Babu Banarasi Das University, Lucknow

School of Engineering

Bachelor of Technology

Evaluation Scheme (First Year)

SEMESTER I									
Course Category	**Course Code**	**Code Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	BAS2101	Matrices and Calculus	3	1	0	40	60	**100**	**4**
C	BAS2102	Physics-I	2	1	0	40	60	**100**	**3**
Students need to select either GROUP 'A' or GROUP 'B'									
	GP2101	General Proficiency	-	-	-	100	-	**100**	**1**
Total			**5**	**2**	**0**	**180**	**120**	**300**	**8**

GROUP 'A'									
Course Category	**Course Code**	**Code Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
F	BME2101	Engineering Mechanics	3	1	0	40	60	**100**	**4**
F	BCS2101	Foundation of Information Technology	3	1	0	40	60	**100**	**4**
F	BEC2101	Basic Electronics Engineering	3	1	0	40	60	**100**	**4**
C	BAS2104	Environmental Studies	2	0	0	40	60	**100**	**2**
F	BME2151	Engineering Mechanics Lab	0	0	2	40	60	**100**	**1**
F	BCS2151	Foundation of Information Technology Lab	0	0	2	40	60	**100**	**1**
F	BME2152	Workshop Practice Lab	0	1	2	40	60	**100**	**2**

C	BAS2152	Physics-I Lab	0	0	2	40	60	**100**	**1**
Total			**11**	**4**	**8**	**320**	**480**	**800**	**19**

GROUP 'B'

Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
F	BEE2101	Basic Electrical Engineering	3	1	0	40	60	**100**	**4**
F	BME2102	Basic Mechanical Engineering	2	1	0	40	60	**100**	**3**
C	BAS2103	Chemistry	3	1	0	40	60	**100**	**4**
C	BHS2101	Professional Communication	3	1	0	40	60	**100**	**4**
F	BEE2151	Basic Electrical Engineering Lab	0	0	2	40	60	**100**	**1**
F	BME2153	Engineering Graphics Lab	0	1	2	40	60	**100**	**2**
C	BHS2151	Professional Communication Lab	0	0	2	40	60	**100**	**1**
C	BAS2153	Chemistry Lab	0	0	2	40	60	**100**	**1**
Total			**11**	**5**	**8**	**320**	**480**	**800**	**20**

SEMESTER II

Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	BAS2201	Differential Equations and Fourier Analysis	3	1	0	40	60	**100**	**4**
C	BAS2202	Physics-II	2	1	0	40	60	**100**	**3**
Students need to select either GROUP 'A' or GROUP 'B'									
	GP2201	General Proficiency	-	-	-	100	-	**100**	**1**
Total			**5**	**2**	**0**	**180**	**120**	**300**	**8**

Note: Students who have selected GROUP 'A' in the first semester will select GROUP 'B' in the second semester and Vice-Versa

GROUP 'A'									
Course Category	**Course Code**	**Code Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
F	BME2201	Engineering Mechanics	3	1	0	40	60	**100**	**4**
F	BCS2201	Foundation of Information Technology	3	1	0	40	60	**100**	**4**
F	BEC2201	Basic Electronics Engineering	3	1	0	40	60	**100**	**4**
C	BAS2204	Environmental Studies	2	0	0	40	60	**100**	**2**
F	BME2251	Engineering Mechanics Lab	0	0	2	40	60	**100**	**1**
F	BCS2251	Foundation of Information Technology Lab	0	0	2	40	60	**100**	**1**
F	BME2252	Workshop Practice	0	1	2	40	60	**100**	**2**
C	BAS2252	Physics-I Lab	0	0	2	40	60	**100**	**1**
Total			**11**	**4**	**8**	**320**	**480**	**800**	**19**

GROUP 'B'									
Course Category	**Course Code**	**Code Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
F	BEE2201	Basic Electrical Engineering	3	1	0	40	60	**100**	**4**
F	BME2202	Basic Mechanical Engineering	2	1	0	40	60	**100**	**3**
C	BAS2203	Chemistry	3	1	0	40	60	**100**	**4**
C	BHS2201	Professional Communication	3	1	0	40	60	**100**	**4**
F	BEE2251	Basic Electrical Engineering Lab	0	0	2	40	60	**100**	**1**
F	BME2253	Engineering Graphics	0	1	2	40	60	**100**	**2**

C	BHS2251	Professional Communication Lab	0	0	2	40	60	**100**	**1**
C	BAS2253	Chemistry Lab	0	0	2	40	60	**100**	**1**
Total			**11**	**5**	**8**	**320**	**480**	**800**	**20**

SYLLABUS

BCS2101/BCS2201 Foundation of Information Technology

Course Objective:

1. Study the basic concepts and functions of hardware and software.
2. Study the basic concepts and functions of operating system.
3. Study the basic concepts and functions of computer network.
4. Study the basic concepts and functions of Information Technology.
5. Study the basic concepts of C programming language.

Learning Outcome:

At the end of the course, the student should be able to:

1. An ability to understand the basics of computer hardware and software.
2. To understand the use of Information Technology in business.
3. To analyse and understand various types of software system.
4. An ability to understand operating system and its functions.
5. To analyse various computer networks.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Hardware and Software** Hardware, Software, Information technology, Types of computer: Mainframe computer, network computer, personal computer, laptop, personal digital assistant (PDA); Personal computer: Central processing unit (CPU), hard disk, common input or output devices, types of memory viz. RAM, ROM, peripheral device, computer performance. **Input Devices**: Mouse, keyboard, trackball, scanner, touchpad, light pen, joystick, digital camera and microphone. **Output Devices**: Monitors, screens, printers, plotters, speakers. **Input/output Devices:** Modems , touch screens. **Storage Devices**: Diskette, Zip disk, data cartridges, CD-ROM, internal, external hard disk: Disk formatting **Software:** Types Of Software: Operating systems software and application software, Software versions, Operating System : Functions and Types. Application Software: Word processing, spreadsheet and database, web browsing, desktop publishing and accounting Graphical User Interface (GUI), SDLC and its phases.	30 Hours	1
II	**Computer Network** Networks: LAN, WAN, client/server, sharing printers, applications, and files across a network. Intranet, Extranet, Internet and its uses, World Wide Web (WWW) The Telephone Network In Computing: Public Switched Telephone Network (PSTN), Integrated Services Digital	30 Hours	1

	Network (ISDN), Asymmetric Digital Subscriber Line (ADSL), Analog and digital modem and transfer rate.		
III	**Information Technology (IT)** Applications of IT: Applications in business such as: business administration systems, airline booking systems, insurance claims processing, online banking. Uses of large-scale computer applications in government such as: public records systems (census, vehicle registration), revenue collection, electronic voting. Applications in education such as: student registration and timetabling systems, computer-based training (CBT), distance learning, homework using the Internet. Electronic World: electronic mail, E-Commerce, concept of purchasing goods and services online, payment methods, advantages and disadvantages of purchasing goods and services online Health, safety and environment: Ergonomics, health issues, precautions, recycling printed outputs, recycling printer toner cartridges, using efficient monitor	30 Hours	1
IV	**Introduction to the C Language** Introduction to the C Language and its Advantages, C Program: Structure, Writing, Building an Executable Version, Debugging, and Running. Data Types and Variables, Operands, Operators, and Arithmetic Expressions, Control statements and loop structure.	30 Hours	1

Text/Reference Books:

1. D. S. Yadav, "Foundations of Information Technology", New Age International Pvt. Ltd.
2. Silberschatz, Galvin and Gagne, "Operating Systems Concepts", Wiley Publication
3. D M Dhamdhere, "Operating Systems: A Concept based Approach", TMH
4. Yashavant P. Kanetkar, "Let us C", BPB

BCS2151/BCS 2251 Foundation of Information Technology Lab

1) Run basic DOS commands.
2) Learn the use of Word Processor.
3) Learn the use of Excel.
4) Prepare presentation on any topic of your choice.
5) Write a C program to find sum of two numbers.
6) Write a C program to learn the function of FOR loop.
7) Write a C program to learn the function of WHILE/ DO WHILE loop.
8) Write a C program for pattern printing
9) Write a C program to print Fibonacci series.
10) Write a C program to find factorial and reverse of a number.

BEC2101/BEC2201 BASIC ELECTRONICS ENGINEERING

Course Objective:

This course provides
1. Comprehensive idea about basic electronics devices like Diodes, BJT, JFET, MOSFET, Operational Amplifier.
2. Fundamental principles of Electronic instruments like CRO and digital multimeter.
3. Fundamental principle of communication.

Learning Outcome:

At the end of the course students will be able to gain knowledge about the
1. Fundamentals of electronic devices like Diodes, BJT, JFET, MOSFET, Operational Amplifier and Electronic instruments like CRO and digital multimeter.
2. Number system, Boolean algebra, logic gates, Kaurnaugh map
3. Basics of communication systems.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**DIODES :** Energy band theory, Semiconductor material, PN junction: Forward and Reverse Bias characteristics, Diode as Rectifier: Half wave and Full wave Rectifiers, Breakdown Mechanism: Zener & Avalanche breakdown, Zener Diode and its application, LED, LCD, and Solar Cell.	30 Hours	1
II	**TRANSISTORS** Construction of Bipolar Junction Transistor: PNP and NPN, Working of Transistor, BJT configurations: CE, CB and CC, Input & Output characteristics of CB & CE configuration, Biasing: Fixed bias, Emitter bias, Potential divider bias, Comparison of biasing circuits. JFET: Basic construction and characteristics, Concept of pinch off, maximum drain saturation current, Input and transfer characteristics, Biasing: Self bias and fixed bias. MOSFET- Depletion and Enhancement type MOSFET- construction, operation and characteristics.	30 Hours	1
III	**DIGITAL ELECTRONICS AND COMMUNICATION SYSTEM** Number System, Complements, Boolean Algebra: Basic Theorems and De Morgan Theorems, Standard logic gates, Universal Logic Gates, Implementation of Boolean function using Basic gates and Universal gates, Reduction of Boolean function using K-Map upto4variables.	30 Hours	1

	Block Diagram of Communication System, Electromagnetic spectrum, Need for Modulation, Basic Definitions AM,FM,PM		
IV	**OPERATIONAL AMPLIFIER AND ELECTRONIC INSTRUMENTS** Introduction to OP-AMP, Characteristics of ideal OP-AMP, Basics of ideal and practical OP-AMP, Configurations: Open loop and closed loop, Applications of OP-AMP, Inverting amplifier , Non-inverting amplifier, Voltage follower, summing amplifier, Integrator and Differentiator. Introduction and Basic Principle of CRT, Block Diagram of CRO, Introduction and Basic Principle of Digital Multimeter	30 Hours	1

Text Books:

1. Robert L. Boylestad and Louis Nashelsky Electronic Devices and Circuit Theory,Pearson India.
2. Kennedy,Electronic Communication System,TMH
3. Kalsi H.S,,Electronic Instrumentation,TMH
4. M.Morris Mano,Digital Logic and Computer Design, PHI

Reference Books:

1. Jacob Millman, Christos C. Halkias, Integrated Electronics: Analog and Digital Circuits and Systems (McGraw-Hill electrical and electronic engineering series).
2. William D. Cooper, Albert D.Hefrick, Modern Electronic instrumentation and measurement technique 5th edition Prentice Hall Of India, New Delhi 1997.
3. Ramakant Gaikwad .Op –Amp's & linear Integrated Circuits, 4th edition, Prentice Hall of India, New Delhi 2002.
4. Albert Paul Malvino, Donald P Leach , Digital Principle & Application 4th edition, Tata McGraw –Hill Edition , New Delhi -1991.

BEE2101/BEE2201BASIC ELECTRICAL ENGINEERING

Course Objective:

1. This course provides comprehensive idea about circuit analysis.
2. The subject gives the knowledge about combinational circuits.
3. Subject gives the knowledge about the analysis and design of new electrical circuits.
4. Other logical working principles of machines and common Measuring instruments.

Learning Outcome:

At the end of the course students will be able.

1. Understand basic electrical engineering.
2. To understand the basic concepts of magnetic, AC & DC circuits.
3. To explain the working principle, construction, applications of DC & AC machines & measuring instruments.
4. To gain knowledge about the fundamentals of electric components, devices.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Electric Circuit:** Introduction to linear and nonlinear circuits, circuit elements, various sources and source transformation, Star delta transformation, solution of D.C. circuits using Kirchhoff's laws- Mesh Analysis and Nodal Analysis.Signal wave forms, Passive elements specifications. **Basic theorems:** Thevenin, Norton, Maximum Power, Superposition, Millman's Theorem, Tellegen's Theorem applied to DC networks.	30 Hours	1
II	**A. C. Circuits:** A.C. voltage and currents, average and r.m.s. values, Form factor and peak factor, Phasor representation of sinusoidal quantities, phasor in polar, rectangular and exponential forms. Analysis of single phase series, parallel and series-parallel circuits, Active & reactive and apparent power, p.f., Volt-amperes, frequency response and Q-factor. Analysis of balanced three phase a.c. circuits, Introductory concept, voltage, current and power in three phase balanced circuits. Star-delta connections. Measurement of three phase power by Wattmeter Method.	30 Hours	1

III	**Measuring Instruments & Electromagnetic and Transformer:** Types of instruments, construction, working principles & applications, PMMC, MI, Single phase dynamometer, Ammeter, Voltmeter, Wattmeter, Induction type Energy meter, Use of shunt and multiplier. Magnetic circuit concept, B-H curves characteristics of magnetic materials, Practical magnetic circuits. Magnetic circuits with D.C. and A.C. excitation, Hysteresis and eddy current losses, Magnetic force. Self and mutual inductances, Faraday`s laws, Lenz`s Law, Statically and dynamically induced emfs, Energy stored in magnetic fields. Principle of Transformer operation, emf equation, Equivalent circuit of transformer, Losses and efficiency, Introduction of Auto Transformer and its applications.	30 Hours	1
IV	**Electrical Machines:** Basic concepts of rotating electric machines, DC machines (motor and generator), working principle, types, EMF and torque equations characteristics and application of DC motor. Three phase induction motors, types, principle of operation, applications. Single phase induction motors, principle of operation, starting methods, applications. Synchronous machines (motor and generator), principle of operation and applications.	30 Hours	1

Text &Reference books:

1. 'Fundamental of Electric Circuits' by Charles K Alexander and Matthew N. O. Sadiku, Tata McGraw Hill Publication.
2. 'Electrical Engineering Fundamentals' by Vincent Del Toro, PHI Publication.
3. 'Electric Technology' by H Cotton, CBS Publishers and Distributors.
4. 'Basic Electrical Technology' by A.E. Fitzgerald, McGraw Hill Publication.
5. 'Basic Electrical Engineering' by Kothari and I.J. Nagrath, Tata McGraw Hill.
6. 'Basic Electrical Engineering'by S. N. Singh, PHI Publication.

BEE2151/BEE2251BASIC ELECTRICAL ENGINEERING LAB

(Any 10 experiments)

1. Verification of KCL & KVL.
2. Verification of Thevenin's theorem and Norton's theorem.
3. Verification of Superposition theorem.
4. Measurement of active and reactive power in 1-phase and Power Factor Improvement.
5. Measurement of active power in 3 -phase circuit using TWO wattmeter methods.
6. Study of transformer through assembling and polarity check.
7. Determination of equivalent circuit parameters of a single phase transformer by O.C. and S.C. tests and estimation of voltage regulation and efficiency at various loading conditions and verification by load test.
8. Study of dc shunt motor speed control using (1) Armature control (2) Field Control.
9. Determination of efficiency of DC shunts motor by load test.
10. Study of Electrical Equipment used in daily life.
11. Study of DC Machine.
12. Full wave rectifier circuit using diodes.
13. Transistor input-output characteristics.

ENGINEERING MECHANICS (BME2101/BME2201)

Course Objective:

1. To know how to apply laws of mechanics to actual engineering problems.

2. To calculate the reactive forces and analyse the structures.

3. To know the geometric properties of the different shapes& to learn energy and momentum methods.

4. To know the elastic properties of different bodies.

Learning Outcome:

At the end of the course student should be able to:

1. Solve the engineering problems in case of equilibrium and non- equilibrium conditions & solve the problems involving dry friction.

2. Calculate the reaction forces and forces in members of statically determinate structures.

3. Determine the centroid, centre of gravity and moment of inertia of various surfaces and solids &calculate the forces acting on the rigid body, structures using varying principles.

