SCHEME & DETAILED SYLLABUS

(3rd year CBCS)

FOR

BACHELORS OF TECHNOLOGY
[Mechanical and Automation Engineering]

Offered by MAE Dept.

Indira Gandhi Delhi Technical University for Women (Established by Govt. of Delhi vide Act 09 of 2012)

(Formerly Indira Gandhi Institute of Technology)

Kashmere Gate, Delhi-110006

Indira Gandhi Delhi Technical University for Women
Kashmere Gate, Delhi-110006

BACHELOR OF TECHNOLOGY
(Mechanical & Automation Engineering) B.Tech, MAE Third Year (CBCS)

First Semester Scheme

S. No.	Subject Code	Subject	L-T-P	Credits	Category
1.	BAS-101	Applied Mathematics-I	3-1-0	4	**BAS**
2.	BAS-103	Applied Physics-I	2-1-2	4	**BAS**
3.	BAS-105	Applied Chemistry	2-1-2	4	**BAS**
4.	BMA-110/ BEC-110	Engineering Mechanics/ Basic Electrical Engineering	3-0-2	4	**OEC**
5.	BMA-120/ BMA-130	Workshop Practice/ Engineering Graphics Lab	0-1-2	2	**OEC**
6.	HMC-110/ BCS-110	Humanities and Social Science/ Programming in C Language	3-1-0/ 3-0-2	4	**HMC/ OEC**
		Total		**22**	

Second Semester Scheme

S. No.	Code	Subject	L-T-P	Credits	Category
1.	BAS-102	Applied Mathematics-II	3-1-0	4	**BAS**
2.	BAS-104	Applied Physics-II	2-1-2	4	**BAS**
3.	BAS-106	Environmental Science	2-1-2	4	**BAS**
4.	BEC-110/ BMA-110	Engineering Mechanics/ Basic Electrical Engineering	3-0-2	4	**OEC**
5.	BMA-130/ BMA-120	Workshop Practice/ Engineering Graphics Lab	0-1-2	2	**OEC**
6.	BCS-110/ HMC-110	Programmingin C Language/ Humanities and Social Science	3-0-2/ 3-1-0	4	**HMC/ OEC**
		Total		**22**	

Third Semester Scheme

S.No.	Subject Code	Subject Name	L-T-P	Credits	Category
1.	BMA -201	Production technology -I	3-0-2	4	**DCC**
2.	BMA -203	Strength of Materials	3-0-2	4	**DCC**
3.	BMA- 205	Thermal Engineering - I	3-0-2	4	**DCC**
4.	BAS -205	Numerical Techniques for Engineers	2-1-0	3	**BAS**
5.	BMA- 207	Machine Drawing Lab	0-0-2	1	**DCC**
6.	BMA- 253	Industrial Training	-	1	**DCC**
7.	GEC- 201	Generic Open Elective –I	2-0-0/ 1-1-0/ 0-0-4	2	**GEC**
8.	BEC -209	Analog and Digital electronics	3-0-2	4	**OEC**
	BCS - 201	Data Structures	3-0-2		
	BIT - 201	Database Management Systems	3-0-2		
	BAS - 201	Material Science and Engineering	3-1-0		
		Total		23	

Fourth Semester Scheme

S.No.	Subject Code	Subject Name	L-T-P	Credits	Category
1	BMA- 202	Production technology - II	3-0-2	4	**DCC**
2	BMA- 204	Theory of Machines	3-0-2	4	**DCC**
3	BMA -206	Engineering Materials	3-0-2	4	**DCC**
4	BMA- 208	Thermal Engineering-II	3-0-2	4	**DCC**
5	BCS -202	Computer Organization & Architecture	3-0-2	4	**OEC**
	BIT -204	Object Oriented Programming	3-0-2		
	BEC -210	Elements of Information Theory	3-1-0		
	BAS-202	Nano Structures & Materials in Engineering	3-1-0		
	BAS-204	Optical Engineering	2-1-2		
	BAS -206	Optimization Techniques	3-1-0		
6	HMC - 202	Disaster Management	1-0-2	**2**	**HMC**
		Total		**22**	

Fifth Semester Scheme

S.No.	Subject Code	Subject Name	L-T-P	Credits	Category
1.	BMA -301	Machine Design	3-0-2	4	**DCC**
2.	BMA -303	Fluid Mechanics and Hydraulic Machines	3-0-2	4	**DCC**
3.	BMA -305	Automobile Engineering	3-0-2	4	**DCC**
4.	BMA -3XX	**Department Elective I**	3-0-2 /3-1-0	4	**DEC**
5.	HMC-301	Professional Ethics and Human Values	3-0-0	3	**HMC**
6.	BMA- 353	Industrial Training	-	1	**DCC**
7.	GEC -301	Generic Open Elective- II	2-0-0	2	**GEC**
		Total		22	

Sixth Semester Scheme

S.No.	Subject Code	Subject Name	L-T-P	Credits	Category
1.	BMA- 304	Heat Transfer	3-0-2	4	**DCC**
2.	BMA -306	Computer Aided Design	3-0-2	4	**DCC**
3.	BMA -308	Production Management	3-0-0	3	**DCC**
4.	BMA -310	Advanced Machine Design Lab	0-0-2	1	**DCC**
5.	BMA -3YY	**Department Elective II**	3-0-2 /3-1-0	4	**DEC**
6.	BMA -3ZZ	**Department Elective III**	3-0-2 /3-1-0	4	**DEC**
7.	HMC-302 HMC-304 HMC-306 HMC-308	Principles of Management Marketing Management Financial Management Human Resource Management	**2-0-0** **2-0-0** **2-0-0** **2-0-0**	2	**HMC**
		Total		22	

List of Department Elective Courses

Category	Course Code	Subject	Credit
Department Elective Course – I	BMA-307	Mechanical Vibration	3-0-2
	BMA-309	Introduction to composites	3-0-2
	BMA-311	Automation in Manufacturing	3-0-2
	BMA-313	IC Engines	3-0-2
	BMA-315	Artificial Intelligence	3-0-2
Department Elective Course – II	BMA-312	Metal Forming & Casting	3-0-2
	BMA-314	Advanced Strength of Materials	3-0-2
	BMA-316	Quality Management & Six Sigma Applications	3-0-2
	BMA-318	Gas Dynamics	3-1-0
	BMA-320	Design of Mechanisms	3-0-2
Department Elective Course – III	BMA-322	Industrial Tribology	3-0-2
	BMA-324	Power Electronics	3-0-2
	BMA-326	Power Plant Engineering	3-0-2
	BMA-328	Combustion, Emission and Pollution Control	3-0-2
	BMA-330	Measurement and Meteorology	3-0-2

Machine Design	
Course Code: BMA-301	Credits: 4
Contact Hours: L-3 T-0 P-2	Semester: 5
Course Category: DCC	

Introduction: This is one of the most important core subjects of Mechanical Engineering which gives the basic knowledge of designing the various components of machines and its analysis. The knowledge is important for quality of designed product and sustainability in competitiveness markets.

Course Objectives: The objectives of this course are

- Develop basic knowledge of designing the products.
- To develop the design process for automation.
- Learn the design of various components of machines.
- Students will learn the design and assembly of various parts of a systems
- To learn the design of power transmission system.
- Students will learn the analysis of various parts of machines and their failure criterion.

Pre-Requisites: Material Science, Theory of Machines and Strength of Materials

Course Outcomes: After successful completion of the course, the students will be able –

CO1: Identify the factors for engineering components design and analyze various members subjected to direct stress, bending stress, torsional stress, and variable stress using various failure theories.

CO2: To design and analyze fastener, and Joints

CO3: Design various machine components under torsion such as keys and shaft couplings, , levers power screws and Springs

CO4: Design the machines parts for automation such as Gears and Bearings

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	11Hours
Introduction to the design process for automation, Factor influencing machine design, Mechanical properties of materials, Direct stress, Bending stress, torsional stress and variable stress in machine parts, theory of failure, stress concentration factor, factor of safety. Manufacturing & environment consideration in Design- Tolerance, type of fits, selection of fits, limits.	
UNIT II	11 Hours
Analysis and design of fastener and joints - Key and keyed joints, Cotter and Knuckle joint, bolts and bolted joint with and without initial tightening loads, riveted joints, boiler joints, structural joints, welded joints, bolted, riveted and welded joints under eccentric loading, classification and design of springs.	
UNIT III	10 Hours
Design of Shaft - Shaft subject to combined loading, subjected to fatigue loading, power screws and Design of Power screws (screw jack). Coupling - Rigid and Flexible types, Design of levers and classification of springs, Design of helical springs for static and fluctuation loading, Design of leaf spring	
UNIT IV	10 Hours
Gears: Basic concepts and classifications of gears, design of spur and helical gears **Bearing and Lubrication** - Types of sliding bearing, materials, types of lubrication, design of sliding bearings, selection and application of rolling bearings	

Text Books

1	R.G. Budynas, J.K Nisbett, “Mechanical Engineering Design” ,10th Edition, McGraw Hill Education (India) Private Limited, 2017.
2	V. B. Bhandari, “Design of Machine Elements”, 5th Edition, McGraw Hill, 2017.
3	M. Hartman, O.P. Grover, “Machine Design”, 6th Edition, CBS Publication & Publishers, 2018.

Reference Books	
1	P.C. Sharma, D.K Aggarwal, “Machine Design”, 1st Edition, S.K. Kataria & Sons, 2012.
2	G.E. Dieter, L.C. Schmidt, “Engineering Design”, 5th Edition McGraw Hill Education (India) Private Limited, 2017.
3	J. E. Shigley, C. R. Mischke, “Mechanical Engineering Design”, 10th Edition, McGraw Hill, 2006.
4	Mahadevan, “Design Data Book”,4th Edition, CBS Publication & Publishers, 2019.
5	www.nptel.ac.in
6	http://ocw.mit.edu

Fluid Mechanics and Hydraulic Machines	
Course Code: BMA-303 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 5

Introduction: This course emphasizes the fundamental underlying fluid mechanical principles and application of those principles to solve real life problems. Special attention is given towards understanding all the governing equations starting from the fundamental principle. A strong fundamental understanding of the basic principles of Fluid Mechanics to analyze fluid mechanical systems is provided.

Course Objectives: The Objective of this course is to

- Familiarize the student with basic Fluid Properties.
- Equip students with the concepts of Fluid statics and Fluid Dynamics.
- Provide the tools to analyze external as well as internal flows
- Give an introduction to Hydraulic Machines.

Pre-Requisites: Applied Mathematics, Engineering Mechanics

Course Outcomes: Having successfully completed this course, the student will:

CO1: Understanding of the fundamental concept of the fluid properties, pressure measurement, hydrostatics and kinematics of fluids.
CO2: Application of integral and differential analysis.
CO3: Knowledge of boundary layer flow.
CO4: Analysis of internal as well as external flows.

