.

Module- IV **9hrs**

Network Methods in PM: Origin of Network Techniques, AON and AOA differentiation, CPM network, PERT network, other network models.

Module- V **6hrs**

Optimisation in PM: Time and Cost trade-off in CPM, crashing procedure, Scheduling when resources are limited.

Module- VI **8hrs**

Project Risk Management: Risk analysis, Work Breakdown Structure, Earned Value Management.

Course Outcomes:

1. Understand the importance of projects and its phases.
2. Analyze projects from marketing, operational and financial perspectives.
3. Evaluate projects based on discount and non-discount methods.
4. Develop network diagrams for planning and execution of a given project.
5. Apply crashing procedures for time and cost optimization.
6. Development of project management as per field data

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	-	2	1	1	1		-	-	-	-	3	2	-	-
CO2	L 2	3	-	-	-	-	1	1	-	-	-	-	-	-	-	1
CO3	L 2	3	-	2	1	1	-	1	-	-	-	-	-	2	2	-
CO4	L 2	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO5	L 3	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO6	L 3	3	-	2		1	-	-	-	-	-	-	-	2	2	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Prasanna Chandra, Project: A Planning Analysis, Tata McGraw Hill Book Company, New Delhi, 4th Edition, 2009.
2. Cleland, Gray and Laudon, Project Management, Tata McGraw Hill Book Company, New Delhi, 3rd Edition, 2007.

PRINCIPLES OF MANAGEMENT

Course code- MEO508 **42hrs**

Objectives:

- To understand the principles of Management and their application to the functioning of organization

Contents:

Module- I **6hrs**

Definition of management, science or art, manager vs. entrepreneur; Types of managers- managerial roles and skills; Evolution of management-scientific human relations, system and contingency approaches.

Module- II **8hrs**

Types of Business organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; current trends and issues in management, Nature and purpose of planning, types of planning, objectives, policies, Strategic Management, planning Tools and Techniques, Decision making steps & processes.

Module- III **8hrs**

Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization. Job design, human resource management, HR planning, Recruitment selection, Training & Development, Performance Management, carrier planning and Management.

Module- IV **6hrs**

Directing, individual and group behaviour, motivation, motivation theories, motivational techniques, Job satisfaction, job enrichment, leadership, types and theories of leadership, effective communication.

Module- V **8hrs**

Production planning and control: Forecasting models, aggregate production, and planning, scheduling, materials requirement planning; Controlling, system and process of controlling, budgetary and non-budgetary control techniques.

Module- VI **6hrs**

Inventory Control: Deterministic models, safety stock inventory control system Use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

Course Outcomes:

1. Get a clear understanding of management functions in an organization

2. Develop leadership quality to guide their work force to get done assigned jobs in time.

3. Maintain correct stock of spares and material for sustained production

4.Maintaining and hiring human resources of required skill and experience in time

5.Preparation of master budget and other budget to arrange required funds to carry out planned activities of organization

6. Application exposer

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	-	2	1	1	1		-	-	-	-	3	2	-	-
CO2	L 2	3	-	-	-	-	1	1	-	-	-	-	-	-	-	1
CO3	L 2	3	-	2	1	1	-	1	-	-	-	-	-	2	2	-
CO4	L 2	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO5	L 3	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO6	L 3	3	-	2		1	-	-	-	-	-	-	-	2	2	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Robbins S.P. and Couiter M, Management, Prentice Hall India, 10th ed., 2009

2. Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education 2004.

3. Tripathy PC & Reddy PN, Principles of Management, Tata Mcgraw Hill, 1999.

4. O.P. Khanna - Industrial Engineering and Management – Dhan pat Rai Publications O.P. Khanna

TOTAL QUALITY MANAGEMENT

Course code- MEO509 **42hrs**

Objectives:

To facilitate the understanding of total quality management principles and processes.

Contents:

Module-I **8hrs**

Introduction, evolution of quality control, Definitions of quality, Quality and productivity; Basic concepts of TQM, TQM framework, contributions of Deming, Joran and Crosby.; Quality conformance, customer need, customer orientation & satisfaction, customer complaints; Quality cost, product & service, costing measuring quality cost

Module-II **6hrs**

TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment.

Module-III **8hrs**

Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCA cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

Module-IV **6hrs**

The seven traditional tools of quality management; New management tools; Six sigma- concepts, methodology, applications to manufacturing, Bench marking process, evaluation; FMEA-stages, types.

Module-V **8hrs**

TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.

Module-VI **6hrs**

Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation; Quality auditing, QS 9000, ISO 14000-concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.

Course Outcomes:

1. Understand the importance of quality and its assurance.
2. Analyze quality statements, customer focus and market plan.
3. Evaluate quality-based products & methods.
4. Develop tools, methodology for the assurance of quality.
5. Apply & use the tools and techniques of TQM in manufacturing and service sector.
6. Applying principles like benchmarking, PDCA cycle, Lean, and Six Sigma.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	-
CO3	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	1
CO4	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	1
CO5	L 4	2	2	1	-	-	-	-	-	-	-	-	-	3	-	1
CO6	L 4	3	3	2	-	-	-	-	-	-	-	-	-	2	-	2

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Biesterfield D.H. et al., Total Quality Management, 3rd ed., Pearson Education Asia, 2006.

2. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.

3. Janaki Raman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.

4. Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.

HEAT TRANSFER LAB

Course Code - ME501P

LIST OF EXPERIMENTS:

1. Thermal conductivity measurement using guarded plate apparatus.

2.Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.

3. Determination of heat transfer coefficient under natural convection from a vertical cylinder.

4. Determination of heat transfer coefficient under forced convection from a tube.

5.Determination of Thermal conductivity of composite wall.

6. Determination of Thermal conductivity of insulating powder.

7. Heat transfer from pin-fin apparatus (natural & forced convection modes)

8. Determination of Stefan – Boltzmann constant.

9. Determination of emissivity of a grey surface.

10. Effectiveness of Parallel / counter flow heat exchanger.

Note: 1. At least eight experiments should be performed from the above list.

DESIGN OF MACHINE ELEMENTS SESSIONAL

Course Code - ME502P

List of Experiments:

1.Design of shaft

2.Design of rigid coupling

3.Design of flexible coupling

4.Design of helical spring

5.Design of leaf spring

6.Design of brake

7.Design of clutches

8.Design of Journal Bearing

9.Selection of rolling element bearing

10.Design of Spur Gear

11.Design of Helical Gear

12. Design of Bevel Gear

Note: 1. At least eight experiments should be performed from the above list.

INTERNAL COMBUSTION ENGINES LAB

Course Code - ME 503P

List of the experiments:

1 To study the cut models of I.C. engine.

2 To study the actual valve timing diagram of 4-stroke petrol engine.

3 To study the actual valve timing diagram of 4-stroke diesel engine.

4 To determine the flash point & fire point of the diesel engine by means of the Cleveland apparatus.

5 To determine the calorific value of diesel by bomb calorimeter.

6 To prepare the heat balance sheet by conducting performance test on single cylinder 4-stroke diesel engine (with electrical brake dynamometer)

7 To determine the load test on a single cylinder 4-stroke diesel engine (with rope brake dynamometer)

8 To determine the Morse test on a multi cylinder petrol engine.

ENERGY SYSTEM AND MANAGEMENT LAB

Course Code - ME506P

List of Experiments:

1. Determination of flash point and fire point – Abel-Pensky apparatus.
2. Determination of flash and fire point – Pensky Martin apparatus.
3. Determination of viscosity of oil – Saybolt viscometer.
4. Determination of viscosity of oil – Redwood viscometer.
5. Determination of calorific value of a gaseous fuel using Bomb Calorimeter.
6. Determination of calorific value of a solid and liquid fuel using Boy's Gas Calorimeter.
7. Computation of area of irregular shapes by using Planimeter.
8. Valve timing diagram for a 4-Stroke Horizontal Diesel Engine.
9. Performance test on 4-Stroke Diesel Engine with Mechanical Loading Test Rig.

Note: 1. At least eight experiments should be performed from the above list.

RADHA GOVIND UNIVERSITY

RAMGARH, JHARKHAND

DEPARTMENT OF MECHANICAL ENGINEERING
B.TECH (6th) SEMESTER SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

6th SEMESTER

COURSE CONTENTS

Mechanical Engineering

6th semester course structure

S. No.	Course Code	Subject	L	T	P	Credit
		Theory				
1.	MEC601	Solid Mechanics	3	1	0	4
2.	MEC602	Automobile Engineering	2	1	0	3
3.	MEC603	Design of Transmission System	2	1	0	3
4.*	MEP604 MEP605 MEP606	Computer Aided Design Mechatronic Systems Microprocessor in Automation	2	1	0	3
5.**	MEO607 MEO608 MEO609	Operations Research Reliability Engineering Machine Tool Design	2	1	0	3
		Laboratory/Sessionals				
1.	ME601P	Solid Mechanics	0	0	2	1
2.	ME602P	Automobile Engineering	0	0	2	1
3.	ME603P	Manufacturing Lab	0	0	2	1
4.	ME604P	Computer Aided Design	0	0	2	1
5	ME605I	Internship/Tour & Training/Industrial Training	0	0	2	2
Total Credit						**22**

***Professional Elective II**

**** Open Elective II**

SOLID MECHANICS

Course Code – MEC601 **42hrs**

Objective:

The objective is to present the mathematical and physical principles in understanding the linear continuum behaviour of solids.

Contents:

Module-I **8hrs**

Introduction to Cartesian tensors, Strains: Concept of strain, derivation of small strain tensor and compatibility, strain gauges and rosettes.

Module-II **8hrs**

Stress: Derivation of Cauchy relations and equilibrium and symmetry equations, principal stresses and directions, octahedral shear stresses.

Module-III **6hrs**

Constitutive equations, Generalized Hooke'sLaw, elasticity, Material symmetry, Boundary Value Problems: concepts of uniqueness and superposition.

Module-IV **7hrs**

Plane stress and plane strain problems, introduction to governing equations in polar and cylindrical coordinates, axisymmetric problems.

Module-V **8hrs**

Application to thick cylinders, rotating discs, torsion of non-circular cross-sections, stress concentration, thermo-elasticity.

Module-VI **5hrs**

Solutions using potentials energy methods, Introduction to plasticity.

