Bundelkhand Institute of Engineering and Technology, Jhansi

Department of Mechanical Engineering

Syllabus

B.Tech.

(Mechanical Engineering)

BUNDELKHAND INSTITUT OF ENGINEERING & TECHNOLOGY, JHANSI

Department of Mechanical Engineering

B.Tech.

Mechanical Engineering

YEAR I, SEMESTER-I

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credit
						SESSIONAL EXAM.			ESE		
			L	T	P	CT	TA	Total			
THEORY											
1.	EAS-103	Mathematics-I	3	1	0	30	20	50	100	150	4
2.	EAS-101	Engg. Physics-I	2	1	0	15	10	25	50	75	3
3.	EAS-102/ EME-102	Engg. Chemistry/ Engg. Mechanics	3	1	0	30	20	50	100	150	4
4.	EEE-101/ ECS-101	Electrical Engg. / Computer Concepts & Programming in C	3	1	0	30	20	50	100	150	4
5.	EEC-101/ EAS-104	Electronics Engineering / Professional Communication	3	1	0	30	20	50	100	150	4
6.	EME-101/ EAS-105	Manufacturing Processes/ Environment & Ecology	2	0	0	15	10	25	50	75	2
7.	EAS-109	*Remedial English Language**	*2*	*0*	*0*	-	-	-	*50**	*50**	*0*
PRACTICAL/TRAINING/PROJECT											
8.	EAS-152/ EME-152	Engg. Chemistry Lab/ Engg. Mechanics Lab	0	0	2	10	10	20	30	50	1
9.	EEE-151/ ECS-151	Electrical Engg Lab / Computer Programming Lab	0	0	2	10	10	20	30	50	1
10.	EWS-151/ ECE-151	Workshop Practice/ Computer Aided Engg. Graphics	0	1	3	10	10	20	30	50	2
11.	EAS-151/ EAS-154	Physics Lab / Professional Communication Lab	0	0	2	10	10	20	30	50	1
			0	0	2	30	20	50	-	50	1
12.	GP-101	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	**18**	**6**	**9**	**190/210**	**140/150**	**380/410**	**670/640**	**1000**	**27**

**Remedial English language is compulsory Audit-course. Candidate has to secure minimum 30% pass marks*

L - Lecture
T - Tutorial
P - Practical
CT - Cumulative Test
TA - Teacher's Assessment
ESE - End Semester Exam.

BUNDELKHAND INSTITUT OF ENGINEERING & TECHNOLOGY, JHANSI

Department of Mechanical Engineering

B.Tech.

Mechanical Engineering

YEAR I, SEMESTER-II

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credit
						SESSIONAL EXAM.			ESE		
			L	T	P	CT	TA	Total			
THEORY											
1.	EAS-203	Mathematics-II	3	1	0	30	20	50	100	150	4
2.	EAS-202	Engg. Physics-II	2	1	0	15	10	25	50	75	3
3.	EME-202/ EAS-202	Engg. Mechanics/ Engg. Chemistry	3	1	0	30	20	50	100	150	4
4.	ECS-201/ EEE-201	Computer Concepts & Programming in C / Electrical Engg.	3	1	0	30	20	50	100	150	4
5.	EAS-204/ EEC-201	Professional Communication/ Electronics Engineering	3	1	0	30	20	50	100	150	4
6.	EAS-205/ EME-201	Environment & Ecology/ Manufacturing Processes	2	0	0	15	10	25	50	75	2
PRACTICAL/TRAINING/PROJECT											
7.	EME-252/ EAS-252	Engg. Mechanics Lab/ Engg. Chemistry Lab	0	0	2	10	10	20	30	50	1
8.	ECS-251/ EEE-251	Computer Programming Lab/ Electrical Engg. Lab	0	0	2	10	10	20	30	50	1
9.	ECE-251/ EWS-251	Computer Aided Engg. Graphics/ Workshop Practice	0	1	3	10	10	20	30	50	2
10.	EAS-254/ EAS-251	Professional Communication Lab/	0	0	2	30	20	50	-	50	1
		Physics Lab	0	0	2	10	10	20	30	50	1
11.	GP-201	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	**16**	**6**	**9**	**210/190**	**150/140**	**410/380**	**590/620**	**1000**	**27**