4. To find out the stress, strain and elastic properties of different bodies.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Two Dimensional Force Systems:** Basic concepts, Laws of motion, Principle of Transmissibility of forces, Transfer of a force to parallel position, Resultant of a force system, Simplest Resultant of Two dimensional concurrent Force systems, Simplest Resultant of Two dimensional Non-concurrent Force systems, Distributed force system, free body diagrams, Equilibrium and Equations of Equilibrium, Applications. **Friction**: Introduction, Laws of Coulomb Friction, Equilibrium of Bodies involving Dry friction, Belt friction, Application.	**30**	**1**
II	**Beam**: Introduction, Shear force and Bending Moment, Differential Equations for shear force & bending moment, Shear force and Bending Moment Diagrams for Statically Determinate Beams. **Trusses:** Introduction, Simple Truss and Solution of Simple truss, Method of	**30**	**1**

	Joints, Method of Sections.		
III	**Centroid and Moment of Inertia:** Introduction,Centroid of plane, curve, area, volume and composite bodies, Moment of inertia of plane area,Parallel Axes Theorem & Perpendicular axes theorem, Moment of inertia of composite bodies. **Kinematics and Kinetics:** Linear motion, Instantaneous center,D'Alembert principle, Rotation of rigid bodies, Impulse and momentum principle, Work and energy principle.	**30**	**1**
IV	**Simple Stress and Strain:** Normal and Shear stresses, Stress- Strain Diagrams for ductile and brittle material, Elastic Constants, One Dimensional Loading of members of varying cross-sections, Strain energy. **Pure Bending of Beams:** Simple Bending Theory, Stress in beams of different cross sections. **Torsion:** Torsion of shafts of circular section, Torque and twist, Shear stress due to torque.	**30**	**1**

Reference Books:

1. Engineering Mechanics by Irving H. Shames. Prentice-Hall.

2. Engineering Mechanics by S.S. Bhavikatti, K.G. Rajashekarappa, New Age Publications.

3. A textbook of Engineering Mechanics by Dr. R.K. Bansal, Laxmi Publications.

4. Mechanics of Solids by Abdul Mubeen, Pearson Education Asia.

5. Mechanics of Materials by E.P. Popov, Prentice Hall of India Private Limited.

BASIC MECHANICAL ENGINEERING (BME2102/BME2202)

Course Objective:

1. To learn the basic principles of classical thermodynamics.

2. To apply the laws of thermodynamics to various systems and analyze the significance of the results.

3. To learn the basic concepts of internal combustion engines.

Learning Outcome:

At the end of the course student should be able to:

1. Differentiate between closed and open systems and analyze related problems.

2. Apply the concept of first and second law to analyze thermodynamic systems.

3. Analyze the performance of IC engines and identify methods to improve the efficiency.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Fundamental Concepts and Definitions:** Definition of thermodynamics, Microscopic and Macroscopic approaches, Systems, surroundings and universe, Concept of continuum, Properties and state, Thermodynamic properties, Thermodynamic path, process and cycle, Thermodynamic equilibrium, Reversibility and irreversibility, Quasi static process, Work and heat, Zeroth law of thermodynamics, concept of temperature.	**30**	**1**
II	**First law of thermodynamics**: Thermodynamic processes, flow work, Joules' experiment, Internal energy and enthalpy, First law of thermodynamics applied to open systems, Steady flow systems and their analysis, Application of steady flow energy equation, Limitations of first law of thermodynamics, PMM-I. **Second law of thermodynamics:** Statement of second law, heat engine, heat pump and refrigerator,PMM- II, Efficiency of Carnot engine,Entropy, Clausius Inequality, definition of third law of thermodynamics.	**30**	**1**

III	**IC engines:** Classification of IC engines, engine terminology, Compression Ignition engines and Spark Ignition engines, Construction and working of two stroke and four stroke engines, Difference between SI and CI engines, difference between 2-stroke and 4-stroke engine, Efficiency of Otto cycle and diesel cycle.	**30**	**1**

Reference Books:

1. P.K. Nag, Basic and Applied Thermodynamics, Tata McGraw-Hill Publishing Company Ltd.

2. Yunus A. Cengel and M.A. Boles, Thermodynamics: An Engineering Approach, Tata McGraw- Hill Publishing Company Ltd.

3. C.P. Arora,Thermodynamics, Tata McGraw- Hill Publishing Company Ltd.

ENGINEERING MECHANICS LAB (BME2151/BME2251)

(Any 10 experiments of the following)

1. To conduct the tensile test and determine the ultimate tensile strength, percentage elongation for a steel specimen.
2. To determine the compression test and determine the ultimate compressive strength for aSpecimen.
3. To conduct the Impact-tests (Izod/Charpy) on Impact-testing machine to find the toughness.
4. To determine the hardness of the given specimen using Vickers/Brinell/Rockwell hardness testing machine.
5. Friction experiment(s) on inclined plane and/or on screw-jack.
6. Worm & worm-wheel experiment for load lifting.
7. Belt-Pulley experiment.
8. Bending of simply-supported and cantilever beams for theoretical & experimental deflection.
9. Torsion of rod/wire experiment.
10. Experiment on Trusses.
11. Statics experiment on equilibrium.
12. Experiment on Moment of Inertia.

WORKSHOP PRACTICE (BME2152/BME2252)

1. **Carpentry Shop:**Study of tools & operations and carpentry joints, Simple exercise using jack plane, to prepare half-lap corner joint, mortise &tennon joints, Simple exercise on wood working lathe.
2. **Fitting Bench Working Shop:** Study of tools & operations, Simple exercises involving fitting work,Make perfect male-female joint,Use of drills/taps idea.
3. **Black Smithy Shop:** Study of tools & operations, Simple exercises base on black smithy operations such as upsetting, drawing down, punching, bending, fullering& swaging.
4. **Welding Shop:** Study of tools & operations of Gas welding & Arc welding, Simple butt and Lap welded joints, Oxy-acetylene flame cutting.
5. **Sheet-metal Shop:** Study of equipment & operations, Making Funnel complete with 'soldering', Fabrication of tool-box, tray, electric panel box etc.
6. **Machine Shop:** Study of machine tools and operations, Plane turning, Step turning, Taper turning, Threading, Grinding of turning equipment.
7. **Foundry Shop:** Study of tools & operations, Pattern making,Mould making with the use of a core,Method of material pouring and Casting.

ENGINEERING GRAPHICS LAB (BME2153/BME2253)

1. **Scales**: Representative factor, plain scales, diagonal scales, scales of chords.
2. **Projection**: Types of projection, orthographic projection, first and third angle projection.
3. **Projection of points:** The principle of orthographic projections of a point on HP and VP, Conventional representation, Projection of a point in all the quadrants.
4. **Projection of Lines:** Line inclined to one plane, inclined with both the plane, True Length and True Inclination, Traces of straight lines.
5. **Projection of planes and solids**: Projection of Planes like circle and polygons in different positions; Projection of polyhedrons like prisms, pyramids and solids of revolutions like cylinder, cones in different positions.
6. **Section of Solids:** Section of right solids by normal and inclined planes; Intersection of cylinders.
7. **Isometric Projections:** Isometric scale, Isometric axes, Isometric Projection from orthographic drawing.
8. **Perspective Projection:** Nomenclature of Perspective Projection, Method of drawing perspective views, Visual Ray Method, using Top and Front, Top and Side views.
9. **Computer Aided Drafting (CAD)**-I: Introduction, benefit, software's basic commands of drafting entities like line, circle, polygon, polyhedron, cylinders.
10. **Computer Aided Drafting (CAD)**-II: Transformations and editing commands like move, rotate, mirror, array; solution of projection problems on CAD.

Reference Books:

1. Computer Aided Engineering Drawing by S.Trymbaka Murthy, I.K. International Publishing House Pvt. Ltd., New Delhi, 3rd revised edition-2006.
2. Engineering Graphics by K.R.Gopalakrishna, 32nd edition, 2005, Subash Publishers Bangalore.

Effective from Session 2015-16
Babu Banarasi Das University, Lucknow
Department of Mechanical Engineering
School of Engineering
Bachelor of Technology
Evaluation Scheme

Semester III									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
C	BHS2301/ BHS2302	Industrial Psychology / Industrial Sociology	2	0	0	40	60	100	2
C	BAS2301	Complex Analysis & Integral Transform	3	1	0	40	60	100	4
C	BME2301	Materials Science	3	1	0	40	60	100	4
C	BME2302	Strength of Materials	3	1	0	40	60	100	4
C	BME2303	Manufacturing Science- I	2	1	0	40	60	100	3
C	BCE2302	Fluid Mechanics	3	1	0	40	60	100	4
C	BME2351	Material Science & Testing Lab	0	0	2	40	60	100	1
C	BME2352	Machine Drawing-I	0	0	2	40	60	100	1
C	BME2353	Manufacturing Science- I Lab	0	0	2	40	60	100	1
C	BCE2352	Fluid Mechanics Lab	0	0	2	40	60	100	1
	GP2301	General Proficiency	-	-	-	100	-	100	1
Total			16	5	8	500	600	1100	26

Legends:

L	Number of Lecture Hours per week
T	Number of Tutorial Hours per week
P	Number of Practical Hours per week
CIA	Continuous Internal Assessment
ESE	End Semester Examination

Category of Courses:

F	Foundation Course
C	Core Course
GE	Generic Elective
OE	Open Elective

Babu Banarasi Das University, Lucknow

Department of Mechanical Engineering
School of Engineering
Bachelor of Technology
Evaluation Scheme

Semester IV									
Course Category	**Course Code**	**Code Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	**BHS2401/ BHS2402**	Industrial Psychology / Industrial Sociology	**2**	**0**	**0**	**40**	**60**	**100**	**2**
C	**BME2401**	Applied Thermodynamics	**3**	**1**	**0**	**40**	**60**	**100**	**4**
C	**BME2402**	Manufacturing Science-II	**3**	**1**	**0**	**40**	**60**	**100**	**4**
C	**BME2403**	Measurement Metrology & Control	**3**	**1**	**0**	**40**	**60**	**100**	**4**
C	**BAS2401**	Statistical & Numerical Techniques	**2**	**1**	**0**	**40**	**60**	**100**	**3**
C	**BCS2405**	Programming in 'C'	**3**	**1**	**0**	**40**	**60**	**100**	**4**
C	**BME2451**	Machine Drawing-II	**0**	**0**	**2**	**40**	**60**	**100**	**1**
C	**BME2452**	Manufacturing Science-II Lab	**0**	**0**	**2**	**40**	**60**	**100**	**1**
C	**BME2453**	Measurement & Metrology Lab	**0**	**0**	**2**	**40**	**60**	**100**	**1**
C	**BCS2455**	'C'- Programming Lab	**0**	**0**	**2**	**40**	**60**	**100**	**1**
	GP2401	General Proficiency	**-**	**-**	**-**	**100**	**-**	**100**	**1**
Total			**16**	**5**	**8**	**500**	**600**	**1100**	**26**

Legends:

L	Number of Lecture Hours per week
T	Number of Tutorial Hours per week
P	Number of Practical Hours per week
CIA	Continuous Internal Assessment
ESE	End Semester Examination

Category of Courses:

F	Foundation Course
C	Core Course
GE	Generic Elective
OE	Open Elective

Babu Banarasi Das University, Lucknow

Department of Mechanical Engineering
School of Engineering
Bachelor of Technology
Evaluation Scheme

Semester V									
Course Category	**Course Code**	**Code Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	**BHS2501**	Engineering and Managerial Economics	**3**	**0**	**0**	**40**	**60**	**100**	**3**
C	**BME2501**	Machine Design-I	**2**	**1**	**0**	**40**	**60**	**100**	**3**
C	**BME2502**	Theory of Machines-I	**3**	**1**	**0**	**40**	**60**	**100**	**4**
C	**BEE2505**	Electrical Machines	**2**	**1**	**0**	**40**	**60**	**100**	**3**
C	**BME2503**	Heat & Mass Transfer	**3**	**1**	**0**	**40**	**60**	**100**	**4**
C	**BME2504**	I.C. Engines &Compressors	**3**	**1**	**0**	**40**	**60**	**100**	**4**
C	**BME2551**	Machine Design-I Lab	**0**	**0**	**2**	**40**	**60**	**100**	**1**
C	**BME2553**	Heat & Mass Transfer Lab	**0**	**0**	**2**	**40**	**60**	**100**	**1**
C	**BEE2555**	Electrical Machines & Automatic control Lab	**0**	**0**	**2**	**40**	**60**	**100**	**1**
C	**BME2558**	Seminar	**0**	**0**	**2**	**40**	**60**	**100**	**1**
	GP2501	General Proficiency	**-**	**-**	**-**	**100**	**-**	**100**	**1**
Total			**16**	**5**	**8**	**500**	**600**	**1100**	**26**

Legends:

L	Number of Lecture Hours per week
T	Number of Tutorial Hours per week
P	Number of Practical Hours per week
CIA	Continuous Internal Assessment
ESE	End Semester Examination

Category of Courses:

F	Foundation Course
C	Core Course
GE	Generic Elective
OE	Open Elective

Babu Banarasi Das University, Lucknow

Department of Mechanical Engineering
School of Engineering
Bachelor of Technology
Evaluation Scheme

Semester VI									
Course Category	Course Code	Code Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
C	BHS2601	Industrial Management	2	1	0	40	60	100	3
C	BME2603	Machine Design-II	3	1	0	40	60	100	4
C	BME2601	Theory of Machine- II	2	1	0	40	60	100	3
C	BME2602	Refrigeration & Air-conditioning	3	1	0	40	60	100	4
C	BME2604	Advanced Welding Technology	2	1	0	40	60	100	3
GE		Generic Elective-I	3	1	0	40	60	100	4
C	BME2653	Fluid Machinery Lab	0	0	2	40	60	100	1
C	BME2652	Refrigeration & Air Conditioning Lab	0	0	2	40	60	100	1
C	BME2651	Theory of Machines Lab	0	0	2	40	60	100	1
C	BME2658	Seminar	0	0	2	40	60	100	1
	GP2601	General Proficiency	-	-	-	100	-	100	1
Total			15	6	8	500	600	1100	26

Note- Student needs to undergo 4-6 weeks of industrial training that will be evaluated in 7thSemester.

Legends:

L	Number of Lecture Hours per week
T	Number of Tutorial Hours per week
P	Number of Practical Hours per week
CIA	Continuous Internal Assessment
ESE	End Semester Examination

Category of Courses:

F	Foundation Course
C	Core Course
GE	Generic Elective
OE	Open Elective

Babu Banarasi Das University, Lucknow

Department of Mechanical Engineering
School of Engineering
Bachelor of Technology
Evaluation Scheme

Semester VII									
Course Category	**Course Code**	**Code Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	**BME2701**	Computer Aided Design	**3**	**1**	**0**	**40**	**60**	**100**	**4**
C	**BME2702**	Automobile Engineering	**3**	**1**	**0**	**40**	**60**	**100**	**4**
GE		Generic Elective-II	**3**	**1**	**0**	**40**	**60**	**100**	**4**
GE		Generic Elective-III	**3**	**1**	**0**	**40**	**60**	**100**	**4**
OE		Open Elective-I*	**-**	**-**	**-**	**40**	**60**	**100**	**4**
C	**BME2751**	CAD/CAM Lab	**0**	**0**	**2**	**40**	**60**	**100**	**1**
C	**BME2752**	Automobile Lab	**0**	**0**	**2**	**40**	**60**	**100**	**1**
C	**BME2759**	ProjectI#	**0**	**0**	**2**	**100**	**0**	**100**	**1**
C	**BME2757**	Industrial Training Evaluation	**0**	**0**	**2**	**100**	**0**	**100**	**1**
	GP2701	General Proficiency	**-**	**-**	**-**	**100**	**-**	**100**	**1**
Total			**12**	**4**	**8**	**580**	**420**	**1000**	**25**

***** Student will select any one of the open elective from the list of open electives provided by the university.

Student need to submit an abstract for the project, select the Guide and will complete at least 20% of the Project work.

Legends:

L	Number of Lecture Hours per week
T	Number of Tutorial Hours per week
P	Number of Practical Hours per week
CIA	Continuous Internal Assessment
ESE	End Semester Examination

Category of Courses:

F	Foundation Course
C	Core Course
GE	Generic Elective
OE	Open Elective

Babu Banarasi Das University, Lucknow

Department of Mechanical Engineering
School of Engineering
Bachelor of Technology
Evaluation Scheme

Semester VIII									
Course Category	**Course Code**	**Code Title**	**Contact Hours**			**Evaluation Scheme**			**Credits**
			L	**T**	**P**	**CIA**	**ESE**	**Course Total**	
C	**BME2801**	Power Plant Engineering	**3**	**1**	**0**	**40**	**60**	**100**	**4**
GE		Generic Elective-IV	**3**	**1**	**0**	**40**	**60**	**100**	**4**
GE		Generic Elective-V	**3**	**1**	**0**	**40**	**60**	**100**	**4**
OE		Open Elective-II **	**-**	**-**	**-**	**40**	**60**	**100**	**4**
C	**BME2859**	Project II##	**0**	**0**	**16**	**160**	**240**	**400**	**8**
	GP2801	General Proficiency	**-**	**-**	**-**	**100**	**-**	**100**	**1**
Total			**9**	**3**	**16**	**420**	**480**	**900**	**25**

** Student will select any one of the open elective from the list of open electives provided by the university. The opted Subject should be different from the one selected in Semester VII.

This is in continuation with the Project work started in Semester VII. In this semester student will complete the Project.

Legends:

L	Number of Lecture Hours per week
T	Number of Tutorial Hours per week
P	Number of Practical Hours per week
CIA	Continuous Internal Assessment
ESE	End Semester Examination

Category of Courses:

F	Foundation Course
C	Core Course
GE	Generic Elective
OE	Open Elective

Babu Banarasi Das University, Lucknow

Department of Mechanical Engineering
School of Engineering
Bachelor of Technology
Evaluation Scheme

Credit Summary Chart

Course Category	Semester								Total Credits	%age
	I	II	III	IV	V	VI	VII	VIII		
F	10	16							**26**	**12.44%**
C	17	10	25	25	25	21	12	12	**147**	**70.33%**
GE						4	8	8	**20**	**9.57%**
OE							4	4	**8**	**3.83%**
GP	1	1	1	1	1	1	1	1	**8**	**3.83%**
Total	28	27	26	26	26	26	25	25	**209**	**100.00%**

Discipline wise Credit Summary Chart

Course Category	Semester								Total Credits	%age
	I	II	III	IV	V	VI	VII	VIII		
Basic Sciences	11	11	4	3					**30**	**13.88%**
Humanities & Social Sciences		5	2	2	3	3			**15**	**7.18%**
Engineering Sciences	16	10							**26**	**12.44%**
Professional Subject - Core			19	20	21	17	10	4	**91**	**43.54%**
Professional Subject – Generic Elective						4	8	8	**20**	**9.57%**
Professional Subject – Open Elective							4	4	**8**	**3.83%**
Project Work, Seminar and/or Internship in Industry or elsewhere	1	1	1	1	2	2	3	9	**20**	**9.57%**
Total	28	27	26	26	26	26	25	25	**209**	**100.00%**

Babu Banarasi Das University, Lucknow

Department of Mechanical Engineering
School of Engineering
Bachelor of Technology
Evaluation Scheme

List of Generic Electives

S.N.	Course Code	Generic Elective-I
1	BME2011	Fluid Machinery
2	BME2012	Unconventional Manufacturing Processes
3	BME2013	Product Development & Design

S.N.	Course Code	Generic Elective-II
1	BME2021	Reliability Engineering
2	BME2022	Non-Destructive Testing
3	BME2023	Design of Thermal Systems

S.N.	Course Code	Generic Elective-III
1	BME2031	Mechanical Vibrations
2	BME2032	Operations Research
3	BME2033	Maintenance Engineering & Management

S.N.	Course Code	Generic Elective-IV
1	BME2041	Advanced Synthesis of Mechanisms
2	BME2042	Six Sigma Methods & Applications
3	BME2043	Finite Element Method

S.N.	Course Code	Generic Elective-V
1	BME2051	Advanced Materials Technology
2	BME2052	Production & Operations Management
3	BME2053	Optimization Techniques in Engineering

Babu Banarasi Das University, Lucknow

Department of Mechanical Engineering
School of Engineering
Bachelor of Technology
Evaluation Scheme

List of Open Electives Offered by the Department

S.N.	Course Code	Open Electives	L	T	P
1	**OME2001**	Quality management	**3**	**1**	**0**
2	**OME2002**	Product development	**3**	**1**	**0**

ENGINEERING MECHANICS (BME2101/BME2201)

Course Objective:

1. To know how to apply laws of mechanics to actual engineering problems.

2. To calculate the reactive forces and analyse the structures.

3. To know the geometric properties of the different shapes & to learn energy and momentum methods.

4. To know the elastic properties of different bodies.

Learning Outcome:

At the end of the course student should be able to:

1. Solve the engineering problems in case of equilibrium and non- equilibrium conditions & solve the problems involving dry friction.