Course Outcomes:

1. Understand the deformation behaviour of solids under different types of loading.
2. Find mathematical solutions for simple geometries under different types of loading.
3. Transform the state of stress from one set of co-ordinate axes to another set of co- ordinate axes.
4. Apply compatibility equation for different system of strain.
5. Find the mathematical solution for axisymmetric problem.
6. Understand the concept of elasticity and plasticity.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 4	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	L 3	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO3	L 5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	L 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO5	L 3	2	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO6	L 3	3	-	-	-	-	-	-	-	-	-	-	-	-	2	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. G. T. Mase, R. E. Smelser and G. E. Mase, Continuum Mechanics for Engineers, Third Edition, CRC Press, 2004.
2. Y. C. Fung, Foundations of Solid Mechanics, Prentice Hall International, 1965.
3. 3.Lawrence. E. Malvern, Introduction to Mechanics of a Continuous Medium, Prentice Hall international, 1969.
4. S M A Kazimi, Solid Mechanics, Mc Graw Hill, 2016

AUTOMOBILE ENGINEERING

Course Code – MEC602 **41hrs**

Objectives:

- To provide basics of automobile.
- To understand the construction and working principle of various parts of an automobile.
- Providing transmission and breaking knowledge
- Imparting electrical system of automobile.
- Providing knowledge of performance parameters.

Contents:

Module-I **5hrs**

Types of automobiles, vehicle construction and layouts, chassis, frame and body, vehicle aerodynamics, IC engines- components, function and materials.

Module-II **10hrs**

Engine auxiliary systems, fuel supply system, starting system, ignition system, electronic injection for SI and CI engines, engine lubrication and cooling system, engine emission control by 3-way catalytic converter system, Emission norms.

Module-III **6hrs**

Transmission systems, AWD and 4WD transmission, clutch types & construction, gear boxes, Automatic transmission, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle,

Module-IV **5hrs**

Steering geometry and types of steering gear box, power steering, types of front axle, wheel alignment types of suspension systems.

Module-V **5hrs**

General braking requirement, elementary theory of shoe brake, weight transfer, mean lining pressure and heat generation during braking, mechanical Pneumatic and hydraulic braking systems, power brake, antilock braking system (ABS).

Module-VI **10hrs**

Alternative energy sources, natural gas, LPG, biodiesel, bioethanol, gasohol and hydrogen fuels in automobiles, modifications needed, performance, combustion &emission characteristics of alternative fuels in SI and CI engines. Electric and Hybrid vehicles, application of Fuel Cells.

Course Outcomes:

1.Acquire fundamental knowledge of various system of automobile.
2.Associate the function of each system with its design and layout.
3.Depict various systems using simple schematics
4. Able to apply concepts learn in core auto sector
5.Use automobile labs and workshop equipment competently and safely.
6.Use modern engineering tools necessary for automobile engineering practice.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	-	2	1	1	1		-	-	-	-	3	2	-	-
CO2	L 2	3	-	-	-	-	1	1	-	-	-	-	-	-	-	1
CO3	L 2	3	-	2	1	1	-	1	-	-	-	-	-	2	2	-
CO4	L 2	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO5	L 3	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO6	L 3	3	-	2		1	-	-	-	-	-	-	-	2	2	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text books:

1. Kripal Singh, Automobile Engineering, 7thed., Standard Publishers, New Delhi, 1997.
2. Jain K.K. and Asthana R.B., Automobile Engineering, Tata McGraw Hill, New Delhi,2002.
3. Heitner J., Automotive Mechanics, 2nd ed., East-West Press, 1999.
4. Heisler H., Advanced Engine Technology, SAE International Publ., USA, 1998.

DESIGN OF TRANSMISSION SYSTEM

Course Code – MEC603 **40hrs**

Objectives:

To learn about the design procedures for mechanical power transmission components.

Contents:

Module-I **6hrs**

Flexible transmission elements- design of flat belts & pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets.

Module-II **6hrs**

Gear transmission- speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, gear materials; Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; equivalent number of teeth and forces for helical gears.

Module-III **4hrs**

Straight bevel gear- tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears.

Module-IV **4hrs**

Worm gear, merits & demerits, terminology, thermal capacity, materials, forces & stresses, efficiency, estimating the size of worm gear pair. Cross helical gears, terminology, helix angles, sizing of a pair of helical gears.

Module-V **10hrs**

Gear box- geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box- Design of multi-seed gear box for machine too applications; constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid couplings, Torque converters for automotive applications.

Module-VI **6hrs**

Cam design, types: pressure angle and undercutting base circle determination, forces and surface stresses; Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches; Electromagnetic clutches; Band and Block brakes.

Module-VII **4hrs**

External shoe brakes, internal expanding shoe brake.

Course Outcomes:

1. Understanding of the design and selection of flexible transmission elements, including flat belts, V-belts, hoisting wire ropes, chains, and sprockets.
2. Knowledge of gear transmission, including speed ratios, number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, and gear materials.
3. Familiarity with the design of straight tooth spur gears and parallel axis helical gears based on strength and wear considerations.
4. Understanding of the terminology, forces, stresses, efficiency, and sizing of worm gears and cross helical gears.
5. Knowledge of gear box design, standard step ratio, kinematics layout and different gear boxes
6. Familiarity with cam design and the design of various types of clutches and brakes.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	-
CO3	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	1
CO4	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	1
CO5	L 4	2	2	1	-	-	-	-	-	-	-	-	-	3	-	1
CO6	L 4	3	3	2	-	-	-	-	-	-	-	-	-	2	-	2

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8thed., Tata McGraw Hill, 2010.
2. Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010.
3. Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill,2001.

COMPUTER AIDED DESIGN

Course Code – MEP604 **42hrs**

Objectives:

•To provide an overview of how computers can be utilized in mechanical component design.

Contents:

Module- I **8hrs**

Fundamentals of Computer Graphics- Product cycle, sequential and concurrent engineering, Computer Aided Design, CAD system architecture, computer graphics, Coordinate systems, 2D and 3D transformations, viewing transformation

Module- II **5hrs**

Geometric Modelling- straight line, representation of curves, Hermite curves, Bezier curves, B- spline curves, rational curves.

Module- III **6hrs**

Techniques of surface modelling, plane surface, cylindrical surface, surface of revolution, surface patch, Coons and bicubic patches, Bezier and B-spline surfaces.

Module- IV **6hrs**

Fundamental of solid design, parametric space of a solid, surface and curves in a solid, Solid modelling techniques, CSG and B-rep.

Module- V **5hrs**

Visual realism- hidden line-surface-solid removal algorithms, shading, colouring, computer animation.

Module- VI **12hrs**

Assembly of parts- assembly modelling, interferences of positions and orientation, tolerance analysis, mass property calculations, mechanism simulation and interference checking CAD standards- Graphical Kernel System (GKS), standards for exchange images, Open Graphics Library (OpenGL), Data exchange standards- IGES, STEP, CALS etc., Communication standards.

Course Outcomes:

1. Use computer and CAD software for modelling mechanical component.
2. Draw different types of curves in 2D.
3. Draw different types of surfaces.
4. Draw solid modelling.
5. Assembly of different part modelling.
6. Apply 3D modelling concepts (wireframe, surface, and solid modeling).

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 3	3	2	2	-	-	-	-	-	-	-	-	-	1	-	-
CO2	L 3	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
CO3	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	-
CO4	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
CO5	L 4	3	3	3	-	-	-	-	-	-	-	-	-	3	2	-
CO6	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	2

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Ibrahim Zeid, Mastering CAD CAM, Tata McGraw Hill Publishing Co. 2007.
2. C. McMahan and J. Browne, CAD/CAM Principles, II edition, Pearson Education, 1999.
3. W. M. Neumann and R.F. Sproul, Principles of Computer Graphics McGraw Hill, 1989.
4. D. Hearn and M.P Baker, Computer Graphics, Prentice Hall Inc., 1992.

MECHATRONIC SYSTEMS

Course Code – MEP605 **42hrs**

Objectives:

•To provide an overview of mechatronics applications and the use of micro-sensors and microprocessors.

Contents:

Module-I **8hrs**

Introduction: Definition of Mechanical Systems, Philosophy and approach; Systems and Design: Mechatronic approach, Integrated Product Design, Modelling, Analysis and Simulation, Man-Machine Interface.

Module-II **5hrs**

Sensors and transducers: classification, Development in Transducer technology, Opto- electronics-Shaft encoders, CD Sensors, Vision System, etc.

Module-III **5hrs**

Drives and Actuators: Hydraulic and Pneumatic drives, Electrical Actuators such as servo motor and Stepper motor, Drive circuits, open and closed loop control.

Module-IV **6hrs**

Embedded Systems: Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems.

Module-V **8hrs**

Smart materials: Shape Memory Alloy, Piezoelectric and Magneto strictive Actuators: Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation, etc.

Module-VI **10hrs**

Micro mechatronic systems: Micro sensors, Micro actuators; Micro-fabrication techniques LIGA Process: Lithography, etching, Micro-joining etc. Application examples; Case studies Examples of Mechatronic Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology.

Course Outcomes:

1. Understanding of the definition and philosophy of mechanical systems, as well as the mechatronic approach to integrated product design, modelling, analysis, simulation, and man-machine interface.
2. Knowledge of sensors and transducers, including their classification and developments in transducer technology, as well as opto-electronics such as shaft encoders, CD sensors, and vision systems.
3. Familiarity with drives and actuators, including hydraulic and pneumatic drives, electrical actuators such as servo motors and stepper motors, drive circuits, and open and closed loop control.
4. Understanding of embedded systems, including hardware structure, software design and communication, programmable logic devices, automatic control, and real-time control systems.
5. Knowledge of smart materials such as shape memory alloys, piezoelectric actuators, and magneto strictive actuators, including their materials, static and dynamic characteristics, and applications for positioning and vibration isolation.
6. Familiarity with micro-mechatronic systems, including micro-sensors and micro-actuators, micro-fabrication techniques such as the LIGA process and application examples from robotics manufacturing, machine diagnostics, road vehicles, and medical technology.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	-
CO3	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	1
CO4	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	1
CO5	L 4	2	2	1	-	-	-	-	-	-	-	-	-	3	-	1
CO6	L 4	3	3	2	-	-	-	-	-	-	-	-	-	2	-	2

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Devdas Shetty & Richard A. Kolk, Mechatronics System Design, PWS Publishing Company (Thomson Learning Inc.)
2. William Bolton, Mechatronics: A Multidisciplinary Approach, Pearson Education
3. R. K. Rajput, A Textbook of Mechatronics, S. Chand & Company Private Limited
4. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall

MICROPROCESSOR IN AUTOMATION

Course Code – MEP606 **40hrs**

Objectives:

•To introduce the basic concepts of Digital circuits, Microprocessor system and digital Controller.

Contents:

Module- I **10hrs**

Number Systems, codes, digital electronics: Logic Gates, combinational circuits design, Flip- flops, Sequential logic circuits design: Counters, Shift registers. Introduction to 8085 Functional Block Diagram, Registers, ALU, Bus systems, Timing and control signals

.

Module- II **3hrs**

Machine cycles, instruction cycle and timing states, instruction timing diagrams, Memory interfacing.