1. EME-102/202: Engineering Mechanics L T P [3 1 0]

Unit	Topic	Hour
I	**Force Systems:** • Basic concepts: Definitions, Basic assumptions, Scalar & Vector quantities, Free, Forced and fixed vectors. • Force System: Force, Classification & Representation, Force as a Vector, Composition of forces, Parallelogram Law, Resolution, Principle of Transmissibility of forces • Moment of a force, Vector representation, Moment for coplanar force system, Varignon's theorem • Couple, Vector representation, Resolution of a force into a force and a couple. • Force Systems: Coplanar Concurrent Force system and Coplanar Non Concurrent force systems, Resultant of coplanar force system. • Equilibrium of coplanar force system, Free body diagrams, Determination of reactions, Equilibrium of a body under three forces, Lami's theorem. **Friction:** • Introduction, Wet and Dry friction, Theory of Dry friction, Angle of friction, Angle of Repose, Cone of friction, Coulomb's laws of friction.	8
II	**Basic Structural Analysis:** • **Plane Truss**, Difference between truss and frame, Perfect and imperfect truss, Assumptions and Analysis of Plane Truss , Method of joints, Method of section, Zero force members. • Beams, Types of beams, Statically Determinate Beams, Shear force and bending moment in beams, Shear force and bending moment diagrams, Relationships between load, shear and bending moment.	8
III	**Centroid and Moment of Inertia:** • Center of Gravity, Center of Mass and Centroid of curves, areas, volumes, Determination of centroid by integration, Centroid of composite bodies. • Definition of Moment of inertia of area, Perpendicular axis theorem and Polar moment of Inertia, Parallel axis theorem, Moment of inertia of simple areas by integration, Moment of Inertia of Composite Areas. • Moment of Inertia of masses, Parallel axis theorem for mass moment of inertia, Mass moment of inertia of simple bodies by integration, Mass moment of inertia of composite bodies.	8
IV	**Kinematics of Rigid Body:** • Introduction, Absolute motion, Plane rectilinear motion of rigid body, Plane curvilinear Motion of rigid body, x-y and n-t components, Rotation of rigid bodies, Relative Motion, Plane Motion of rigid bodies, Instantaneous center of zero velocity **Kinetics of Rigid Body:** • Introduction, Force, Mass and Acceleration, Newton's law of motion, D' Alembert's Principles and Dynamic Equilibrium, Laws of motion applied to planar translation, rotation and plane motion. • Work and energy, Kinetic Energy, Principle of work and energy, Conservative forces, Law of Conservation of energy. • Linear impulse and momentum, Conservation of linear momentum.	9
V	**Mechanics of Deformable Solids:** • **Simple stress and strain**: Normal and shear stresses. One Dimensional Loading; members of varying cross section, bars in series. Tensile Test diagram for ductile and brittle materials, Elastic constants, Strain energy. • **Bending of Beams**: theory of pure bending, neutral surface and neutral axis, stresses in beams of different cross sections. • **Theory of Torsion**, Torque and twist, Shear stress due to torsion circular sections.	**8**

2. EME-101/201: Basic Manufacturing Processes L T P [2 0 0]

Unit	Topic	Hour
I	• **Engineering Materials** Materials and Civilization, their socio economic impact. Engineering Materials their classification and applications. • **Metals & Alloys: Properties and Applications** • **Mechanical Properties of Materials:** Strength, elasticity, plasticity, stiffness, malleability, ductility, brittleness, malleability, toughness, hardness, resilience, hardness, machine ability, formability, weld ability. Elementary ideas of fracture fatigue & creep. • **Steels and Cast Irons:** Carbon steels, their classification based on percentage of carbon as low, mild, medium & high carbon steel, their properties & applications. Wrought iron. Cast iron. Alloy steels: stainless steel, tool steel. • **Alloys of Non Ferrous Metals:** Common uses of various non-ferrous metals (Copper, Zink, Tin, Magnesium, Lead, Aluminum etc.) & alloys and its composition such as Cu-alloys: Brass, Bronze, Al-alloys.	1 2 2 2
II	• **Basic Metal Forming & Casting Processes.** • **Forming Processes:** Basic metal forming operations & uses of such as: Forging, Rolling, Wire & Tube-drawing/making and Extrusion, and their uses. Press-work: Die & Punch assembly, cutting and forming, its applications. Hot-working versus cold-working • **Casting:** Pattern: Materials, types and allowances. Type and composition of Molding sands and their desirable properties. Mould making with the use of a core. Gating system. Casting defects & remedies. Cupola Furnace. Die-casting and its uses.	4 3
III	• **Machining and Welding Operations and their Applications** • **Machining:** Basic principles of Lathe-machine and operations performed on it. Basic description of machines and operations of Shaper-Planer, Drilling, Milling & Grinding. • **Welding:** Introduction, classification of welding processes. Gas-welding, types of flames and their applications. Electric-Arc welding. Resistance welding. Soldering & Brazing processes and their uses.	4 3
IV	• **Misc. Topics/ Processes** • **Heat Treatment Processes**: Introduction to Heat- treatment of carbon steels: annealing, normalizing, quenching, tempering and case-hardening. • **Manufacturing Establishment**: Plant location. Plant layout–its types. Types of Production. Production versus Productivity. • **Non-Metallic Materials:** Common types & uses of Wood, Cement-concrete, Ceramics, Rubber, Plastics and Composite-materials. • **Misc. Processes:** Introduction to Galvanizing and Electroplating.	1 3 1

EME- 152/252: Engineering Mechanics Lab L T P [0 0 2]

Topic
(Any 10 experiments of the following or similar experiments suitably designed)
1. To verify the law of parallelogram of forces. **2.** To study the equilibrium of a body under three forces. **3.** To determine the coefficient of friction of a flat surface. **4.** Friction experiment on screw-jack. **5.** Experiment based on analysis of truss. **6.** To determine the mass moment of inertia of a rotating disc. **7.** To conduct the tensile test and determine the ultimate tensile strength, percentage elongation for a mild steel specimen. **8.** To conduct the Impact-tests (Izod / Charpy) on Impact-testing machine to find the Impact Strength

of the specimen.