2. Calculate the reaction forces and forces in members of statically determinate structures.

3. Determine the centroid, centre of gravity and moment of inertia of various surfaces and solids &calculate the forces acting on the rigid body, structures using varying principles.

4. To find out the stress, strain and elastic properties of different bodies.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Two Dimensional Force Systems:** Basic concepts, Laws of motion, Principle of Transmissibility of forces, Transfer of a force to parallel position, Resultant of a force system, Simplest Resultant of Two dimensional concurrent Force systems, Simplest Resultant of Two dimensional Non-concurrent Force systems, Distributed force system, free body diagrams, Equilibrium and Equations of Equilibrium, Applications. **Friction**: Introduction, Laws of Coulomb Friction, Equilibrium of Bodies involving Dry friction, Belt friction, Application.	**30**	**1**
II	**Beam**: Introduction, Shear force and Bending Moment, Differential Equations for shear force & bending moment, Shear force and Bending Moment Diagrams for Statically Determinate Beams. **Trusses:**	**30**	**1**

	Introduction, Simple Truss and Solution of Simple truss, Method of Joints, Method of Sections.		
III	**Centroid and Moment of Inertia:** Introduction, Centroid of plane, curve, area, volume and composite bodies, Moment of inertia of plane area,Parallel Axes Theorem & Perpendicular axes theorem, Moment of inertia of composite bodies. **Kinematics and Kinetics:** Linear motion, Instantaneous center, D'Alembert principle, Rotation of rigid bodies, Impulse and momentum principle, Work and energy principle.	**30**	**1**
IV	**Simple Stress and Strain:** Normal and Shear stresses, Stress- Strain Diagrams for ductile and brittle material, Elastic Constants, One Dimensional Loading of members of varying cross-sections, Strain energy. **Pure Bending of Beams:** Simple Bending Theory, Stress in beams of different cross sections. **Torsion:** Torsion of shafts of circular section, Torque and twist, Shear stress due to torque.	**30**	**1**

Reference Books:

1. Engineering Mechanics by Irving H. Shames. Prentice-Hall.

2. Engineering Mechanics by S.S. Bhavikatti, K.G. Rajashekarappa, New Age Publications.

3. A textbook of Engineering Mechanics by Dr. R.K. Bansal, Laxmi Publications.

4. Mechanics of Solids by Abdul Mubeen, Pearson Education Asia.

5. Mechanics of Materials by E.P. Popov, Prentice Hall of India Private Limited.

BASIC MECHANICAL ENGINEERING (BME2102/BME2202)

Course Objective:

1. To learn the basic principles of classical thermodynamics.

2. To apply the laws of thermodynamics to various systems and analyze the significance of the results.

3. To learn the basic concepts of internal combustion engines.

Learning Outcome:

At the end of the course student should be able to:

1. Differentiate between closed and open systems and analyze related problems.

2. Apply the concept of first and second law to analyze thermodynamic systems.

3. Analyze the performance of IC engines and identify methods to improve the efficiency.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Fundamental Concepts and Definitions:** Definition of thermodynamics, Microscopic and Macroscopic approaches, Systems, surroundings and universe, Concept of continuum, Properties and state, Thermodynamic properties, Thermodynamic path, process and cycle, Thermodynamic equilibrium, Reversibility and irreversibility, Quasi static process, Work and heat, Zeroth law of thermodynamics, concept of temperature.	**30**	**1**
II	**First law of thermodynamics**: Thermodynamic processes, flow work, Joules' experiment, Internal energy and enthalpy, First law of thermodynamics applied to open systems, Steady flow systems and their analysis, Application of steady flow energy equation, Limitations of first law of thermodynamics, PMM-I. **Second law of thermodynamics:** Statement of second law, heat engine, heat pump and refrigerator, PMM- II, Efficiency of Carnot engine, Entropy, Clausius Inequality, definition of third law of thermodynamics.	**30**	**1**

III	**IC engines:** Classification of IC engines, engine terminology, Compression Ignition engines and Spark Ignition engines, Construction and working of two stroke and four stroke engines, Difference between SI and CI engines, difference between 2-stroke and 4-stroke engine, Efficiency of Otto cycle and diesel cycle.	**30**	**1**

Reference Books:

1. P.K. Nag, Basic and Applied Thermodynamics, Tata McGraw-Hill Publishing Company Ltd.

2. Yunus A. Cengel and M.A. Boles, Thermodynamics: An Engineering Approach, Tata McGraw- Hill Publishing Company Ltd.

3. C.P. Arora,Thermodynamics, Tata McGraw- Hill Publishing Company Ltd.

ENGINEERING MECHANICS LAB (BME2151/BME2251)

(Any 10 experiments of the following)

1. To conduct the tensile test and determine the ultimate tensile strength, percentage elongation for a steel specimen.
2. To determine the compression test and determine the ultimate compressive strength for a Specimen.
3. To conduct the Impact-tests (Izod/Charpy) on Impact-testing machine to find the toughness.
4. To determine the hardness of the given specimen using Vickers/Brinell/Rockwell hardness testing machine.
5. Friction experiment(s) on inclined plane and/or on screw-jack.
6. Worm & worm-wheel experiment for load lifting.
7. Belt-Pulley experiment.
8. Bending of simply-supported and cantilever beams for theoretical & experimental deflection.
9. Torsion of rod/wire experiment.
10. Experiment on Trusses.
11. Statics experiment on equilibrium.
12. Experiment on Moment of Inertia.

WORKSHOP PRACTICE (BME2152/BME2252)

1. **Carpentry Shop:** Study of tools & operations and carpentry joints, Simple exercise using jack plane, to prepare half-lap corner joint, mortise & tennon joints, Simple exercise on wood working lathe.
2. **Fitting Bench Working Shop:** Study of tools & operations, Simple exercises involving fitting work, Make perfect male-female joint, Use of drills/taps idea.
3. **Black Smithy Shop:** Study of tools & operations, Simple exercises base on black smithy operations such as upsetting, drawing down, punching, bending, fullering & swaging.
4. **Welding Shop:** Study of tools & operations of Gas welding & Arc welding, Simple butt and Lap welded joints, Oxy-acetylene flame cutting.
5. **Sheet-metal Shop:** Study of equipment & operations, Making Funnel complete with 'soldering', Fabrication of tool-box, tray, electric panel box etc.
6. **Machine Shop:** Study of machine tools and operations, Plane turning, Step turning, Taper turning, Threading, Grinding of turning equipment.
7. **Foundry Shop:** Study of tools & operations, Pattern making, Mould making with the use of a core, Method of material pouring and Casting.

ENGINEERING GRAPHICS LAB (BME2153/BME2253)

1. **Scales**: Representative factor, plain scales, diagonal scales, scales of chords.
2. **Projection**: Types of projection, orthographic projection, first and third angle projection.
3. **Projection of points:** The principle of orthographic projections of a point on HP and VP, Conventional representation, Projection of a point in all the quadrants.
4. **Projection of Lines:** Line inclined to one plane, inclined with both the plane, True Length and True Inclination, Traces of straight lines.
5. **Projection of planes and solids**: Projection of Planes like circle and polygons in different positions; Projection of polyhedrons like prisms, pyramids and solids of revolutions like cylinder, cones in different positions.
6. **Section of Solids:** Section of right solids by normal and inclined planes; Intersection of cylinders.
7. **Isometric Projections:** Isometric scale, Isometric axes, Isometric Projection from orthographic drawing.
8. **Perspective Projection:** Nomenclature of Perspective Projection, Method of drawing perspective views, Visual Ray Method, using Top and Front, Top and Side views.
9. **Computer Aided Drafting (CAD)-**I: Introduction, benefit, software's basic commands of drafting entities like line, circle, polygon, polyhedron, cylinders.
10. **Computer Aided Drafting (CAD)-**II: Transformations and editing commands like move, rotate, mirror, array; solution of projection problems on CAD.

Reference Books:

1. Computer Aided Engineering Drawing by S.Trymbaka Murthy, I.K. International Publishing House Pvt. Ltd., New Delhi, 3rd revised edition-2006.
2. Engineering Graphics by K.R. Gopalakrishna, 32nd edition, 2005, Subash Publishers Bangalore.

MATERIAL SCIENCE (BME2301)

Course Objective:

1. The main objective of this course is to provide the basic knowledge needed to explore the discipline of materials science and engineering. To introduce the concepts of structure-property relationships.

2. To develop the knowledge of how the structure of materials is described technically, including crystallography, microstructure, defects, and phase diagrams. To develop knowledge in various class of materials and their applications.

3. To develop the knowledge of how the properties of materials are described technically and how material failure is analyzed.

Learning Outcome:

At the end of the course student should be able to:

1. Understand how materials are formed and their classification based on atomic arrangement.

2. Describe the mechanical behaviour of metallic systems and its importance.

3. Evaluate system for fatigue failures. Gain knowledge on different class of materials and their applications.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction:** Historical perspective, importance of materials. **Crystallography and Imperfections :** Concept of unit cell space lattice, Bravais lattices, Common crystal structures, Atomic packing factor and density, Miller indices, X-ray crystallography techniques, Imperfections, Defects & Dislocations in solids. **Mechanical properties and Testing:** Stress strain diagram, Ductile & brittle material, Stress vs. strength, Toughness, Hardness, Fracture Fatigue and Creep, Testing's such as Strength testing's, Hardness testing, Impact testing's, Fatigue testing, Creep testing, Non-destructive testing (NDT). **Microstructural Exam:** Pantograph, Microscope principle and methods, Preparation of samples and Microstructure exam and grain size determination, Comparative study of microstructure of various metals & alloys such as Mild	**30**	**1**

	steel, CI, Brass.		
II	**Phase Diagram and Equilibrium Diagram:** Unary and Binary diagrams, Phase rules, Types of equilibrium diagrams: Solid solution type, eutectic type and combination type, Iron-carbon equilibrium diagram. **Ferrous materials:** Non-Ferrous metals and alloys: Non-ferrous metals such as Cu, Al, Zn, Cr, Ni and its applications, Various type Brass, Bronze, bearing materials, its properties and uses. Aluminum alloys such as Duralumin, Brief introduction of iron and steel making furnaces, Various types of carbon steels, alloy steels and cast irons, its properties and uses. **Heat Treatment:** Various types of heat treatment such as Annealing, Normalizing, Quenching, Tempering and Case hardening, Time Temperature Transformation (TTT) diagrams. **Non-Ferrous metals and alloys:** Non- ferrous metals such as Cu, Al, Zn, Cr, Ni etc. and its applications. Various type Brass, Bronze, bearing materials, its properties. Aluminum alloys such as Duralumin.	**30**	**1**
III	**Magnetic properties :** Concept of magnetism: Dia, Para, Ferro Hysteresis. Soft and hard magnetic materials, Magnetic storages, Electric properties: Energy band concept of conductor, insulator and semi-conductor, Intrinsic & Extrinsic semi-conductors: P-n junction and transistors, Basic devices and its application. Diffusion of Solid. Super conductivity and its applications. Messier effect. Type I& II superconductors. High TC superconductors. **Ceramics:** Structure types and properties and applications of ceramics, Mechanical/Electrical behavior and processing of Ceramics. **Plastic:** Various types of polymers/plastics and its applications, Mechanical behavior and processing of plastics. Future of plastics.	**30**	**1**

Reference Books:

1. W. D. Callister, Jr. - Material Science & Engineering Addition-Wesley Publication.

2. K.M.Gupta, Materials Science, Umesh Publication.

3. Van Vlash – Elements of Material Science & Engineering John Wiley & Sons.

4. V. Raghvan – Material Science, Prentice Hall.

5. Narula –Material Science, TMH.

6. Srivastava, Srinivasan Science of Materials Engineering, New Age Publication.

STRENGTH OF MATERIALS (BME2302)

Course Objective:

1. To develop the relationship between the loads applied to a non-rigid body and the internal stresses and deformations induced in the body.
2. To study the general state of stresses and strains in a given loaded member and the magnitude and direction of the principal stresses.
3. To understand the different approaches to calculate slope and deflection for various types of beams.
4. To analyse the columns with different edge conditions by using different theories.

Learning Outcome:

At the end of the course student should be able to:

1. Apply concepts of strength of materials to obtain solutions to real time Engineering problems.
2. Able to analyse the different types of loading and the consequent deflection.
3. To apply various methods of deflection of beams under different type of loading
4. To analyse material failure.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Compound stress and strains:** Introduction, state of plane stress, Principal stress and strain, Mohr's stress circle. **Theory of failure, Casting lion's Theorem, Impact load:** Generalized Hook's Law, Theories of Failure, Castigliano's Theorem, Impact load & stresses.	**30**	**1**
II	**Stresses in Beams:** Review of pure Bending**,** Direct and shear stresses in beams due to transverse load, Direct and shear stresses in beams due to axial load, Composite beams. **Deflection of Beams:** Equation of elastic curve, Cantilever and simply supported beams, Macaulay's method, Area moment method, Fixed and continuous beams. **Torsion:** Review of torsion, Combined bending & torsion of solid & hollow shafts.	**30**	**1**

III	**Helical and Leaf Springs:** Deflection of springs by energy method, Helical springs under axial load and under axial twist,(respectively for circular and square cross sections), Axial load and twisting moment acting simultaneously both for open and closed coiled springs, Laminated springs. **Columns and Struts:** Combined bending and direct stress, Middle third and middle quarter rules, Struts with different end conditions, Euler's theory and experimental results, Ranking Gardon Formulae. **Thin cylinders & spheres:** Hoop and axial stresses and strain, Volumetric strain. **Thick cylinders:** Radial, axial and circumferential stresses in thick cylinders subjected to internal or external pressures, Compound cylinder, stresses due to interference fits.	**30**	**1**
IV	**Curved Beams:** Bending of beams with large initial curvature, Position of neutral axis for rectangular, trapezoidal and circular cross sections, Stress in crane hooks, circular rings subjected to tension or compression. **Unsymmetrical Bending:** Properties of beam cross-section slope of neutral axis, Stress and deflection in unsymmetrical bending, Determination of shear center and flexural axis (for symmetry about both axis and about one axis) for I-section and channel- section.	**30**	**1**

Reference Books:

1. S.S. Rattan (2011) Strength of material Tata McGraw Hill Education.

2. S.P. Timoshenko and D.H. Young (2011), Strength of Materials, 5th edition, East West Press Ltd.

3. R.K. Bansal (2010), Strength of Materials, 5th Edition, Laxmi Publications.

MANUFACTURING SCIENCE- I (BME2303)

Course Objective:

1. To acquire basic knowledge about the behavior and manufacturing properties of engineering materials and concepts of foundry and casting processes.
2. To acquire knowledge about various methods of welding, cold and hot working and forming.
3. To understand forging, Moulding and powder metallurgy processes in detail and application of these in manufacture of a product.

Learning Outcome:

At the end of the course student should be able to:

1. Use the principles of foundry and casting.
2. Choose materials in a manufacturing process based on their properties.
3. Conduct experiments on various manufacturing processes.
4. Demonstrate an ability to solve engineering problems in welding and powder metallurgy processes.
5. Choose correct manufacturing process for a particular engineering application.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction:** Importance of manufacturing, Economic & technological considerations in manufacturing, Classification of manufacturing processes, Materials & manufacturing processes for common items. **Metal Forming Processes:** Elastic & plastic deformation, yield criteria, Hot working vs. cold working, Analysis (equilibrium equation method) of forging process for load estimation with sliding friction, Sticking friction and mixed condition for slab and disc. Work required for forging, hand, Power, Drop Forging.	**30**	**1**
II	Analysis of wire / strip drawing and maximum reduction, Tube drawing, Extrusion and its application, Rolling and rolled section, condition for rolling force and power in rolling, Defects in metal forming processes.	**30**	**1**
III	**Sheet Metal working:** Presses and their classification Die & punch assembly	**30**	**1**

	and press work methods and processes, Cutting/Punching mechanism, blanking vs. Piercing, Compound vs. Progressive die, Flat-face vs. Inclined-face punch and Load (capacity) needed, Analysis of forming process like cup/deep drawing, Bending & spring-back. **Powder Metallurgy :** Powder metallurgy manufacturing process, The need, process, advantage and applications.		
IV	**Casting (Foundry):** Basic principle & survey of casting processes, Types of patterns and allowances, Types and properties of Moulding sand, Elements of mould and design considerations, Gating, Riser, Runners, Core, Solidification of casting, Sand casting, defects, remedies and inspection, Cupola furnace, Die Casting, Centrifugal casting, Investment casting, CO2 casting. **Jigs & Fixtures:** Locating & Clamping devices & principles, Jigs and Fixtures and its applications.	**30**	**1**

Reference Books:

1. Manufacturing Science by Ghosh and Mallik, Prentice Hall PTR.

2. Production Engg. Science by P.C. Pandey, Standard Publishers Distributors.

3. Production Technology by R.K. Jain, Khanna Publishers.

4. Manufacturing Technology by P.N. Rao, TMH.

5. Materials and Manufacturing by Paul Degarmo, Prentice Hall.

6. Manufacturing Science by K. M. Moeed, Umesh Publication.

7. Manufacturing Engineering & Technology by Kalpaksjian, Pearson Publication.

MATERIAL SCIENCE & TESTING LAB (BME2351)

(A) Material Science Lab Experiments:

(Say, min 5 **experiments** out of the following)

1. Making a plastic mould for small metallic specimen.

2. Specimen preparation for micro structural examination-cutting, grinding, polishing, etching.

3. Grain Size determination of a given specimen.

4. Comparative study of micro structures of different given specimens (mild steel, gray C.I., brass, copper etc.)

5. Heat treatment experiment such as annealing, normalizing, quenching, case hardening and comparison of hardness before and after.