Module- III **10hrs**

Assembly Language Programming: 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; Interfacing peripherals: Programmable peripheral interface (8255).

Module- IV **10hrs**

Interfacing Analog to Digital Converter & Digital to Analog converter, Multiplexed seven segments LED display systems, Stepper Motor Control, Data Communication: Serial Data communication (8251), Programmable Timers (8253); 8086/8088 Microprocessor and its advanced features.

Module- V **7hrs**

Introduction to Digital Control: Sampling theorem, Signal conversion and Processing, Z Transform, Digital Filters, Implementation of Digital Algorithm.

Course Outcomes:

1. Understanding of number systems, codes, and digital electronics, including logic gates, combinational circuit design, flip-flops, and sequential logic circuit design.
2. Knowledge of the functional block diagram, registers, ALU, bus systems, timing and control signals, machine cycles, instruction cycle and timing states, and memory interfacing for the 8085 microprocessors.
3. Familiarity with assembly language programming for the 8085 microprocessors, including addressing modes, instruction set, and simple programs.
4. Understanding of the concept of interrupts and their handling, as well as interfacing with peripherals such as programmable peripheral interfaces (8255), analog-to-digital converters, digital-to-analog converters, multiplexed seven-segment LED display systems, stepper motor control, serial data communication (8251), and programmable timers (8253).
5. Knowledge of the 8086/8088 microprocessor and its advanced features.
6. Introduction to digital control, including sampling theorem, signal conversion and processing, Z-transforms, digital filters, and implementation of digital algorithms.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	-
CO3	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	1
CO4	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	1
CO5	L 4	2	2	1	-	-	-	-	-	-	-	-	-	3	-	1
CO6	L 4	3	3	2	-	-	-	-	-	-	-	-	-	2	-	2

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

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. Digital Control Systems, Benjamin C. Kuo, Oxford University Press (2/e, Indian Edition, 2007).
5. Microcomputer Experimentation with the Intel SDK-85, Lance A. Leventhal, Prentice Hall

OPERATIONS RESEARCH

Course Code-MEO607 **42hrs**

Objectives:

- Formulate a real-world problem as a mathematical programming model
- Know the theoretical workings of the simplex method for linear programming and perform iterations of it
- Analyze the relationship between a linear program and its dual, including strong duality and complementary slackness
- Solve specialized linear programming problems like the transportation, assignment, sequencing, games theory, and queuing model problems
- The use of Operations Research approaches in solving real problems in industry; mathematical models for analysis of real problems in Operations Research.

Contents:

Module-I **8hrs**

Introduction: Scope and limitations of O.R., Linear Programming: Mathematical formulation of the problem. Graphical solution and Simplex Method.

Module-II **6hrs**

Linear Programming: Big-M Method, Concept of duality, Dual simplex method.

Module-III **10hrs**

Transportation Model: Basic feasible solution by different methods, Finding optimal solutions, Degeneracy in transportation problems, Unbalanced transportation problems.

Assignment Model: Balanced and unbalanced assignments, Assignment to given schedules.

Module-IV **5hrs**

Sequencing: Processing of 2 jobs through machines graphical method, Processing of n jobs through two machines, processing n jobs through three machines.

Module-V **5hrs**

Games Theory: Two-persons zero sum games, Pure and mixed strategies, Rules of dominance, Solution methods without saddle point.

Module-VI **8hrs**

Queuing Model: Queuing systems and their characteristics, The M/M/1/FIFO Queuing system, Introduction to dynamic programming.

Course Outcomes:

1. Identify and develop operations research model describing a real-life problem.
2. Understand advanced techniques for solving linear programming problems.
3. Optimization of problems using basic feasible solution by different methods.
4. Able to solve sequencing problems using graphical methods.
5. Use various approaches to solve a mathematical model for various practical problems in Industry.
6. Able to use dynamic programming terminology.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	-	2	1	1	1		-	-	-	-	3	2	-	-
CO2	L 2	3	-	-	-	-	1	1	-	-	-	-	-	-	-	1
CO3	L 2	3	-	2	1	1	-	1	-	-	-	-	-	2	2	-
CO4	L 2	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO5	L 3	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO6	L 3	3	-	2		1	-	-	-	-	-	-	-	2	2	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. P. Rama Murthy, Operations Research, New Age, New Delhi
2. P.K. Gupta & D. S. Hira, Operations Research, S. Chand & Company Ltd, New Delhi.

References Books:

1. Hamdy A Taha, 1999. Introduction to Operations Research, PHI Limited, New Delhi.
2. 2.Sharma, J.K., 1989. Mathematical Models in Operations Research, Tata McGraw Hill publishing Company Ltd., New Delhi.
3. 3.Beer, Stafford, 1966. Decision and Control, John Wiley & Sons, Inc., New York.

RELIABILITY ENGINEERING

Course Code – MEO608 **40hrs**

Objectives:

To understand the applications of reliability in engineering decision making.

Contents:

Module-I **6hrs**

Introduction: Probabilistic reliability, failures and failure modes, repairable and non-repairable items, pattern of failures with time, reliability economics.

Module-II **10hrs**

Component Reliability Models: Basics of probability & statistics, hazard rate & failure rate, constant hazard rate model, increasing hazard rate models, decreasing hazard rate model, time-dependent & stress-dependent hazard models, bath-tub curve.

Module-III **10hrs**

System Reliability Models: Systems with components in series, systems with parallel components, combined series-parallel systems, k-out-of-m systems, standby models, load-sharing models, stress-strength models, reliability block diagram.

Module-IV **8hrs**

Life Testing & Reliability Assessment: Censored and uncensored field data, burn-in testing, acceptance testing, accelerated testing, identifying failure distributions & estimation of parameters, reliability assessment of components and systems.

Module-V **6hrs**

Reliability Analysis & Allocation: Reliability specification and allocation, failure modes and effects and criticality analysis (FMECA), fault tree analysis, cut sets & tie sets approaches; Maintainability Analysis: Repair time distribution, MTTF / MTBF, MTTR, availability, maintainability, preventive maintenance.

Course Outcomes:

1. Understand the concepts of reliability, availability and maintainability.
2. Develop hazard-rate models to know the behaviour of components.
3. Build system reliability models for different configurations
4. Assess reliability of components and systems using field and test data
5. Implement strategies for improving reliability of repairable and non-repairable systems.
6. Assess failure modes and effects, critically analyse availability and maintenance.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	-	2	1	1	1		-	-	-	-	3	2	-	-
CO2	L 2	3	-	-	-	-	1	1	-	-	-	-	-	-	-	1
CO3	L 2	3	-	2	1	1	-	1	-	-	-	-	-	2	2	-
CO4	L 2	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO5	L 3	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO6	L 3	3	-	2		1	-	-	-	-	-	-	-	2	2	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Ebeling CE, An Introduction to Reliability and Maintainability Engineering, TMH, New Delhi, 2004.
2. O'Connor P and Kleymer A, Practical Reliability Engineering, Wiley, 2012.

MACHINE TOOL DESIGN

Course Code – MEO609 **40hrs**

Objectives:

- Implement the tool design process when designing tooling for the manufacturing of a product.
- Apply Geometric Tolerancing principles in the designs of tooling.
- Evaluate and select appropriate materials for tooling applications.
- Design, develop, and evaluate cutting tools and work holders for a manufactured product.

Contents:

Module- I **4hrs**

Introduction to Machine Tools: Classification, similarities; various cutting tools and cutting fluids: speed of cutting, feed rate, machining rate and machining time.

Module- II **4hrs**

Lathe: Construction, important mechanisms viz. apron, tail stock, head- stock, feed box; specification, operations e.g., taper turning, eccentric turning, screw cutting.

Module- III **10hrs**

Milling machine: Construction, types specifications; cutters, dividing head, simple compound and differential indexing; various operations: Slab milling, angle cutting, slot milling, fly milling, slit gear milling, spur and bevel, T- slot milling, nature of operations, up and down milling.

Module- IV **7hrs**

Shaper, Slotter, Planer: Construction, automatic feed mechanism, quick return mechanisms: operations e.g., horizontal, vertical and inclined machining, spline cutting, keyway cutting, contour machining.

Module- V **5hrs**

Drilling machine: Construction, feed mechanism: Specification, geometry and nomenclature of twist drill, operations e.g., reaming, boring, tapping.

Module- VI **10hrs**

Grinding Machines: M, N types and construction features, Operations e.g. Plane, cylindrical, internal and centreless grinding, tool and cutter grinding, grinding wheels- specifications, shapes, setting, dressing, truing.

Course Outcomes:

1. Able to identify various cutting tools and use of cutting fluids.
2. Able to calculate mathematically feed rate, machining rate and machining time and design of machine tool structure.
3. Understanding of lathe machine with its construction and various application.
4. Ability to work with milling machine and different milling operation.
5. Understanding of various operations of drilling operations.
6. Ability to work with grinding machine and Understand control strategies for machine tool operations.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 3	3	2	2	-	-	-	-	-	-	-	-	-	1	-	-
CO2	L 3	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
CO3	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	-
CO4	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
CO5	L 4	3	3	3	-	-	-	-	-	-	-	-	-	3	2	-
CO6	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	2

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. B.L. Juneja, G.S. Sakhon &Nitin Seth, Fundamentals of Metal Cutting & Machine Tools, New Age International Publications
2. P.N. Rao, Manufacturing Technology: Metal Cutting & Machine Tools, Tata McGraw Hill Publications.
3. G.K. Lal, Introduction to Machining Science, New Age International Publications.
4. B.S. Raghuvanshi, Workshop Technology, Dhanpat Rai& Sons, Publications
5. Hazra Chandhari, Elements of Workshop Technology.

SOLID MECHANICS LABORATORY

Course Code - ME601P

List of Experiments:

1. To conduct tension test on the given steel specimen for determining the Stress at yield point.
2. Ultimate stress. Nominal breaking stress. Actual breaking stress. Percentage elongation.
3. Percentage reduction in area. Young's modulus.
4. To determine the shear stress and rigidity modulus orate given material using the torsion testing machine.
5. To determine the impact strength of the given specimen by conducting Charpy test.
6. To determine the suitability of a material, which is expected to resist repeated shocks by determining the energy required to break the material by conducting Izod test.
7. Compression test to determine the ultimate crushing strength of concrete and wood.
8. To measure the Rockwell hardness number for the given material (hard steel).
9. To measure the Brinell hardness number for given material (mild steel).
10. To determine the young's modulus and bending stress for the given steel beam by conducting deflection test.
11. To determine the Stiffness of the spring while Tension and Compression loads are applied and to determine in which case tension / compression the stiffness is more.
12. To determine bending moment in simply supported beam.\

Note: 1. At least eight experiments should be performed from the above list.