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	10 Hours
Fluid properties and pressure measurement: Mass density, Specific Volume, Specific Weight & Relative density, Viscosity, Newton's law of viscosity, Newtonian and Non-Newtonian Fluids, Ideal and Real fluids, Compressibility, Bulk modulus, Surface Tension, Pressure at a point, Pascal's law, Hydrostatic pressure law, Absolute and Gauge pressure, Measurement of pressure, Simple and Differential Manometers. **Hydrostatic and kinematics of fluids:** Definition of total pressure, Centre of pressure, Equation for hydrostatic force and depth of centre of pressure on plane surfaces (vertical and inclined), Hydrostatic force on submerged curved surfaces, Classification of flow, steady & unsteady, uniform and non-uniform, Definition of path line, streamline, streak line, stream tube, one, two, three dimensional flows, Rotational and irrotational flow, Definition of velocity potential, stream functions, stream line, equipotential line, Relation between velocity potential and stream function.	
UNIT II	10 Hours
Integral Analysis: Basic Laws, Conservation of Mass, Newton's second Law, First Law of Thermodynamics, Second Law of Thermodynamics. Control Volume formulation of Basic Laws. **Differential Analysis:** Conservation of Mass (Continuity Equation), Introduction to Motion of a Fluid Particle (Kinematics), Momentum Equation – Navier Stokes Equations.	
UNIT III	11 Hours
Dimensional Analysis: Buckingham's π theorem, Model analysis, Similitude. **Fluid dynamics:** Derivation of Euler's equation and Bernoulli's equation, Application of Bernoulli's equation, Pitot tube, Venturimeter, problems, Momentum equation. **Internal Flow:** Flow through pipes and dimensional analysis, Flow through pipes, Reynolds number, classification of flow, Definition of hydraulic gradient, energy gradient, Major and minor losses in pipe flow, Equation for head loss due to friction (Darcy-Weishbach equation), Friction factor for commercial	

pipes, Minor losses (types), equation for head loss due to sudden expansion, Pipes in series, pipes in parallel and equivalent pipe, laminar and turbulent flow.	
UNIT IV	11 Hours
External Flow: Boundary layer concept; Displacement; Momentum and Energy thickness; Von-Karman momentum integral equation; Laminar boundary layer flow; Drag on a flat plate; Boundary layer separation and control. Streamlined and bluff bodies; lift and drag on a cylinder and an air foil. **Introduction to hydrodynamic machines:** Turbine's classification, elementary analysis, specific and unit quantities, performance characteristics of Kaplan, Pelton and Francis turbines. Performance characteristics of Centrifugal and reciprocating Pumps, elementary analysis of pumps and turbines, specific and unit quantities, performance characteristics.	
Text Books	
1.	W. M. Frank, "Fluid Mechanics", 8th Edition, Mc Graw Hill publication, 2017.
2.	R.K. Bansal, "Fluid Mechanics & Hydraulic Machines", 9th Edition Laxmi Publications (P) Ltd., 2018.
3.	J.P. Pritchard, J.W. Mitchell, "Fox and McDonald's Introduction to Fluid Mechanics", 7th Edition, John Wiley & Sons, 2016.
4.	Y. A. Çengel, J.M. Cimbala, "Fluid Mechanics: Fundamentals and Applications",4th Edition, McGraw-Hill Education, 2018.
Reference Books	
1.	Som, Biswas, "Fluid Mechanics", 3rd Edition, Mc Graw Hill publication, 2012.
2.	D.S. Kumar, "Fluid Mechanics & Fluid Power Engineering", 5th Edition, S.K. Kataria & Sons, 2012.
3.	J. F. Douglas, "Fluid Mechanics", 5th Edition, Pearson Education, 2011.
4.	www.nptel.ac.in
5.	http://ocw.mit.edu

Automobile Engineering	
Course Code: BMA-305 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 5

Introduction: This course focuses on the Automobile Engineering and its parts and systems which are used in automobile vehicle namely, Transmission System, Suspension System, and Brakes etc. We study various constructional, static and dynamic parts of an Automobile in this, such as valves and mechanism, crank shafts and connecting rods, springs, clutches etc.

Course Objectives: The Objective of this course is to

- Familiarize the student with Automobile Engineering
- Make them able to decide proper selection of different parts and systems of Automobile for their efficient working.
- The overall goal is to develop an understanding of how the functionality, shape, materials of Automobile parts effect Automobile operations.
- The students are to be provided practical exposure on topics covered in the course.

Pre-Requisites: Thermal Engineering

Course Outcomes: Having successfully completed this course, the student will:

CO1: Explain the concept of working of IC Engine and SI engine and their parts.
CO2: Illustrate transmission systems and its components.
CO3: Describe Gear-box and steering components.
CO4: Analyze different suspension in automobiles.

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	10 Hours
Introduction to Automotive: Introduction to automotive vehicle and construction. Engines, crank shafts, connecting rods, pistons, piston pins, piston rings, valves mechanisms, manifolds, air cleaners, mufflers, radiators and oil filters, Resistance and performance characteristics of internal combustion engines, Numerical. Introduction to Electric Vehicle, Difference between Electric Vehicle and Fuel Vehicle, General construction of Electric Vehicle.	
UNIT II	10 Hours
Transmission systems: Transmission requirements, general arrangement of clutch, gear box and rear axle transmission, general arrangement of rear engines and vehicles with live axles. General arrangement, arrangement of front engine and front wheel drives, four-wheel drives. Transmission, principle of friction clutch, single and multi-plate clutches, centrifugal clutch, friction materials. Derivations and Numerical.	
UNIT III	11 Hours
Transmission: Description and working of manually operated gearboxes like sliding mesh, constant mesh, synchromesh, semi-automatic transmission, analysis of differentials and numerical, live axles, construction and working, requirement of overdrive, steering geometry, Ackermann steering, center point steering, power steering.	
UNIT IV	11 Hours
Suspension: Independent suspension, perpendicular arm type, parallel arm type, air suspension, shock absorbers, general wheel requirements, difference between mechanical and hydraulic brakes, working and construction.	
Text Books	
1.	D. Crolla, D. E. Foster, T. Kobayashi, N. Vaughan, "Automobile Engineering", 1st Edition, Wiley, 2014.

2.	Srinivasan, “Automotive Engines”, 2nd Edition, McGraw Hill, 2013.
3.	K.K. Jain , R.B. Asthana, “Automobile Engineering”, 1st Edition, McGraw Hill, 2013.
Reference Books	
1.	R.K. Rajput, “Automobile Engineering”, 2nd Edition, Kataria Publication, 2014.
2.	K. Singh, “Automobile Engineering. Vol. 1.”, 13th Edition, Standard Publishers Distributors, 2020.
3.	K. Singh, “Automobile Engineering. Vol. 2.”, 13th Edition, Standard Publishers Distributors, 2020.
4.	www.nptel.ac.in
5.	http://ocw.mit.edu

Mechanical Vibrations	
Course Code: BMA-307 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 3

Introduction: This course covers harmonic and periodic motion including both damped and undamped free and forced vibration, single- and multi-degree-of freedom systems and matrix techniques suitable for computer simulations.

Course Objectives: To impart knowledge on the following topics:

One and multi-degree-of-freedom systems, Natural frequencies and modes of vibrations, resonance, beat phenomenon, effect of damping, applications to practical problems, and methods to avoid excessive vibrations, Lagrange's equations.

Pre-Requisites: Engineering Mechanics, Dynamics, Theory of Machines

Course Outcomes: Having successfully completed this course, the student will:

CO1: Knowledge of Fundamentals of vibration.
CO2: Analysis of the Damped system under Harmonic Force base.
CO3: Applications of Vibration Under General Forcing Conditions.
CO4: Analysis of an Undamped System Torsional System.

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	11 Hours
Fundamentals of Vibration, Brief History of the Study of Vibration, Basic Concepts of Vibration Classification of Vibration, Vibration Analysis Procedure, Mass or Inertia Elements, Harmonic Motion, Harmonic Analysis Free Vibration of Single-Degree-of-Freedom Systems, Free Vibration of an undamped Translational System, Response of First Order Systems, Graphical Representation of Characteristic Roots, Free Vibration with Coulomb Damping, Free Vibration with Hysteretic Damping	
UNIT II	11 Hours
Harmonically Excited Vibration, Equation of Motion, Response of an Undamped System Under Harmonic Force, Response of a Damped System under Harmonic Force base – excitation Response of a Damped System Under the, Harmonic Motion of the Base, Response of a Damped System Under Rotating, Unbalance, Forced Vibration with Coulomb Damping, Self-Excitation and Stability Analysis	
UNIT III	10 Hours
Vibration Under General Forcing Conditions, Response Under a General Periodic Force Response Under a Periodic Force of Irregular Form, Response Under a Non-periodic Force Convolution Integral, Response Spectrum, Laplace transform	
UNIT IV	10 Hours
Two-Degree-of-Freedom Systems, Equations of Motion for Forced Vibration, Free Vibration Analysis of an Undamped System Torsional System, Coordinate Coupling and Principal Coordinates, Forced-Vibration Analysis, Self-Excitation and Stability Analysis	

Text Books	
1.	J.P. Denhartong, "Mechanical Vibration", 3rd Edition, Crastre Press, 2011.
2.	S.S. Rao, "Mechanical Vibrations", 5th Edition, Pearson Education Inc., 2010.
3.	Tse, "Mechanical Vibrations", 2nd Edition, Allyn and Bacon, 2004.
Reference Books	
1.	M. Leonard, "Fundamentals of Vibrations", 1st Edition, Mc-Graw Hill Inc., 2010.
2.	Thomson, T. William, "Theory of vibration with applications", 4th Edition, CRC Press, 2008

3.	G. K. Grover, and S. P. Nigam, Nem Chand, “Mechanical vibrations”, 8th Edition, Nem Chand & Bros, 2009.
4.	www.nptel.ac.in
5.	http://ocw.mit.edu

Introduction to Composites	
Course Code: BMA-309	Credits: 4
Contact Hours: L-3 T-0 P-2	Semester: 5
Course Category: DEC	

Introduction: This is one of the most important core subjects of Mechanical Engineering which gives the basic knowledge of composite materials and its proper selection in the various composite structure designs. The knowledge is important for quality and high strength of composite structures and sustainability in competitiveness markets.

Course Objectives: The objectives of this course are

- To train the students to be able to design composite structures,
- To learn the proper, select composite materials and analysis of different loading
- To learn an appropriate strength criteria and properties composite structures
- To learn the composite structure under mechanical loading static and cyclic conditions.

Pre-Requisites: Strength of Materials

Course Outcomes: After successful completion of the course, the students will be able to –

CO1: Knowledge of Engineering materials.
CO2: Analysis of various types of composites and classification based on reinforcements.
CO3: Analysis of fabrication methods and manufacturing techniques.
CO4: Evaluation of composites.

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	11Hours
Introduction: Classifications of Engineering Materials, Concept of composite materials, Matrix materials, Functions of a Matrix, Desired Properties of a Matrix, Polymer Matrix (Thermosets and Thermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc. **Types of Reinforcements/Fibers:** Role and Selection or reinforcement materials, Types of fibres, Glass fibers, Carbon fibers, Aramid fibers, Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers, Quartz and Silica fibers, Multiphase fibers, Whiskers, Flakes etc., Mechanical properties of fibres. Material properties that can be improved by forming a composite material and its engineering potential	
UNIT II	11 Hours
Various types of composites: Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC), Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramic matrix composites (CMC); Classification based on reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites, Comparison with Metals, Advantages & limitations of Composites	
UNIT III	12 Hours
Fabrication methods: Processing of Composite Materials: Overall considerations, Autoclave curing, Other Manufacturing Processes like filament welding, compression molding, resin-transplant method, pultrusion, pre-peg layer, Fiber-only performs, Combined Fiber-Matrix performs, **Manufacturing Techniques:** Tooling and Specialty materials, Release agents, Peel plies, release films and fabrics, Bleeder and breather plies, bagging films	
UNIT IV	8 Hours
Testing of Composites: Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc.	
Text Books	

1.	G. Dieter, “Mechanical Metallurgy”, 3rd Edition, Mc-Graw Hill, 2017.
2.	N. Thomson, “Composite Materials: Science and Engineering”, 1st Edition, NY Research Press. 2020.
3.	A.K. Bhargava, “Engineering Materials: Polymers, Ceramics and Composites”, 2nd Edition, Prentice Hall India, 2012.
Reference Books	
1.	“Materials characterization”, Vol. 10, ASM hand book, 2019.
2.	D. William, J. Callister., D.G. Rethwisch, “Materials Science and Engineering: An Introduction”, 9th Edition, 2013.
3.	K.I Parashivamurthy, “Material Science and Metallurgy”, 1st Edition, Pearson, 2012.
4.	www.nptel.ac.in
5.	http://ocw.mit.edu

Automation in Manufacturing	
Course Code: BMA-311 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 5

Introduction: This is an introductory course on automation in Industry. It is a course which concentrates on importance of automation, effect of automation on production in an organization, choosing the level of automation required and enlightens the students about costing involved and problems such as simulation, artificial intelligence etc. involved in automation.