6. Material identification of say 50 common items kept in a box.

7. Faradays law of electrolysis experiment.

8. Study of corrosion and its effects.

9. Study of microstructure of welded component and HAZ. Macro & Micro Examination.

10. Suitable experiment on Magnetic/Electrical/Electronic materials.

(B). Material Testing Lab Experiments:

(Say, min 5 **experiments** out of the following)

1. Strength testing of a given mild steel specimen on UTM with full details and s-e plot on the machine.

2. Shear bend tests on UTM.

3. Impact testing on impact testing machine like Charpy, Izod or both.

4. Hardness testing of given specimen using Rockwell and Vickers/Brinell testing machines.

5. Spring index testing on spring testing machine.

6. Fatigue testing on fatigue testing machine.

7. Creep testing on creep testing machine.

8. Deflection of beam experiment, comparison of actual measurement of deflection with dial gauge to the calculated one, and or evaluation of young's modulus of beam.

9. Torsion testing of a rod on torsion testing machine.

10. Study of non-destructive testing methods like magnetic flaw detector, ultrasonic flaw detector, eddy current testing machine, dye penetrates tests.

MACHINE DRAWING-I (BME2352)

1. Introduction: (1 drawing sheet)

Graphics Language, Classification of drawings, Principles of drawing, IS codes for machine drawing, scales, types of lines, section lines, Dimensioning.

2. Orthographic Projections: (1 drawing sheet)

Principle of first angle and third angle projection, drawing of machine elements in first angle projection, selection of views, sectional views.

3. Screwed fasteners: (2 drawing sheet)

Thread nomenclature, Forms of thread, Thread series, designation,

Representation of threads, Bolted joints, Locking arrangement of nuts.

4. Keys and Cotters and Pin joint: (1 drawing sheet)

Types of keys, Cotter joint or Knuckle joint.

5. Shaft Couplings: (1 drawing sheet)

Introduction, Rigid coupling or Flexible coupling.

6. Riveted joints: (1 drawing sheet)

Introduction, rivets and riveting, Types of rivet heads, Types of riveted joints, Boiler joint.

7. Assembly Drawing: (1 drawing sheet)

Introduction, Engine parts-stuffing box, cross head.

MANUFACTURING SCIENCE- I LAB (BME2353)

Say, min 8 **experiments** out of the following:

1. Design of pattern for a desired casting (containing hole)
2. Pattern making
3. Making a mould (with core) and casting.
4. Sand testing (at least one such as grain fineness number determination)
5. Injection moulding with plastics
6. Forging hand forging processes
7. Forging - power hammer study & operation
8. Tube bending with the use of sand and on tube bending m/c.
9. Press work experiment such as blanking/piercing, washer, making etc.
10. Wire drawing/extrusion on soft material.
11. Rolling-experiment.
12. Bending & spring back.
13. Powder metallurgy experiment.
14. Jigs & Fixture experiment.
15. Any other suitable experiment on manufacturing science / process / technique.

APPLIED THERMODYNAMICS (BME2401)

Course Objective:

1. To learn the basic principles of classical thermodynamics.

2. To apply the laws of thermodynamics to various systems and analyze the significance of the results.

3. To analyze the performance of thermodynamic gas and vapor power cycles.

4. To generate thermodynamic relation for real fluid system.

Learning Outcome:

At the end of the course student should be able to:

1. Differentiate between closed and open systems and analyze related problems.

2. Apply the concept of second law to design thermodynamic systems.

3. Analyze the performance of gas and vapor power cycles and identify methods to improve thermodynamic performance.

4. To analyze practical problems of combustion and stoichiometry.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Thermodynamic relations**: Mathematical conditions for exact differentials, Maxwell Relations, Clapeyron Equation, Joule-Thompson coefficient and inversion curve, Coefficient of volume expansion, adiabatic & isothermal compressibility. **Fuels and combustion:** Combustion analysis, heating values, air requirement, Air/Fuel ratio, Standard heat of reaction and effect of temperature on standard heat of reaction, Heat of formation, Adiabatic flame temperature.	**30**	**01**
II	**Boilers**: Steam generators-classifications, Working of fire-tube and water-tube boilers, Boiler mountings & accessories, Draught & its calculations, Air pre heater, feed water heater, super heater, Boiler efficiency, equivalent evaporation, Boiler trial and heat balance. **Condensers**: Classification of condenser, Air leakage, condenser performance parameters.	**30**	**01**

III	**Steam engines :** Rankine cycle and modified Rankine cycle, Working of steam engine, Classification of steam engines, Indicator diagram, saturation curve, missing quantity, Heat balance. **Steam & Gas Nozzles:** Flow through nozzle, variation of velocity, Area and specific volume. Choked flow, throat area, Nozzle efficiency, off design operation of nozzle, Effect of friction on nozzle, super saturated flow.	**30**	**01**
IV	**Vapor Power cycles:** Carnot vapor power cycle, Effect of pressure & temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heater Binary vapor cycle, combined cycles, Cogeneration. **Steam Turbines:** Classification of steam turbine, Impulse and reaction turbines, Velocity diagram of simple & compound multistage impulse and reaction turbines, Staging, stage and overall efficiency, reheat factor, bleeding, &, state point locus. Comparison with steam engines, losses in steam turbines, Governing of turbines. **Gas Turbine:** Gas turbine classification, Brayton cycle, principles of gas turbine. Gas turbine cycles with intercooling, reheat and regeneration and their combinations, Stage efficiency, polytrophic efficiency, Deviation of actual cycles from ideal cycles. **Jet Propulsion:** Introduction to the principles of jet propulsion, turbojet and turboprop engines & their processes, Principle of rocket propulsion, introduction to rocket Engine.	**30**	**1**

Reference Books:

1. C.P Arora (2009), Refrigeration and Air Conditioning, Tata McGraw-Hill Publishing Company Ltd.

2. V. Ganesan (2008), Internal Combustion Engines, Tata McGraw-Hill Publishing Company Ltd.

3. Onkar Singh (2009) Applied Thermodynamics, New Age International

MANUFACTURING SCIENCE-II (BME2402)

Course Objective:

1. To acquire knowledge about the theory of metal cutting, mechanism of machining and the parameters that influence the machining processes.

2. To get basic idea about different conventinal and non conventional machining process.

3. To gain knowledge of various instruments for linear measurement, angular measurement and surface finish etc.

Learning Outcome:

At the end of the course student should be able to:

1. Explain the mechanisim of chip formation in machining.

2. Explain the various machining processes such as turning, drilling, boring, shaping, slotting, milling and grinding.

3. Describe the principle of gear generation and non-traditional machining processes.

4. Identify and suggest correct manufacturing process for particular application. Know the principle of different metrology instrument.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Metal Cutting:** Mechanics of metal cutting. Geometry of tool and nomenclature, ASA system Orthogonal vs. oblique cutting, Mechanics of chip formation, types of chips, Shear angle relationship. Merchant's force circle diagram, Cutting forces, power required, Cutting fluids/lubricants and Tool materials. Tool wear and tool life, Machinability, Dynamometer, Brief introduction to machine tool vibration and surface finish, Economics of metal cutting Introduction: Historical perspective, importance of materials.	**30**	**1**
II	**Machine Tools- Lathe:** Principle, construction, types, operations, turret/capstan/ Automatic, Tool layout, Shaper, slotter, planer: Construction, operations & drives. **Milling:** Construction, Milling cutters, up & down milling. Dividing head & indexing, Max chip thickness& power required. **Drilling and boring:** Drilling, boring, reaming tools, Geometry of twist	**30**	**1**

	drills. Grinding & Super finishing. **Grinding :** Grinding wheels, abrasive & bonds, cutting action, Grinding wheel, specification, Grinding wheel wear - attritions wear, fractures wear, Dressing and Truing, Max chip thickness and Guest criteria, Surface and cylindrical grinding, Center less grinding. Super finishing: Honing, lapping and polishing.		
III	**Standardization & Interchangeability, Limits, Fits & Tolerance and Surface- roughness:** Introduction to Standardization & Interchangeability, Limits, Fits, Tolerances and IS standards, Limit-gauges, surface-roughness. **Metal Joining (Welding):** Survey of welding and allied processes, Gas welding and cutting, process and equipment, Arc welding: Power sources and consumables, TIG & MIG processes and their parameters, Resistance welding - spot, seam projection etc., Other welding processes such as atomic hydrogen, submerged arc, Electroslag, friction, welding, Soldering, Brazing.	**30**	**1**
IV	**Introduction to Un-conventional Machining and Welding:** Need & benefits, application and working principle of EDM, ECM, LBM, EBM, USM, AJM, WJM. Similarly, non-conventional welding applications such as LBW, USW, EBW, Plasma-arc welding, Diffusion welding, Explosive welding/cladding.	**30**	**1**

Reference Books:

1. Manufacturing science by Ghosh and Mallik, Prentice Hall PTR.

2. Fundamentals of Metal Cutting and Machine tools by Boothroyd, Script a Book Co.

3. Production Technology by R.K. Jain, Khanna Publication.

4. Production Technology - H.M.T.

5. Production Engineering Science by P.C. Pandey, Standard Publishers Distributors.

6. Modern Machining Processes by P.C. Pandey& H.S. Shan, Tata McGraw-Hill.

7. Manufacturing science by Degarmo, Wiley.

8. Fundamentals of metal cutting &machine tools – Juneja & Shekhon, Wiley.

9. Process & materials of manufacturing –Lindburg, Allyn and Bacon.

10. Advanced Machining Process - VK Jain.

MEASUREMENT METROLOGY & CONTROL (BME2403)

Course Objectives:

1. To gain knowledge of various instruments for linear measurement, angular measurement and surface finish.

2. Measuremeants of various instruments with the help of various gauges.

3. Statistical analysis of errors.

Learning Outcome:

At the end of the course student should be able to:

1. Identify and suggest correct manufacturing process for particular application.

2. Know the principle of different metrology instrument.

3. To perform statistical analysis for calculating errors.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Mechanical Measurements:** **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, sources of error, Statistical analysis of errors. **Sensors and Transducers:** Types of sensors, Types of transducers and their characteristics. **Signal transmission and processing:** Devices and systems, Signal display & recording devices. **Metrology and Inspection:** Standards of linear measurement, line and end standards, Limit fits and tolerances, Interchangeability and standardization, Linear and angular measurements devices and systems, Comparators, Sigma, Johansson's Microkrator, Limit gauges classification, Taylor's Principle of gauge design.	**30**	**1**

II	**Time related measurements:** Counters, stroboscope, frequency measurement by direct comparison, Measurement of displacement. **Measurement of pressure:** Gravitational, directing acting, elastic and indirect type pressure transducers, Measurement of very low pressures. **Strain measurement:** Types of strain gauges and their working, Strain gauge circuits, temperature compensation. Strain rosettes, calibration. **Measurements of force and torque:** Different types of load cells, Elastic transducers, pneumatic & hydraulic systems. **Temperature measurement:** Thermometers, bimetallic thermocouples, Thermistors and pyrometers. **Vibration:** Seismic instruments, vibration pickups and decibel meters. Vibrometers, accelerometers.	**30**	**1**
III	**Introduction:** Measurement of geometric forms like straightness, flatness, roundness, Tool maker's microscope, profile project autocollimator, Interferometry, principle and use of interferometry, optical flat, measurement of screw threads and gears. **Surface texture:** Quantitative evaluation of surface roughness and its measurement. **Measurement and Inspection:** Dimensional inspection – tolerance, limit gauging, comparators, Surface roughness, feature inspection. **Introduction:** Concept of automatic control- open loop & closed loop system, Servomechanisms, block diagrams, transfer functions, Applications of Laplace transform in control system. **Representation of control components &**	**30**	**1**

	systems: Translation and rotational mechanical components, series and parallel combinations, Cascade system, analogous system. **Controllers:** Brief introduction of pneumatic, Hydraulic, & electric controllers.		

Reference Books:

1. P.C. Sharma, (2008), Text book of Production Technology, 7th Edition, S. Chand & Company Ltd, New Delhi.
2. O.P. Khanna & M. Lal (2010), A Text book of Production Technology, Dhanpat Rai, Publications, New Delhi.

MACHINE DRAWING-II (BME2451)

1. Review of Orthographic Projections (1 drawing sheet)

Orthographic Projection of solids in First angle of projection, missing lines views, interpretation of views.

2. Part and Assembly Drawing (2 drawing sheet)

Assembly drawing of eccentric, lathe tail stock, air valve, screw jack, connecting rod, safety valve etc.

3. Specification of Materials (1 drawing sheet)

4. Engineering materials, representation, Code designation of steel, copper, aluminum etc.

5. Limits, Tolerance and Fits (1 drawing sheet)

Limit system, Tolerances, Method of placing limit dimensions, Fits-types.

6. Surface Roughness (1 drawing sheet)

Introduction, nomenclature, machining symbols, indication of surface roughness.

7. Production Drawing (1drawing sheet)

Types, Examples of simple machine elements like helical gear, bevel gear, crank, connecting rod, belt pulley, piston etc.

8. Computer Aided Drafting (2 drawings)

Introduction, input, output devices, introduction to software like AutoCAD,

Pro-E, basic commands and development of 2D and 3D drawings of simple parts.

MANUFACTURING SCIENCE-II LAB (BME2452)

Say, min 8 **experiments** out of the following

1. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine.
2. Bolt (thread) making on Lathe machine.
3. Tool grinding (to provide tool angles) on tool-grinder machine.
4. Gear cutting on milling machine.
5. Machining a block on shaper machine.
6. Finishing of a surface on surface-grinding machine.
7. Drilling holes on drilling machine and study of twist-drill.
8. Study of different types of tools and its angles & materials.
9. Experiment on tool wear and tool life.
10. Experiment on jigs/Fixtures and its uses
11. Gas welding experiment
12. Arc welding experiment
13. Resistance welding experiment.
14. Soldering & Brazing experiment
15. Experiment on unconventional machining.
16. Experiment on unconventional welding.
17. Experiment on TIG/MIG Welding.

MEASUREMENT & METROLOGY LAB (BME2453)

Say, min 8 **experiments** out of the following

1. Study & working of simple measuring instruments- Vernier calipers, micrometer, tachometer.
2. Measurement of effective diameter of a screw thread using 3 wire method.
3. Measurement of angle using sine bar & slip gauges. Study of limit gauges.
4. Study & angular measurement using level protector.
5. Adjustment of spark plug gap using feeler gauges.
6. Study of dial indicator & its constructional details.
7. Use of dial indicator to check a shape run use.
8. Study and understanding of limits, fits & tolerances.
9. Study of Pressure & Temperature measuring equipment.
12. Strain gauge measurement.
13. Speed measurement using stroboscope.
14. Flow measurement experiment.
15. Vibration/work measuring experiment.
16. Experiment on Dynamometers.

MACHINE DESIGN-I (BME2501)

Course Objective:

1. To understand the design methodology for machine elements and analyze the forces acting on a machine element and apply the suitable design methodology.

2. To understand the working of Riveted Joints and shafts under different type of condition as stresses, moments and types of loads.

3. To understand Keys, Coupling and Power Screws.

Learning Outcome:

At the end of the course student should be able to:

1. Analyze and select machine elements/components.

2. To know the applications of the various elements, materials used to make them, and methods used

3. Integrate various machine elements and components into the design of a machine or mechanical system through a design project.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction:** Definition, Design requirements of machine elements, Design procedure, Standards in design, Selection of preferred sizes, Indian Standards designation of carbon & alloy steels, Selection of materials for static and fatigue loads. **Design against Static Load:** Modes of failure, Factor of safety, Stresses due to bending and torsion, Theory of failure. **Design against Fluctuating Loads:** Cyclic stresses, Fatigue and endurance limit, Stress concentration factor, Stress concentration factor for various machine parts, Notch sensitivity, Design for finite and infinite life, Soderberg, Goodman & Gerber criteria.	**30**	**1**
II	**Riveted Joints**: Riveting methods, Types of rivet heads, Types of riveted joints, Caulking and Fullering, Failure of riveted joint, Efficiency of riveted joint, Design of boiler joints, Eccentric loaded riveted joint.	**30**	**1**

	Shafts: Cause of failure in shafts, Stresses in shafts, Design of shafts subjected to twisting moment, Bending moment and combined twisting and bending Moments, Shafts subjected to fatigue loads, Design for rigidity.		
III	**Keys and Couplings:** Types of keys, Splines, Selection of square & flat keys, Strength of sunk key, Couplings- design of rigid and flexible couplings. **Mechanical Springs:** Types, Material for helical springs, End connections for compression and tension helical springs, Stresses and deflection of helical springs of circular wire, Design of helical springs subjected to static and fatigue loading. **Power Screws:** Forms of threads, Multiple threads, Efficiency of square threads, Trapezoidal threads, Stresses in screws, Design of screw jack.	**30**	**1**

Reference Books:

1. Mechanical Engineering Design – Joseph E. Shigely, McGraw Hill Publications.

2. Design of Machine Memebers-Alex Valance and VI Doughtie, McGraw Hill Co.

3. Machine design-M.F. Spott, Prentice Hall India.

4. Machine Design-Maleev and Hartman, CBS.

5. Machine design -Black & Adams, McGraw Hill.

6. Machine Design-Sharma and Agrawal, S.K. Katara & Sons.

7. Design of Machine Elements-V.B. Bhandari, Tata McGraw Hill Co.

THEORY OF MACHINES-I (BME2502)

Course Objective:

1. To familiarize students with basic types of mechanisms, joints and degrees of freedom to perform position, velocity and acceleration analysis using graphical and analytical methods.
2. To provide students an understanding of different types of mechanisms and to teach the basics of synthesis of simple mechanisms.
3. To understand Friction and types of brakes and dynamometer.
4. To teach students the kinematic analysis of cam-follower motion and gear train configurations.