AUTOMOBILE ENGINEERING LABORATORY

Course Code - ME602P

List of Experiments:

1. To study and prepare report on the constructional details, working principles and operation of the Automotive Clutches.
2. To study and prepare report on the constructional details, working principles and operation of the Automotive Transmission systems.
3. To study and prepare report on the constructional details, working principles and operation of the Automotive Drive Lines & Differentials.
4. To study and prepare report on the constructional details, working principles and operation of the Multi-cylinder: Diesel and Petrol Engines.
5. To study and prepare report on the constructional details, working principles and operation of the Automotive Engine Systems & Sub Systems.
6. To study and prepare report on the constructional details, working principles and operation of the Fuels supply systems.
7. To study and prepare report on the constructional details, working principles and operation of the Engine cooling & lubricating Systems.
8. To study and prepare report on the constructional details, working principles and operation of the Automotive Suspension Systems.
9. To study and prepare report on the constructional details, working principles and operation of the Automotive Steering Systems.
10. To study and prepare report on the constructional details, working principles and operation of the Automotive Brake systems.
11. To study and prepare report on the constructional details, working principles and operation of the Automotive Tyres & wheels.
12. To study and prepare report on the constructional details, working principles and operation of Automotive Emission / Pollution control systems.

Note: 1. At least eight experiments should be performed from the above list.

MANUFACTURING LABORATORY

Course Code - ME603P

List of Experiments:

1. Fabrication of simple structural shapes using Gas and Arc Welding.
2. Preparation of green sand moulds from the prepared pattern.
3. Manufacturing of simple sheet metal components using shearing and bending operations.
4. Spur gear cutting in milling machine.
5. Helical Gear Cutting in milling machine.
6. Plain Surface grinding.
7. Cylindrical grinding.
8. External slot cutting in shaper.
9. Machining and Machining time estimations for:

   (a)Straight Turning (b) Taper Turning (c) External Thread cutting
10. Study of chip morphology and tool wear in turning of ductile and brittle metals.
11. Measurement of cutting forces in Milling / Turning Process.

Note: 1. At least eight experiments should be performed from the above list.

COMPUTER AIDED DESIGN LAB

Course Code - ME604P

List of Experiments:

1. Introduction of 3D Modelling software

2. Initiating the Graphics Package; Setting the paper size, space; setting the limits, units; use of snap and grid commands.

3. Drawing of primitives (Line, arc, circle, ellipse, triangle etc.)

4. Dimensioning the drawing and adding text.

5. Setting the layers and application of layers.

6. Isometric and Orthographic projections.

7. Viewing in three dimensions.

8. Removal of hidden lines – Shading and Rendering.

Creation of 3D assembly model of following machine elements using 3D Modelling software:

Flange Coupling Screw Jack Lathe Tailstock Universal Joint Machine Vice Stuffing Box Crosshead Safety Valves Connecting rod Piston Crankshaft.

RADHA GOVIND UNIVERSITY

RAMGARH, JHARKHAND

DEPARTMENT OF MECHANICAL ENGINEERING
B.TECH (7^{th}) SEMESTER SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

7th SEMESTER

COURSE CONTENTS

Mechanical Engineering

7th Semester Course Structure

S. N.	Code	Course Title	Lecture	Tutorial	Practica l	Credits
1	MEC701	Automation in Manufacturing	3	0	0	3
2	PEC-III		3	0	0	3
3	PEC-IV		3	0	0	3
4	OEC III		3	0	0	3
5	OEC IV		3	0	0	3
6	ME701P	Lab VII (RAC)	0	0	2	1
7	ME702D	Project-I	0	0	4	2
8	ME703I	Internship Assessment	0	0	2	2
Total credits						20

Code	Professional Elective-III (Anyone)	Code	Professional Elective-IV (Any one)
MEP702	Refrigeration and Air Conditioning	MEP705	Power Plant Engineering
MEP703	Cryogenics	MEP706	Finite Element Analysis
MEP704	Gas Dynamics	MEP707	Tool Design

Code	Open Elective-III (Any one)	Code	Open Elective- IV (Any one)
MEO708	Mechanical Vibrations	MEO713	Rapid Prototyping
MEO709	Convective Heat Transfer	MEO714	Industrial Automation
MEO710	Micro and Nano Manufacturing	MEO715	Technology management
MEO711	Energy Systems and Management	MEO716	Computer Aided Manufacturing
MEO712	Condition Monitoring	MEO717	Maintenance Engineering & management

- **PEC-III- Professional Elective-III**
- **OEC III- Open Elective-III**
- **PEC-IV- Professional Elective-IV**
- **OEC IV- Open Elective- IV**

AUTOMATION IN MANUFACTURING

Course code: MEC701 **42hrs**

Objectives:

- To understand the importance of automation in the of field machine tool-based manufacturing
- To get the knowledge of various elements of manufacturing automation – CAD/CAM, sensors, pneumatics, hydraulics and CNC.
- To understand the basics of product design and the role of manufacturing automation.

Contents:

Module I **10hrs**

Introduction: Why automation, Current trends, CAD, CAM, CIM; Rigid automation: Part handling, Machine tools. Flexible automation: Computer control of Machine Tools and Machining Centers.

Module II **06hrs**

NC and NC part programming, CNC-Adaptive Control, Automated Material handling. Assembly, Flexible fixturing.

Module III **10hrs**

Computer Aided Design: Fundamentals of CAD - Hardware in CAD-Computer Graphics Software and Data Base, Geometric modeling for downstream applications and analysis methods; Computer Aided Manufacturing: CNC technology, PLC, Micro-controllers, CNC Adaptive Control.

Module IV **06hrs**

Low-cost automation: Mechanical & Electro mechanical Systems, Pneumatics and Hydraulics, Illustrative Examples and case studies Introduction to Modeling and Simulation.

Module V **10hrs**

Product design, process route modeling, Optimization techniques, Case studies & industrial applications, Autonomous vehicles.

Course Outcomes:

1. Understand the importance of automation in the industry and basics of CAD, CAM, and CIM.
2. Understand rigid and flexible automation and understanding of NC and NC part programming.
3. Understand CNC adaptive control and understand automated material handling, assembly and flexible fixturing.
4. Understand the fundamentals of CAD and hardware in CAD, computer graphics software and database, geometric modelling for downstream applications and analysis methods.
5. Knowledge of CNC technology, PLC, microcontrollers, and CNC adaptive control.
6. Understand low-cost automation along with mechanical and electromechanical systems, pneumatics, and hydraulics.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	-
CO3	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	1
CO4	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	1
CO5	L 4	2	2	1	-	-	-	-	-	-	-	-	-	3	-	1
CO6	L 4	3	3	2	-	-	-	-	-	-	-	-	-	2	-	2

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Mikell Groover, Automation, Production Systems, and Computer-integrated Manufacturing, prentice Hall.
2. Serope Kalpakian and Steven R. Schmid, Manufacturing – Engineering and Technology, 7th edition, Pearson

REFRIGERATION AND AIR CONDITIONING

Course code: MEP702 **40hrs**

Objectives:

- To familiarize with the terminology associated with refrigeration systems and air conditioning
- To understand basic refrigeration processes
- To understand the basics of psychrometry and practice of applied psychometrics
- To acquire the skills required to model, analyse and design different refrigeration as well as air conditioning processes and components.

Contents:

Module I **10hrs**

Classification of refrigeration systems: Advanced vapour compression cycles, Refrigerants and their mixtures: properties and characteristics - Ozone depletion and global warming issues - System components.

Module II **8hrs**

Compressors, Condensers, Expansion devices and Evaporators Performance matching of components of refrigeration systems.

Module III **4hrs**

Advanced sorption refrigeration systems and their components.

Module IV **8hrs**

Review of Psychrometry and Air-conditioning processes - Comfort air conditioning and Cooling load calculations.

Module V **10hrs**

Applications of AC systems - Concept of enthalpy potential – Air washers, Cooling towers, Evaporative condensers, Cooling and dehumidifying coils.

Course Outcomes:

1. Understanding of the working principles of refrigeration and air-conditioning systems.
2. Analyse and perform calculations for vapour compression refrigeration system.
3. Analyse different components of vapour compression refrigeration system.
4. Compare different refrigerants and suggest environmentally friendly refrigerant.
5. Estimate different psychrometric properties using psychrometric chart and equations.
6. Calculate the load on the cooling coil and fix the supply conditions for various air-conditioning systems

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	BL	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	-	2	1	1	1		-	-	-	-	3	2	-	-
CO2	L 2	3	-	-	-	-	1	1	-	-	-	-	-	-	-	1
CO3	L 2	3	-	2	1	1	-	1	-	-	-	-	-	2	2	-
CO4	L 2	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO5	L 3	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO6	L 3	3	-	2		1	-	-	-	-	-	-	-	2	2	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Gosney, W.B, Principles of Refrigeration, Cambridge University Press, 1982.
2. Stoecker, W.F. and Jones, J.W., Refrigeration and Air conditioning, Tata McGraw Hill,1986.
3. Arora, C.P., Refrigeration and Air conditioning, Tata McGraw Hill, 2nd Edition, 2000.
4. Kuehn, T.H., Ramsey, J.W. and Threlkeld, J.L., Thermal Environmental Engineering, 3rd Edition, Prentice Hall, 1998.

CRYOGENICS

Course code: MEP703 **40hrs**

Course objectives:

- Introduce students to cryogenic engineering principles.
- Understand the definition and fundamentals of ultra-low-temperature refrigerators.
- Understand the equipment associated with low-temperature systems.
- Understand the various advantages and disadvantages of ultra-low-temperature refrigerators

Contents:

Module I **5hrs**

Introduction: Definition and Engineering Applications of Cryogenics, Properties of solids for cryogenic systems.

Module II **10hrs**

Refrigeration and Liquefaction: Simple Linde cycle, Pre-cooled Joule-Thomson cycle, dual- pressure cycle, Simon helium liquefier, classical cascade cycle, mixed-refrigerant cascade cycle.

Module III **10hrs**

Ultra-low-temperature refrigerators: Definition and Fundamentals regarding ultra-low-temperature refrigerators, Equipment associated with low-temperature systems, Various Advantages and Disadvantages.

Module IV **10hrs**

Storage and Handling of Cryogenic Refrigerants: Storage and Transfer systems, Insulation, Various Types of Insulation typically employed, Poly Urethane Foams (PUFs) and Polystyrene Foams (PSFs), Vacuum Insulation, and so on.

Module V **5hrs**

Applications: Broad Applications of Cryogenic Refrigerants in various engineering systems.