Course Objectives: The objectives of this course are

- To develop the understanding related to the need of automation in manufacturing systems.
- To familiarize with the potential benefits obtained with the implementation of automation at various levels in industry.
- Describe the basic concepts of automation in manufacturing systems.
- Acquire the fundamental concepts of automated flow lines and their analysis.
- Classify automated material handling, automated storage and retrieval systems.
- The students are to be provided hands on practical exposure on topics covered in the course.

Pre-Requisites: Production Technology

Course Outcomes: Having successfully completed this course, the student will be able to:

CO1: Knowledge of the various types of automation systems and importance of hydraulic systems.
CO2: **A**nalysis of the pneumatic system.
CO3: Applications of sensors, transducers, signal processing and programmable logic controllers.
CO4: Application of CNC and Robot Technology.

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	10 Hours
Introduction: Need of automation in the manufacturing industry, Types of automation, Systems required, building blocks of an automated system, working principle and examples. **Automation using Hydraulic Systems:** Importance of hydraulic systems in automation, hydraulic fluids, various parts of hydraulic system such as pumps, valves, filters, reservoirs, accumulators, actuators, intensifiers etc., and their selections, hydraulic circuits, practical case studies on hydraulic circuit design and performance analysis.	
UNIT II	10 Hours
Automation using Pneumatic Systems: Need of pneumatic system in automation, pneumatic air, components such as compressors, filters regulators, lubricators, valves etc., selection of components, air treatment and distribution, working of pneumatic system, different applications, design of pneumatic circuits, hydro pneumatic circuits, practical case studies on pneumatic circuit design. **Automation using Electrical Drives:** Importance, selection criteria, construction and operating principle, types of DC and AC motors, control of DC and AC motors, speed controls, servo Motors, stepper motors, case studies.	
UNIT III	11 Hours
Control Technologies in Automation: Industrial control systems, process industries versus discrete-manufacturing industries, continuous versus discrete control, computer-based control process and its form, open and closed loop control system, control system components, introduction to sensor technology, various sensors, transducers, signal processing, programmable logic controllers, practical applications.	
	11 Hours
Automation using CNC and Robot Technology: Importance of CNC, interpolators and programming, role of robots, applications, classification, robot components, robot coordinate systems, position, path and speed control systems, robot programming for pick and place operation, welding operation and machining.	
Text Books	

1.	M.P. Grover, "Automation, Production Systems and Computer Integrated Manufacturing", 4th Edition, Pearson Education Asia, 2016.
2.	Lamb, Frank, "Industrial Automation" ,1st Edition, McGraw-Hill Education, 2013.
3.	U. Elangovan, "Smart automation to smart manufacturing: Industrial Internet of Things", 1st Edition, Momentum Press, 2019.
Reference Books	
1.	K.C. Jain, S. Jain, "Principles of Automation and Advanced Manufacturing Systems", 1st Edition, Khanna Publishers, 2003.
2.	Y. Wang, Martinsen, K. Wang, "Advanced manufacturing and automation IX" ,1st edition Singapore, Singapore: Springer, 2021.
3.	Benhabib, Beno. "Manufacturing: design, production, automation, and integration", 1st Edition, CRC Press, 2003.
4.	www.nptel.ac.in
5.	http://ocw.mit.edu

IC Engines	
Course Code: BMA-313 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 5

Introduction: The course IC Engines is intended to build up necessary fundamentals for the understanding of IC Engines components, operating cycles, various systems and recent trends in IC Engines. It also emphasizes on the environmental impact of certain fuels and solutions to minimize the pollution.

Course Objectives: The Objective of this course is to

- To teach students the operating characteristics and thermodynamic analysis of common internal combustion engine cycles
- To teach students to analyze the combustion process of common fuels.
- To make students aware of the roles of fluid flow and heat transfer in engine operation.
- To teach students the environmental, social, and technological issues related to the future wide-spread use of internal combustion engines.

Pre-Requisites: Thermal Engineering

Course Outcomes: Having successfully completed this course, the student will be able to

CO1: Knowledge of combustion in SI and CI engines.
CO2: Knowledge of fuels and air fuel mixing in SI engines.
CO3: Knowledge of fuels and air fuel mixing in CI engines.
CO4: Evaluation of exhaust emissions from SI and CI engines and its control.

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	10 Hours
Review of IC Engines **Combustion in SI Engines:** Phenomenon of homogeneous combustion, Stages of Combustion, Flame speed, Delay period, Rate of pressure rise, Abnormal combustion, Auto ignition, Detonation, Factors affecting detonation, Control of detonation, Combustion chamber design for SI engines. **Combustion in CI Engines:** Combustion Phenomenon, Air fuel ratio, Ignition delay, Diesel knock, Factors affecting knocking, knock control, Combustion chamber design of CI engines, Cold starting of CI Engines.	
UNIT II	10 Hours
Fuels: Fuels for SI and CI engine, Important qualities of SI and CI engine fuels, Rating of SI engine and CI engine fuels, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines. **Air-Fuel Mixing in SI Engines:** Properties of air-petrol mixtures, Mixture requirements under different operating conditions, Different types of carburettors, Fuel injection system in SI Engine, Electronic fuel injection, Advantages and disadvantages of petrol injection.	
UNIT III	11 Hours
Fuel Injection Systems for CI Engines: Requirements of injection system, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings. **Engine Cooling and Lubrication:** Different cooling systems, Radiators and cooling fans, Engine friction, Lubrication principle, Type of lubrication systems.	
UNIT IV	11 Hours
Exhaust Emissions from SI and CI Engines and It's Control: pollutants from gasoline engine, Gasoline engine emission control, Diesel emission, Diesel smoke and control, Diesel odour and control. **Supercharging and Turbocharging:** Effects of supercharging on engine performance, Methods of supercharging, Turbo charging.	

Testing and Performance: Performance parameters, indicated power, brake power, friction power, Various efficiencies, Indicated and brake mean effective pressures.	
Text Books	
1.	P.W Gill, "Fundamentals of Internal Combustion Engines", 4th Edition, Oxford & IBH Publishing Company, 2007.
2.	V. Ganeshan, "I.C Engine", 4th Edition, Mc-Graw Hill Publishers, 2017.
3.	R. Yadav, "I.C Engine", 4th Edition, Central Publishing House, Allahabad, 2012.
Reference Books	
1.	R.K. Rajput, "A Textbook of Internal Combustion Engines", 3rd Edition, Laxmi Publications, 2016.
2.	H.N. Gupta, "Fundamentals of Internal Combustion Engines", 2nd Edition, Prentice Hall of India, 2013.
3.	J. Heywood, "Internal Combustion Engine- Fundamentals", 1st Edition, Mc-Graw Hill, 2012.
4.	www.nptel.ac.in
5.	http://ocw.mit.edu

Artificial Intelligence	
Course Code: BMA-315 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 5

Introduction: The subject includes an introduction to artificial intelligence as well as current trends and characterization of knowledge-based systems. Search, knowledge representation schemes, production systems, and expert systems will be examined. Additional areas include knowledge discovery and neural learning.

Course Objectives

To understand the basic concept of artificial intelligence and expert system and their applications in manufacturing system for decision making

The students are to be provided hands on practical exposure on topics covered in the course.

Pre-Requisites: Programming

Course Outcomes: On Completion of the course the student will be able to:

CO1: Application of AI.
CO2: Knowledge of agents and basics of robot programming languages.
CO3: Applications of State Space Search and Heuristic Search Techniques.
CO4: Knowledge of Intelligent Casting systems.

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	10 Hours
Defining Artificial Intelligence, Defining AI techniques, Applications of AI**,** Intelligent Machines, Expert Systems, Games theorem proving, natural expert system, AI techniques-search knowledge, abstraction, Introduction to Fuzzy Logic.	
UNIT II	10 Hours
Agents: Autonomy, Properties, Environments, Taxonomy, Mobile Agents, Architectures-Reactive, Hybrid& Mobile Architecture. Robotics: Taxonomy, Hard & Soft Robots, Natural Sensing Control, Perception with sensors, Actuation with Effectors, Movement Planning, Robot Programming Languages	
UNIT III	11 Hours
State Space Search and Heuristic Search Techniques, differences and applications. Defining problems as State Space search, Production systems and characteristics, Hill Climbing, Breadth first and depth first search, Best first search, Algorithms and Applications	
UNIT IV	11 Hours
Artificial Intelligence and expert system in automation, Applications of Artificial Intelligence in Robotics, Rapid Prototyping Manufacturing Processes. Introduction to IOT and Machine Learning, Objectives and Application of AI in Real world. Case Study - Intelligent machining & & Intelligent Casting systems, Intelligent Vehicle.	

Text Books	
1.	M.T. Jones, “Artificial Intelligence -A systems Approach”, 1st Edition, Jones & Bartlett Learning, 2009.
2.	G.F. Luger, “Artificial Intelligence -Structures and Strategies for Complex Problem Solving”, 5th Edition, Pearson Education, 2010.
Reference Books	
1.	S. Russel, P. Norvig, “Artificial Intelligence: A Modern Approach”, 4th Edition, Pearson, 2013.
2.	R. Schalkoff, “Intelligent Systems -Principles, Paradigms & Pragmatics”, 1st Edition, Jones & Bartlett Learning, 2011.
3.	I. Goodfellow, Y. Bengio, A. Courville, “Deep Learning”, 1st Edition, MIT Press. 2016.

4.	V. Chandra, A. Hareendran, "Artificial Intelligence and Machine Learning", 1st Edition, PHI Learning, 2014.
5.	www.nptel.ac.in
6.	http://ocw.mit.edu

Professional Ethics and Human Values	
Course Code: HMC-301 Contact Hours: L-3 T-0 P-0 Course Category: HMC	Credits: 3 Semester: 5

Introduction: Values and Ethics are very relevant in today's environment of conflicts and stress in every profession, with obligations to be met by one person in many directions. A formal study will certainly improve one's ability and judgment and refine one's behavior, decisions, and actions in performing the duty to the family, organization, and to the society.

Course Objectives:

To facilitate the development of a Holistic perspective among students towards life, profession and happiness, based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Value based living in a natural way. To inculcate Ethics and Human Values into the young minds and develop moral responsibility and would them as best professional which will create ethical vision and achieve harmony in life.

Pre-requisite: None

Course Outcomes: After completion of the course, the students should be able to:

CO1: Knowledge about human values and the basic difference between morals, values, ethics and integrity.
CO2: Understanding about the different types of ethical theory.
CO3: Analysis of different case studies.
CO4: Application of the automated manufacturing system in industries.

Pedagogy: The teaching pedagogy will be a blend of teaching and learning techniques including:

- Lectures and Case studies
- Project works and assignments
- Group works and Interactive discussions.