9. To determine the hardness of the given specimen using Vicker/Brinell/Rockwell hardness testing machine.
10. Simple & compound gear-train experiment.
11. Worm & worm-wheel experiment for load lifting.
12. Belt-Pulley experiment.
13. Bending of simply-supported and cantilever beams for theoretical & experimental deflection.
14. Dynamics experiment on momentum conservation
15. Dynamics experiment on collision for determining coefficient of restitution.
16. Experiment on Torsion of Rod/wire

EWS-151/ 251: WORKSHOP PRACTICE **L T P [0 1 3]**

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

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YEAR II, SEMESTER-III

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credits
						SESSIONAL EXAM.					
			L	T	P	CT	TA	Total	ESE		
THEORY											
1.	EHU-301/ EHU-302	Industrial Psychology / Industrial Sociology	2	0	0	15	10	25	50	75	2
2	EAS-301 / EOE-031-EOE 038	Mathematics-III / Science Based Open Elective***	3	1	0	30	20	50	100	150	4
3.	ECE-301	Fluid Mechanics** *Engineering Core (interdisciplinary)*	3	1	0	30	20	50	100	150	4
4.	EME301	Materials Science in Engineering	3	1	0	30	20	50	100	150	4
5.	EME-302	Strength of Materials	3	1	0	30	20	50	100	150	4
6.	EME-303	Thermodynamics	2	1	0	15	10	25	50	75	3
7.	*EHU-111*	**Human Values & Professional Ethics*	*2*	*0*	*0*	*15*	*10*	*25*	*50*	*75*	
PRACTICAL/TRAINING/PROJECT											
8.	EME-351	Material Science & Testing Lab	0	0	2	10	10	20	30	50	1
9.	EME-352	Machine Drawing-I	0	0	3	10	10	20	30	50	1
10.	EME-353	Thermodynamics Lab	0	0	2	10	10	20	30	50	1
11.	ECE-351	Fluid Mechanics Lab *	0	0	2	10	10	20	30	50	1
12.	GP-301	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	**16**	**5**	**9**	**-**	**-**	**-**	**-**	**1000**	**26**

NOTE: Up to IV semesters – common to Mechanical and related branches (such as Production, Industrial, Manufacturing, Automobile, Aeronautical etc.).

Paper Code	**Science Based Open-Electives**
EOE-031/EOE-041	Introduction to Soft Computing (Neural Networks, Fuzzy Logic and Genetic Algorithm)
EOE-032/EOE-042	Nano Sciences
EOE-033/EOE-043	Laser System and Applications
EOE-034/EOE-044	Space Science
EOE-035/EOE-045	Polymer Science &
EOE-036/EOE-046	Technology Nuclear Science
EOE-037/EOE-047	Materials Science
EOE-038/EOE-048	Discrete Mathematics

**Common to Civil Engg. and Mechanical Engg & related branches *(as Engineering Core – Interdisciplinary)*.

*Human values & Professional Ethics will be offered as a compulsory audit course for which passing marks are 40% in theory & 50% in aggregate. Students will be required to audit it with in the period of their study. There will not carry over facility for this course and the failure student will be required to repeat this course (in next-semester).

Note : Mechanical Engineering & related branches students cannot take the Open Elective Course EOE-037/EOE-047: Materials Science

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B.Tech.

Mechanical Engineering

YEAR II, SEMESTER-IV

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credits
						SESSIONAL EXAM.			ESE		
			L	T	P	CT	TA	Total			
THEORY											
1.	EHU-402/ EHU-401	Industrial Sociology / Industrial Psychology	2	0	0	15	10	25	50	75	2
2.	EOE-041-EOE-048/ EAS-401	Science Based Open Elective*** / Mathematics-III	3	1	0	30	20	50	100	150	4
3.	EEE-409	Electrical Machines & Automatic Control *Engineering Core (interdisciplinary)*	3	1	0	30	20	50	100	150	4
4.	EME-401	Applied Thermodynamics	3	1	0	30	20	50	100	150	4
5.	EME-402	Manufacturing Science-I	3	1	0	30	20	50	100	150	4
6.	EME-403	Measurement & Metrology	2	1	0	15	10	25	50	75	3
7	*EHU-111*	**Human values & Professional Ethics*	*2*	*0*	*0*	*15*	*10*	*25*	*50*	*75*	
PRACTICAL/TRAINING/PROJECT											
8.	EME-451	Machine Drawing-II	0	0	3	10	10	20	30	50	1
9.	EME-452	Manufacturing Science-I Lab	0	0	3	10	10	20	30	50	1
10.	EME-453	Measurement & Metrology Lab	0	0	2	10	10	20	30	50	1
11.	EEE-459	Electrical Machines & Automatic Control Lab	0	0	2	10	10	20	30	50	1
12.	GP-401	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	**16**	**5**	**10**	**-**	**-**	**-**	**-**	**1000**	**26**
		Industrial Training-I of 4 weeks after IV semester or Minor fabrication project involving work for nearly 4 weeks , which will be evaluated in VII semester									

NOTE: Practical summer training-I of 4-weeks after IV –semester or Minor fabrication project will be evaluated in VII semester

EME- 301: MATERIAL SCIENCE IN ENGINEERING

Unit	Topic	Periods
I	**Introduction:** Historical perspective, importance of materials. Brief review of modern & atomic concepts in Physics and Chemistry. Atomic models, Periodic table, Chemical bondings. **Crystallography and Imperfections:** Concept of unit cell space lattice, Bravais lattices, common crystal structures, Atomic packing factor and density. Miller indices. Xray crystallography techniques. Imperfections, Defects & Dislocations in solids.	7
II	**Mechanical properties and Testing:** Stress strain diagram, Ductile & brittle material, Stress vs strength. Toughness, Hardness, Fracture, Fatigue and Creep. Testings such as Strength testings, Hardness testing, Impact testings, Fatigue testing Creep testing, Non-destructive testing (NDT) **Microstructural Exam:** 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 steel, CI, Brass. **Phase Diagram and Equilibrium Diagram:** Uniary and Binary diagrams, Phase rules. Types of equilibrium diagrams: Solid solution type, eutectic type and combination type. Iron-carbon equilibrium diagram.	10
III	**Ferrous materials:** 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-ferrrous metals such as Cu, Al, Zn, Cr, Ni etc. and its applications. Various type Brass, Bronze, bearing materials, its properties and uses. Aluminum alloys such as Duralumin. Other advanced materials/alloys.	8
IV	**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.	7
V	**Ceramics:** Structure types and properties and applications of ceramics. Mechanical/Electrical behavior and processing of Ceramics. **Plastics:** Various types of polymers/plastics and its applications. Mechanical behavior and processing of plastics. Future of plastics. **Other materials:** Brief description of other material such as optical and thermal materials concrete, Composite Materials and its uses. Brief introduction to Smartmaterials & Nano-materials and their potential applications **Performance of materials in service:** Brief theoretical consideration of Fracture, Fatigue, and Corrosion and its control.	9