Course Outcomes:

1. Understand principles of cryogenic systems.
2. Understand air and helium liquefaction processes.
3. Storage and Handling of cryogenic
4. Classify cascade refrigeration systems.
5. Understand principles of ultra-low temperature systems and their applications.
6. Evaluate storage systems used in cryogenic applications.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	B L	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 4	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	L 3	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO3	L 5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	L 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO5	L 3	2	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO6	L 3	3	-	-	-	-	-	-	-	-	-	-	-	-	2	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Traugott H.K. Frederking and S.W.K. Yuan, Cryogenics - Low Temperature Engineering and Applied Sciences, Yutopian Enterprises, 2005.
2. Arora, C.P., Refrigeration and Air-conditioning, Tata-McGraw Hill, 2008.

GAS DYNAMICS

Course Code: MEP704 **40hrs**

Objective:

- Understand Basic Fluid Dynamic and Thermodynamic Principles
- Analyze One-Dimensional Flow Phenomena
- Examine Flow with Changing Conditions
- Study Supersonic Flow Principles and Techniques
- Apply Mathematical Methods to Fluid Dynamics
- Develop Analytical and Computational Skills

Contents:

Module I **10hrs**

Introduction: Review of basic fluid dynamic and thermodynamic principles, Conservation equations for inviscid lows.

Module II **10hrs**

One Dimensional flow: One-dimensional wave motion, normal shock waves, Oblique shock waves, Prandtl-Meyer expansions and applications, Generalized one-dimensional flow Nozzle.

Module III **10hrs**

Flow: Isentropic flow with area change, Flow with friction (Fanno flow), Flow with heat addition (Rayleigh flow), Method of characteristics (application to one-dimensional unsteady isentropic flow).

Module IV **10hrs**

Supersonic Flow: Velocity Potential Equation, Numerical Techniques for Steady Supersonic Flow, Time Marching Technique for Supersonic Blunt Bodies and Nozzles.

Course Outcomes:

1. Understanding of basics fluid dynamics and thermodynamics principles and conservation laws.
2. Solve flow equations for quasi one-dimensional flow through variable area ducts.
3. Analyze the flow through constant area ducts with friction and heat transfer.
4. Analyze flows with normal and oblique shocks.
5. Solve flow problems with supersonic velocities using shock-expansion theory.
6. Solve linearized velocity potential equation for multi-dimensional flows.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	B L	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	-
CO3	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	1
CO4	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	1
CO5	L 4	2	2	1	-	-	-	-	-	-	-	-	-	3	-	1
CO6	L 4	3	3	2	-	-	-	-	-	-	-	-	-	2	-	2

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Anderson, J.D Jr., Modern Compressible Flows, Tata McGraw Hill, 2012.
2. Yahya, S.M., Fundamentals of Compressible Flow, New age International Pub., 2013.
3. Zucrow, M., Gas Dynamics, Wiley India, 2013.

POWER PLANT ENGINEERING

Course Code: MEP705 **43hrs**

Objectives:

- Comprehend Coal-Based Thermal Power Plants and Their Components
- Analyze Gas Turbine and Combined Cycle Power Plants
- Explore Nuclear Power Generation Principles and Reactor Types
- Understand Hydroelectric and Alternative Energy Systems
- Analyze Economic and Environmental Aspects of Power Generation
- Develop Critical Thinking Skills for Energy Decision-Making

Contents:

Module I **10hrs**

Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam and heating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems.

Module II **8hrs**

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifier based Combined Cycle (IGCC) systems.

Module III **10hrs**

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

Module IV **5hrs**

Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems Energy.

Module V **10hrs**

Economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Course Outcomes:

1. Upon completion of the course, the students can understand the principles of operation for different power plants and their economics.
2. Understand the concept of Rankine cycle.
3. Understand working of boilers including water tube, fire tube and high-pressure boilers and determine efficiencies.
4. Analyze the flow of steam through nozzles.
5. Evaluate the performance of condensers and steam turbines.
6. Evaluate Economic and environmental issues and know pollution control technologies including waste disposal options for coal and nuclear plants.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	B L	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	-	2	1	1	1		-	-	-	-	3	2	-	-
CO2	L 2	3	-	-	-	-	1	1	-	-	-	-	-	-	-	1
CO3	L 2	3	-	2	1	1	-	1	-	-	-	-	-	2	2	-
CO4	L 2	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO5	L 3	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO6	L 3	3	-	2		1	-	-	-	-	-	-	-	2	2	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.
2. El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.

FINITE ELEMENT ANALYSIS

Course code – MEP706 **42hrs**

Objectives:

- To illustrate the principle of mathematical modeling of engineering problems
- To introduce the basics and application of Finite Element Method

Contents:

Module I **10hrs**

Historical Background, Mathematical modeling of field problems in engineering, governing equations, discrete and continuous models, boundary and initial value problems, Weighted Residual Methods, Variational formulation of boundary value problems, Ritz technique, Basic concept of Finite Element Method.

Module II **12hrs**

One dimensional second order equation, discretization, linear and higher order elements, derivation of shape functions, Stiffness matrix and force vectors, assembly of elemental matrices, solution of problems from solid mechanics and heat transfer, longitudinal vibration and mode shapes, fourth order beam equation, transverse deflections and natural frequencies.

Module III **6hrs**

Two dimensional equations, variational formulation, finite element formulation, triangular elements-shape functions, elemental matrices and RHS vectors.

Module IV **8hrs**

Application to thermal problems, torsion of non-circular shafts, quadrilateral and higher order elements. Plane stresses and plane strain problems, body forces and thermal loads, plate and shell elements.

Module V **6hrs**

Natural coordinate systems, isoperimetric elements and shape functions, numerical integration and application to plane stress problems, matrix solution techniques, solution of dynamic problems, introduction to FE software.

Course Outcomes:

1. Apply finite element formulation to solve one dimensional and two-dimensional problems.
2. Understanding of Ritz technique and basic concept of finite element method.
3. Understanding of basic matrix manipulation, stiffness matrix, force vector, longitudinal and transverse vibration.
4. Solve problems from solid mechanics and heat transfer.
5. Able to use FEM to solve thermal problem, torsion of circular shaft, plain stresses, and plain strain problems.
6. Understanding of FE software and able to solve dynamic problems using FEM.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	B L	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	-
CO3	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	1
CO4	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	1
CO5	L 4	2	2	1	-	-	-	-	-	-	-	-	-	3	-	1
CO6	L 4	3	3	2	-	-	-	-	-	-	-	-	-	2	-	2

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Reddy J.N., An Introduction to Finite Element Method, 3rd ed., Tata McGraw Hill, 2005.
2. Seshu P., Text Book of Finite Element Analysis, Prentice Hall, New Delhi, 2007.
3. Rao S.S. The Finite Element Method in Engineering, Butterworth Heinemann,2004.
4. Chandraputla & Belegundu, Introduction to Finite Elements in Engineering, 3rd ed., Prentice Hall, 1990.

TOOL DESIGN

Course Code - MEP707 **40hrs**

Objectives:

- Understanding of Basic Tool Design Principles
- Proficiency in Work Holding Devices
- Understanding in Jig and Fixture Design
- Introduction to Press Tool Design
- Proficiency in Cutting Tool Design
- Application of Tool Design Principles to NC Machines

Module I **10hrs**

Basic principles of tool design: Tool design an overview, Introduction to Jigs and fixtures. Work holding devices: Basic principle of six-point location, Locating methods and devices, Principle of clamping and Types of clamps.

Module II **6hrs**

Design of jigs: Type of Drill bushes, Classification of drill jigs, Design of drill jigs. Design of fixtures: Design of milling fixtures, Design of turning fixtures.

Module III **10hrs**

Introduction of press tool design: Introduction to Die cutting operations, Introduction to press and classifications, die set assembly with components, Introduction to Centre of pressure, Examples of centre of pressure, Design of piercing die, Design of blanking die, Progressive, Compound and Combination dies.

Module IV **4hrs**

Design of cutting tools: Introduction to cutting tools, Design of single point tool, Design of drill bit, Design of milling cutter.

Module V **10hrs**

Brief introduction of NC machines work holding devices: Tool design for NC machines- An introduction, Fixture design for NC Machine, cutting tools for NC Machine, Tool holding methods for NC Machine, ATC and APC for NC Machine, Tool presetting for NC Machine.

Course Outcomes:

1. Understanding of basics of tool design.
2. Interpret the geometrical and dimensional details of a production drawing.
3. Understand principles of locating and clamping systems.
4. Design jigs and fixtures for conventional and NC machining
5. Select and design progressive, compound or combination dies for press working operations
6. Design single point and multipoint cutting tools.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	B L	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 3	3	2	2	-	-	-	-	-	-	-	-	-	1	-	-
CO2	L 3	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
CO3	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	-
CO4	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
CO5	L 4	3	3	3	-	-	-	-	-	-	-	-	-	3	2	-
CO6	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	2

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Donaldson.C, G.H. Lecain and V.C. Goold "Tool Design", TMH, New Delhi, 2010
2. F.W.Wilson.F.W. "Fundamentals of Tool Design", ASME, PHI, New Delhi, 2020

MECHANICAL VIBRATIONS

Course Code – MEO708 **41hrs**

Objective:

- Understanding Vibration Fundamentals
- Formulation of Equations of Motion for Single Degree of Freedom (SDF) Systems
- Analysis of Free Vibration Response
- Analysis of Forced Vibration Response
- Analysis of Two Degree of Freedom Systems
- Analysis of Multi Degree of Freedom Systems

Contents:

Module I **6hrs**

Introduction: Causes and effects of vibration, Classification of vibrating system, Discrete and continuous systems, degrees of freedom, Identification of variables and Parameters, Linear and nonlinear systems, linearization of nonlinear systems, Physical models, Schematic models and Mathematical models.

Module II **4hrs**

SDF systems: Formulation of equation of motion: Newton –Euler method, De Alembert's method, Energy method

Module III **5hrs**

Free Vibration: Undamped Free vibration response, Damped Free vibration response, Case studies on formulation and response calculation.

Module IV **6hrs**

Forced vibration response: Response to harmonic excitations, solution of differential equation of motion, Vector approach, Complex frequency response, Magnification factor Resonance, Rotating/reciprocating unbalances, Force Transmissibility, Motion Transmissibility, Vehicular suspension, Vibration measuring instruments, Case studies on forced vibration.

Module V **10hrs**

Two degree of freedom systems: Introduction, Formulation of equation of motion: Equilibrium method, Lagrangian method, Case studies on formulation of equations of motion.

Free vibration response, Eigen values and Eigen vectors, Normal modes and mode superposition, Coordinate coupling, decoupling of equations of motion, Natural coordinates, Response to initial conditions, free vibration response case studies, Forced vibration response, undamped vibration absorbers, Case studies on undamped vibration absorbers.