Learning Outcome:

At the end of the course student should be able to:

1. Demonstrate an understanding of the concepts of various mechanisms and pairs.
2. Conduct velocity and acceleration analysis of simple mechanisms and Synthesize simple mechanisms for function, path generation and body guidance
3. Analyze the principle of Friction, Brakes and Dynamometer.
4. Design a layout of cam for specified motion and demonstrate an understanding of principles of operation of gears.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction:** Links-types, Kinematics pairs-classification, Constraints-types, Degrees of freedom of planar mechanism, Grubler's equation, Linkage mechanisms, Inversions of four bar chain, Slider crank chain and double slider crank chain. **Velocity in Mechanisms:** Velocity of point in mechanism, Relative velocity method, Velocities in four bar mechanism, Slider crank mechanism and quick return motion mechanism, Rubbing velocity at a pin joint, Instantaneous center method, Types & location of instantaneous centers, Kennedy's theorem, Velocities in four bar mechanism & slider crank mechanism.	**30**	**1**

II	**Acceleration in Mechanisms:** Acceleration of a point on a link, Acceleration diagram, Coriolis component of acceleration, Crank and slotted lever mechanism, Klein's construction for Slider Crank mechanism and Four Bar mechanism. **Mechanisms with Lower Pair:** Pantograph, Exact straight line motion mechanisms- Peaucellier, Hart and Scott Russell mechanisms, Approximate straight line motion mechanisms–Grass-Hopper, Watt and Tchebicheff mechanisms, Analysis of Hooke's joint, Davis and Ackermann steering gear mechanisms.	**30**	**1**
III	**Friction:** Laws of friction, Friction on inclined plane, Efficiency on inclined plane, Friction in journal bearing-friction circle, Pivots and collar friction-uniform pressure and uniform wear, Belt and pulley drive, Length of open and cross belt drive, Ratio of driving tensions for flat belt drive, Centrifugal tension, Condition for maximum power transmission, V belt drive. **Brakes & Dynamometers:** Shoe brake, Band brake, Band and block brake, Absorption and transmission type dynamometers.	**30**	**1**
IV	**CAMS:** Cams and Followers-Classification & terminology, Cam profile by graphical methods with knife edge and radial roller follower for uniform velocity, Simple harmonic and parabolic motion of followers, Analytical methods of cam design–tangent cam with roller follower and circular cams with flat faced follower. **Gears& Gear Trains:** Classification & terminology, Law of gearing, Tooth forms & comparisons, Systems of gear teeth, Length of path of contact, Contact ratio, Interference & under cutting in involute gear teeth, Minimum number of teeth on gear and pinion to avoid interference, Simple, compound, reverted and planetary gear trains, Sun and planet gear.	**30**	**1**

Reference Books:

1. Theory of Machines - Thomas Bevan.

2. Theory of Machines and Mechanisms- Shigley.

3. Theory of Machines and Mechanisms- Ghosh & Mallik.

4. Theory of Machines and Mechanisms- Rao & Dukkipati.

5. Theory of Machines-S.S. Rattan.

6. Kinematics of Machines-Dr. Sadhu Singh.

7. Mechanics of Machines – V. Ramamurti.

8. Theory of Machines – Khurmi & Gupta.

9. Theory of Machines – R. K. Bansal.

HEAT & MASS TRANSFER (BME2503)

Course Objective:

1. To comprehend and evaluate various modes of heat and mass transfer

2. To design fin enhanced systems, Transient conduction and forced convection.

3. To understand Natural Convection and Thermal Radiation.

4. To determine effectiveness of heat exchangers using LMTD and NTU.

Learning Outcome:

At the end of the course student should be able to:

1. Apply basic principles of fluid mechanics, thermodynamics, heat transfer for designing heat and mass transfer systems.

2. Model Fins and analyze different type of boundary layer condition.

3. Model heat, mass and momentum transport systems and develop predictive correlation.

4. Assess and evaluate various designs for heat and mass transfer and optimize the solution

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction to Heat Transfer:** Concepts of the mechanisms of heat flows, Conduction, Convection and radiation, Effect of temperature on thermal conductivity of materials, Introduction to combined heat transfer mechanism. **Conduction:** One-dimensional general differential heat conduction equation in the rectangular, Cylindrical and spherical coordinate systems, Initial and boundary conditions. **Steady State one-dimensional Heat conduction:** Composite Systems in rectangular, Cylindrical and spherical coordinates with and without energy generation, Thermal resistance concept, Analogy between heat and electricity flow, Thermal contact resistance, Critical thickness of insulation.	**30**	**1**

II	**Fins:** Heat transfer from extended surfaces, Fins of uniform cross-sectional area, Errors of measurement of temperature in thermometer wells. **Transient Conduction:** Transient heat conduction, Lumped capacitance method, Time constant, Unsteady state heat conduction in one dimension only, Heisler charts. **Forced Convection:** Basic concepts, Hydrodynamic boundary layer, Thermal boundary layer, Approximate integral boundary layer analysis, Analogy between momentum and heat transfer in turbulent flow over a flat surface, Mixed boundary layer, Flow over a flat plate, Flow across a single cylinder and a sphere, Flow inside ducts, Empirical heat transfer relations, Relation between fluid friction and heat transfer, Liquid metal heat transfer.	**30**	**1**
III	**Natural Convection :** Physical mechanism of natural convection, Buoyant force, Empirical heat transfer relations for natural convection over vertical planes and cylinders, Horizontal plates and cylinders and sphere, Combined free and forced convection. **Thermal Radiation :** Basic radiation concepts, Radiation properties of surfaces, Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law, Gray body, Shape factor, Black-body radiation, Radiation exchange between diffuse nonblack bodies in an enclosure, Radiation shields, Radiation combined with conduction and convection, Absorption and emission in gaseous medium, Solar radiation, Greenhouse effect.	**30**	**1**
IV	**Heat Exchanger :** Types of heat exchangers, Fouling factors, Overall heat transfer coefficient, Logarithmic mean temperature difference (LMTD) method, Effectiveness-NTU method, & Compact Heat Exchangers. **Condensation and Boiling:** Introduction to condensation phenomena, Heat transfer relations for laminar film condensation on	**30**	**1**

	vertical surfaces and on outside & inside of a horizontal tube, Effect of non-condensable gases. **Introduction To Mass Transfer:** Introduction, Fick's law of diffusion, Steady state equimolar counter diffusion, Steady state diffusion though a stagnant gas film.		

Reference Books:

1. Elements of Heat transfer by Bayazitouglu & Ozisik, McGraw-Hill Book Company.
2. Heat Transfer by J.P. Holman, McGraw-Hill International edition.
3. Schaum's outline of Heat Transfer by Pitts & Sisson McGraw-Hill International edition.
4. Principles of Heat Transfer by Frank Kreith, McGraw-Hill Book co.
5. Fundamentals of Momentum, Heat and Mass Transfer by James R. Welty; John Wiley & Sons (Pvt). Ltd.
6. Heat Transfer, by Vijay Gupta, New Age International (P) Ltd. Publishers.
7. Heat Transfer, by Y.V.C. Rao, University Press.
8. Heat Transfer, by R. Yadav, Central Publishing House, Allahabad.

I.C. ENGINES &COMPRESSORS (BME2504)

Course Objective:

1. To apply the laws of thermodynamics, heat and mass transfer to thermal energy systems.

2. To apply and understand the concepts S.I.Engine.

3. To apply and understand the concepts I.C.Engine.

4. To understand the basic principle of Engine Cooling, Lubrication, Supercharging etc.

Learning Outcome:

At the end of the course student should be able to:

1. Appreciate the application of the laws of thermodynamics in heat and mass transfer and operations of core thermal engineering systems like engines.

2. Learn basic principle of S.I.Engine.

3. Learn basic principle of C.I.Engine.

4. Learn basic principle of Engine Cooling, Lubrication, and Supercharging etc.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction to I.C Engines:** Engine classification, Air standard cycles, Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles, Stirling cycle, Ericsson cycles, Actual cycle analysis, Two and four stroke engines, SI and CI engines, Valve timing diagram, Rotary engines, Stratified charge engine. **Fuels:** Fuels for SI and CI engine, Important qualities of SI and CI engine fuels, Rating of SI engine and CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines. **Testing and Performance:** Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines.	**30**	**1**
II	**SI Engines:** Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and its control, Combustion chamber design for SI engine, Carburetion, Mixture requirements, Carburetor types, Theory of carburetor,	**30**	**1**

	M. P. F. I., Ignition system requirements, Magneto and battery ignition systems, Ignition timing and spark plug, Electronic ignition.		
III	**CI Engine:** Combustion in CI engines, Ignition delay, Knock and its control, Combustion chamber design of CI engines, Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings, Scavenging in 2 Stroke engines, Pollution and its control.	**30**	**1**
IV	**Engine Cooling:** Different cooling systems, Radiators and cooling fans. **Lubrication:** Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation. **Supercharging:** Effect of altitude on power output, Types of supercharging. **Compressors:** Classification, Reciprocating compressors, Single and Multi stage compressors, Intercooling, Volumetric efficiency, Rotary compressors, Classification, Centrifugal compressor, Axial compressors, Surging and stalling, Roots blower, Vaned compressor.	**30**	**1**

Reference Books:

1. Fundamentals of Internal Combustion Engine by Gill, Smith, Ziurs, Oxford & IBH Publishing Co.

2. IC Engines, by Rogowsky, International Book Co.

3. A Course in International Combustion Engines, by Mathur & Sharma, Dhanpat Rai& Sons.

4. I.C Engine Analysis & Practice by E.F Obert.

5. I.C Engine, by Ganeshan, Tata McGraw Hill Publishers.

6. I.C Engine, by R. Yadav, Central Publishing House, Allahabad.

7. Reciprocating and Rotary Compressors, by Chlumsky, SNTI Publications, Czechoslovakia.

8. Turbines, Compressors and Fans, by S.M.Yahya, Tata McGraw Hill.

MACHINE DESIGN-I LAB (BME2551)

1. Design & drawing of Cotter joint.

2. Design & drawing of Knuckle joint.

3. Design of machine components subjected to combined steady and variable loads.

4. Design of eccentrically loaded riveted joint.

5. Design of boiler riveted joint.

6. Design of shaft for combined constant twisting and bending loads.

7. Design of shaft subjected to fluctuating loads.

8. Design and drawing of flanged type rigid coupling.

9. Design and drawing of flexible coupling.

10. Design and drawing of helical spring.

11. Design and drawing of screw jack.

HEAT & MASS TRANSFER LAB (BME2553)

Minimum 10 experiment of the following

1. Conduction - Composite wall experiment

2. Conduction - Composite cylinder experiment

3. Convection - Pool boiling experiment

4. Convection - Experiment on heat transfer from tube-natural convection.

5. Convection - Heat Pipe experiment.

6. Convection - Heat transfer through fin-natural convection.

7. Convection - Heat transfer through tube/fin-forced convection.

8. Any experiment on Stefan's Law, on radiation determination of emissivity, etc.

9. Any experiment on solar collector, etc.

10. Heat exchanger - Parallel flow experiment

11. Heat exchanger - Counter flow experiment

12. Any other suitable experiment on critical insulation thickness.

13. Conduction - Determination of thermal conductivity of fluids.

14. Conduction - Thermal Contact Resistance Effect.

MACHINE DESIGN-II (BME2603)

Course Objective:

1. To understand and design the Spur Gears, Helical and Worm and Worm Gears.

2. To understand and design Bevel Gears and Sliding Contact Bearing.

3. To understand and design Rolling Contact Bearings.

4. To understand and design the various parts of I.C. Engine.

Learning Outcome:

At the end of the course student should be able to:

1. Design various types of Gears.

2. Analyse and design Sliding Contact Bearing.

3. Analyse Rolling Contact Bearing.

4. Analyse and design various types of I.C.Engine.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Spur Gears:** Tooth forms, System of gear teeth, Contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Gear manufacturing methods, Design considerations, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear tooth, Design of spur gears, AGMA and Indian standards. **Helical Gears:** Terminology, Proportions for helical gears, Beam strength and wear strength of helical gears, Herringbone gears, Crossed helical gears, Design of helical gears. **Worm Gears:** Types of worms, Terminology, Gear tooth proportions, Efficiency of worm gears, Heat dissipation in worm gearing, Strength and wear tooth load for worm gears, Design of worm gearing.	**30**	**1**

II	**Bevel Gears:** Terminology, Proportions for Bevel gears. Design of right angle bevel gears. **Sliding Contact Bearing:** Types, Selection of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubricants and lubrication, Hydrodynamic journal bearing, Heat generation, Design of journal bearing, Thrust bearing-pivot and collar bearing, Hydrodynamic thrust bearing.	**30**	**1**
III	**Rolling Contact Bearing:** Advantages and disadvantages, Types of ball bearing, Thrust ball bearing, Types of roller bearing, Selection of radial ball bearing, Bearing life, Selection of roller bearings, Dynamic equivalent load for roller contact bearing under constant and variable loading, Reliability of Bearing, Selection of rolling contact bearing, Lubrication of ball and roller bearing, Mounting of bearing.	**30**	**1**
IV	**ICENGINE PARTS:** Selection of type of IC engine, General design considerations, Design of Cylinder and cylinder head, Design of piston, Piston ring and gudgeon pin, Design of connecting rod, Design of center crankshaft.	**30**	**1**

Reference Books:

1. Mechanical Engineering Design – Joseph E. Shigely, McGraw Hill Publications.

2. Design of Machine Memebers- Alex Valance and VI Doughtie, McGraw Hill Co.

3. Machine design-M.F. Spott, Prentice Hall India.

4. Machine Design-Maleev and Hartman, CBS.

5. Machine design -Black & Adams, McGraw Hill.

6. Machine Design-Sharma and Agrawal, S.K. Katara & Sons.

7. Design of Machine Elements-V.B. Bhandari, Tata McGraw Hill Co.

THEORY OF MACHINE- II (BME2601)

Course Objective:

1. To understand the concepts of turning moment diagrams, flywheel design and the dynamics of reciprocating engines.

2. To understand the balancing procedures for rotating and reciprocating masses, rotors and engines and gyroscopic motion.

3. To understand the fundamentals of Governors, free and forced vibrations.

Learning Outcome:

At the end of the course student should be able to:

1. Demonstrate skills to design flywheel for an IC engine and punching press with the consideration of geometrical and economic constraints.
2. Perform static and dynamic balancing of high speed rotary and reciprocating machines and Calculate gyroscopic couple and finds its effect on various vehicles.
3. Apply concept of governors for speed control, Analyse free and forced vibrations of machines, engines and structures.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Static & Dynamic Force Analysis:** Static equilibrium of two/three forces members, Static equilibrium of member with two forces and torque, Static force analysis of linkages, D'Alembert's principle, Equivalent offset inertia force, Dynamic force analysis of four link mechanism and slider crank mechanism, Engine force analysis-Piston and crank effort. **Turning Moment & Flywheel:** Turning moment on crankshaft, Turning moment diagrams-single cylinder double acting steam engine, Four stroke IC engine and multi-cylinder steam engine, Fluctuation of energy, Flywheel.	**30**	**1**
II	**Balancing of Machines:** Static and dynamic balancing, Balancing of several masses in the same plane and different planes, Balancing of reciprocating masses, Balancing of primary force in reciprocating engine, Partial balancing of two cylinder locomotives, Variation of tractive force,	**30**	**1**

	Swaying couple, Hammer blow. **Gyroscopic Motion:** Principles, Gyroscopic torque, Effect of gyroscopic couple on the stability of aero planes & automobiles.		
III	**Governors:** Terminology, Centrifugal governors-Watt governor, Dead weight governors-Porter & Proell governor, Spring controlled governor-Hartnell governor, Sensitivity, Stability, Hunting, Isochronism, Effort and Power of governor, Controlling force diagrams for Porter governor and spring controlled governors. **Mechanical Vibrations:** Types of vibrations, Degrees of freedom, Single degree free & damped vibrations.	**30**	**1**

Reference Books:

1. Theory of Machines - Thomas Bevan

2. Theory of Machines and Mechanisms- Shigley

3. Theory of Machines and Mechanisms- Ghosh & Mallik

4. Theory of Machines and Mechanisms- Rao & Dukkipati

5. Theory of Machines - S.S. Rattan

6. Theory of Machines – R.K. Bansal

7. Mechanics of Machines – V. Ramamurti

8. Theory of Machines – Khurmi & Gupta

9. Theory of Machines – P.L. Ballaney

REFRIGERATION & AIR-CONDITIONING (BME2602)

Course Objective:

1. To apply the laws of thermodynamics, heat and mass transfer to thermal energy systems
2. To apply the concepts of thermal energy systems to practical problems and finding solutions.
3. To arrive at a basic and holistic understanding of the design of refrigeration and air-conditioning systems.
4. To understand Refrigerant Equipment and its application.

Learning Outcome:

At the end of the course student should be able to:

1. Appreciate the application of the laws of thermodynamics in heat and mass transfer and operations of core thermal engineering systems like engines, compressors, refrigerators and air-conditioners.
2. Possess skills to distinguish the various types of ideal gas cycles, engine cycles, refrigeration cycles and power cycles and their engineering applications.
3. Possess engineering knowledge to arrive at basic innovative ideas on design and performance enhancements of heat and mass transfer systems like engines, compressors, refrigerator cycles and air-conditioning cycles.
4. Develop a full-fledged knowledge of thermal engineering systems and technical practices of energy efficiency improvement and Gain the ability to apply the concepts of heat engineering and applied thermodynamics to the computation of performance parameters of engines, compressors, refrigerators and air-conditioning cycles.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Refrigeration:** Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect & C.O.P. **Air Refrigeration cycle:** Open and closed air refrigeration cycles, Reversed Carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system, Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated	**30**	**1**

	temperature (DART). **Vapour Compression System:** Single stage system, Analysis of Vapour compression cycle, Use of T-S and P-H charts, Effect of change in suction and discharge pressures on C, O, P, Effect of sub cooling of condensate & superheating of refrigerant Vapour on C, O, P of the cycle, Actual vapor compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, Intercooling, Cascade system.		
II	**Vapour Absorption system:** Working Principal of vapor absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy – concentration diagram, Adiabatic mixing of two streams, Ammonia – Water Vapour absorption system, Lithium- Bromide water Vapour absorption system, Comparison. **Refrigerants:** Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants.	**30**	**1**
III	**Air Conditioning:** Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart, Different Psychometric processes, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration & ventilation, Internal heat gain, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP).	**30**	**1**
IV	**Refrigeration Equipment & Application:** Elementary knowledge of refrigeration & air conditioning equipments e. g. compressors, Condensers, Evaporators & expansion devices, Air washers, Cooling, Towers & humidifying efficiency, Food preservation, Cold storage,	**30**	**1**

	Refrigerates Freezers, Ice plant, Water coolers, Basic difference between comfort and industrial air conditioning.		