Contents

UNIT-I	10 Hours
Human Values Morals, Values and Ethics, Integrity, Work Ethic, Respect for Others, Living Peacefully, Caring, Sharing, Honesty, Valuing Time, Co-operation, Commitment, Empathy, Self-Confidence, Character, Spirituality. Indian values (on the conceptual framework of Vedas): Purusharth, Niskama karma, Religion and Human Values, Towards a World Religion, Ethical Living and Harmony in Life.	
UNIT-II	11 Hours
Profession and Professionalism, Ethical Theories: Kohlberg's Theory, Gilligan's Theory, Feminist Consequentialism, Moral Dilemmas, Types of Enquiries, Uses of Ethical Theories, Engineering Profession, Engineering Professionals- Training, Skill Set, Life Skills, Engineering Ethics: Making Senses and Issues, Ethical Obligations of Engineers, Ethical Codes for Engineers.	
UNIT-III	10 Hours
Engineering as a Social Experimentation, Safety Responsibility and Rights: Engineering as experimentation, Engineers as responsible Experimenters, Concept of Safety and Risk, Engineer's Responsibility for Safety, Risk – Benefit Analysis, Case Studies: The challenger case study, The Three Mile Island, Fukushima Nuclear Disaster, Bhopal Gas Tragedy. Disaster Management, Professional Rights, Employee Rights, Intellectual Property Rights (IPRs), Human Rights and Human Responsibilities. Major Ethical Issues.	
UNIT IV	11 Hours

Ethics and Global Issues Ethics in Global Scenario, Multinational corporations, Environmental ethics, computer ethics, Business Ethics. Corporate Social responsibility, Weapons Development, Research Ethics.	
Text Books	
1.	M. Govindarajan M., S. Natarajan, V.S. Kumar, "Engineering Ethics", Prentice Hall, 2004.
2.	R. Subramaniam, "Professional Ethics", Oxford University Press, 2013.
3.	M. Martin, R. Schinzinger, "Ethics in engineering", McGraw-Hill, 1996.
4.	R.R. Gaur, R. Sangal, G.P. Bagaria, "A Foundation Course in Human values and Professional Ethics", Excel Books Pvt. Ltd, 2009.
5.	A.N. Tripathi, "Human Values", 2nd Edition, New Age International Publishers, 2004.
Reference Books	
1.	B.P. Banerjee, "Foundation of Ethics and Management", Excel Books, 2005
2.	Fleddermann, Charles D., "Engineering Ethics", Pearson Education, 2004.
3.	Harris, E. Charles, Protchard, S. Michael, Rabins, J. Michael, Wadsworth, "Engineering Ethics- Concepts and Cases", Thompson Learning, 2000.
4.	Boatright, R. John, "Ethics and the Conduct of Business", Pearson Education, 2003.
5.	S. Ranganathananda, "Universal Message of the Bhagavad Gita: An exposition of the Gita in the light of modern thought and modern needs", Vol. I – III, Advaita Ashrama Publication, 2000.
6.	Peter Singer, "Practical Ethics", Oxford University Press, 1993.

Heat Transfer	
Course Code: BMA-304 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 6

Introduction: This course introduces the student to various modes of heat transfer and their analysis. Students gain in depth knowledge and know-how of the phenomenon of heat transfer and its applications.

Course Objectives: The Objective of this course is to

- Familiarize the student with the laws of heat transfer
- Develop an intuition about energy flow in form of heat
- Develop and understanding about various modes of heat transfer and their analysis
- Equip the students with tools to design heat transfer equipment.

Pre-Requisites: Applied Mathematics, Fluid Mechanics

Course Outcomes: Having successfully completed this course, the student will possess:

CO1: Knowledge about the general conduction equation.
CO2: Analysis of forced and free convection.
CO3: Analysis of heat exchangers.
CO4: Understanding the basic concepts of thermal radiation.

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	10 Hours
Introduction to Heat transfer: Various modes of heat transfer, Fourier's, Newton's and Stefan Boltzman's Law, combined modes of heat transfer, thermal diffusivity, and overall heat transfer coefficient, thermal conductivity of solids, liquids and gases, factors influencing conductivity. **Conduction:** General 3-D differential equation of conduction, one dimensional steady state conduction, linear heat flow through a plane and composite wall, tube and sphere, critical thickness of insulation, effect of variable thermal conductivity, conduction with heat generation.	
UNIT II	10 Hours
Conduction (continued): Heat transfer from extended surfaces, fin performances, transient heat conduction-lumped system analysis. **Forced Convection:** Introduction, laminar boundary layer equations for internal and external flows, laminar forced convention on a flat plate and in a tube, Reynolds-Colburn analogy, Dimensional analysis and physical significance of the dimensionless parameters.	
UNIT III	11 Hours
Natural Convection: Dimensional analysis of natural convection, empirical relationship for natural convection. **Boiling and Condensation:** Convection with phase change, description of condensing flow, theoretical model of condensing flow, regimes of boiling heat transfer, empirical relationships for convection with phase change. **Heat Exchangers:** Different types of heat exchangers, design of heat exchangers, LMTD and NTU methods, fouling factor and correction factor, Introduction to compact and plate heat exchangers.	
UNIT IV	11 Hours
Thermal Radiation: Introduction, absorption and reflection of radiant energy, emission, radiosity and irradiation, black and non-black bodies, Kirchhoff's law, intensity of radiation, radiation exchange between black surface, geometric configuration factor, grey body radiation exchange between surfaces of unit configuration factors, radiation shields, electrical analogy to simple problems.	

Text Books	
1.	Cengel, A. Yunus, and A.J. Ghajar, "Heat and Mass Transfer: Fundamentals and Applications", 6th Edition, McGraw-Hill Professional, 2020.
2.	P. Frank, Incropera, D.P. DeWitt, "Fundamentals of Heat and Mass Transfer", 8th Edition, John Wiley &Sons, 2018.
3.	J. P. Holman, "Heat and Mass Transfer", 10th Edition, McGraw Hill Education, 2017.
Reference Books	

1.	R. C. Sachdeva, "Fundamentals of Engineering Heat and Mass Transfer", 5th Edition, New Age International Publishers, 2017.
2.	M.M. Rathore, "Engineering Heat and Mass Transfer", 3rd Edition, Laxmi Publications, 2015.
3.	D. S. Kumar, "Heat and Mass Transfer", 1st Edition, S. K. Kataria & Sons, (2013).
4.	www.nptel.ac.in
5.	http://ocw.mit.edu

Computer Aided Design	
Course Code: BMA-306 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 6

Introduction: Computer Aided Design is the use of computers to aid in the creation, modification, analysis, or optimization of a design.

Course Objectives: To familiarize students with the mathematical concepts required in the backend algorithms of CAD software.

Pre-requisites: Linear Algebra, Calculus, Strength of materials.

Course Outcomes: Upon completion of this course, the students will be able to:

CO1: Knowledge about the working of a CAD software.
CO2: Knowledge about manipulating the transformations on the computer screen and geometric model generation.
CO3: Knowledge about the mathematical concepts of geometric modelling in CAD software.
CO4: Knowledge about the basics of Finite Element Modelling.

Pedagogy: Apart from class room teaching, main focus is to enhance problem solving ability supported by weekly assignments and discussing individual's doubts.

Content

UNIT-I	8 Hours
Introduction: Introduction to CAD, Need and scope of CAD, Integrated CAD/CAM systems, Benefits of CAD. **Computer Graphics** Graphics Functions, Output primitives- Bradenham's line drawing algorithm and Bradenham's circle generating algorithm.	
UNIT-II	13 Hours
Geometric Transformations: 2D Geometric Transformations-Translation, Scaling, Shearing, Rotation & Reflection Matrix representation, Composite transformation, 3 D transformations, multiple transformation **Curves:** Curve's representation, Properties of curve design and representation, Interpolation vs approximation, parametric representation of analytic curves.	
UNIT-III	13 Hours
Parametric continuity conditions, parametric representation of synthetic curves-Hermite cubic splines, Bezier curves, curve manipulations, Modelling of surfaces- parametric representation of analytic surfaces **3D Graphics:** Solid modelling-Solid entities, Fundamentals of Solid modeling-Set theory, regularized set operations; Boundary representation, Constructive solid geometry, Sweep representation.	
UNIT-IV	8 Hours
Finite Element Method: Introduction, Principles of Finite elements modeling, Finite Element Analysis, Solution of1D and 2D structural and solid mechanics problems - linear static analysis.	

Text Books	
1.	I. Zeid and R. Sivasubramanian, "CAD/CAM Theory and Practice", 2nd Edition, McGraw Hill Publications, 2009.
2.	D.L. Logan, "A first course in the finite element method ",6th Edition, Mason, OH: CENGAGE Learning Custom Publishing, 2015.
3.	T.R. Chandrupatla, A.D. Belegundu, T. Ramesh, C. Ray, "Introduction to finite elements in engineering", 4th Edition, Upper Saddle River, NJ: Prentice Hall, 2015.
Reference Books	

1.	J.N. Reddy, “An Introduction to Finite Element Method”, 4th Edition, McGraw Hill Book Company, 2009.
2.	Vince, John. “Vector analysis for computer graphics”, 2nd Edition, Springer Science & Business Media, 2010.
3.	N.K. Chougule, “CAD/ CAM/CAE”, 1st Edition, Scitech Publications (India) Pvt.,2009.
4.	www.nptel.ac.in
5.	http://ocw.mit.edu

Production Management	
Course Code: BMA-308 Contact Hours: L-3 T-0 P-0 Course Category: DCC	Credits: 3 Semester: 6

Introduction: This course focuses on the production management and its concepts and methods which are used in the industries. The learners will study production management concepts and apply them for economic production processes to make overall production process to be cost effective and optimum.

Course Objectives: The Objective of this course is to

- Familiarize the student with production management.
- Make them able to decide proper management step for real time economic industry operations.
- The overall goal is to develop an understanding about management process and steps to solve daily industrial issues.
- The students are to be tutorial exposure on topics covered in the course.

Pre-Requisites: Production Technology

Course Outcomes: Having successfully completed this course, the student will:

CO1: Knowledge about capacity planning, plant location and plant layout.
CO2: Analysis of demand forecasting and work study.
CO3: Knowledge about inventory control and production cost concepts.
CO4: Analysis of product management.

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	10 Hours
Introduction - Production and productivity, Multi Factor productivity, Classical view of Production management, Production structure, Role of Production Manager, Taylor Principle of Management, Motivation Theory. **Capacity Planning, Plant Location and Plant Layout** – Introduction, Need for selecting a suitable location, Location Factors, Quantitative Method, Principles of Plant layout, Types of Layout – Product, Process, Fixes Position, Cellular Layout	
UNIT II	10 Hours
Demand Forecasting-Need for demand forecasting, Techniques of forecasting, Time series analysis, Least Square Method, Moving Average, Exponential Method and Qualitative Techniques and Numericals Method Study- Introduction, Objectives Steps, Micromotion Study, Cycle graph and chrono-cycle graph, Therbligs and SIMO charts. Work Study – Objectives, Different Techniques, Standard Time, Allowances, Time study Numerical, Performance Rating, Work sampling.	
UNIT III	11 Hours
Inventory Control - Introduction, Reasons for Holding Inventories, Relevant Costs of Inventories, EOQ models, Quantity Discount Models, Safety Stock, Inventory control system, Selective Control of Inventory ABC analysis, VED analysis and Numerical Production Cost Concepts – Introduction, Cost of Production, Classification and analysis of Cost, Break even analysis, Make and Buy.	
UNIT IV	11 Hours

Introduction to Project management: Characteristics of projects, Definition of Project Entities and objectives of Project Management, Stages of Project Management, Project scheduling and Planning Tools CPM/PERT Networks and Numerical.

Text Books	
1.	J.S. Martinich, "Production and Operations Management: An Applied Modern Approach", 1st Edition, John Wiley and Sons, New Delhi, 2008.
3.	V.K Khurana, "Production and Operations Management", 1st Edition, Boca Raton, FL: CRC Press, 2011.
4.	J. Heizer, Render, "B.M. Operations Management", 11th Edition, Pearson Education, 2013.
Reference Books	
1.	R. Paneerselvam, "Production and Operations Management", 3rd Edition, Prentice Hall India, 2012.
2.	O.P. Khanna, "Industrial Engineering and Management", 1st Edition, Dhanpat Rai & Sons, 2018.
3.	Telsang, T. Martand, "Industrial Engineering and Production Management", 3rd Edition, S. Chand Publishing, 2018.
4.	www.nptel.ac.in
5.	http://ocw.mit.edu

Advanced Machine Design Lab	
Course Code: BMA-310	Credits: 1
Contact Hours: L-0 T-0 P-2	Semester: 6
Course Category: DCC	

Introduction: This is one of the most important Labs of Mechanical Engineering discipline which gives the advanced knowledge of design and analysis of machines components.