Module VI **6hrs**

Multi degree of freedom systems: Introduction, Formulation of equations of motion, Free vibration response, Natural modes and mode shapes, orthogonally of model vectors, normalization of model vectors, decoupling of modes, model analysis, mode superposition technique, Free vibration response through model analysis, forced vibration analysis through model analysis, Model damping, Rayleigh's damping, Introduction to experimental model analysis.

Module VII **4hrs**

Continuous systems: Introduction to continuous systems, Exact and approximate solutions, free vibrations

of bars and shafts, Free vibrations of beams, Forced vibrations of continuous systems Case studies, Approximate methods for continuous systems and introduction to Finite element method.

Course Outcomes:

1. Understand the causes and effects of vibration in mechanical systems.
2. Understand the role of damping, stiffness and inertia in mechanical systems
3. Analyze rotating and reciprocating systems and compute critical speeds.
4. Develop schematic models for physical systems and formulate governing equations of motion.
5. Analyze and design machine supporting structures, vibration isolators and absorbers.
6. Exact and approximate analysis of free and forced vibration.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	B L	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 4	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	L 3	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO3	L 5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	L 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO5	L 3	2	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO6	L 3	3	-	-	-	-	-	-	-	-	-	-	-	-	2	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. L. Meirovich, Elements of Vibration analysis, 2nd Ed. Tata Mc-Graw hill 2007

.Reference Books:

1. Singers S Rao, Mechanical Vibrations. 4th Ed. , Pearson education 2011
2. W.T., Thompson, Theory of Vibration. CBS Publishers
3. Clarence W. de Silva , Vibration: Fundamentals and Practice, CRC Press LLC, 2000

CONVECTIVE HEAT TRANSFER

Course Code - MEO709 **40hrs**

Objective:

- Comprehensive Understanding of Thermodynamics, Fluid Mechanics, and Heat Transfer
- Analysis of Laminar Forced Convection in External Flows
- Analysis of Laminar Forced and Natural Convection in Internal Flows
- Study of Internal Natural Convection
- Analysis of Turbulent Boundary Layer Flow

Contents:

Module I **8hrs**

Introduction: Course structure, Basics of Thermodynamics, Fluid mechanics and Heat transfer Fundamental Principles: Continuity, momentum and energy equations, Reynolds transport theorem, Second law of TD, Rules of Scale analysis, Concept of Heat line visualization.

Module II **8hrs**

Laminar forced convection: External flows: Boundary layer concept, velocity and thermal boundary layer, Governing equations, Similarity solutions, various wall heating conditions, Flow over sphere, wedge and stagnation flow.

Module III **10hrs**

Laminar forced convection: Internal flows: Fully developed laminar flow: Constant heat flux, Constant wall temperature, developing length. External Natural convection Governing equations for natural convection, Bossiness approximation, Dimensional Analysis, Boundary layer equations, Scale analysis, Low and high Prandtl number fluids, vertical walls, horizontal walls, sphere.

Module IV **6hrs**

Internal Natural Convection: Natural convection in enclosures: isothermal and constant heat flux side walls, triangular enclosures, heated from below, inclined enclosures, annular space between horizontal cylinders.

Module V **8hrs**

Turbulent boundary layer flow: Boundary layer equations, mixing length model, flow over single cylinder, cross flow over array of cylinders, Natural convection along vertical walls, Turbulent duct flow.

Course Outcomes:

1. Understanding of basics of thermodynamics, fluid mechanics and heat transfer.
2. Understand principles of forced and free convection heat transfer processes.
3. Formulate and solve convective heat transfer problems.
4. Estimate heat dissipation from heat transfer devices.
5. Evaluate energy requirements for operating a flow system with heat transfer.
6. Understand current challenges in the field of convective heat transfer.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	B L	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	L 3	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	L 2	3	2	-	-	-	-	-	-	-	-	-	-	1	-	-
CO4	L 3	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	L 4	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO6	L 3	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Bejan, A., Convection Heat Transfer, John Willey and Sons, New York, 2001.
2. Louis, C. Burmeister, Convective Heat Transfer, John Willey and Sons, New York, 2003.
3. Kays, W.M. and Crawford, M. E., Convective Heat and Mass Transfer, McGraw Hill, New York, 2001

MICRO AND NANO MANUFACTURING

Course Code - MEO710 **40hrs**

Objective:

- Understanding the Fundamentals of Nanotechnology
- Proficiency in Nanomaterial Synthesis and Processing
- Ability to Characterize Nanomaterials
- Understanding Spectroscopic and Surface Characterization Techniques
- Proficiency in Thermal Characterization and Micro fabrication Techniques
- Knowledge of Nanofabrication Techniques and MEMS Devices

Contents:

Module I **11hrs**

Introduction: Importance of Nanotechnology, Emergence of Nanotechnology, Bottom-up and Top- down approaches, challenges in Nanotechnology. Nanomaterials Synthesis and Processing: Methods for creating Nanostructures; Processes for producing ultrafine powders- Mechanical grinding; Wet Chemical Synthesis of nanomaterials- sol- gel process, Liquid solid reactions; Gas Phase synthesis of nanomaterials- Furnace, Flame assisted ultrasonic spray pyrolysis; Gas Condensation Processing(GPC), Chemical Vapour Condensation(CVC)- Cold Plasma Methods, Laser ablation, Vapour – liquid –solid growth, particle precipitation aided CVD, summary of Gas Condensation Processing(GPC).

Module II **9hrs**

Structural Characterization: X-ray diffraction, Small angle X-ray Scattering, Optical Microscope and their description, Scanning Electron Microscopy (SEM), Scanning Probe Microscopy (SPM), TEM and EDAX analysis, Scanning Tunneling Microscopy (STM), Atomic force Microscopy (AFM).

Module III **10hrs**

Spectroscopic characterizations: Basic concepts of spectroscopy, operational principle and application for analysis of nanomaterials, UV-VIS-IR Spectrophotometers, Principle of operation and application for band gap measurement, Raman spectroscopy.

Surface Characterization: X-ray Photoelectron Spectroscopy (XPS), Auger electron spectroscopy, Low Energy Ion Scattering Spectroscopy (LEISS), Secondary Ion Mass Spectroscopy (SIMS), Rutherford Backscattering Spectroscopy (RBS).

Module IV **6hrs**

Thermal Characterization of Nanomaterials: DTA, TGA, DSC (Principle and Applications), Determination of thermos physical parameters.

Microfabrication Techniques: Lithography, Thin Film Deposition and Doping, Etching and Substrate Removal, Substrate Bonding. MEMS Fabrication Techniques, Bulk Micromachining, Surface Micromachining, High- Aspect-Ratio Micromachining.

Module V **4hrs**

Nanofabrication Techniques: E-Beam and Nano-Imprint Fabrication, Epitaxy and Strain Engineering, Scanned Probe Techniques, Self-Assembly and Template Manufacturing.

MEMS devices and applications: Pressure sensor, Inertial sensor, Optical MEMS and RF-MEMS, Micro-actuators for dual-stage servo systems.

Course Outcomes:

1. Understanding nanotechnology and its emergence, challenges, methods of creating nanostructures.
2. Able to understand X-ray diffraction ,optical microscope,SEM,SPM,STM and AFM
3. Understanding of spectroscopy such as Raman spectroscopy,XPS,LEISS and SIMS
4. Understanding of principles and applications of DTA, TGA and DSC.
5. Able to explain E-beam and nano imprint fabrication.
6. Understanding of pressure sensors, inertial sensor, micro actuators for dual stage servo system.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	B L	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 3	3	2	2	-	-	-	-	-	-	-	-	-	1	-	-
CO2	L 3	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
CO3	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	-
CO4	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
CO5	L 4	3	3	3	-	-	-	-	-	-	-	-	-	3	2	-
CO6	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	2

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Mark James Jackson, Microfabrication and Nanomanufacturing, CRC Press, 2005.
2. Gabor L. Hornyak, H.F Tibbals, Joydeep Dutta & John J Moore, Introduction to Nanoscience and Nanotechnology, CRC Press, 2009.
3. Ray F. Egerton, Physical Principles of Electron Microscopy: An Introduction to TEM, SEM, and AEM , Springer, 2005.
4. Robert F Speyer, Thermal Analysis of Materials, Marcel Dekker Inc, New York, 1994. 5.
5. B.D. Cullity - Elements of X-Ray Diffraction, 3rd edition, Prentice Hall 2002.
6. Tai-Ran Hsu, "MEMS and Microsystems: Design and Manufacture," McGraw- Hill, 2008.

ENERGY SYSTEMS AND MANAGEMENT

Course Code:(MEO711) **41hrs**

Objective:

- Understanding of Thermodynamics, Fluid Flow, and Heat Transfer
- Proficiency in Heat Transfer Equipment and Energy Storage Systems
- Understanding of Energy Conversion and Heat Recovery Systems
- Knowledge of Energy Management Principles and Practices
- Proficiency in Energy Audit Methodology
- Ability to Perform Economic Analysis of Energy Project

Contents:

Module I **8hrs**

Introduction to Thermodynamics, Fluid Flow and Heat Transfer, Heat transfer media: Water, steam, Thermal fluids, Air-water vapour mixtures.

Module II **10hrs**

Heat transfer equipment: Heat exchangers, Steam plant, Energy storage systems: Thermal energy storage methods, Energy saving, Thermal energy storage systems.

Module III **10hrs**

Energy conversion systems: Furnaces, turbines
Heat recovery systems: Incinerators, regenerators and boilers
Energy Management: Principles of Energy Management, Energy demand estimation, Organizing and Managing Energy Management Programs, Energy pricing.

Module IV **8hrs**

Energy Audit: Purpose, Methodology with respect to process Industries, Characteristic method employed in Certain Energy Intensive Industries.

Module V **5hrs**

Economic Analysis: Scope, Characterization of an Investment Project, Case studies.

Course Outcomes:

1. Understand the terminology associated with engineering thermodynamics and have knowledge of contemporary issues related to chemical engineering thermodynamics.
2. Knowledge of phase equilibrium in two-component and multi-component systems.
3. Ability to estimate thermodynamic properties of substances in gas or liquid state of ideal and real mixture.
4. Ability to analyze the separation system for multi-component mixtures.
5. Designing experiments involving chemical reactors and analyzing and interpreting data.
6. Ability to audit Energy, Purpose, Methodology with respect to process Industries, Characteristic method employed in Certain Energy Intensive Industries.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	B L	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 4	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	L 3	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO3	L 5	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	L 4	3	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO5	L 3	2	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO6	L 3	3	-	-	-	-	-	-	-	-	-	-	-	-	2	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Turner, W. C., Doty, S. and Turners, W. C., Energy Management Hand book, 7th edition, Fairmont Press, 2009.
2. De, B. K., Energy Management audit & Conservation, 2nd Edition, Brinda Publication, 2010.
3. Murphy, W. R., Energy Management, Elsevier, 2007.
4. Smith, C. B., Energy Management Principles, Pergamon Press, 2007

CONDITION MONITORING

Course Code: MEO712 **40hrs**

Objective:

- Understanding of Failure Analysis and Maintenance Schemes
- Comprehension of Vibration Monitoring Principles
- Familiarity with Vibration Monitoring Equipment
- Proficiency in Contaminant Analysis and Temperature Monitoring
- Understanding of Special Techniques for Condition Monitoring
- Application of Condition Monitoring Techniques

Contents:

Module I **8hrs**

Introduction: Failures – System, component and services failures – classification and its causes, Maintenance Schemes – objectives – types and economic benefits, break down, preventive and predictive monitoring.