Reference Books:

1. Refrigeration and Air conditioning, by Manohar Prasad, New Age International (P) Ltd. Pub.
2. Refrigeration and Air conditioning by C.P Arora.
3. Refrigeration and Air conditioning by Arora & Domkundwar.
4. Refrigeration and Air conditioning by Stoecker & Jones.
5. Refrigeration and Air conditioning by Roy J. Dossat.
6. Refrigeration and Air conditioning by P.L. Baloney.

ADVANCED WELDING TECHNOLOGY (BME2604)

Course Objective:

1. To understand the basic principles of various types of welding.

2. To know about the different types of advanced joining processes.

3. To understand metallurgy of welding defects and remedial measures for it.

Learning Outcome:

At the end of the course student should be able to:

1. Understand welding concepts.

2. Describe special welding techniques of laser beam, plasma arc, electron beam and plasma arc welding.

3. Select proper welding technique for the application.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction :** Importance and application of welding, Classification of welding process, Selection of welding process. **Brief review of conventional welding process :** Gas welding, Arc welding, MIG, Tig welding, Resistance welding, Electroslag welding, Friction welding etc., Welding of MS, CI, AL, and stainless steel Maurer/schaefflar diagram, Soldering & brazing.	**30**	**1**
II	**Advanced welding Techniques**: Principle, working and application of advanced welding techniques such as Plasma Arc welding, Laser beam welding, Electron beam welding, Ultrasonic welding etc., Explosive welding/ cladding, Underwater welding. **Weld Design:** Welding machines/equipment and its characteristics and arc-stability, Weld defects and distortion and its remedies, Inspection/testing of welds, Weld Design, Welding of pipe-lines and pressure vessels.	**30**	**1**

III	**Thermal and Metallurgical consideration**: Thermal considerations for welding and Temperature distribution, Analytical/Empirical analysis/formulae, Heating & cooling curves, Metallurgical consideration of weld, HAZ and Parent metal, Micro & macro structure, Solidification of weld and properties.	**30**	**1**

Reference Books:

1. Welding Hand Book

FLUID MACHINERY LAB (BME2653)

Note: Eight experiments out of the following are to be conducted

1. Impact of Jet experiment.

2. Turbine experiment on Pelton wheel.

3. Turbine experiment on Francis turbine.

4. Turbine experiment on Kaplan turbine.

5. Experiment on Reciprocating pump.

6. Experiment on centrifugal pump.

7. Experiment on Hydraulic Jack/Press.

8. Experiment on Hydraulic Brake.

9. Experiment on Hydraulic Ram.

10. Study through detailed visit of any water pumping station/plant.

11. Experiment on Compressor.

12. Experiment for measurement of drag and lift on aerofoil in wind tunnel

REFRIGERATION & AIR CONDITIONING LAB (BME2652)

Note: Eight experiments out of the following are to be conducted.

1. Experiment on refrigeration test rig and calculation of various performance parameters.
2. To study different types of expansion devices used in refrigeration system.
3. To study different types of evaporators used in refrigeration systems.
4. To study basic components of air-conditioning system.
5. Experiment on air-conditioning test rig & calculation of various performance parameters.
6. Experiment on Desert coolers.
7. Study of window air conditioner.
8. Study & determination of volumetric efficiency of compressor.
9. Visit of a central air conditioning plant and its detailed study.
10. Experiment on Ice-plant.

THEORY OF MACHINES LAB (BME2651)

Note: Eight experiments out of the following are to be conducted

1. Study of simple linkage models/mechanisms.

2. Study of inversions of four bar linkage.

3. Study of inversions of single/double slider crank mechanisms.

4. Experiment on gears tooth profile, interference etc.

5. Experiment on gear trains.

6. Experiment on longitudinal vibration.

7. Experiment on transverse vibration.

8. Experiments on dead weight type governor.

9. Experiment on spring controlled governor.

10. Experiment on critical speed of shaft.

11. Experiment on gyroscope.

12. Experiment on static/dynamic balancing.

13. Experiment on brake.

14. Experiment on clutch.

FLUID MACHINERY (BME2011)

Course Objective:

1. To familiarize student with Classification of fluid machines, devices and turbines.

2. To make aware students of different types of turbines and pumps with their working principles.

3. To make aware students of Positive Displacement Pumps and their types.

4. To teach them the basics and principle working of other fluid machinery.

Learning Outcome:

At the end of the course student should be able to:

1. Demonstration of hydraulic and reaction turbines with their classification.

2. Demonstration of Centrifugal of pumps.

3. Demonstration of Positive Displacement pumps.

4. Demonstration of different fluid based machineries.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction:** Classification of Fluid Machines & Devices, Application of momentum and momentum equation to flow through hydraulic machinery, Euler's fundamental equation, Impact of jet: Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat & curve), Effect of inclination of jet with the surface. **Hydraulic Turbines:** Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Governing of Pelton wheel. **Reaction Turbines:** Francis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Degree of reaction, Draft tube, Cavitation in turbines, Principles of similarity, Unit and specific speed, Performance characteristics, Selection of water turbines.	**30**	**1**
II	**Centrifugal Pumps**: Classifications of centrifugal pumps, Vector diagram,	**30**	**1**

	Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Model testing, Cavitation & separation and their control, Performance characteristics.		
III	**Positive Displacement Pumps**: Reciprocating pump theory, Slip and coefficient of discharge, Indicator diagram, Effect and acceleration, Work saved by fitting air vessels, Comparison of centrifugal and reciprocating pumps, Positive rotary pumps, Gear and Vane pumps, Performance characteristics.	**30**	**1**
IV	**Other Machines:** Hydraulic accumulator, Special duty pumps, Intensifier, Hydraulic press, Lift and cranes, Theory of hydraulic coupling and torque converters, Performance characteristics, Water Lifting Devices: Hydraulic ram, Jet pumps, Air lift pumps.	**30**	**1**

Reference Books:

1. Hydraulic Machines by Jagdish Lal, Metropolitan book co. pvt ltd.

2. Hydraulic Machines: Theory & Design, V.P. Vasandhani, Khanna Pub.

3. Applied Hydraulics by Addison.

4. Hydraulic Machines by R K Rajput, S. Chand & co Ltd.

5. Hydraulic Machines by D S Kumar.

UNCONVENTIONALMANUFACTURINGPROCESSES (BME2012)

Course Objective:

1. To teach the principles of material removal mechanism of advanced machining processes such as mechanical, electro-chemical and thermal.
2. To provide in depth knowledge in selection of advanced machining process to fabricate intricate and complex shapes in difficult to machine material.
3. To provide awareness of advanced finishing processes to achieve submicron/nano surface finish.
4. To teach the principles of EBM, EDM and High Explosive Forming.

Learning Outcome:

At the end of the course student should be able to:

1. Identify and suggest the suitable manufacturing process for advanced materials and critical finishing.
2. Select a process for a given application such as IBM, EBM, PAM etc.
3. Learn the basic principle of Unconventional Welding Process.
4. Select Right path to achieve Unconventional Forming Process.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction:** Limitations of conventional manufacturing processes Need of unconventional manufacturing processes & its classification and its future possibilities. **Unconventional Machining Process:** Principle and working and applications of unconventional machining process such as Electro-Discharge machining, Electro-chemical machining, Ultrasonic machining, Abrasive jet machining etc.	**30**	**1**
II	**Unconventional Machining Process (continued) :** Principle and working and application of unconventional machining processes such as Laser beam machining, Electron beam machining, Ultrasonic machining etc.	**30**	**1**

III	**Unconventional welding processes:** Explosive welding, Cladding, under water welding, Metalizing, Plasma are welding/cutting etc.	**30**	**1**
IV	**Unconventional Forming processes:** Principle. Working and applications of High energy forming processes such as Explosive Forming, Electromagnetic forming, Electro-Discharge forming, Water hammer forming. **Electronic-device Manufacturing:** Brief description of Diffusion and Photo-Lithography process for electronic-device manufacturing.	**30**	**1**

Reference Books:

1. Modern Machining Processes – P.C. Pandey.

2. Unconventional Machining – V.K. Jain.

PRODUCT DEVELOPMENT AND DESIGN (BME2013)

Course Objective:

1. To acquire skills to design and develop products in a structured way.

2. To get aware with general design principles for manufacturability.

3. To understand the incorporation of ergonomics in product design.

4. To understand the various methods and techniques used for product appraisal.

Learning Outcome:

At the end of the course student should be able to:

1. Explain product development process and review design of existing product.

2. Incorporate the ergonomics into the product design.

3. Explain product development process considering Reliability.

4. Explain Product appraisal methods.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction to Product Design:** Introduction to PDD, Applications, Relevance, Product Definition, Scope, Terminology, Design definitions, The role and nature of design, Old and new design methods, Design by evolution, Examples such evolution of bicycle, Safety razor etc., Need based development, Technology based developments, Physical reliability & Economic feasibility of design concepts.	**30**	**1**
II	**Morphology of Design:** Divergent, Transformation and convergent phases of product design, Identification of need, Analysis of need, Design criteria, Functional aspects, Aesthetics, Ergonomics, Form (structure), Shape, Size, Color, Mental blocks, Removal of blocks, Ideation Techniques, Creativity, Checklist.	**30**	**1**
III	**Transformations:** Brainstorming & Synectics, Morphological techniques, Utility concept, Utility value, Decision making under multiple criteria,	**30**	**1**

	Economic aspects of design, Fixed and variable costs, Break-even analysis. **Reliability:** Reliability considerations, Bath tub curve, Reliability of systems in series and parallel, Failure rate, MTTF and MTBF, Optimum spares from reliability consideration, Design of displays and controls, Man-Machine interface, Compatibility of displays and controls, Ergonomic aspects, Anthropometric data and its importance in design, Applications of Computers in product design.		
IV	**Product Appraisal:** Information and literature search, Patents, Standards and codes, Environment and safety considerations, Existing techniques such as work-study, Sqc etc, Which could be used to improve method & quality of product? Innovation versus invention, Technological forecasting.	**30**	**1**

Reference Books:

1. Product Design & Manufacturing - A.K. Chitab & R.C. Gupta, PHI (EEE).

2. The Technology of Creation Thinking - R.P. Crewford – Prentice Hall.

3. The Art of Thought – Grohem Walls – Bruce & Co., New York.

4. Product Design & Decision Theory - M.K. Starr - Prentice Hall.

5. Engg. Product Design -C .D. Cain, Bussiness Books.

6. Industrial design for Engineers –W .H. Mayall, Itiffe.

7. Design Methods – seeds of human futures – J. Christopher Jones, John Wiley & Sons.

8. Human Factor Engg. – Mccormick E.J., McGraw Hill.

9. Engineering: An Introduction to Creative profession – G.C. Beakley HW leach, Macmillan.

10. Industrial Design In Engineering – A marriage of Techniques – Charles H. Flurscheim,

11. Design Council - London.

COMPUTER AIDED DESIGN (BME2701)

Course Objective:

1. To get aware with basic concept of Computer Aided Designing.
2. To acquire the skills needed for various types of Graphics & Transformations.
3. To understand the various methods involved in 3 Dimensional Graphics
4. To understand the various types of models.

Learning Outcome:

At the end of the course student should be able to:

1. Develop various types of graphs and curves.
2. Apply the practical aspect of 2D & 3D Graphics.
3. Use the various types of mathematical methods for various types of practical applications.
4. Develop the new types of mathematical models as per requirement.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction:** Introduction to CAD/CAED/CAE, Elements of CAD, Essential requirements of CAD, Concepts of integrated CAD/CAM, Necessity & its importance, Engineering Applications Computer Graphics-ICAD/CAM systems, Graphics Input devices-cursor control Devices, Digitizers, Keyboard terminals, Image scanner, Speech control devices and Touch, panels, Devices-Cathode Ray Tube, Random & Raster scan display, Colour CRT monitors, Direct View Storage Tubes, Flat Panel display, Hard copy printers and plotters. **Computer Graphics-II:** Graphics standards, Graphics Software, Software Configuration, Graphics Functions, Output primitives-Bresenham's line drawing algorithm, Bresenham's circle generating algorithm. **Geometric Transformations:** World/device Coordinate Representation, Windowing and clipping, 2 D Geometric transformations-Translation, Scaling, Shearing, Rotation & Reflection Matrix representation, Composite transformation, 3 D transformations.	**30**	**1**

II	**Curves:** Curves representation, Properties of curve design and representation, Interpolation vs approximation, Parametric representation of analytic curves, Parametric continuity conditions, Parametric representation of synthetic curves, Hermite cubic splines-Blending function formulation and its Properties, Bezier curves-Blending function formulation and its properties, Composite Bezier curves, B-spline curves and its properties.	**30**	**1**
III	**Three Dimensional Graphics:** Polygon surfaces-Polygon mesh representations, Quadric and Super quadric surfaces and blobby objects, Solid modeling-Solid entities, Fundamentals of Solid modeling-Set theory, Regularized set operations, Half spaces, Boundary representation, Constructive solid geometry, Sweep representation, Color models Application commands for AutoCAD & Pro-E software.	**30**	**1**
IV	**Numerical Methods:** Introduction, Errors in numbers, Binary representation of numbers, Root finding Bisection method, Newton Raphson method, Curve fitting-Least square method, Numerical differentiation-Newton's interpolation, Numerical Integration-Trapezoidal And Simpson method. **Finite Element Method:** Introduction, Principles of Finite elements modeling, Stiffness matrix/displacement matrix, Stiffness matrix for spring system, Bar & beam elements, Bar elements in 2Dspace (truss element).	**30**	**1**

Reference Books:

1. Computer Graphics, Hearn & Baker, Prentice Hall of India.
2. Computer Aided Engineering Design, Anupam Saxena & B. Sahay, Anamaya Publishers.
3. CAD/CAM, HP Groove r& E W Zimmers,, Jr. Prentice Hall India Ltd.
4. CAD/CAM Theory and Practice, Ibrahim Zeid & R Sivasubramaniam, McGraw Hill.
5. Computer Aided Design, RK Srivastava, Umesh Publications.

AUTOMOBILE ENGINEERING (BME2702)

Course Objective:

1. To have the knowledge of elementary components, which are used in an automobile.
2. To know about the various mechanism which are used in an automobile.
3. To get the knowledge of various properties which are suitable for its different types of Components.
4. To know about fuel supply system & electrical system.

Learning Outcome:

At the end of the course student should be able to:

1. Select the various components according to the requirement of an automobile.
2. Have the knowledge of various types of ratio`s and angles which are involved in an automobile.
3. Latest Technologies which are used in Automobile sector.
4. Can develop new types of electrical system which are more energy efficient.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Power Unit and Gear Box:** Principles of Design of main components, Valve mechanism, Power and Torque characteristics, Rolling, air and gradient resistance, Tractive effort, Gear Box, Gear ratio determination, Design of Gear box.	**30**	**1**
II	**Transmission System:** Requirements. Clutches, Toque converters, Over Drive and free wheel, Universal joint, Differential Gear Mechanism of Rear Axle, Automatic transmission, Steering and Front Axle. Castor Angle, Wheel camber & Toe-in, Toe-out etc., Steering geometry. Ackerman mechanism, Understeer and Oversteer.	**30**	**1**
III	**Braking System:** General requirements, Road tyre adhesion, Weight transfer, Braking ratio, Mechanical brakes, Hydraulic brakes, Vacuum and air brakes, Thermal aspects. **Chassis and Suspension System:** Loads on the frame, Strength and stiffness, Various suspension systems.	**30**	**1**

IV	**Electrical System :** Types of starting motors, Generator & regulators, Lighting system, Ignition system, Horn, Battery etc. **Fuel Supply System:** Diesel & Petrol vehicle system such as Fuel Injection Pump, Injector & Fuel Pump, Carburetor etc. MPFI.	**30**	**1**

Reference Books:

1. Automotive Engineering- Hietner
2. Automobile Engineering - Kripal Singh.
3. Automobile Engineering - Narang.
4. Automotive Mechanics- Crouse

QUALITY MANAGEMENT* (OME2001)

Course Objective:

1. To have knowledge of Quality concept & Quality Management.
2. To be aware about the importance Quality Management.
3. To have knowledge about Control charts.
4. To have knowledge of ISO9000series.

Learning Outcome:

At the end of the course student should be able to:

1. Know the importance of Quality Management Tools and their applications.
2. Increase the productivity and efficiency of organization with the help of Quality Management Tools.
3. Can develop new types Quality Management Techniques.
4. Apply Taguchi method & JIT method for various applications.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Quality Concepts:** Evolution of Quality control, Concept change, TQM Modern concept, Quality concept in design, Review off design, Evolution of proto type. **Control on Purchased Product:** Procurement of various products, Evaluation of supplies, Capacity verification, Development of sources, Procurement procedure. **Manufacturing Quality:** Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims.	**30**	**1**
II	**Quality Management:** Organization structure and design, Quality function, Decentralization, Designing and fitting organization for different types products, Economics of quality value and contribution, Quality cost, Optimizing quality cost. **Human Factor in Quality:** Attitude of top management, Co-operation, of groups, Operators attitude, responsibility, Causes of operators error and corrective methods.	**30**	**1**

III	**Control Charts:** Theory of control charts, Measurement range, Construction and analysis of R charts, Process capability study, Use of control charts. **Attributes of Control Charts:** Defects, Construction and analysis off-chart, Improvement by control chart, Variable sample size, Construction and analysis of C-chart.	**30**	**1**
IV	**Defects Diagnosis and Prevention:** Defect study, Identification and analysis of defects, Corrective measure, Factors affecting reliability, MTTF, Calculation of reliability, Building reliability in the product, Evaluation of reliability, Interpretation of test results, Reliability control, Maintainability, Zero defects, quality circle. **IS0-9000 and its concept of Quality Management:** ISO 9000 series, Taguchi method, JIT in some details	**30**	**1**

Reference Books:

1. Concurrent Engineering Kusiak John Wiley.
2. Concurrent Engineering Menon Chapman & hall.

RELIABILITY ENGINEERING (BME2021)

Course Objective:

1. To enable the students understand the reliability mathematics.
2. To provide students details of methods of reliability improvement.
3. To acquire skills to develop the reliability testing techniques.
4. To provide students an understanding of methods of reliability evaluation.