EME- 302 STRENGTH OF MATERIALS

Unit	Topic	Periods
I	**Compound stress and strains:** Introduction, state of plane stress, Principal stress and strain, Mohr's stress circle. **3-D Stress, Theory of failure, Castinglion's Theorem, Impact load:** Threedimensional state of stress & strain, equilibrium equations. Generalized	8
II	**Stresses in Beams:** Review of pure Bending**.** Direct and shear stresses in beams due to transverse and axial loads, 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.	8
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. 4 **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, Examples of columns in mechanical equipments and machines.	8
IV	**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 cylinders. Stresses in rotating shaft and cylinders. Stresses due to interference fits.	2
V	**Curved Beams:** Bending of beams with large initial curvature, position of neutral axis for rectangular, trapezoidal and circular cross sections, stress in crane hooks, stress in 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 channelsection.	8

EME-303: THERMODYNAMICS

Units	Topic	Periods
I	**Fundamental Concepts and Definitions:** Introduction and definition of thermodynamics, Dimensions and units, Microscopic and Macroscopic approaches, Systems, surroundings and universe, Concept of continuum, Control system boundary, control volume and control surface, Properties and state, Thermodynamic properties, Thermodynamic path, process and cycle, Thermodynamic equilibrium, Reversibility and irreversibility, Quasi static process, Energy and its forms, Work and heat, Gas laws, Ideal gas, Real gas, Law of corresponding states, Dalton's law, Amagat's law, Property of mixture of gases. 3 **Zeroth law of thermodynamics:** Zeroth law of thermodynamics, Temperature and its' measurement, Temperature scales. **First law of thermodynamics:** Thermodynamic definition of work, Thermodynamic processes, Calculation of work in various processes and sign convention, Non-flow work and flow work, Joules' experiment, First law of thermodynamics, Internal energy and enthalpy, First law of thermodynamics applied to open systems, Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc. First law analysis for closed system (non flow processes), Analysis of unsteady processes such as filling and evacuation of vessels with and without heat transfer, Limitations of first law of thermodynamics, PMM-I.	8
II	**Second law:** Devices converting heat to work, Thermal reservoir, Heat engines, Efficiency, Devices converting work to heat, Heat pump, refrigerator, Coefficient of Performance, Reversed heat engine, Kelvin Planck statement of second law of thermodynamics, Clausius statement of second law of thermodynamics, Equivalence of two statements of second law of thermodynamics, Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and it's corollaries, thermodynamic temperature scale, PMM-II.	4
III	**Entropy :** Clausius inequality, Concept of Entropy, Entropy change in different thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law of thermodynamics. **Availability and Irreversibility**: Available and unavailable energy, Availability and Irreversibility, Second law efficiency, Helmholtz & Gibb's function.	7
IV	**Properties of steam and thermodynamics cycles:** Pure substance, Property of steam, Triple point, Critical point, Sub-cooled liquid, Saturation states, Superheated states, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T & P-V diagrams, T-S and H-S diagrams, use of property diagram, Steam-Tables & Mollier charts, Dryness factor and it's measurement, processes involving steam in closed and open systems. Simple Rankine cycle. **Introduction to working of IC engines:** Compression Ignition engines, Spark Ignition engines, 2 stroke and 4 stroke engines, Performance parameters of IC engine, Heat balance sheet.	7

EME- 351: MATERIALS SCIENCE AND TESTING Lab

Topic
Say minimum 10 experiments out of following (or such experiment).
(A). Material Science Lab Experiments : (at least 5 of the following) 1. Making a plastic mould for small metallic specimen. 2. Specimen preparation for micro structural examination-cutting, grinding, polishing, etching. 1. Grain Size determination of a given specimen. 2. Comparative study of microstructures of different given specimens (mild steel, gray C.I., brass, copper etc.) 3. Heat treatment experiments such as annealing, normalizing, quenching, case 4. Hardening and comparison of hardness before and after. 5. Material identification of, say, 50 common items kept in a box. 6. Faradays law of electrolysis experiment. 7. Study of corrosion and its effects. 8. Study of microstructure of welded component and HAZ. Macro & Micro Examination. 9. Suitable experiment on Magnetic/ Electrical/Electronic materials. **(B). Material Testing Lab Experiments :** (at least 5 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. Other tests such as 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 penetrant tests.