Module II **5hrs**

Vibration Monitoring – causes and effects of vibration, review of mechanical vibration concepts – free and forced vibrations, vibration signature of active systems – measurement of amplitude, frequency and phase.

Module III **6hrs**

Vibration monitoring equipment– vibration sensors (contact and non-contact type) –factors affecting the choice of sensors, signal conditioners, recording and display elements, vibration meter and analyzers, measurement of overall vibration levels.

Module IV **11hrs**

Contaminant analysis: Contaminants in used lubricating oils – monitoring techniques (wear debris) – SOAP technique, Ferrography, X-ray spectrometry, Particle classification.

Temperature Monitoring – Various techniques – thermograph, pyrometers, indicating paint and NDT methods.

Module V **10hrs**

Special Techniques: Ultrasonic measurement method, shock pulse measurement, Kurtosis, Acoustic Emission mentoring, critical speed analysis, shaft orbit analysis, Cestrum analysis. Non- destructive techniques, Structural health monitoring weldments for surface and subsurface cracks.

Course Outcomes:

1. To define failures and classify them into system, component, and service failures and explain their causes.
2. To identify the causes and effects of vibration in mechanical systems and review the basic concepts of mechanical vibration, such as free and forced vibrations.
3. To operate and interpret various signal conditioners, recording and display elements, vibration meter and analyzers for vibration monitoring.
4. To recognize the contaminants in used lubricating oils and their effects on system performance and reliability.
5. To apply various monitoring techniques (wear debris) for contaminant analysis, such as SOAP technique, Ferrography, X-ray spectrometry, and particle classification.
6. To use various temperature monitoring techniques, such as thermograph, pyrometers, indicating

paint and NDT methods for detecting faults and anomalies in mechanical systems.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	B L	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	-	2	1	1	1		-	-	-	-	3	2	-	-
CO2	L 2	3	-	-	-	-	1	1	-	-	-	-	-	-	-	1
CO3	L 2	3	-	2	1	1	-	1	-	-	-	-	-	2	2	-
CO4	L 2	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO5	L 3	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO6	L 3	3	-	2		1	-	-	-	-	-	-	-	2	2	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Rao J. S., Vibration Condition Monitoring, Narosa Publishing House, 2/e 2000.
2. Isermann R., Fault Diagnosis Application, Springer-Verlag Berlin, 2011.

RAPID PROTOTYPING

Course Code-MEO713 **38hrs**

Objective:

- Understanding Prototyping Concepts and Technologies
- Proficiency in RP Software and CAD Model Preparation
- Understanding Photo polymerization RP Processes
- Exploration of Powder Bed Fusion and Extrusion-Based RP Systems
- Understanding Printing and Sheet Lamination RP Processes
- Exploration of Reverse Engineering and Error Analysis in RP Processes

Contents:

Module I **5hrs**

Introduction: Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP.

Module II **9hrs**

RP Software: Need for RP software, MIMICS, Magics, Surgi Guide, 3-matic, 3D-Doctor, Simplant, Velocity2, Vo Axim, Solid View, 3DView, etc., software, Preparation of CAD models, Problems with STL files, STL file manipulation, RP data formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP.
Photopolymerization RP Processes: Stereolithography (SL), SL resin curing process, SL scan patterns, Micro stereo lithography, Applications of Photopolymerization Processes.

Module III **6hrs**

Powder Bed Fusion RP Processes: Selective laser Sintering (SLS), Powder fusion mechanism and powder handling, SLS Metal and ceramic part creation, Electron Beam melting (EBM), Applications of Powder Bed Fusion Processes.
Extrusion-Based RP Systems: Fused Deposition Modelling (FDM), Principles, Plotting and path control, Applications of Extrusion-Based Processes.

Module IV **6hrs**

Printing RP Processes: 3D printing (3DP), Research achievements in printing deposition, technical challenges in printing, Printing process modelling, Applications of Printing Processes.
Sheet Lamination RP Processes: Laminated Object Manufacturing (LOM),Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications.

Module V **6hrs**

Beam Deposition RP Processes: Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Processing-structure-properties, relationships, Benefits and drawbacks. Rapid Tooling: Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods. Reverse Engineering: Reverse Engineering (RE) Methodologies and Techniques, Selection of RE systems, RE software, RE hardware, RE in product development. Errors in RP Processes: Pre-processing, processing, post-processing errors, Part building errors in SLA, SLS, etc. Applications: Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.

Module VI **6hrs**

Reverse Engineering: Reverse Engineering (RE) Methodologies and Techniques, Selection of RE systems, RE software, RE hardware, RE in product development. Errors in RP Processes: Pre-processing, processing, post-processing errors, Part building errors in SLA, SLS, etc. RP Applications: Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.

Course Outcomes:

1. Understanding of the need for time compression in product development and the usage of Rapid Prototyping (RP) parts.
2. Knowledge of various RP software and their applications, as well as the ability to prepare CAD models and manipulate STL files.
3. Familiarity with different RP processes such as Photo polymerization, Powder Bed Fusion, Extrusion-Based, Printing, Sheet Lamination, and Beam Deposition.
4. Ability to compare and contrast conventional tooling with rapid tooling and understanding of the classification of rapid tooling methods.
5. Knowledge of Reverse Engineering (RE) methodologies and techniques, as well as the ability to select appropriate RE systems, software, and hardware.
6. Understanding of the errors that can occur in RP processes during pre-processing, processing, and post-processing stages, as well as the ability to identify part building errors in various RP processes.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	B L	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	-	2	1	1	1		-	-	-	-	3	2	-	-
CO2	L 2	3	-	-	-	-	1	1	-	-	-	-	-	-	-	1
CO3	L 2	3	-	2	1	1	-	1	-	-	-	-	-	2	2	-
CO4	L 2	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO5	L 3	3	-	2	1	1	-	-	-	-	-	-	-	2	2	-
CO6	L 3	3	-	2		1	-	-	-	-	-	-	-	2	2	-

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Chua Chee Kai., Leong Kah Fai., Chu Sing Lim, Rapid Prototyping: Principles and Applications in Manufacturing, World Scientific, 2010.
2. Ian Gibson., David W Rosen., Brent Stucker., Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, Springer, 2010.
3. Rafiq Noorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, 2006.

INDUSTRIAL AUTOMATION

Course Code: MEO714 **40hrs**

Objective:

- Maintenance management skill
- Need of safety devices
- Increase the productivity of the plant at minimal cost
- Failure analysis of plant machineries
- Concept of tribology, conditioning monitoring
- Concept of maintainability and availability of mechanical components and systems.

Contents:

Module I **10hrs**

Principles and Strategies of Automation-Power to Accomplish the Automated Process, program of Instruction, Control System, Advanced automation Functions-safety Monitoring, maintenance and repair Diagnostics, error Detection and Recovery, levels of automations-Five levels of automation and control in manufacturing.

Module II **10hrs**

Material Handling systems and Design-Introduction to Material Handling, Material Transport Equipment, analysis of Material Transport Systems, Storage Systems-Storage System Performance and Location Strategies, Conventional Storage Methods and Equipment.

Module III **6hrs**

Automation Storage Systems, Engineering Analysis of Storage Systems.
Automatic identification methods-Overview of Automatic Identification Methods, Bar Code Technology, Radio Frequency Identification, Other AIDC Technologies.

Module IV **10hrs**

Industrial control systems-Process Industries Vs Discrete Manufacturing Industries, Levels of Automation in the two industries, Variables and Parameters in the two industries.
Continuous Vs Discrete control- Continuous Control System, Discrete Control System.
Computer process control and its forms- Control Requirements, Capabilities of Computer Control, and Forms of Computer process Control.

Module V **4hrs**

Control system components-Sensors, Actuators, Analog-to-Digital Convertors, Digital-to-Analog Convertors, Input/output Devices for Discrete Data.

Course Outcomes:

1. Understand basics of automation along with advanced automation function such as safety monitoring maintenance and repair diagnostics, error detection and recovery.
2. Analyze material transport systems and understanding of storage system such as storage system performance and location strategies.
3. Understand automatic storage system and automatic identification method such as bar code technology, FID and other AIDC technology.
4. Able to understand industrial control systems such as process industries vs discrete manufacturing industries.
5. Operate computer process control such as control requirements and capabilities of computer control.
6. Understanding of control system components such as sensors, actuators, ADCs, DACs etc.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	B L	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 3	3	2	2	-	-	-	-	-	-	-	-	-	1	-	-
CO2	L 3	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
CO3	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	-
CO4	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
CO5	L 4	3	3	3	-	-	-	-	-	-	-	-	-	3	2	-
CO6	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	2

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Groover, M.P., Automation production Systems and Computer Integrated Manufacturing, Pearson Education, 2003.
2. Krishna Kant, Computer Based Industrial Control, Prentice Hall of India, New Delhi, 2000.
3. Tiess Chiu Chang and Richard A.W., An Introduction to Automated Process planning Systems, Tata McGraw-Hill Publishing company, New Delhi, 2000.

TECHNOLOGY MANAGEMENT

Course code: MEO715 **40hrs**

Objectives:

In the Management of Technology programme, the students learn to explore and understand technology as a corporate resource - a resource that allows a firm to keep many different balls in the air. It shows how firms can use technology to design and develop products and services that maximize customer satisfaction on the one hand, while maximizing corporate productivity, profitability and competitiveness on the other.

Contents:

Module I:

Introduction to Technology Management: **8hrs**

Definition, Concept of creativity, Components, Features, Classification of Technology, Concept and Nature of Technology Management, Drivers of MOT, Significance and Scope of MOT, Role of Chief Technology Officer, Responding to Technology challenges.

Module-II:

The Role of Technology in the Creation of Wealth: **6hrs**

The creation of wealth, Long-wave cycle, Evolution of production technology, Critical Factors in Managing Technology: The creativity factor, Types of innovation, Technology, price relationship, Managing change.