Learning Outcome:

At the end of the course student should be able to:

1. Apply the knowledge of mathematics and engineering to solve problems by approximate and numerical methods.

2. Demonstrate an understanding of the concepts of reliability improvement.

3. Conduct various analysis of reliability testing.

4. Explain reliability system and can develop logic diagram.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction:** Definition of reliability, Types of failures, Definition and factors influencing system effectiveness, Various parameters of system effectiveness. **Reliability Mathematics:** Definition of probability, Laws of probability, Conditional probability, Bay's theorem, Various distributions: Data collection, Recovery of data, Data analysis Procedures, Empirical reliability calculations	**30**	**1**
II	**Reliability:** Types of system- Series, Parallel, series parallel, Stand by and complex, Development of logic diagram, Methods of reliability evaluation, Cut set and tie set methods, Matrix methods event trees and fault trees methods, Reliability evaluation using probability distributions, Markov method, Frequency and duration method.	**30**	**1**

III	**Reliability Improvements:** Methods of reliability improvement, Component redundancy, System redundancy, Types of redundancies- Series, Parallel, series parallel, Stand by and hybrid, Effect of maintenance.	**30**	**1**
IV	**Reliability Testing:** Life testing, Requirements, Methods, Test planning, Data reporting system, Data reduction and analysis, Reliability test standards.	**30**	**1**

Reference Books:

1. R. Billintan & R.N. Allan, "Reliability Evaluation of Engineering and Systems", Plenum Press.
2. K.C. Kapoor & L.R. Lamberson,"Reliability in Engineering and Design", John Wiely and Sons.
3. S.K. Sinha & B.K. Kale, "Life Testing and Reliability Estimation", Wiely Eastern Ltd.
4. M.L. Shooman, "Probabilistic Reliability, An Engineering Approach", Mc GrawHill.
5. G.H.Sandler, "System Reliability Engineering", Prentice Hall.

NON-DESTRUCTIVE TESTING (BME2022)

Course Objective:

1. To have knowledge of different types of Non-Destructive testing techniques.
2. To understand the various types of Non-Destructive testing techniques.
3. To get an idea about Radiographic methods.
4. To know about Ultrasonic testing methods.

Learning Outcome:

At the end of the course student should be able to:

1. Know the importance of different types of Non-Destructive Testing techniques.
2. Have an idea of new types of Non-Destructive Testing techniques which can be developed in near future.
3. To have knowledge about latest technology in Radiography.
4. To have knowledge about applications of Ultrasonic.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction:** Scope and advantages of NDT, Comparison of NDT with DT, Some common NDT methods used since ages, Terminology. Flaws and Defects, Visual inspection, Equipment used for visual inspection, Ringing test chalk test (oil whitening test), Attractive uses of above tests in detecting surface cracks, Bond strength & surface defects. **Die penetrate test:** Liquid penetrate inspection, Principle, scope, Equipment & techniques, Tests stations, Advantages, types of penetrant and developers, Illustrative examples –Heavy casting of large size, Frame of jet engine, Porosity testing of nickel, Leak testing. Zyglo test.	**30**	**1**
II	**Magnetic particle Inspection:** Scope, Principle, Ferro magnetic and non-Ferro magnetic materials, Equipment & testing, Advantages, limitations, Interpretations of results, DC & AC magnetization, Skin Effect, Use of dye & wet powders for magna glow, Different methods to generate magnetic fields, Applications.	**30**	**1**

III	**Radiographic methods:** X-ray radiography principle, Equipment & methodology, Applicability, Types of radiations, Limitations. Interpretation of Radiographs, Limitations of γ-ray radiography – principle, Attenuation of electromagnetic radiations, Sources of radioactive materials & technique, Photo electric effect, Rayleigh's scattering (coherent scattering), Compton`s scattering (Incoherent scattering), Pair production, Beam geometry, Scattering factor, Advantages of γ-ray radiography over X-ray radiography, Precautions against radiation hazards, Case Study ─ X-ray of human body.	**30**	**1**
IV	**Ultrasonic testing methods:** Introduction, Principle of operation, Piezoelectricity, Ultrasonic probes, CRO Techniques, Advantages, Limitation & typical applications, Applications in inspection of castings, Forgings, Extruded steel parts, Bars, Pipes, Rails and dimensions measurements, Case Study- Ultrasonography of human body. **Eddy Current Inspection:** Principle, Methods, Advantages, Scope and limitations, Types of Probes, Case Studies.	**30**	**1**

Reference Books:

1. ASM Handbook Vol. 11, 8th Edition – Non-destructive Testing & Evaluation.
2. Research Techniques in NDT Vol.3, R.S. Shah, Academic.
3. Industrial Quality Control, Webstar.
4. Bray, Don E. and Stanley, Roderic K., Nondestructive Evaluation: A Tool in Design, Manufacturing, and Service. Revised Edition 1997, CRC Press New York.

DESIGN OF THERMAL SYSTEMS (BME 2023)

Course Objective:

1. To apply the laws of thermodynamics, heat and mass transfer to thermal energy systems.
2. To apply the concepts of thermal energy systems to practical problems and finding solutions.
3. To arrive at a basic and holistic understanding of the design of refrigeration and air-conditioning systems.
4. To understand the basic principles of design of turbo machines and heat exchangers.

Learning Outcome:

At the end of the course student should be able to:

1. Appreciate the application of the laws of thermodynamics in heat and mass transfer and operations of core thermal engineering systems like engines, compressors, refrigerators and air-conditioners.
2. Possess skills to distinguish the various types of ideal gas cycles, engine cycles, refrigeration cycles and power cycles and their engineering applications.
3. Possess engineering knowledge to arrive at basic innovative ideas on design and performance enhancements of heat and mass transfer systems like engines, compressors, refrigerator cycles and air-conditioning cycles.
3. Develop a full-fledged knowledge of thermal engineering systems and technical practices of energy efficiency improvement.
4. Gain the ability to apply the concepts of heat engineering and applied thermodynamics to the computation of performance parameters of engines, compressors, refrigerators and air-conditioning cycles.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction:** Psychrometry of Air Conditioning Processes, Design Conditions & Load Calculations Psychrometric, Processes in Air Conditioning Equipments, Analysis of Air Conditioning systems for summer & winter conditions, Inside & outside design conditions for comfort, Industrial Air Conditioning. **Cooling & Heating Load calculations:** Heat transfer through building structures, Solar heat gain, Internal heat gain, Occupancy & Product load, Room sensible heat factor, Effective sensible heat factor & Grand sensible heat factor, Capacity of the	**30**	**1**

	plant.		
II	**Design & Selection of Air conditioning Apparatus:** Heat & moisture transfer in Air conditioning apparatus, Enthalpy potential, Analysis of Coil & Spray Equipments Design of Cooling & Dehumidifying coils, Design of Air Washer & Cooling Towers. **Analysis of Complete Vapour Compression System:** Design and Balancing of System Components, Type of Refrigerant Compressors, Condensers, Evaporators & Expansion devices used in Vapour Compression Refrigeration Cycles, Design and Selection of individual components and their performance characteristics, Use of P-H charts for different Refrigerants in performance predication of the cycle, Analysis of the complete vapour-compression system and determination of 'Balance Points' using Graphical and Analytical methods, System simulation, Layout & selection of Refrigerant, Water and Brine pipings for the designed system, Selection of Refrigeration and Air conditioning Controls for the system.	**30**	**1**
III	**Design of Turbo machines:** Principles of Design of turbo machines, Design of axial flow turbine stage, Design of axial flow compressor stage, Design of centrifugal compressor. **Design of Heat Exchanger:** Study of design aspects, Fluid flow and heat transfer characteristics, Material requirement of heat exchange equipments, Liquid to liquid and Liquid to gas heat exchange systems, Familiarity with use of design related standards and codes, Design of Heat exchanger.	**30**	**1**
IV	**Design of Thermal System:** Optimization of design of thermal systems like condenser, evaporator, cooling tower for minimum cost and maximum performance, Development of computer program for design, Environmental consideration in design of thermal systems, Analysis of thermal systems using FEM.	**30**	**1**

Reference Books:

1. Refrigeration& Air Conditioning - By C.P. Arora.
2. Refrigeration& Air Conditioning - By Manohar Prasad.
3. Principles of Refrigeration (S.I. Units) – By Roy J. Dossat.
4. Air Conditioning Engineering – By P.Jones.
5. Ventilating and Air Conditioning- By McQuistion, Parker & Spitler.
6. Refrigeration& Air Conditioning Data Book – Manohar Prasad.
7. ASHRAE hand Book – Fundamentals.
8. Refrigeration& Air Conditioning- Stoecker & Jones.
9. Refrigeration& Air condioning – By P.L. Ballaney.

MECHANICAL VIBRATIONS (BME2031)

Course Objective:

1. To learn the basics of vibrations including causes and effects of vibrations.
2. To study the undamped and damped free vibration.
3. To study the forced vibrations and vibration measuring instrument.
4. To study multi degrees of freedom system.

Learning Outcome:

At the end of the course student should be able to:

1. Write differential equation of the given vibration model.
2. Calculate the frequencies of free or natural, damped and forced vibrations.
3. Find the response of a vibrating system.
4. Calculate the natural frequencies and mode shapes of multi degrees of freedom systems.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction:** Periodic motion, Harmonic motion, Superposition of simple harmonic motions, Beats, Fourier analysis. **Single Degree Freedom System:** Free vibration, Natural frequency, Equivalent systems, Energy method for determining natural frequency, Response to an initial disturbance, Torsional vibrations, Damped vibrations, Vibrations of systems with viscous damping, Logarithmic decrement.	**30**	**1**
II	**Single Degree Freedom: Forced Vibration:** Harmonic excitation with viscous damping, Steady state vibrations, Forced vibrations with rotating and reciprocating unbalance, Support excitation, Vibration isolation, Transmissibility, Vibration measuring instruments, Displacement, velocity and acceleration measuring instruments.	**30**	**1**
III	**Two Degree Freedom systems:** Introduction, Principal modes, Double pendulum, Torsional system with damping, Coupled system, Undamped dynamic vibration absorbers, Centrifugal pendulum absorbers, Dry friction damper.	**30**	**1**

IV	**Multi Degree Freedom system: Exact Analysis:** Undamped free and forced vibrations of multi-degree freedom systems, Influence number, Reciprocal theorem, Torsional vibration of multi-degree rotor system, Vibration of gear system, Principal coordinates, Continuous systems- Longitudinal vibrations of bars, Torsional vibrations of circular shafts. **Multi Degree Freedom system: Numerical Analysis:** Rayleigh's methods, Dunkerely's methods, Holzer's ad Stodola methods, Rayleigh-Ritz method. **Critical speed of shafts:** Shaft with one disc with and without damping, Multi-disc shafts, Secondary critical speed.	**30**	**1**

Reference Books:

1. William T. Thomson, Theory of vibration with applications, 5th Edition, Pearson Education India.
2. R V Dukkipati, Advanced Mechanical Vibrations, Alpha Science.
3. G K Grover, Mechanical Vibrations , Nem Chand & Bros. Roorkee.

OPERATIONS RESEARCH (BME2032)

Course Objective:

1. To provide students the knowledge of optimization techniques and approaches.
2. To enable the students apply mathematical, computational and communication skills needed for the practical utility of Operations Research.
3. To introduce students to research methods and current trends in Operations Research.
4. To develop project management techniques using various theories.

Learning Outcome:

At the end of the course student should be able to:

1. Apply operations research techniques in industrial optimization problems.
2. Solve transportation problems using various OR methods.
3. Illustrate the use of OR tools in a wide range of applications in industries.
4. Explain current topics and advanced techniques of Operations Research for industrial solutions.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction:** Basics of Operations Research. **Linear Programming:** Introduction & Scope, Problem formulation, Graphical Method, Simplex methods, Primal & dual problem sensitivity analysis.	**30**	**1**
II	**Transportation & Assignment problems.** **Deterministic Dynamic Programming:** Multistage decision problems & solution, Principle of optimality. **Decision theory:** Decision under various conditions. **Game Theory:** Two Person Zero sum game, Solution with / without Saddle point, Dominance Rule, Different Methods like Algebraic, Graphical, Liner Programming.	**30**	**1**

III	**Sequencing:** Basic assumption, n Jobs through two / three machines, 2 Jobs on m machines. **Stochastic inventory models:** Single & multi period models with continuous & discrete demands, Service level & reorder policy. **Simulations:** Use, advantages & limitations, Monte-carlo simulation, Application to queuing, Inventory & other problems.	**30**	**1**
IV	**Queuing models:** Characteristics of Queuing Model, M/M/1 & M/M/S system, Cost consideration. **Project Management:** Basic concept, Rules for drawing the network diagram, Applications of CPM and PERT techniques in Project planning and control, Crashing of operations, Resource allocation.	**30**	**1**

Reference Books:

1. Operations Research by: Wangner.
2. Operations Research by: Taha.
3. Introduction to Management Science by: Hiller & Hiller.
4. Operations Research by: Wayne L. Winston.

MAINTENANCE ENGINEERING & MANAGEMENT (BME2033)

Course Objective:

1. To acquire skills to develop maintenance strategies.
2. To get aware with general maintenance engineering & management principles.
3. To understand about the different types of maintenance planning models.
4. To know about maintenance management and economics of management.

Learning Outcome:

At the end of the course student should be able to:

1. Explain maintenance engineering & management process and review strategies of existing product considering reliability.
2. Develop models according to requirement of product.
3. Incorporate the ergonomics into the maintenance engineering.
4. Develop production maintenance system and planning.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction:** Operating life cycle, Reliability, Failure data analysis, Failure rate curve, Hazard models, Elements in series, parallel & mix, Logic diagrams, Improving reliability, Redundancy-element, unit, standby, Maintainability, Availability, reliability and maintainability trade off.	**30**	**1**
II	**Maintenance Strategies:** Break down maintenance, Planned maintenance, Preventive maintenance, Design out maintenance, Planned lubrication, Total productive maintenance, Zero break down, Preventive inspection of equipment used in emergency.	**30**	**1**
III	Replacement planning maintain or replace decision, Replacement of items that deteriorate identical equipment, Replacement of items that fail without deterioration individual, Group replacement, Replacement in anticipation of failure.	**30**	**1**

IV	Break down maintenance planning, Assignment model, Waiting time models expected waiting time, Minimum cost service rate., PERT, Maintenance Management, Production maintenance system, Objectives and functions: forms, policy, planning, organization, Economics of maintenance, Manpower planning, Materials planning, Spare parts planning and control, Evaluation of maintenance management.	**30**	**1**

Reference Books:

1. Management of systems – R.N. Nauhria & R. Prakash.

2. Operations Research –Wangner.

CAD/CAM LAB (BME2751)

Total TEN Experiments are to carried out. FIVE Experiments each from CAD and CAM.

A. CAD Experiments:

1. Line Drawing or Circle Drawing experiment: Writing and validation of computer program.
2. Geometric Transformation algorithm experiment for translation/rotation/scaling: Writing and validation of computer program.
3. Design of machine component or other system experiment: Writing and validation of computer program.
4. Understanding and use of any 3-D Modeling Software commands.
5. Pro/E/Idea etc. Experiment: Solid modeling of a machine component.
6. Writing a small program for FEM for 2 spring system and validation of program or using a FEM Package.
7. Root findings or curve fitting experiment: Writing and validation of computer program.
8. Numerical differentiation or numerical integration experiment: Writing and validation of compute program.

B. CAM Experiments:

1. To study the characteristic features of CNC machine.
2. Part Programming (in word address format) experiment for turning operation (including operations such as grooving and threading) and running on CNC machine.
3. Part Programming (in word address format or ATP) experiment for drilling operation (point to point) and running on CNC machine.
4. Part Programming (in word address format or ATP) experiment for milling operation (contouring) and running on CNC machine.
5. Experiment on Robot and programs.
6. Experiment on Transfer line/Material handling.
7. Experiment on difference between ordinary and NC machine, study or retrofitting.
8. Experiment on study of system devices such as motors and feedback devices.
9. Experiment on Mecatronics and controls.

AUTOMOBILE LAB (BME2752)

Experiments: Minimum 10 experiments out of following in depth and details.

1. Performance Analysis of Four strokes S.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
2. Determination of Indicated H.P. of I.C. Engine by Morse Test.
3. Performance Analysis of Four strokes C.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance.
4. Study & experiment on Valve mechanism.
5. Study & experiment on Gear Box.
6. Study & experiment on Differential Gear Mechanism of Rear Axle.
7. Study & experiment on Steering Mechanism.
8. Study & experiment on Automobile Braking System.
9. Study & experiment on Chassis and Suspension System.
10. Study & experiment on Ignition system of I.C. Engine.
11. Study & experiment on Fuel Supply System of S.I. Engines- Carburetor, Fuel Injection Pump and MPFI.
12. Study & experiment on Fuel Supply System of C.I. Engines- Injector & Fuel Pump.
13. Study & experiment on Air Conditioning System of an Automobile.
14. Comparative study of technical specifications of common small cars (such as Maruti Swift, Hyundai i20, Cheverlet Aveo, Tata Indica, Ford Fusion etc.
15. Comparative study & technical features of common scooters & motorcycles available in India.
16. Visit of an Automobile factory.
17. Visit to a Modern Automobile Workshop.
18. Experiment on Engine Tuning.
19. Experiment on Exhaust Gas Analysis of an I.C. Engine.

POWER PLANT ENGINEERING (BME2801)

Course Objective:

1. To have the basic knowledge of various types of loads and also of economics of a power plant.
2. To know about the various basic components of steam power plant.
3. To get the knowledge of diesel power plant, Gas turbine power plant & Nuclear power plant.