Course Objectives: The objectives of this lab are:

- To learn the design analysis of individual parts of machine components
- To learn the design and analysis of entire machine

Course Pre-Requisites: Machine Design

Course Outcomes: After successful completion of the course, the students will be able to:

CO1: Knowledge about how to design the new machines and its parts.
CO2: Analyze the new machine parts.
CO3: To design and analysis of machines for automation

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents: Analysis, design and drawing of the following components:

- Components under fatigue loading
- Belts and chain drives
- Gearbox (bevel and worm gears)
- Brakes and clutches
- Wire ropes and crane hooks
- Piston and connecting rod of IC engine
- Centre and overhang crankshaft
- Hydrodynamic and hydrostatic journal bearings

Text Books:	
1	R.G. Budynas, J.K. Nisbett, "Mechanical Engineering Design", 11th Edition, McGraw Hill Education Private Limited, 2013
2	V.B. Bhandari, "Design of Machine Elements", 5th Edition, McGraw – Hill, 2010.
3	M. Hartman and O.P. Grover, "Machine Design", 6th Edition, CBS Publication & Publishers,201
Reference Books	
1	P.C. Sharma and D.K Aggarwal, "Machine Design", 1st Edition, S.K. Kataria& Sons, 2012.
2	G.E. Dieter, L.C. Schmidt, "Engineering Design", 4th Edition, McGraw Hill Education, 2013
3	J.E. Shigley, C.R. Mischke, "Mechanical Engineering Design", 11th Edition, McGraw Hill,2006
4	Mahadevan, "Design Data Book", CBS Publication & Publishers, 2011.

Metal Forming & Casting	
Course Code: BMA-312 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 6

Introduction: This is one of the important elective courses of Mechanical Engineering discipline which gives the advanced knowledge of casting and its design, metal forming, rolling, drawing and extrusion process of manufacturing.

Course Objectives:

- To inculcate the principle, thermal and metallurgical aspects during solidification of metal and alloys.
- Impart knowledge about principles/methods of casting with detail design of gating/riser system needed for casting, defects in cast objects and requirements for achieving sound casting.
- Impart knowledge about welding behavior of machine and process during welding, analysis of common and newer welding techniques and metallurgical and weldability aspects of different common engineering materials
- Introduce the material behavior and deformation criteria as happens in all metal forming processes, elementary theory of plasticity.
- Analyze different metal forming processes such as rolling, wire and strip drawing, extrusion, forging, and High Energy Rate Forming process.
- To apply mathematical concepts to solve problems related to an industrial/technical environment.
- Determine the forces involved in different metal forming operations.

Pre-Requisites: Material Science, Manufacturing Technology

Course Outcomes: Having successfully completed this course, the student will be able to:

CO1: Knowledge about basics of casting.
CO2: Knowledge about different mould designs.
CO3: Analysis of different metal forming processes.
CO4: Knowledge about basics of drawing and extrusion processes.

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	11 Hours
Casting Technology & problems, Survey and scope, Interfacial Heat Transfer, Thermodynamics & metallurgical aspects in solidification of pure metals and alloys, Solidification of actual castings, Homogeneous and heterogeneous nucleation, Codification for pure metals and alloys. Grain refinement technique	
UNIT II	10 Hours
Moulds Design: Risering curves, NRL, Caine method, feeding distance, Rising of complex castings, Gating systems and their characteristics. Type of gates and design consideration, Chills, pattern design consideration, Sand testing, Advanced metal casting processes, Casting defects, Their causes & redressal, Heat treatment of castings, Gases in metals.	
UNIT III	11 Hours

Classification of Metal Forming Processes: Elementary theory of plasticity, stress/ strain, strain-rate characteristics of materials, yield criteria of metals, formability, Hot forming/ Cold forming. Mechanics of Forming Process: Rolling, process parameters, pressure distribution and roll separating force, rolling pressure, driving torque and power requirements. Forging: Determination of forces in strip forging and disc forging, defects in forged components.

UNIT IV	10 Hours

Drawing: Drawing stresses, limiting draw ratio, factors affecting drawability determination of force and power in wire drawing, determination of maximum allowable reduction, deep drawing force analysis, defects in drawn components. Bending: Bendability, determination of work load and spring back.

Extrusion: Process, parameters, determination of work load from stress analysis and energy considerations, power loss, hydrostatic extrusion, pressure required to extrude, variables affecting the process. Punching & Blanking: Two-dimensional deformation model and fracture analysis, determination of working force.

Text Books	
1.	P. N. Rao, "Manufacturing Technology", 4th Edition, McGraw Hill, 2008.
2.	N.V. Reddy, G.K. Lal, "Introduction to Engineering Plasticity", 1st Edition, Narosa Publication, 2009.
3.	S. Kalpakjian, S. R. Sechmid, "Manufacturing Technology", 7th Edition, Pearson Education Asia, 2018.
Reference Books	
1.	Dieter, G.Ellwood, D.J. Bacon, "Mechanical Metallurgy", 3rd Edition, McGraw-Hill, 2017.
2.	R.A. Lindberg, "Process and Materials of Manufacturing", 4th Edition, Pearson Education, 2015.
3.	S. Kumar, "Technology of Metal Forming Processes", 1st Edition, PHI Learning Pvt. Ltd., 2008.
4.	www.nptel.ac.in
5.	http://ocw.mit.edu

Advanced Strength of Materials	
Course Code: BMA-314	Credits: 4
Contact Hours: L-3 T-0 P-2	Semester: 6
Course Category: DEC	

Introduction: This is one of the most important core subjects of Mechanical Engineering which gives the basic knowledge of designing the various components of machines and its analysis. The knowledge is important for quality of designed product and sustainability in competitiveness markets.

Course Objectives: The objectives of this course are

- To present a problem oriented in depth knowledge of advanced strength of materials
- To address the underlying concepts and methods behind advanced strength of materials

Pre-Requisites: Strength of Materials

Course Outcomes: After successful completion of the course, the students will be able to:

CO1: Knowledge about stresses and strains in three dimensions.
CO2: Analysis of theories of elastic failure.
CO3: Knowledge about stresses due to rotation and bending of curved bars.
CO4: Evaluation of torsion of non circular members and bending of thin plates.

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	11Hours
Stresses in Three Dimensions: Concept of Continuum, Homogeneity and Isotropy, Types of forces on a body, State of stress at a point, Equality of cross shear, Cauchy formula, principal stresses and planes, Stress invariants, Hydrostatic and deviatoric stress tensor, Mohr's circle for general state of stress, stress transformations, Octahedral stresses, Differential equation of equilibrium **Strains in Three Dimensions:** Types of strain, Strain displacement relationship, Shear strain, Rigid body rotation, Principal strain and axes, Strain deviator and invariants, Compatibility conditions, Concept of Plane stress and strain, Stress strain relationship	
UNIT II	11 Hours
Theories of Elastic Failure: Concept of factor of safety, Maximum principal stress theory, maximum shear stress theory, maximum principal strain theory, Maximum strain energy theory, maximum shear strain energy theory **Buckling of Column**: Concept of buckling and stability, differential equations of compression member with different boundary conditions, eccentrically loaded columns, secant formula, column with initial imperfections, Rankine formula	
UNIT III	10 Hours
Stresses Due to Rotation: Rotating ring, rotating thin disc, rotating thin solid and hollow disc, disc of uniform strength, rotating long solid and hollow cylinders **Bending of Curved Bars**: Introduction, Stresses in curved bars (Winkler-Bach theory) (Rectangular section, Circular section, Triangular section, Trapezoidal section, T-Section), Stresses in crane hooks	
UNIT IV	10 Hours
Torsion of Non-Circular Members: St. Venant's theory, approximate solution of rectangular and elliptical sections, rigorous solution, stress function approach, membrane analogy, torsion of thin hollow sections, Torsional of thin and open sections **Bending of Thin Plates**: Assumptions of plate theory, governing differential equations for deflection of plates, boundary conditions, solutions for rectangular plate	

Text Books

1.	Timoshenko, “Elements of Strength of Materials”, 5th Edition, East West Publisher, 2003
2.	L.S. Srinath, “Advanced Solid Mechanics”, 3rd Edition, McGraw Hill Education, 2017.
3.	R.S. Lehri, “Strength of Materials”, 1st Edition, S.K Kataria and Sons, 2012.
4.	S.M.A. Kazimi, “Solid Mechanics”, 1st Edition, McGraw Hill, 2017.
Reference Books	
1.	J. Gere, B. Goodno, “Mechanics of Materials”, 9th Edition, Cengage Learning Custom Publishing, 2016.
2.	E.J. Hearn, “Mechanics of Materials-I”, 3rd Edition, Butterworth-Heinemann, 2013.
3.	K. Singh, “Mechanics of Materials”, 1st Edition, Standard Publishers & Distributors, 2003.
4.	www.nptel.ac.in
5.	http://ocw.mit.edu

Quality Management & Six Sigma Applications	
Course Code: BMA-316 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 6

Introduction: This course will teach a focused managerial strategy of process improvement and variation reduction called Six Sigma, a measure of quality that strives for near perfection.

Course Objectives: To enrich the fundamentals of Total Quality Management to foster the emerging trends in production whereby students practically would know how the six sigma technique could be used to minimize defects.

Pre-Requisites: Engineering Mathematics

Course Outcomes: Upon completion of this course, the students will have:

CO1: Knowledge about basics of quality.
CO2: Evaluation of different tools of TQM.
CO3: Applications of six sigma in various fields
CO4: Applications of different tools of six sigma.

Pedagogy: Classroom teaching is supported by white board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	11 Hours
Introduction - Need for Quality – Evaluation of Quality – Definitions of Quality – Dimensions of product and service quality – Basic concepts of TQM – TQM frame work – Contributions of Deming, Juran, and Crossby – Barriers of TQM – Quality statements – Customer focus – Customer orientation, Customer satisfaction, Customer complaints – Customer retention – Costs of Quality.	
UNIT II	10 Hours
TQM tools- Benchmarking: Definition, concepts, benefits, elements, reasons for benchmarking, process of benchmarking, FMEA, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function.	
UNIT III	11 Hours
Introduction to six sigma, Indicators of requirement of Six sigma, Elements of six sigma, Six sigma process – Define phase, Six sigma tools (QFD, SIPOC) – Define phase, Six sigma process – Measure phase, Six sigma tools (CTQ tree, Process capability calculation, Measurement system analysis using gauge R&R) – Measure phase, Six sigma process – analyse phase, Six sigma tools (Histogram, box plot, control chart, scatter chart, fish bone diagram, pareto analysis chart, interrelations diagram) – analyse phase.	
UNIT IV	10 Hours
Six sigma special tools (Regression analysis, Hypothesis testing, ANOVA, Multivariate analysis), Six sigma – process improvement, Six sigma tools (Affinity diagram, FMEA, DOE), Six sigma process – control phase, Six sigma tools (Value stream mapping, control charts, TPM, Poka – yoke), Implementing six sigma	

Text Books	
1.	G.R. Henderson, "Six Sigma Quality Improvement with MINITAB", 2nd Edition, Wiley, 2011
2.	J.R. Evans, W.M Lindsay, "Total Quality: Management, Organization and Strategy", 4th Edition, CENGAGE, 2005.
3.	D.C. Montgomery, "Introduction to statistical quality control", 8th Edition, John Wiley & Sons, 2019.
References	
1.	Juran, M. Joseph, A. Joseph, "Juran's Quality Handbook: The Complete Guide to Performance Excellence", 6th Edition, McGraw-Hill Education, 2017.
2.	Evans, J. Robert, W.M. Lindsay, "The Management and Control of Quality", 8th Edition, Cincinnati, OH: South-western, 2010.

3.	B. Janakiraman, R. K. Gopal, "Total quality management: Text and cases", 1st Edition, PHI Learning Pvt. Ltd, 2017
4.	www.nptel.ac.in
5.	http://ocw.mit.edu

Gas Dynamics	
Course Code: BMA-318 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 6

Introduction: Theoretical understanding of this subject along with the experimental introduction is very useful for advanced studies like missile and re-entry aerodynamics and hypersonic aerothermodynamics. Hence, in order to build the basic platform, this course starts with basic governing equations of the fluid flows.