EME – 352: MACHINE DRAWING-I LAB

Units	**Topic**	Periods
I	**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
II	**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	2
III	**Screwed fasteners** (2 drawing sheet)	2

	Thread nomenclature, Forms of thread, Thread series, designation, Representation of threads, Bolted joints, Locking arrangement of nuts	
IV	**Keys and Cotters and Pin joint** (1 drawing sheet) Types of keys, Cotter joint or Knuckle joint **Shaft Couplings** (1 drawing sheet) Introduction, Rigid coupling or Flexible coupling **Riveted joints** (1 drawing sheet) Introduction, rivets and riveting, Types of rivet heads, Types of riveted joints, Boiler joint **Assembly Drawing** (1 drawing sheet) Introduction, Engine parts-stuffing box, cross head **Free hand sketching*** Introduction, Need for free hand sketching, Free hand sketching of foundation bolts, studs, pulleys, couplings etc.	6

EME-353 : THERMODYNAMICS LAB

Topic
Minimum 10 experiments out of following (or such experiment).
1. Study of Fire Tube boiler 2. Study of Water Tube boiler 3. Study and working of Two stroke petrol Engine 4. Study and working of Four stroke petrol Engine 5. Determination of Indicated H.P. of I.C. Engine by Morse Test 6. Prepare the heat balance for Diesel Engine test rig 7. Prepare the heat balance sheet for Petrol Engine test rig 8. Study and working of two stroke Diesel Engine 9. Study and working of four stroke Diesel Engine. 10. Study of Velocity compounded steam turbine 11. Study of Pressure compounded steam turbine 12. Study of Impulse & Reaction turbine 13. Study of steam Engine model. 14. Study of Gas Turbine Model 15. Any other suitable experiment on thermodynamics

EME- 401: Applied Thermodynamics

Unit	Topic	Periods
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.	7
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. **Condenser:** Classification of condenser, Air leakage, Condenser performance parameters	8
III	**Steam Engines:** Rankine and modified Rankine cycles, Working of stream 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.	7
IV	**Vapour Power cycles:** Carnot vapour power cycle, Effect of pressure & temperature on Rankine cycle, Reheat cycle, Regenerative cycle, Feed water heaters, Binary vapour cycle, Combined cycles, Cogeneration. **Steam Turbines :** Classification of steam turbine, Impulse and reaction turbines, Staging, Stage and overall efficiency, Reheat factor, Bleeding, Velocity diagram of simple & compound multistage impulse & reaction turbines & related calculations work done efficiencies of reaction, Impulse reaction Turbines, state point locus, Comparison with steam engines, Losses in steam turbines, Governing of turbines.	7
V	**Gas Turbine:** Gas turbine classification Brayton cycle,Principles of gas turbine, Gas turbine cycles with intercooling, reheat and regeneration and their combinations, Stage efficiency, Polytropic 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.	7

EME- 402: Manufacturing Science I

Unit	Topic	Periods
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	9
II	**Metal Forming Processes (continued):** Analysis of Wire/strip drawing and max. Reduction, Tube drawing, Extrusion andits application. Condition for Rolling force and power in rolling. Rolling mills. Design, lubrication and defects in metal forming processes.	6
III	**Sheet Metal working :** Presses and their classification, Die & punch assembly 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 and bending.	3
IV	**Unconventional Metal forming processes :** Unconventional metal forming processes such as explosive forming, electromagnetic, electro-hydraulic forming. **Powder Metallurgy :** Powder metallurgy manufacturing process. The process, advantage and applications. **Jigs & Fixtures :** Locating & clamping devices/principle. Jigs and Fixtures and its applications. **Manufacturing of Plastic components :** Review of plastics, and its past, present & future uses. Injection moulding. Extrusion of plastic section. Welding of plastics. Future of plastic & its applications. Resins & Adhesives.	10
V	**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, runnes, core. Solidification of casting, theory and analysis. Sand casting, defects & remedies and inspection. Cupola furnace. Die Casting centrifugal casting. Investment casting etc.	

EME- 403: Measurement & Metrology

Units	Topic	Periods
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	9
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, pneumalic & hydraulic systems. **Temperature measurement:** Thermometers, bimetallic thermocouples, thermistors and pyrometers. **Vibration:** Seismic instruments, vibration pickups and decibel meters, vibrometers accelerometers.	10
III	**Metrology** **Metrology and Inspection :** Standards of linear measurement, line and end standards. Limit fits and tolerances. Interchangeability and standarisation. Linear and angular measurements devices and systems Comparators: Sigma,	5

	Johansson's Microkrator. Limit gauges classification, Taylor's Principle of Gauge Design	
IV	Measurement of geometric forms like straightness, flatness, roundness. Tool makers 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.	7

EME – 451: MACHINE DRAWING-II LAB

Units	**Topic**	Periods
I	**Review of Orthographic Projections** (1 drawing sheet) Orthographic Projection of solids in First angle of projection, missing lines views, interpretation of views	2
II	**Part and Assembly Drawing** (2 drawing sheet) Assembly drawing of eccentric, lathe tail stock, air valve, screw jack, connecting rod, safety valve etc.	2
III	**Specification of Materials** (1 drawing sheet) Engineering materials, representation, Code designation of steel, copper, aluminium etc.	1
IV	**Limits, Tolerance and Fits** (1 drawing sheet) Limit system, Tolerances, Method of placing limit dimensions, Fits-types	2
V	**Surface Roughness** (1 drawing sheet) Introduction, nomenclature, machining symbols, indication of surface roughness	1
VI	**Production Drawing** (1drawing sheet) Types, Examples of simple machine elements like helical gear, bevel gear, crank, connecting rod, belt pulley, piston etc.	2
VII	**Computer Aided Drafting** (2 drawings) Introduction, input, output devices, introduction to software like AutoCAD, ProE, basic commands and development of 2D and 3D drawings of simple parts	3

EME-452: MANUFACTURING SCIENCE-1 LAB

Topic
Say minimum 8 experiments out of following (or such experiment).
1. Design of pattern for a desired casting (containing hole) 2. Pattern making 3. Making a mould (with core) and casting. 4. Sand testings (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.

EME 453: MEASUREMENT & METROLOGY LAB

Topic
Minimum 8 experiments out of following (or such experiment).
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 sinebar & 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.