Module III:

Management of Technology: **4hrs**

The New Paradigms Essential issues in technology management, Project planning and management, Management paradigm and the technology factor.

Module-IV:

Technology Life Cycles: **2hrs**

S-curve of technological progress, Multiple generation technologies, Diffusion of technology

Module-V:

The Process of Technological Innovation: **5hrs**

The Process of Technological Innovation and creative transformation in the knowledge age: critical trajectories, Case- Xerox, A model for technological innovation in biomedical devices.

Module-VI:

Strategic planning: **6hrs**

Strategic planning, Competitiveness, Business Strategy and Technology Strategy, Technology Planning. The Acquisition and Exploitation of Technology: Acquisition of technology. Exploitation of technology, Stages of technology development, Technology Transfer

Module-VIII:

Technology Diffusion: **9hrs**

Technology Diffusion Concept of Diffusion, Integrated Diffusion Strategy, influencing factors, Innovation adoption, Diffusion strategies, Community effects and network externalities, Distribution of Adopters, Crossing the Chasm, Market dynamics. Technology Absorption and Deployment, Technology Absorption,

Influencing factors, Deployment strategies, Corporate Venturing, Benefits and Drawbacks of Corporate Venturing, Spin-off Companies.

Course Outcomes:

1. Understanding of the concept of creativity and the components, features, and classification of technology.
2. Knowledge of the role of technology in the creation of wealth and the critical factors in managing technology, including the creativity factor and types of innovation
3. Familiarity with the new paradigms and essential issues in technology management, including project planning and management.
4. Understanding of technology life cycles, including the S-curve of technological progress and multiple generation technologies
5. Knowledge of the process of technological innovation and creative transformation in the knowledge age, including critical trajectories and case studies.
6. Familiarity with technology diffusion, including the concept of diffusion, integrated diffusion strategy, influencing factors, innovation adoption, diffusion strategies, community effects and network externalities.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	B L	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	-
CO3	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	1
CO4	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	1
CO5	L 4	2	2	1	-	-	-	-	-	-	-	-	-	3	-	1
CO6	L 4	3	3	2	-	-	-	-	-	-	-	-	-	2	-	2

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Book:

1. Management of Technology by Tarek Khalil.
2. Rastogi P.N: "Management of Technology and Innovation", Sage Publications, New Delhi, 2009.
3. Scott Shane: "Technology Strategy for Managers and Entrepreneurs", Pearson Education, New Delhi, 2009.
4. CSG Krishnamacharya, Lalitha Ramakrishnan, "Management of Technology", Himalaya, Publishing House Private Limited, New Delhi, 2008.

COMPUTER AIDED MANUFACTURING

Course code: MEO716 **40hrs**

Objectives:

- This course introduces students with computer assisted modern manufacturing technologies.
- The objective of this course is to make students learn the important theoretical concepts, and the state-of-the-art technological developments in the area of modern manufacturing.
- Various topics to be covered are basics of automation, NC programming (Manual and APT),
- Concepts of group technology, Flexible Manufacturing system, CIM and robotics.

Contents:

Module I **8hrs**

Automation: Definition of Automation, Need for Automation, building block of automation technology, Types of automation systems, Automation strategies, levels of automation, types of control system, Advantages, Disadvantages and applications of Automation.

Module II **10hrs**

NC, CNC and Adaptive control: Introduction, history, components of NC machines, classification of NC machines, input media for NC machines, microprocessor-based CNC systems, block diagram of a typical CNC system, features of CNC, advantages of CNC, direct numeric control (DNC) and its advantages, Adaptive control and its types.

Module III **10hrs**

Part programming: Introduction, NC coordinate system, fixed and floating zero machines, NC motion control systems, part programming methods, Manual part programming for milling and lathe using G and M codes, various canned cycles, Computer aided part programming: Introduction to APT language, simple problems on APT programming.

Module IV **4hrs**

Group Technology: Introduction, part families, part classification and coding, production flow analysis, composite part concept, machine cell design, benefits of GT.

Module V **8hrs**

FMS and CIM: Concept and definition of Flexible Manufacturing System (FMS), components of FMS, FMS workstations, Automated material handling and storage systems, Automated storage and retrieval system and Industrial robots, FMS layout and benefits, Introduction and concept of Computer Integrated manufacturing (CIM) through CIM wheel.

Course Outcomes:

1. To define automation and explain its need, building blocks, types, strategies, levels, and applications in various industries.
2. To operate and program NC and CNC machines using G and M codes and canned cycles.
3. Able to use NC coordinate system, fixed and floating zero machines, and NC motion control systems for part programming.
4. To perform manual part programming for milling and lathe using G and M codes.
5. To understand the concept and benefits of group technology (GT) and its applications in manufacturing.
6. To explain the concept and definition of flexible manufacturing system (FMS) and its components, workstations, layout, and benefits.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	B L	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 3	3	2	2	-	-	-	-	-	-	-	-	-	1	-	-
CO2	L 3	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
CO3	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	-
CO4	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
CO5	L 4	3	3	3	-	-	-	-	-	-	-	-	-	3	2	-
CO6	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	2

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text books:

1. Groover M. P., Automation, Production Systems and Computer-integrated Manufacturing, PHI.
2. Kundra, Rao and Tiwari., Computer Aided manufacturing, Tata McGraw Hill Publishers.

Reference books:

1. Steve Karr, Arthur Gill, "CNC technology and programming", McGraw-Hill, 1990
2. James Madison, "CNC machining hand book", Industrial Press Inc., 1996
3. Jha, N. K., Handbook of Flexible Manufacturing Systems, Academic Press Inc.
4. Miller R. K., FMS/CIM Systems Integrated Handbook, Prentice Hall

MAINTENANCE ENGINEERING & MANAGEMENT

Course code: MEO717 **40hrs**

Objectives:

- To keep asset in productivity and availability state based on requirement level of reliability and effectiveness.
- To spend optimal maintenance cost in relation to achieve the availability and effectiveness of equipment's.
- To prevent or reduce the likelihood or frequency of failures of engineering components and systems.
- To increase the quality, quantity of the product with minimal cost and increase the productivity of the plant.
- To identify and correct the causes of failures that does occur in engineering system.

Contents:

Module I **8hrs**

Introduction: Fundamentals of Maintenance Engineering, Maintenance engineering its importance in material &energy conservation, Inventory control, Productivity, Safety, Pollution control, Safety Regulations, Pollution problems, Human reliability.

Module II **8hrs**

Maintenance Management: Types of maintenance strategies, Planned and unplanned maintenance, Breakdown, Preventive &Predictive maintenance their comparison, Computer aided maintenance, Maintenance scheduling, Spare part management, Inventory control, TPM.

Module III **8hrs**

Tribology In Maintenance: Friction wear and lubrication, Friction & wear mechanisms, Prevention of wear, Types of lubrication mechanisms, Lubrication processes. Lubricants types, General and special purpose, Additives, Testing of lubricants, Degradation of lubricants, Seal & packing.

Module IV **8hrs**

Machine Health Monitoring: Condition based maintenance, Signature analysis, Oil analysis, NDT, Vibration, Noise and thermal signatures, on line & off line techniques, Instrumentation & equipment used in machine health monitoring. Instrumentation in maintenance, Signal processing, Data acquisition and analysis, Application of intelligent systems, Data base design.

Module V **8hrs**

Reliability, Availability & Maintainability (RAM) Analysis: Introduction to RAM failure mechanism, Failure data analysis, Failure distribution, Reliability of repairable and non-repairable systems, Improvement in reliability, Reliability testing, Reliability prediction, Utilization factor, System reliability by Monte Carlo Simulation Technique.

Course Outcomes:

1. Understanding of the fundamentals of maintenance engineering, its importance in material and energy conservation, inventory control, productivity, safety, pollution control, safety regulations, pollution problems, and human reliability.
2. Understanding of the different types of maintenance strategies, including planned and unplanned maintenance, breakdown, preventive and predictive maintenance.
3. Understanding of tribology in maintenance, including friction wear and lubrication.
4. Able to understand friction and wear mechanisms, types of lubrication mechanisms and processes ,different lubricant types of additives, testing of lubricants, degradation of lubricants, seal and packing.
5. Able to work with machine health monitoring techniques such as condition-based maintenance, signature analysis, NDT, vibration analysis, noise analysis and thermal signatures.
6. Understanding of failure mechanisms failure data analysis, failure distribution and reliability of repairable and non-repairable systems.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

CO	B L	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L 3	3	2	2	-	-	-	-	-	-	-	-	-	1	-	-
CO2	L 3	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
CO3	L 3	3	3	1	-	-	-	-	-	-	-	-	-	3	-	-
CO4	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	-
CO5	L 4	3	3	3	-	-	-	-	-	-	-	-	-	3	2	-
CO6	L 4	3	2	2	-	-	-	-	-	-	-	-	-	2	-	2

3-High, 2- Moderate, 1- Low, '-' for No correlation

Text Books:

1. Krishnan Gopal and Banerji S. K., Maintenance & Spare parts Management, PHI
2. Mishra R. C. and Pathak K., Maintenance Engineering and Management, PHI
3. Shrivastava S.K., Industrial Maintenance Management, S. Chand Publications.
4. Rao C. N. R., Handbook of Condition Monitoring.
5. Banga and Sharma, Industrial Engineering & Management Science, Khanna Publishers.

Reference Books:

1. Higgins L., Mobley R. K. and Mobley K., Maintenance Engineering Hand Book, Mc-Graw Hill, 7th edition.
2. Higgins L., Mobley R. K. and Mobley K., Maintenance Engineering Standard Hand Book, Mc-Graw Hill, 6th edition

REFRIGERATION AND AIR CONDITIONING LAB

List of Experiment:

1. To study the basic components of simple vapour refrigeration cycle.
2. To study various components of room air conditioning system, apparatus, windows conditioning trainer.
3. To study vapour absorption refrigeration system.
4. To study ice plant.
5. To study vehicle air conditioning system
6. To study of cascade refrigeration system for producing low temperature.
7. To study different psychrometric processes.
8. Design of air conditioning system and load calculation for residential and commercial building

RADHA GOVIND UNIVERSITY

RAMGARH, JHARKHAND

DEPARTMENT OF MECHANICAL ENGINEERING
B. TECH (8th) SEMESTER SYLLABUS

CHOICE BASED CREDIT SYSTEM (CBCS)

8th SEMESTER

COURSE CONTENTS

S.N.	Code	Course Title	L	T	P	Credits
1	ME801D	Project- II			16	08
Total Credit						**08**

NOTE- A Student can be allowed to do project outside after the permission of departmental Academic Committee. Those students doing project outside has present their project progress every month. Those students doing project outside can be permitted to present progress every fortnight though video conferencing. Students doing project in house has present their project progress every week.