Course Objectives: The Objective of this course is to

- Understand the basic characteristics of compressible flows, including wave propagation, speed of sound and the Mach number.
- Analyze one-dimensional isentropic compressible flows as well as effects of friction and heat transfer.
- Analyze normal shock, oblique shock and Prandtl Meyer flows.
- Learn the development of thermodynamic and flow relationships and apply these to practical problems; become familiar with application-type problems in gas dynamics.

Pre-Requisites: Thermal Engineering, Fluid Mechanics

Course Outcomes: Having successfully completed this course, the student will:

CO1: Understand the basic concept of Gas Dynamics.
CO2: Understand the behavior of Gas under various conditions.
CO3: Understand basics of compressible flow.
CO4: Correlate fundamentals of Gas Dynamics with various mechanical systems

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	11 Hours
Fundamentals of compressible flow: Continuity, momentum and energy equation, control volume, sonic velocity, Mach number and its significance, Mach waves, Mach cone and Mach angle, stagnation properties.	
UNIT II	10 Hours
Isentropic flow of an ideal gas with variable area: One dimensional isentropic flow in ducts of varying cross-section- nozzles and diffusers, mass flow rate in nozzles, critical properties and choking, area ratio as function of Mach number, Impulse function, effect of back pressure variation of convergent and convergent divergent nozzles, non-dimensional mass flow rate in terms of pressure ratio, area ratio and Mach number, flow through diffusers, use of gas tables.	
UNIT III	11 Hours
Flow in constant area duct with friction (Fanno flow): Fanno curve and Fanno flow equations, solution of Fanno flow equations, variation of flow properties, variation of Mach no. with duct length, isothermal flow in constant area duct with friction, tables and charts for Fanno flow. **Flow in constant area duct with heat transfer (Rayleigh flow):** Rayleigh curve and Rayleigh flow equations, variations of flow properties, maximum heat transfer, tables and charts for Rayleigh flow.	
UNIT IV	10 Hours
Normal shocks in one-dimensional flow: Occurrence of shocks, Analysis of normal shocks, Prandtl's equation, Rankine - Huguenot equation and other normal shock relations, moving shocks. Oblique shocks and expansion waves. **Wind tunnel:** Types of wind tunnels. Wind Tunnel Applications	
Text Books	
1.	S.M. Yahya, "Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion", 8th Edition, New Age Publishers, 2009.
2.	Anderson, "Computational Fluid Dynamics", 1st Edition, Mc-Graw Hill, 2012.

3.	P. Balachandran, “Fundamentals of Compressible Fluid Dynamics”, 1st Edition, PHI Learning, 2006.
4.	H.W. Emmons, “Fundamentals of gas dynamics”, 1st Edition, Princeton, NJ: Princeton University Press, 2015.
Reference Books	
1.	Liepman, Roshk, “Elements of Gas Dynamics”, 1st Edition, Dover Publications, 2002.
2.	M.J. Zuckrow, D.H. Hoffman, “Gas Dynamics”, 1st Edition, Mc-Graw Hill, 2013
3.	E. Rathakrishnan , “Applied Gas dynamics”, 2nd Edition, Prentice Hall India, 2010.
4.	V. Babu, “Fundamentals of gas dynamics”, 2nd Edition, Nashville, TN: John Wiley & Sons. 2014.
5.	www.nptel.ac.in
6.	http://ocw.mit.edu

Design of Mechanisms	
Course Code: BMA-320 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 6

Introduction: This course studies the design of mechanisms to mediate the interaction of strategic individuals so that desirable outcomes are attained. Course gives idea about the basic design procedure. Design steps of various mechanical elements are discussed.

Course Objectives: This course is designed to equip students with fundamental theories and methodologies that are used in synthesis, kinematic, and dynamic analysis of mechanisms commonly encountered in machine design. Students will learn analytical and computational techniques for displacement, velocity, and acceleration analyses of linkages, as well as methods for force analysis in linkages using static and dynamic approaches.

Pre-Requisites: Students are expected to have a working knowledge of differential equations and linear systems. Familiarity with statics, kinematic and dynamics is expected.

Course Outcomes: Having successfully completed this course, the student will:

CO1: Demonstrate an understanding of fundamental concepts in mechanisms (linkages, cams, gears, etc.) and identify basic types of mechanisms, joints, and motion and determine degree of freedom (mobility) of mechanisms and equivalent linkages.
CO2: Perform position, velocity, and acceleration analyses using analytical and computational methods.
CO3: Describe the mechanism design process and synthesize mechanisms for prescribed path and motion generation using analytical and computational methods.
CO4: Analyze (and design) gear trains, cam-followers, belt and chain drives, and screw mechanisms.

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	11 Hours
Definitions and basic concepts, Classification of links, Classification of pairs, Mechanism and machine, Inversions, Grashoff's law, Transmission of torque and force in mechanisms, Mobility, Degree of freedom permitted by joints other than turning and sliding, Equivalent mechanisms, Unique mechanisms.	
UNIT II	10 Hours
Effect of even or odd number of links on degree of freedom, Minimum number of binary links in a mechanism, Minimum possible number of turning pairs, Enumeration of kinematic chain, Degree of freedom of special mechanisms.	
UNIT III	11 Hours
Type, Number and dimensional synthesis, Function generation, Path generation and body guidance, Precision positions, Structural error, Chebychev spacing, Two position synthesis of slider crank mechanisms, Crank-rocker mechanisms with optimum transmission angle.	
UNIT IV	10 Hours
Poles and relative poles, Relative poles of 4-bar mechanism, Relative poles of slider crank mechanism.	

Text Books	
1.	S.N. George, E.G Arthur, "Mechanism Design", 4th Edition, Prentice Hall, 2001.
2.	A.K. Mallik, G. Amitabha, "Theory of Mechanism and Machines", 3rd Edition, EWLP, 2008.
3.	J.E. Shigley, J.J. Vicker, "Theory of Mechanisms", 4th Edition, McGraw Hill ,2014
Reference Books	
1.	Shigley, J.E. Shigley's, "Mechanical Engineering Design", McGraw-Hill Education, 2016.
2.	T. Borgers, D. Krahmer, R. Strausz, "An introduction to the theory of mechanism design". New York, NY: Oxford University Press, 2015.
4.	www.nptel.ac.in
5.	http://ocw.mit.edu

Industrial Tribology	
Course Code: BMA-322	Credits: 4
Contact Hours: L-3 T-0 P-2	Semester: 6
Course Category: DEC	

Introduction: This is one of the most important core subjects of Mechanical Engineering which gives the basic knowledge of designing the various components of machines and its analysis. The knowledge is important for quality of designed product and sustainability in competitiveness markets.

Course Objectives: The objectives of this course are

- Develop basic knowledge of tribology
- Learn the various applications of tribology
- Learn the differentiate between the types of lubricants and its respective application
- Understand and explain different laws of friction and wears
- Learn various modes of friction and wears and its mechanism
- Learn the behavior of bearing under lubrication regimes and to develop mathematical model

Course Pre-Requisites: Material Science, Theory of Machines and Strength of Materials

Course Outcomes: After successful completion of the course, the students will be able to:

CO1: Design the machine and its components from a tribological point of view to save the cost.
CO2: Knowledge about how to elect the right type of the lubricants for various machine components.
CO3: Select the type of different bearings for any required engineering use and determine the load carrying capacity and other related parameters.
CO4: Analysis of hydrodynamic and hydrostatic bearings.

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	11Hours
Tribology, background, practical importance and tribology in industry. Defining Lubrication, Basic Modes of Lubrication, Properties of Lubricants, Lubricant Additives, Defining Bearing Terminology - Sliding contact bearings - Rolling contact bearings, Comparison between Sliding and Rolling Contact Bearings.	
UNIT II	11 Hours
Friction - Laws of friction - Friction classification - Causes of friction, Theories of Dry Friction, Friction Measurement, Stick-Slip Motion and Friction Instabilities, Wear - Wear classification - Wear between solids - Wear between solid and liquid - Factors affecting wear - Measurement of wear, Theories of Wear, Approaches to Friction Control and Wear Prevention, Boundary Lubrication, Bearing Materials and Bearing Construction.	
UNIT III	10 Hours
Mechanics of Fluid Flow - Theory of hydrodynamic lubrication - Mechanism of pressure development in oil film, Two Dimensional Reynolds's Equation and its Limitations, Idealized Bearings, Infinitely Long Plane Fixed Sliders, Infinitely Long Plane Pivoted Sliders, Infinitely Long Journal Bearings, Infinitely Short Journal Bearings, Designing Journal Bearing - Sommerfeld number - Raimondi and Boyd method - Petroff's Solution - Parameters of bearing design - Unit pressure - Temperature rise - Length to diameter ratio - Radial clearance - Minimum oil-film thickness.	
UNIT IV	10 Hours
Introduction - Flat plate thrust bearing - Tilting pad thrust bearing, Pressure Equation - Flat plate thrust bearing - Tilting pad thrust bearing, Load - Flat plate thrust bearing - Tilting pad thrust bearing, Center of Pressure - Flat plate thrust bearing - Tilting pad thrust bearing, Friction - Flat plate thrust bearing - Tilting pad thrust bearing.	
Text Books	

1.	P. Sahoo, “Engineering Tribology”, 1st Edition, PHI Learning, 2011.
2.	K. C. Ludemna, “Friction, Wear and Lubrication”, 1st Edition, CRC Press, 2018.
3.	R.D Arnell, “Tribology: Principles and Design Applications”, 1st Edition, Springer, 2012.
Reference Books	
1.	T. Mang, K. Robzin, T. Bartels, “Industrial Tribology”, 1st Edition, Wiley VCH, 2010
2.	S. Wen, “Principles of Tribology”, 2nd Edition, John Wiley & Sons, 2017.
3.	G.W. Stachowiak, A.W. Batchelor, “Engineering Tribology”, 4th Edition, Butterworth-Heinemann, 2013.
4.	www.nptel.ac.in
5.	http://ocw.mit.edu

Power Electronics	
Course Code: BMA-324 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 6

Introduction: The power electronic devices and converters employing power electronics devices are now widely used in domestic applications as well as in industrial applications like Electrical Drives, Power Systems, Renewable Energy based power generation, heating applications etc. The course is aimed to act as a foundation block and to provide exposure about various aspects (construction, characteristics, operation, ratings etc.) of power electronic devices.

Course Objectives: To impart knowledge on the following topics

- Different types of power semiconductor devices and their switching
- Operation, characteristics and performance parameters of controlled rectifiers
- Operation, switching techniques and basics topologies of DC-DC switching regulators.
- Different modulation techniques of pulse width modulated inverters and to understand harmonic reduction methods.

Pre-Requisites: Basic Electronics and Concept of DC Machines

Course Outcomes: Having successfully completed this course, the student will:

CO1: Select the power devices as per the usage for energy conversion and control and exhibit the designing of firing and commutation circuits for different converter configurations.
CO2: Analyze various converter configuration / topology with different types of loads.
CO3: Identify converter configurations for various power applications.
CO4: Exhibit the usage of power converters for harmonic mitigation, voltage and frequency control.