BUNDELKHAND INSTITUT OF ENGINEERING & TECHNOLOGY, JHANSI
Department of Mechanical Engineering
B.Tech.
Mechanical Engineering

YEAR III, SEMESTER-V

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credits
						SESSIONAL EXAM.			ESE		
			L	T	P	CT	TA	Total			
THEORY											
1.	EHU-501	Engineering and Managerial Economics	3	1	0	30	20	50	100	150	3
2.	EME-501	Machine Design-I	2	1	0	15	10	25	50	75	3
3.	EME-502	Theory of Machines-I	3	1	0	30	20	50	100	150	4
4.	EME-503	Manufacturing Science-II	3	1	0	30	20	50	100	150	4
5.	EME-504	Heat & Mass Transfer	3	1	0	30	20	50	100	150	4
6.	EPI-501	Production Planning & Control	2	1	0	15	10	25	50	75	3
7	*EHU-111*	**Human values & Professional Ethics*	*2*	*0*	*0*	*15*	*10*	*25*	*50*	*75*	
PRACTICAL/TRAINING/PROJECT											
8	EME-551	Machine Design-I Lab	0	0	2	10	10	20	30	50	1
9.	EME 552	Seminar	0	0	3	-	50	-	-	50	1
10.	EME 553	Manufacturing Science-II Lab	0	1	2	10	10	20	30	50	1
11.	EME 554	Heat & Mass Transfer Lab	0	0	3	10	10	20	30	50	1
12.	GP 501	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	**16**	**7**	**10**	**-**	**-**	**-**	**-**	**1000**	**26**

BUNDELKHAND INSTITUT OF ENGINEERING & TECHNOLOGY, JHANSI
Department of Mechanical Engineering
B.Tech.
Mechanical Engineering

YEAR III, SEMESTER-VI

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credits
						SESSIONAL EXAM.			ESE		
			L	T	P	CT	TA	Total			
THEORY											
1.	EHU-601	Industrial Management	3	0	0	30	20	50	100	150	3
2.	EME-011 to EME-014	Departmental Elective-I Fluid machinery	3	1	0	30	20	50	100	150	4
3.	EME-021 to EME-024	Departmental Elective-II Non conventional energy resource & utilization	2	1	0	15	10	25	50	75	3
4.	EME-602	Machine Design-II	3	1	0	30	20	50	100	150	4
5.	EME-603	Theory of Machine- II	2	1	0	15	10	25	50	75	3
6.	EPI-601	Principles of Machine Tool Design	3	1	0	30	20	50	100	150	4
7	*EHU-111*	**Human values & Professional Ethics*	*2*	*0*	*0*	*15*	*10*	*25*	*50*	*75*	
PRACTICAL/TRAINING/PROJECT											
8.	EME-651	Fluid Machinery Lab	0	1	2	10	10	20	30	50	1
9.	EME-652	Machine Design-II Lab	0	0	2	10	10	20	30	50	1
10.	EME-653	Theory of Machines Lab	0	0	3	10	10	20	30	50	1
11.	EPI-651	Machine Tool Design Lab	0	0	2	10	10	20	30	50	1
12.	GP-601	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	**16**	**6**	**9**	**-**	**-**	**-**	**-**	**1000**	**26**
		Industrial Training-II of 4 – 6 weeks after VI semester will be evaluated in VII semester									

NOTE: Practical summer training-I of 4-weeks after IV –semester or Minor fabrication project will be evaluated in VII semester

Note- 4 to 6 Weeks Industrial Training-II after VI semester also to be evaluated in VII semester

DEPARTMENTAL ELECTIVES:

Department Elective - I

1. **EME-011 Fluid Machinery***
2. EME-012 Unconventional Manufacturing Processes
3. EME-013 Product Development & Design
4. EME-014 Reliability Engineering

Department Elective - II

1. **EME-021 Non-Conventional Energy Resources & Utilization****
2. EME-022 Advanced Welding Technology
3. EME-023 Optimization Techniques in Engineering
4. EME-024 Mechanical Vibrations

EME-501 : MACHINE DESIGN-I

1	**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, Principal stresses, Stresses due to bending and torsion, Theory of failure	7
2	**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 **Riveted Joints**-Riveting methods, materials, 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	8
3	**Shafts** Cause of failure in shafts, Materials for shaft, 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 **Keys and Couplings** Types of keys, splines, Selection of square & flat keys, Strength of sunk key, Couplings- Design of rigid and flexible couplings	8
4	**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 **Note: Design data book is allowed in the examination**	7

EME 502: THEORY OF MACHINES – I

Unit	Topic	Periods
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 **5** **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	8
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, Analytical method for slider crank mechanism **Mechanisms with Lower Pairs** Pantograph, Exact straight line motion mechanisms-Peaucellier's, 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.	9
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	9
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	7

V	**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.	7

EME-503: MANUFACTURING SCIENCE-II

Unit	Topic	Periods
I	**Metal Cutting and Machine Tools** ***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. Tool materials. Tool wear and tool life. Machinability. Dynamometer. Brief introduction to machine tool vibration and surface finish. Economics of metal cutting.	9
II	***Machine Tools*** (i) Lathe : Principle, construction, types, operations, Turret/capstan, semi/Automatic, Tool layout. (ii) Shaper, slotter, planer : Construction, operations & drives. (iii) Milling : Construction, Milling cutters, up & down milling. Dividing head & indexing. Max chip thickness & power required. (iv) Drilling and boring : Drilling, boring, reaming tools. Geometry of twist drills.	7
III	**Grinding & Super finishing** (v) Grinding: Grinding wheels, abrasive & bonds, cutting action. Grinding wheel Specification. Grinding wheel wear - attritions wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and Cylindrical grinding. Centerless grinding. (vi) Super finishing : Honing, lapping, polishing. Standardization & Interchangeability, Limits, Fits & Tolerance and Surfaceroughness: Introduction to Standardization & Interchangeability Limits, Fits, Tolerances and IS standards, Limit-gauges, and surface-roughness.	8
VI	**Metal Joining (Welding)** Survey of welding and allied processes. Gas welding and cutting, process and	10