Learning Outcome:

At the end of the course student should be able to:

1. To calculate the various types of loads and can calculate the cost of electricity per unit as produced from power plant.
2. Have the knowledge of type of component used for a particular type of application.
3. Develop the new methods by which overall efficiency of plant can increase**.**

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction:** Power and energy, sources of energy, Review of thermodynamic cycles related to power plants, Fuels and combustion calculations, Load estimation, load curves, Various terms and factors involved in power plant calculations, Effect of variable load on power plant operation, Selection of power plant units, Effect of plant type on costs, rates, Fixed elements, Energy elements, customer elements and investor's profit, Depreciation and replacement, Theory of rates, Economics of plan selection.	**30**	**1**
II	**Steam power plant:** General layout of steam power plant, Power plant boilers including critical and super critical boilers, Fluidized bed boilers, Boilers mountings and accessories, Different systems such as coal handling system, Pulverizers and coal burners, Combustion system, draft, ash handling system, Dust collection system, Feed water treatment, Condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, Feed heating, Reheating, Flange heating and gland leakage, Operation and maintenance of steam power plant, Heat balance and efficiency, Site selection of a steam power plant.	**30**	**1**

III	**Diesel power plant :** General layout, Components of Diesel power plant, Performance of diesel power plant, Fuel system, Lubrication system, Air intake and admission system, Supercharging system, Exhaust system, Diesel plant operation and efficiency, Heat balance, Sites election of diesel power plant, Comparative study of diesel power plant with steam Power plant.	**30**	**1**
IV	**Gas turbine power plant:** Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, Cogeneration, Auxiliary systems such as fuel, Controls and lubrication, Operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant. **Nuclear power plant:** Principles of nuclear energy, Lay out of nuclear power plant, Basic components of nuclear reactions, Nuclear power station, Nuclear waste disposal, Site selection of nuclear power plants.	**30**	**1**

Reference Books:

1. "Power Plant Engineering" F.T. Morse, Affiliated East-West Press Pvt. Ltd, New Delhi/Madras.
2. "Power Plant Engineering" Mahesh Verma, Metropolitan Book Company Pvt. Ltd. New Delhi.
3. "Power Plant Technology" El- Vakil, McGraw Hill.
4. Power Plant Engineering by P.K. Nag, Tata McGraw Hill.
5. Steam & Gas Turbines & Power Plant Engineering by R. Yadav, Central Pub. House.

PRODUCT DEVELOPMENT** (OME2002)

Course Objective:

1. To acquire skills to develop products in a structured way.
2. To get aware with general product development principles for manufacturability.
3. To understand the incorporation of ergonomics in product development.
4. To develop need analysis techniques and morphology of design.

Learning Outcome:

At the end of the course student should be able to:

1. Explain product development process and review design of existing product considering reliability.
2. Develop a product according to requirement of market.
3. Incorporate the ergonomics into the product development.
4. Explain morphological techniques and technological design.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Concept of product, Definition and scope, Applications, Relevance, Product Definition, Scope, Terminology, Design definitions, The role and nature of design, Old and new design methods, Design by evolution, Need based development, Technology based developments.	**30**	**1**
II	Morphology of Design, Divergent, Transformation and convergent phases of product design, Identification of need, Analysis of need, Aesthetics, Ergonomics, Form (structure) Shape, size, color, Mental blocks, Removal of blocks, Ideation Techniques, Creativity, Checklist.	**30**	**1**
III	Transformations, Brainstorming & Synectics, Morphological techniques, Utility concept, Utility value, Utility index, Decision making under multiple criteria, Economic aspects of design, Fixed and variable costs, Break-even analysis.	**30**	**1**
IV	Reliability considerations, Bath tub curve, Reliability of systems in series and parallel, Failure rate, MTTF and MTBF, Optimum spares from reliability consideration, Patents, Standards and codes, Environment and safety considerations, Existing techniques such as work-study, SQC etc. which could be used to improve method & quality of product, Innovation versus Invention,	**30**	**1**

	Technological Forecasting.		

Reference Books:

1. Product Design & Manufacturing - A.K. Chitab & R.C.Gupta, PHI (EEE).
2. The Technology of Creation Thinking - R.P. Crewford – Prentice Hall.
3. The Art of Thought – Grohem Walls – Bruce & Co., New York.
4. Product Design & Decision Theory - M.K. Starr - Prentice Hall.
5. Engg .Product Design -C .D. Cain, Bussiness Books.
6. Industrial design for Engineers –W .H. Mayall, Itiffe. Design Methods – seeds of human futures – J. Christopher Jones, John Wiley & Sons.
7. Human Factor Engg. – Mccormick E.J., McGrawHill.
8. Engineering: An Introduction to Creative profession – G.C. Beakley H W leach, Macmillan.
9. Industrial Design In Engineering – A marriage of Techniques – Charles H .Flurscheim, The Design Council - London.
10. Quality Control & Reliability Analysis – Bijendra Singh, Khanna Publications.

ADVANCED SYNTHASIS OF MECHANISM (BME2041)

Course Objective:

At the end of the course student should be able to:

1. To familiarize students with advanced types of mechanisms, joints and degrees of freedom to perform position, velocity and acceleration analysis using graphical and analytical methods.
2. To provide students an understanding of different types of mechanisms.
3. To teach the basics of synthesis of advanced mechanisms.
4. To teach students the Algebraic Methods of Synthesis.

Learning Outcome:

1. Demonstrate an understanding of the concepts of various mechanisms and pairs.
2. Conduct various analyses of advanced mechanisms.
3. Design a layout of crank for specified motion.
4. Synthesize advanced mechanisms for slider crank and four bar link mechanism.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction:** Mechanisms, Classifications, Relative & absolute motion, Degree of freedom, 4-bar mechanisms-planar & spatial mechanisms, Inversion and equivalent linkage, Transmission deviation and pressure angles, Kinematic analysis of Planer motion, Relative velocity and velocity difference, Instantaneous Centre, Poles and centroids, Relative acceleration, Acceleration difference.	30	1
II	**Kinematic Synthesis:** Kinematic Synthesis type, Number and dimensional synthesis, Spacing of accuracy points, Chebyshev polynomials. **Four bar coupler point curves:** Four bar linkage, Equation of coupler curves, Double points and symmetry, Robert Hebyshev theorem, Approximate and exact straight line mechanisms.	30	1

III	**Geometrical Method of Synthesis:** Poles and relative poles of four bar linkage, Poles and relative poles of slider crank mechanism, Synthesis with three accuracy points, Pole triangle, Four position synthesis.	**30**	**1**
IV	**Algebraic Methods of Synthesis-I:** Displacement equation of four bar linkage, Crank and follower synthesis with three accuracy points, Four bar function generator with three accuracy points, Crank and follower synthesis: angular velocities and accelerations. **Algebraic Methods of Synthesis-II:** Syntheses of slider crank mechanism with three accuracy points, Synthesis of slider crank mechanism with four accuracy points, Five accuracy points synthesis of crank and follower mechanism, Analysis of mechanical errors in linkage, Mechanical error in four bar linkage.	**30**	**1**

Reference Books:

1. Kinematic Synthesis ofL inkages RSH artenberg and J Denavit McGraw Hill, New York.
2. Kinematic and Linkage Design AS Hall Jr Prentice Hall India Ltd.
3. Mechanism and Machine Theory Amitabh Ghosh and AK Mallick.

SIX SIGMA METHODS & APPLICATIONS (BME2042)

Course Objective:

1. To understand the Differences between Conventional and Six Sigma concept of quality.
2. To know about the six sigma success stories, Statistical foundation and methods of quality improvement.
3. To understand the different methodology of Six Sigma.
4. To get aware with six sigma organizations and software for six sigma.

Learning Outcome:

1. Understand six sigma concepts.
2. Describe models of implementation of six sigma.
3. Select proper methods for six sigma implementation.
4. Describe the advantages of six sigma concept of quality over conventional method.
5. .

Course Contents:

Module	Course Topics	Total Hours	Credits
I	Quality Perception, Quality in Manufacturing, Quality in Service Sector, Differences between Conventional and Six Sigma concept of quality, Six Sigma success stories, Statistical foundation and methods of quality improvement, Descriptive statistics: Data Type, Mean, Median, Mode, Range, Variation, Standard Deviation, Skewness, Kurtosis, Probability Distribution: Normal, Binomial, Poisson distribution.	**30**	**1**
II	Basics of Six Sigma, Concept of Six Sigma, Defects, DPMO, DPU, Attacks on X'S, Customer focus, Six Sigma for manufacturing, Six Sigma for service, Understanding Six Sigma organizations, Leadership council, Project sponsors and champions, Master Black Belts, Green Belts.	**30**	**1**
III	Methodology of Six Sigma, DMAIC, DFSS, Models of Implementation of Six Sigma, Selection of Six Sigma Projects, Six Sigma Tools, Project Charter, Process mapping, Measurement system analysis, Hypothesis Testing, Quality Function deployment, Failure mode effect analysis, Design of Experiments.	**30**	**1**

IV	Sustenance of Six Sigma, Communication plan, Company culture, Reinforcement and control, Introduction to software's for Six Sigma, Understanding Minitab, Graphical analysis of Minitab plots.	**30**	**1**

Reference Books:

1. Six Sigma: SPC and TQM in manufacturing and service, Geoff Tennant, Gower Publishing Co.
2. Six Sigma for managers, Greg Brue, TMH.
3. What is Six Sigma, Pete Pande, TMH.
4. The Six Sigma Way, Peter S. Pande, TMH Team Fieldbook.
5. The Six Sigma way, Peter S. Pande, TMH.

FINITE ELEMENT METHOD (BME2043)

Course Objective:

1. To enable the students understand the mathematical and physical principles underlying the Finite Element Method (FEM) as applied to solid mechanics and thermal analysis.
2. To understand the characteristics of various finite elements.
3. To develop finite element equations for simple and complex domains.
4. To understand various numerical methods of FEM.

Learning Outcome:

At the end of the course student should be able to:

1. Apply the knowledge of mathematics and engineering to solve problems in structural and thermal engineering by approximate and numerical methods.
2. Design a new component or improve the existing components using FEA.
3. Solve the problems in solid mechanics and heat transfer using FEM.
4. Use commercial FEA packages like ANSYS and modern CAD/CAE tools for solving real life problems.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction:** Introduction to finite difference method and finite elements method, Advantages and limitations, Mathematical formulation of FEM, Different approaches in Finite Element Method, Direct Stiffness approach, Simple examples, Variational approach, Elements of variational calculus, Euler Lagrange equation, Rayliegh Ritz method, Weighted Residual methods, Point Collocation method, Galarkin method, Steps involved in FEM.	**30**	**1**
II	**Types of Elements Used:** Interpolation Polynomials, Linear elements Shape function, Analysis of simply supported beam, Element and Global matrices, Two-dimensional elements, Triangular and rectangular elements, Local and Natural Co-ordinate systems.	**30**	**1**

III	**Finite Element Formulation of Field Problems:** 1-D and 2-D heat transfer, Fluid flow (incompressible and non-viscous fluid) in ducts, Simple electrical and magnetic field problems, Simple Numerical examples. **Finite Element Formulation of Solid Mechanics Problems:** 1-D problem of shaft, Truss element analysis of pinned truss, Plane stress/strain problems, Axi-symmetric problems, Thin plate problems, Vibration of shafts & beams.	**30**	**1**
IV	**Numerical Methods in FEM:** Evaluation of shape functions, One dimensional & triangular elements, Quadrilateral elements, Isoperimetric elements, Numerical Integration, Gauss Legendre quadrature, Solution of finite element equations, Gauss Elimination Method, Cholesky decomposition.	**30**	**1**

Reference Books:

1. The Finite Element Method O.C. Zienkiewicz and R.L. Taylor McGraw Hill.
2. An Introduction to Finite Element Method J. N. Reddy McGraw Hill.
3. Finite Element Procedure in Engineering Analysis K.J. Bathe McGraw Hill.
4. Finite Element Analysis C.S. Krishnamoorthy Tata McGraw Hill.
5. Concepts and Application of Finite Element Analysis R.D. Cook, D.S. Malcus and M.E. Plesha John Wiley.
6. Introduction to Finite Elements in Engineering T.R Chandragupta and A.D. Belegundu Prentice Hall India.
7. Numerical Methods E Balagurusamy Tata McGraw Hill.

ADVANCED MATERIALS TECHNOLOGY (BME2051)

Course Objective

1. To have knowledge of different types of Advanced Materials.
2. To be aware about the importance of advanced materials.
3. To understand the various ways in which we can use the various types of advanced material in latest technologies**.**
4. To have knowledge of Biomaterials & Nuclear material.

Learning Outcome:

At the end of the course student should be able to:

1. Know the importance of each of each of advanced material.
2. Get the knowledge of the various types properties of advanced materials and the methods to further enhance these properties.
3. Get an idea of new types of advanced materials which can be developed in near future and its application.
4. Apply the best suitable material according to the application.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Introduction to Ferrous Materials:** Plain carbon steels, their properties and application, Plain carbon steels, Effect of alloying elements in plain carbon steels, Alloy steels, tools steels, stainless steels, Low and high temperature resisting steels, High strength steels, selections, Specifications form and availability of steel.	**30**	**1**
II	**Heat Treatment of Steels:** TTT diagrams, annealing Normalizing, hardening and tempering of steel, Austempering and martempering of steel, Surface hardening of steel, Fluxes and indication hardening, Depth of hardening.	**30**	**1**
III	**Nonferrous materials:** Ultra-light materials, Properties and application, Brasses, bronzes, copper-nickel alloys, Aluminum, magnesium and titanium alloys, Bearing materials, Heat treatment of nonferrous material, Aging, Precipitations hardening. **Composites:** Polymer–polymer, Metal-metal, Ceramic–ceramic,	**30**	**1**

	Ceramic-polymer, Metal-ceramic, Metal-polymer, composites, Dispersion reinforced, Particle reinforced, Laminated and fiber reinforced composites.		
IV	**Biomaterials:** Stress strain behavior of bone, The mechanical properties, Fatigue properties of skin, Biocompatible materials and its applications, The effects of degradation and corrosion. **Nuclear Materials:** Introduction to nuclear materials, Materials of nuclear fuel in fission & fusion reactors, Fissile and fertile materials, Control & Construction Materials for Nuclear reactors, Moderators, Heat Exchangers, Radiation proof materials, Brief discussion of safety, Radioactive waste disposal.	**30**	**1**

Reference Books:

1. Biomaterials Science- An Introduction to Materials in Medicine. Buddy D.Rattner, A.S. Hoffman, F.J. Sckoen, and J.E.L Emons, Academic Press, second edition, 2004.
2. Biomaterials: An Introduction (second edition) Joon B. Park & Roderic S.Lakes, Plenum Press, 1992.
3. Handbook of Materials for Medical Devices, Edited by J. R. Davis, ASM international, 2003.
4. Introduction to Nuclear Engineering, by J.R Lamarsh.
5. W.D. Callister, Jr, - Material Science & Engineering Addition- Wesly Publishing Co.
6. Van Vlash - Elements of Material Science & Engineering John Wiley & Sons.

PRODUCTION & OPERATIONS MANAGEMENT (BME2052)

Course Objective:

1. To have knowledge about basic concept of production & operation management.
2. To be aware about the various tools used in production & operation management.
3. To know about scheduling production and service system.
4. To get an idea how to manage in a world class competition.

Learning Outcome:

At the end of the course student should be able to:

1. Able to know about various Managing operations.
2. Compare the different types of Production & Operation Management Techniques and can use the best suitable Technique.
3. Develop new types of Methods which can be used in Production & Operation Management**.**
4. Able to know about material requirement planning.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Managing Operations:** Operations Management, Function, Evolution, Definition, Systems view of P&OM, Operations Strategies for Competitive Advantage.	**30**	**1**
II	**Planning (Designing) the conversion System:** Designing Products, Services and Processes, Operations Capacity, Locating production and servicing facilities, Layout Planning.	**30**	**1**
III	**Organizing the conversion System:** Job design, Production and Operations standards, Work measurement, Project Management. **Scheduling Production and Service System:** Scheduling systems, Aggregate Planning for Production and service system, Operation scheduling.	**30**	**1**
IV	**Material Requirements Planning:** Planning for needs, Applying MRP, Detailed capacity planning, MRP II. **Managing for World class Competition:**	**30**	**1**

	World class Manufacturing practices, Managing for Quality, Conversion Process in change.		

Reference Books:

1. Adam Jr Everett E. R J – Production and Operations Management (Prentice-Hall, 2000, 5th Edition).
2. Russell & Taylor III – Operations Management (Pearson, 4th Edition).
3. Hill T- Operations Management (Palgrave, 2000).
4. McGregor D – Operations Management (McGraw-Hill, 1960).

OPTIMIZATION TECHNIQUES IN ENGINEERING (BME2053)

Course Objective:

1. To have knowledge about Unconstrained & constrained Optimization.
2. To have knowledge of different types of Optimization Techniques.
3. To be aware, how the Optimization Techniques can be used in research.
4. To get an idea about Optimization and Functions of a Complex Variable and Numerical analysis.

Learning Outcome:

At the end of the course student should be able to:

1. Know how to practically apply Unconstrained & constrained Optimization.
2. To understand the various ways in which we can use the Optimization Techniques in various fields.
3. To apply the Optimization Techniques in various processes in industry.
4. To apply the function of a complex variable and Numerical analysis in practical purposes.

Course Contents:

Module	Course Topics	Total Hours	Credits
I	**Unconstrained Optimization:** Optimizing Single-Variable Functions, Conditions for Local Minimum and Maximum, Optimizing Multi-Variable Functions.	**30**	**1**
II	**Constrained Optimization:** Optimizing Multivariable Functions with Equality Constraint, Terminology, Direct Search Method, Lagrange Multipliers Method, Kuhn-Tucker Necessary conditions, Kuhn Tucker Sufficient Condition.	**30**	**1**
III	**Optimization:** Quasi-Newton Methods and line search, Least squares optimization, Gauss-Newton, Levenberg- Marquartd, The Newton Algorithm, Non Linear Least Square, Sequential Quadratics Programming (SQP), Constrained Optimization, SQP Implementation, Multi-Objective Optimization, Branch and Bound Approaches, Genetic Algorithms and Genetic Programming , Singular Based Optimization, On- Line Real-Time Optimization, Optimization in Econometrics Approaches–Blue.	**30**	**1**

IV	**Optimization and Functions of a Complex Variable and Numerical Analysis:** The Finite Difference Method for Poisson`s Equation in two Dimensions and for the Transient Eulers Method, The Modified Eular Method and the Runga –Kutta Method, Gaussian Quardative Tranzoidal Rule and Simpson`s 1/3 and 3/8 Rules, The Newton Raphson in one and two Dimensions, Jacobi`s Iteration Method. **Optimization in Operation Research:** Transportation–Linear Optimization Simplex, Hitchcock Algorithms, Minimax and Maximum Algorithm, Discrete Simulation, Integer Programming–Cutting Plane Methods, Separable Programming, Stochastic Programming.	**30**	**1**

Reference Books:

1. Winston W L: Operations Research: Applications and Algorithms.
2. Rao S.S., Optimization: Theory and Applications.
3. Walsh G R: M methods of Optimization.
4. Williams H.P.: Model Building in Mathematics Programming.
5. Williams H.P.: Model Solving in Mathematics Programming.

END