Pedagogy: Classroom teaching is supported by white board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	11 Hours
Study of switching devices, SCR, TRIAC, GTO, BJT, MOSFET, IGBT and IGCT- Static characteristics: SCR, MOSFET and IGBT – Triggering and commutation circuit for SCR. Introduction to Driver and snubber circuits.	
UNIT II	10 Hours
2-pulse, 3-pulse and 6-pulse converters– performance parameters –effect of source inductance– Firing Schemes for converter–Dual converters, Applications-light dimmer, Excitation system, Solar PV systems.	
UNIT III	11 Hours
Step-down and step-up chopper-control strategy– Introduction to types of choppers-A, B, C, D and E - Switched mode regulators- Buck, Boost, Buck- Boost regulator, Introduction to Resonant Converters, Applications-Battery operated vehicles.	
UNIT IV	10 Hours
Single phase and three phase voltage source inverters (both1200 mode and 1800 mode)– Voltage& harmonic control-PWM techniques: Multiple PWM, Sinusoidal PWM, modified sinusoidal PWM – Introduction to space vector modulation –Current source inverter, Applications-Induction heating, UPS.	
Text Books	
1.	Rashid, M., "Power Electronics", 4th Edition, Prentice□Hall of India, 2017
2.	N. Mohan, T. Underland, W.P. Robbins, "Power Electronics: Converter Applications and Design", 3rd Edition, John Wiley, 2017
3.	Erickson, W. Robert, and D. Maksimovic, "Fundamentals of Power Electronics", 3rd Edition, Springer Science & Business Media, 2020.
Reference Books	
1.	Hart, W. Daniel, "Power Electronics", 1st Edition, McGraw-Hill Education, 2017

2.	Williams, W. Barry, "Principles and Elements of Power Electronics", 1st Edition, University of Strathclyde, Glasgow, 2006
3.	Kazimierczuk, K.Marian , "Pulse-width modulated DC-DC power converters", 1st Edition, John Wiley & Sons, 2014
4.	www.nptel.ac.in
5.	http://ocw.mit.edu

Power Plant Engineering	
Course Code: BMA-326 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 6

Introduction: Power Plant Engineering focuses on power generation principles for real world applications. More specifically this course is focused on application of energy principles and power generation cycles. The main purpose of implementing this course in curriculum is to learn about how the power is generated in a power plant and its applications.

Course Objectives: The Objective of this course is to

- To study the power generation scenario, the components of thermal power plant, improved Rankin cycle, Cogeneration cycle.
- To understand details of steam condensing plant, analysis of condenser, the environmental impacts of thermal power plant, method to reduce various pollution from thermal power plant.
- To study layout, component details of hydroelectric power plant, hydrology and elements, types of nuclear power plant.
- To understand components; layout of diesel power plant, components; different cycles; methods to improve thermal efficiency of gas power plant
- To study the working principle, construction of power generation from non-conventional sources of energy.
- To learn the different instrumentation in power plant and basics of economics of power generation.

Pre-Requisites: Thermal Engineering

Course Outcomes: Having successfully completed this course, the student will be able to:

CO1: Describe the power generation scenario, the layout components of thermal power plant and analyze the improved Rankin cycle, Cogeneration cycle.

CO2: Analyze the steam condensers, recognize the environmental impacts of thermal power plant and method to control the same.

CO3: Recognize the layout, component details of hydroelectric power plant and nuclear power plant and realize the details of diesel power plant, gas power plant and analyze gas turbine power cycle.

CO4: Describe the different power plant electrical instruments and basic principles of economics of power generation and emphasize the fundamentals of non-conventional power plants.

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	10 Hours
Steam Power Plant: General layout of modern thermal power plant, Site selection, Presents status of power generation in India. **High Pressure Boilers & Accessories:** Unique features and advantages of high-pressure boilers, LaMont, Benson, Loeffler, Schmidt- Hartmann, Velox, Different types of super-heaters, Re-heaters, economizers, Air pre-heaters, Methods of superheat control.	
UNIT II	10 Hours
Coal & Ash Handling Systems: Coal handling storage of coal, Burning systems, Types of stokers their working. Necessity of ash disposal, Mechanical, Hydraulic, pneumatic and steam jet ash handling system, Dust collection and its disposal, Mechanical dust collector, Electrostatic precipitator. **Condensers and Cooling Towers:** Types of condensers, sources of air in condenser, Effects of air leakage, Methods of obtaining maximum vacuum in condenser, Necessity of cooling ponds and cooling towers, Condenser water cooling systems, Types of cooling towers, cooling ponds.	
UNIT III	11 Hours

Feed Water Treatment: Necessity of feed water treatment, Different impurities found in feed water, Effect of impurities, pH & its role in corrosion and scale formation, Internal & external water treatment systems-hot lime soda process, Zeolite ion exchange process, Demineralization plants, Reverse osmosis process, Sea water treatment using reverse osmosis, De-aeration.

Gas Turbine Power Plant: Site selection of gas turbine power plant, Components of a gas turbine power plant, Different layouts of plant, Combined cycle power plants, Gas Turbine Fuels, Advantages and disadvantages over diesel and steam power plants.

UNIT IV	11 Hours

Diesel Power Plant: Essential components of diesel power plant, Different systems like fuel supply system, Engine cooling system, Engine lubrication system, Exhaust system, Engine starting and stopping system.

Nuclear Power Plant: Nuclear fusion and fission, Chain reaction, Nuclear fuels, Components of nuclear reactor, Classification of reactors, Pressurized water reactor, Boiling water reactor, Gas cooled reactor, CANDU reactor, Fast breeder reactor, Nuclear waste and its disposal, Nuclear power plants in India.

Text Books	
1.	R.K. Rajput, "Power Plant Engineering", 5th Edition, Laxmi Publication, 2015
2.	P.K. Nag, "Power Plant Engineering", 4th Edition, Mc-Graw Hill, 2014
3.	P.C. Sharma & Nagpal, "Power Plant Engineering", 1st Edition, Khanna Publishers, 2013.
Reference Books	
1.	Arora, Domkundwar, "Power Plant Engineering", 8th Edition, Dhanpat Rai & Co., 2014.
2.	C. Elanchezhian, L. Saravanakumar, B. Vijaya Ramnath, "Power Plant Engineering", 1st Edition, I.K. International, 2019.
3.	T. Elliott, K. Chen, R. Swanekamp, "Standard Handbook of Power plant Engineering", 2nd Edition, McGraw Hill Professional, 2012.
4.	www.nptel.ac.in
5.	http://ocw.mit.edu

Combustion Emission and Pollution Control	
Course Code: BMA-328 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 6

Introduction: The course covers the basis of thermal energy technologies that are common for combustion and fuels. It covers the understanding, analysis and design of combustion systems to account for fuel properties, maximize output and minimize air pollution.

Course Objectives: The Objective of this course is to

- Enable students to apply the knowledge of thermodynamics to combustion.
- Emphasize the basics of fuels, stoichiometry, chemical kinetics and equilibrium, mass transfer, and different types of combustion process.
- Explain the mathematics involved in transport processes of a reactive flow, simplifications involved and the parameters affecting different types of combustion processes.
- Provide basics for Pollution and Emission analysis of combustion process

Pre-Requisites: Thermal Engineering

Course Outcomes: Having successfully completed this course, the student will:

CO1: Knowledge about how to develop a basic know-how on fuel properties and their possible utilization.
CO2: Identify the features of combustion in SI and CI engines.
CO3: Understand about the formation particulates in SI and CI engines.
CO4: Analyze fuels and suggest the best fuels with minimum environmental impact.

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	10 Hours
Introduction: Introduction to air pollution from IC engines, photochemical smog, primary and secondary pollutants. **Thermodynamics of combustion:** Stoichiometry of combustion, heats of reaction and formation, adiabatic flame temperature. **Chemistry of Combustion:** Chemical equilibrium, properties of equilibrium combustion products of air-fuel mixtures, application to IC engines. Introduction to chemical kinetics, order of reaction, reaction rates, engine application. **Combustion in SI Engine:** Conceptual SI engine combustion models, features of SI engine combustion processes, combustion process characterization. Thermodynamic analysis of burned and unburned mixture states, mixed and unmixed combustion models. Combustion variations, factors affecting it and their effect on performance and emissions, effect of EGR.	
UNIT II	10 Hours
Combustion in CI Engine: Features of CI engine combustion process, conceptual CI engine combustion models, combustion process characterization. Fuel injection, spray structure, atomization, penetration, drop size distribution, spray evaporation. Ignition delay, factors affecting delay. Mixing controlled combustion, heat release rates, effect of engine design variables, swirl, injection rates. Thermodynamic analysis of CI engine combustion.	
UNIT III	11 Hours
Formation of NO and NO2 in SI Engines, Prompt and thermal NO, kinetics of NO formation. Formation of NO and NO2 in CI engines, NO formation in premixed and diffusion combustion periods. Formation of CO, kinetic effects, effect of engine variables. Unburned HC formation in SI engines, crevice HC, oil film HC and other sources. HC oxidation in the cylinder and exhaust, exodus of HC, contribution of different sources Formation of HC in CI engines, undermining and over mixing.	

Composition of particulates, soot structure, soot formation-stoichiometric considerations, nucleation, growth and oxidation, effect of engine variables.
Trends in vehicle emission standards, emission limits, test procedures, driving cycles.

UNIT IV	11 Hours

Measurement of emissions: instrumentation for CO HC, NOx, PM.
Emission Control: Strategies for control of emissions in SI engines; Add on systems to control emissions inside the engine: EGR, crankcase and evaporative emission control.
Exhaust gas after treatment, Thermal and catalytic reactors, Elements of catalytic reactors, catalysts and substrates.
Petroleum fuels: impact of fuel characteristics including oxygenates on emissions.
Alternative fuels to reduce emissions: Alcohols, natural gas, biodiesel, hydrogen, DME.

Text Books	
1.	J.B. Heywood, "Internal Combustion Engine Fundamentals", 1st Edition, McGraw Hill International Editions, 2017.
2.	B. P. Pundir, "Engine Emissions: Pollutant Formation and Advances in Control Technology", 1st Edition, Narosa Publishing House, 2007.
3.	V. Ganeshan, "I.C Engine", 4th Edition, Mc-Graw Hill Publishers, 2017.
Reference Books	
1.	D. P. Mishra, "Fundamentals of Combustion", 1st Edition, Prentice Hall of India, 2008.
2.	K.K. Kuo, "Principles of Combustion", 2nd Edition, John Wiley and Sons, 2005.
3.	M. Adachi, H. Nakamura, "Engine Emissions Measurement Handbook", 1st Edition, SAE International, 2014.
4.	P.W. Gill, "Fundamentals of Internal Combustion Engines", 4th Edition, Oxford & IBH Publishing Company, 2007.
5.	www.nptel.ac.in
6.	http://ocw.mit.edu

Measurement and Metrology	
Course Code: BMA-330 Contact Hours: L-3 T-0 P-2 Course Category: DEC	Credits: 4 Semester: 6

Introduction: The subject offers an understanding to learners of engineering measurement and metrology from application point of view. The production of goods is subject to errors and flaws, to identify and gauge dimensions and quality of product, the concept of engineering measurement and metrology is significant.

Course Objectives:

- To understand the basic concept of Engineering Measurement and Metrology and their applications in industry for decision making
- The students are to be provided hands on practical exposure on topics covered in the course.

Pre-Requisites: Production Technology

Course Outcomes: On Completion of the course the student will be able to:

CO1: Identify and use measurement and metrology instruments.

CO2: Describe the key components and key features of measurement and metrology.

CO3: Describe and list the steps to be followed during measurements.

CO4: Evaluate geometric forms.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

Contents:

UNIT I	10 Hours
Introduction: Introduction to measurement and measuring instruments generalized measuring system and functional elements, units of measurement, static and dynamic performance characteristics of measurement devices, calibration, concept of error, Types and sources of error, statistical analysis of errors. **Sensors and Transducers**: Types of sensors, types of transducers and their characteristics, Difference b/w Open loop and Closed loop measurement system, Signal conditioning unit, indicating unit, static characteristics i.e., accuracy, precision, sensitivity, resolution, linearity. **Measurement of Flow**: Methods of flow measurement, hot wire anemometer, ultrasonic flow meter.	
UNIT II	10 Hours
Measurement of pressure: Elastic and indirect type pressure transducers. Measurement of very low pressures. **Strain measurement:** Types of strain gauges and their working, temperature Compensation. **Measurement of force and torque:** Different types of load cells, elastic transducers, pneumatic and hydraulic systems. **Temperature measurement:** Thermocouples, pyrometers	
UNIT III	11 Hours
Metrology and Inspection: Sources of error, Standards of linear measurement, line and end standards, Limit fits and tolerances, Interchangeability and standardization. **Length Standards:** Line standards, end standards, transfer from line standards to end standards, Numerical based on-line standards, Slip gauges **Linear and angular measurements devices and systems Comparators:** Types of Gauges, Limit Gauge, Snap Gauge, Taylor's Principle of Gauge Design	
UNIT IV	11 Hours
Measurement of geometric forms like straightness, flatness, roundness. **Interferometry:** Principle and use of interferometer, Optical flat, Measurement of screw threads.	