	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. Thermodynamic and Metallurgical aspects in welding and weld,. Shrinkage/residual stress in welds. Distortions & Defects in welds and remedies. Weld decay in HAZ.	
V	**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.	6

EME-504 HEAT & MASS TRANSFER

Units	**Topic**	Periods
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.	8
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.	7
III	**Forced Convection:** Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer;	7

	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. **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.	
IV	**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 non black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Green house effect.	8
V	**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 vertical surfaces and on outside & inside of a horizontal tube; Effect of non-condensable gases; Dropwise condensation; Heat pipes; Boiling modes, pool boiling; Hysteresis in boiling curve; Forced convective boiling. **Introduction To Mass Transfer :** Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion though a stagnant gas film.	8

EME-551: MACHINE DESIGN-I Lab

Topic
Say minimum 8 experiments out of following (or such experiment).
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

EME-553: MANUFACTURING SCIENCE -II – LAB

Topic
Say minimum 8 experiments out of following (or such experiment).
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. 18. Macro and Microstructure of welding joints, HAZ.

EME-554: HEAT & MASS TRANSFER – LAB

Topic
Say minimum 8 experiments out of following (or such experiment).
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

EME-011 : FLUID MACHINERY

1	**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 & *c*urve), 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.	8
2	**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.	8
3	**Centrifugal Pumps:** Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Model testing, Cavitation & separation and their control, Performance characteristics.	7
4	**Positive Displacement Pumps:** Reciprocating pump theory, Slip and coefficient of discharges, 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.	6
5	**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.	5

EME-021: NON-CONVENTIONAL ENERGY RESOURCES AND UTILISATION

Unit	Topic	Periods
I	**Energy resources and their utilization :** Indian and global energy sources, Energy exploited, Energy planning, Energy parameters (energy intensity, energy-GDP elasticity), Introduction to various sources of energy, Solar thermal, Photovoltaic, Water power, Wind energy, Biomass, Ocean thermal, Tidal and wave energy, Geothermal energy, Hydrogen energy systems, Fuel cells, Decentralized and dispersed generation. **Solar radiations:** Extra terrestrial radiation, Spectral distribution, Solar constant, Solar radiations on earth, measurement of solar radiation, solar radiation geometry, flux on plane surface, latitude, Declination Angle, Surface azimuth angle, Hour angle, Zenith angle, Solar, altitude angle expression for angle between incident beam and the normal to a plane, surface (no derivation), Local apparent time, Apparent motion of sun, Day length, Solar radiation data for India.	7
II	**Solar energy:** Solar thermal power and it's conversion, Solar collectors, Flat plate, Performance, analysis of flat plate collector, Solar concentrating collectors, Types of concentrating, collectors, Thermodynamic limits to concentration, Cylindrical collectors, Thermal analysis of solar collectors, Tracking CPC and solar swing, Solar thermal energy storage, Different systems, Solar pond. Applications, Water heating, Space heating & cooling, Solar distillation, solar pumping, solar cooking, Greenhouses, Solar power plants **Solar photovoltaic system:** Photovoltaic effect, Efficiency of solar cells, Semiconductor materials for solar cells, Solar photovoltaic system, Standards of solar photovoltaic system, Applications of PV system, PV hybrid system	8
III	**Biogas:** Photosynthesis, Bio gas production Aerobic and anaerobic bio-conversion process, Raw materials, Properties of bio gas, Producer gas, Transportation of bio gas, bio gas plant technology & status, Community biogas plants, Problems involved in bio gas production, Bio gas applications, Biomass conversion techniques, Biomass gasification, Energy recovery from urban waste, Power generation from liquid waste, Biomass cogeneration, Energy plantation, Fuel properties, Biomass resource development in India. **Wind energy:** Properties of wind, Availability of wind energy in India, wind velocity, Wind	8

	machine fundamentals, Types of wind machines and their characteristics, Horizontal and Vertical axis wind mills, Elementary design principles, Coefficient of performance of a wind mill rotor, Aerodynamic considerations in wind mill design, Selection of a wind mill, Wind energy farms, Economic issues, Recent development.	
IV	**Electrochemical effects and fuel cells:** Principle of operation of an acidic fuel cell, Reusable cells, Ideal fuel cells, Other types of fuel cells, Comparison between acidic and alkaline hydrogen-oxygen fuel cells, Efficiency and EMF of fuel cells, Operating characteristics of fuel cells, Advantages offuel cell power plants, Future potential of fuel cells **Tidal power:** Tides and waves as sources of energy, Fundamentals of tidal power, Use of tidal energy Limitations of tidal energy conversion systems. 2 **Hydrogen Energy:** Properties of hydrogen in respect of it's use as source of renewable energy, Sources of hydrogen, Production of hydrogen, Storage and transportation, Problems with hydrogen as fuel, Development of hydrogen cartridge, Economics of hydrogen fuel and its use..	8
V	**Thermoelectric systems:** Kelvin relations, power generation, Properties of thermoelectric materials, Fusion Plasma generators. **Geothermal energy:** Structure of earth's interior, Geothermal sites, earthquakes & volcanoes, Geothermal resources, Hot springs, Steam ejection, Principal of working, Types of geothermal station with schematic representation, Site selection for geothermal power plants. Advanced concepts, Problems associated with geothermal conversion. **Ocean energy;** Principle of ocean thermal energy conversion, Wave energy conversion machines, Power plants based on ocean energy, Problems associated with ocean thermal energy conversion systems, Thermoelectric OTEC, Developments of OTEC, Economics . Impact of renewable energy generation on environment, Kyoto Protocol, Cost of electricity production from different energy sources, Energy options for Indian economy.	6