Surface texture: Quantitative evaluation of surface roughness and its measurement, Comparators, Feature inspection Form Tolerance Inspection. CMM, working and features	
Text Books	
1.	R.K. Jain, "Engineering Metrology", Khanna Publishers, Delhi, 2010.
2.	R.K. Rajput, "Mechanical Measurements and Instrumentation", 2nd Edition, S.K. Kataria & Sons; 2013.
3.	Venkateshan, S. P. "Mechanical Measurements: Venkateshan/mechanical measurements" 2nd Edition, John Wiley & Sons, 2015.
Reference Books/Material	
1.	T.G. Beckwith, R.D. Maragoni and J.H Lienhard, "Mechanical Measurements", 6th Edition, Addison- Wesley, 2013.
2.	F.W. Galyer & C.R. Shotbolt, "Metrology for Engineers", 5thEdition, ELBS edition, 2009
3.	Raghavendra, N. V., and L. Krishnamurthy. "Engineering metrology and measurements", 1st Edition, Oxford University Press, 2013.
4.	www.nptel.ac.in
5.	http://ocw.mit.edu

Principles Of Management	
Course Code: HMC-302 Contact Hours: L-2 T-0 P-0 Course Category: HMC	Credits: 2 Semester: 6

Introduction: To give a preview of basics of management to engineering students, this course discusses about the basic nature of management and describes the functions of management, the specific roles of contemporary management, different approaches to designing organizational structures. This will help the students to understand the role of personality, learning and emotions at work, discover and understand the concept of motivation, leadership, power and conflict, understand the foundations of group behavior and the framework for organizational change and development.

Course Objectives:
To acquaint the students with the fundamentals of managing business
To make them understand individual and group behavior at workplace so as to improve the effectiveness of an organization.
The course will use and focus on Indian experiences, approaches and cases.
Pre-requisite: None

Course Outcomes: After completion of the course, the students should be able to:

CO1: Understand the nature of management and describe the functions of management.
CO2: Knowledge about the specific roles of contemporary management and develop understanding of different approaches to designing organizational structures.
CO3: Understand the role of personality, learning and emotions at work and discover and understand the concept of motivation, leadership, power and conflict.
CO4: Understand the foundations of group behavior and the framework for organizational change and development.

Pedagogy: The teaching pedagogy will be a blend of teaching and learning techniques including:

- Lectures and Case studies
- Project works and assignments
- Group works and Interactive discussions.

Contents

UNIT-I	7 Hours
Introduction: Concept, Nature, Process and Significance of Management; Managerial levels, Development of Management Thought: Classical, Neo-Classical, Behavioral, Systems and Contingency Approaches.	
UNIT-II	7 Hours
Planning: Nature, Scope and Objectives of Planning; Types of plans; Planning Process; Organizing: Nature, Process and Significance; Principles of an Organization; Span of Control; Types of an Organization.	
UNIT-III	7 Hours

Staffing: Concept, Nature and Importance of Staffing. Motivating and Leading: Nature and Importance of Motivation; Types of Motivation; Leadership: Meaning and Importance; Traits of a leader.	
UNIT IV	7 Hours
Controlling: Nature and Scope of Control; Types of Control; Control Process; Control Techniques– Traditional and Modern; Effective Control System.	
Text Books	

1.	S.P. Robbins, "Fundamentals Management: Essentials Concepts Applications", Pearson Education, 2014.
2.	Gilbert, J.A.F. Stoner and R.E. Freeman, "Management", Pearson Education, 2014.
3.	H. Koontz, "Essentials of Management", McGraw Hill Education, 2012.
4.	C. B. Gupta, "Management Concepts and Practices", Sultan
Reference Books	
1.	W. Ghillyer, "Management- A Real World Approach", McGraw Hill Education, 2010.
2.	K. Mukherjee, "Principles of Management", McGraw Hill Education, 2012.
3.	www.nptel.ac.in
4.	http://ocw.mit.edu

Marketing Management	
Course Code: HMC-304 Contact Hours: L-2 T-0 P-0 Course Category: HMC	Credits: 2 Semester: 6

Introduction: This course will build the basic concept of marketing and related concepts for the engineering students. It will provide an in-depth understanding to various elements of marketing mix for effective functioning of an organization. Students will learn some of the tools and techniques of marketing with focus on Indian experiences, approaches and cases.

Course Objectives:

- To familiarize students with the marketing function in organizations.
- To equip the students with understanding of the Marketing Mix elements and sensitize them to certain emerging issues in Marketing.

Pre-requisite: None

Course Outcomes: – After completion of the course, the students should be able to:

CO1: Understand the concept of marketing and related concepts.
CO2: An in-depth understanding of various elements of marketing mix for effective functioning of an organization.
CO3: Knowledge about some of the tools and techniques of marketing with focus on Indian experiences, approaches and cases.

Pedagogy: Apart from interactive class teaching, various individual and group assignments are given. Group discussions, role plays and presentations are conducted in class to enable students to practically apply the theories learnt during the course.

Contents:

UNIT-I	7 Hours
Introduction to Marketing: Nature, Scope and Importance of Marketing, Basic concepts, Marketing Environment.	
UNIT-II	7 Hours
Product: Product Levels, Product Mix, Product Strategy, Product Development, Product Lifecycle and Product Mix Pricing Decisions.	
UNIT-III	7 Hours
Place: Meaning & importance, Types of Channels, Channels Strategies, Designing and Managing Marketing Channel.	
UNIT IV	7 Hours
Promotion: Promotion Mix, Push vs. Pull Strategy; Promotional Objectives, Advertising-Meaning and Importance, Types, Media Decisions, Promotion Mix, Personal Selling-Nature, Importance and Process.	
Text Books	

1.	P. Kotler, P.Y. Agnihotri, E.U. Haque, “Principles of Marketing- A South Asian Perspective”, Pearson Education, 2012.
2.	T. Ramaswamy, S. Namkumar, “Marketing Management Global Perspective: Indian Context”, McMillan, Delhi, 2013.

Reference Books

1.	R. Saxena, “Marketing Management”, McGraw Hill Education, 2012.
2.	C.W. Lamb, J.F. Hair, C. McDaniel, D. Sharma, “MKTG: a South Asian Perspective with Coursemate”, Cengage Learning, 2016.
3.	R. Winer, “Marketing Management”, Pearson Education, 2012.
4.	www.nptel.ac.in
5.	http://ocw.mit.edu

Financial Management	
Course Code: HMC-306 Contact Hours: L-2 T-0 P-0 Course Category: HMC	Credits: 2 Semester: 6

Introduction: Efficient Management of a business enterprise is closely linked with the efficient management of its finances. Accordingly, the objective of the course is to familiarize the engineering students with the basic fundamentals, principles and practices of financial decision-making in a business unit in the context of a changing, challenging and competitive global economic environment. The purpose of the course is to offer the students relevant, systematic, efficient and actual knowledge of financial management that can be applied in practice while making financial decisions and resolving financial problems.

Course Objectives: The objective of the course is to acquaint the students with the overall framework of financial decision-making in a business unit.

- To acquaint the students with the fundamentals of Financial Management
- To make them understand Decisions to be taken as a Finance Manager.
- The course will use and focus on Indian experiences, approaches and cases.

Pre-requisite: None

Course Outcomes: Upon successful completion of the course, students will be able to:

CO1: Understand the overall role and importance of the finance function for decision-making.
CO2: Recommend whether and why a particular investment should be accepted or rejected by determining an appropriate investment criteria and projecting cash flows associated with corporate project evaluation.
CO3: Differentiate between the various sources of finance and their pros and cons and outline capital requirements for starting a business and management of working capital.
CO4: Analyze the complexities associated with management of cost of funds in the capital structure.

Pedagogy: The teaching pedagogy will be a blend of teaching and learning techniques including:

- Lectures and Case studies
- Project works and assignments
- Group works and Interactive discussions.

Contents

UNIT-I	7 Hours
Financial Management Definition, scope, objectives of Financial Management, Functions of a finance manager, Time value of money. Sources of Finance for different Organizations.	
UNIT-II	7 Hours
Capital Structure: Meaning of Capital Structure: Factors Determining Capital Structure. Cost of Capital: Concept, Importance and Classification.	
UNIT-III	7 Hours

Capital Budgeting: Concept, Importance and Appraisal Methods: Pay Back Period, Accounting, Rate of Return, Net Present Value Method (NPV), Profitability Index, and IRR. Capital Rationing.	
UNIT IV	7 Hours
Working Capital Management: Operating cycle, Working Capital Estimation, Inventory Management: EOQ Problem.	

Text Books	
1.	M.Y. Khan, P.K. Jain, "Financial Management", McGraw Hill Education, 8th Edition, 2018.
2.	I. M. Pandey, "Financial Management", Vikas Publishing House, 2015.
Reference Books	
1.	S. Kapil, "Financial Management", Pearson Education, 2012.
2.	C. Prasanna, "Financial Management: Theory and Practice", McGraw Hill, 2017.
3.	S.N. Maheshwari, "Financial Management: Principles and Practice", Sultan Chand, LN, 2019.
4.	www.nptel.ac.in
5.	http://ocw.mit.edu

Human Resource Management	
Course Code: HMC-308 Contact Hours: L-2 T-0 P-0 Course Category: HMC	Credits: 2 Semester: 6

Introduction: This course focuses on issues and strategies required to select and develop manpower resources. The main objective of this course is to help the students to acquire and develop skill to design rational decisions in the discipline of human resource management.

Course Objective: The objective of this course is to make students familiar with the basic concepts of human resource management and people related issues.

- To enable the students to understand the HR Management and system at various levels in general and in certain specific industries or organizations.
- To help the students focus on and analyze the issues and strategies required to select and develop manpower resources.
- To develop relevant skills necessary for application in HR related issues.
- To enable the students to integrate the understanding of various HR concepts along with the domain concept in order to take correct business decisions.

Pre-requisite: None

Course Outcomes: After completion of the course, the students should be able to:

CO1: Develop an understanding of the concept of human resource management and to understand its relevance in organizations.
CO2: Develop necessary skill sets for application of various HR issues.
CO3: Analyze the strategic issues and strategies required to select and develop manpower resources.
CO4: Integrate the knowledge of HR concepts to make correct business decisions.

Pedagogy: The teaching pedagogy will be a blend of teaching and learning techniques including:

- Lectures and Case studies
- Project works and assignments
- Group works and Interactive discussions.

Contents

UNIT-I	7 Hours
Human Resource Management: Introduction to Concept and Functions of HRM, Role, Status and Competencies of HR Manager, HR Policies, Evolution of HRM. Emerging Challenges of Human Resource Management;	
UNIT-II	7 Hours
Human Resource Planning: Human Resource Planning- Quantitative and Qualitative dimensions; Recruitment – Concept and sources; (E-recruitment, recruitment process outsourcing etc.); Selection – Concept and process; test and interview; placement induction. Job analysis – job description and job specification.	

UNIT-III	7 Hours
Training and Development: Concept and Importance; Identifying Training and Development Needs; Designing Training Programs; Role Specific and Competency Based Training; Evaluating Training Effectiveness; Performance appraisal: nature and objectives; Modern Techniques of performance appraisal;	
UNIT-IV	7 Hours
Human Resource Development: Orientation Program; Requisite of an effective Program, Evaluation of Orientation Program. Strategic HRM: HRD audit, ethics and CSR.	

Text Books	
1.	G. Dessler. "A Framework for Human Resource Management", 15th Edition, Pearson Education, 2017.
2.	D. A. Decenzo, S. P. Robbins, S. L. Verhulst, "Human Resource Management", Wiley India Private Limited, 2015.
Reference Book	
1.	Bohlendar and Snell, "Principles of Human Resource Management", Cengage Learning, 2013.
2.	www.nptel.ac.in
3.	http://ocw.mit.edu