EME-602: MACHINE DESIGN-II

Unit	Topic	Periods
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	11
II	**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, **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	11
III	**IC ENGINE 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 centre crankshaft	6

EME-603: THEORY OF MACHINES-II

Units	**Topic**	Periods
I	**Static & Dynamic Force Analysis** Static equilibrium of two/three force 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	8

	double acting steam engine, four stroke IC engine and multi-cylinder steam engine, Fluctuation of energy, Flywheel	
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, swaying couple, hammer blow	7
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	8
IV	**Gyroscopic Motion** Principles, Gyroscopic torque, Effect of gyroscopic couple on the stability of aero planes & automobiles **Mechanical Vibrations** Types of vibrations, Degrees of freedom, Single degree free & damped vibrations, Forced vibration of single degree system under harmonic excitation, Critical speeds of shaft	7

EME 604: REFRIGERATION & AIR CONDITIONING

Units	**Topic**	Periods
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 temperature (DART).	8
II	**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 vapour compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, Intercooling, Different	8

	configuration of multistage system, Cascade system.	
III	**Vapour Absorption system;** Working Principal of vapour 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.	8
IV	**Air Conditioning:** Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart, Different Psychometric processes, Thermal analysis of human body, 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).	8
V	**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, Refrigerates Freezers, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, Basic difference between comfort and industrial air conditioning.	7

EME-651: FLUID MACHINERY Lab

Topic
Say minimum 8 experiments out of following (or such experiment).
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. Any other suitable experiment/test rig such as comparison & performance of different types of pumps and turbines.
12. Experiment on Compressor
13. Experiment for measurement of drag and lift on aerofoil in wind tunnel

EME-652 : MACHINE DESIGN-II Lab

Topic
A. Computer and Language : students are required to learn the basics of computer language such as C and C++ so that they should be able to write the computer programme (*3practical turns*) **B. Writing Computer programme for conventional design:** Students are required to write computer program and validate it for the design of machine components done in theory subject (*5practical turns*) **C. Mini Project:** Each **s**tudent will be given a real life problem for the complete design of a subsystem/system using either manual calculation with the help of design handbook or through computer programme, if needed. This will be done as home

EME-653: THEORY OF MACHINES LAB

Topic
Say minimum 8 experiments out of following (or such experiment).
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. 14. Experiment on clutch

EME-654: REFRIGERATION & AIR CONDITIONING Lab

Topic
Say minimum 8 experiments out of following (or such experiment).
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. To study air washers 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. Visit of cold-storage and its detailed study. 11. Experiment on Ice-plant. 12. Experiment on two stage Reciprocating compressor for determination of volumetric 13. Efficiency, PV diagram and effect of intercooling. 14. Study of Hermetically sealed compressor. 15. 14. Experiment on Desert coolers.

BUNDELKHAND INSTITUT OF ENGINEERING & TECHNOLOGY, JHANSI

Department of Mechanical Engineering

B.Tech.

Mechanical Engineering

YEAR IV, SEMESTER-VII

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credits
						SESSIONAL EXAM.			ESE		
			L	T	P	CT	TA	Total			
		THEORY									
1.	EOE-071-EOE-074	Open Elective-I** Operation research	3	1	0	30	20	50	100	150	4
2.	EME-031 to EME-036	Departmental Elective-III Computer Aided Manufacturing	3	1	0	30	20	50	100	150	4
3.	EME-041 to EME-046	Departmental Elective-IV Mechanical System Design	3	1	0	30	20	50	100	150	4
4.	EME-701	Computer Aided Design	3	1	0	30	20	50	100	150	4
5.	EME-702	Automobile Engineering	3	1	0	30	20	50	100	150	4
6	*EHU-111*	**Human values & professional Ethics*	*2*	*0*	*0*	*15*	*10*	*25*	*50*	*75*	
		PRACTICAL/TRAINING/PROJECT									
7.	EME-751	CAD/CAM Lab	0	1	2	10	10	20	30	50	1
8.	EME-752	I.C.Engine & Automobile Lab	0	0	2	10	10	20	30	50	1
9	EME-753	Project	0	0	3	-	50	50	-	50	2
10	EME-754	Industrial Training I & II Evaluation and viva-	0	0	2		50	50	-	50	1
11.	GP 701	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	**15**	**6**	**9**	**-**	**-**	**-**	**-**	**1000**	**26**

Note-**Practical Training-1 & 2 (4-weeks each) done after 4^{th} & 6^{th} Semesters would be evaluated in 7^{th} semester through Report and viva voice etc.

* Project should be initiated in 7^{th} semester beginning, and should be completer by the end of 8^{th} semester with good Report and power-point Presentation etc.

Paper Code	**Open Electives – I**
EOE-071	Entrepreneurship Development
EOE-072	Quality Management
EOE-073	**Operations Research**
EOE-074	Introduction to Biotechnology

DEPARTMENTAL ELECTIVES:

Department Elective - III

1. **EME-031 Computer Aided Manufacturing**
2. EME-032 Project Management
3. EME-033 Advanced Fluid Mechanics
4. EME-034 Experimental Stress Analysis
5. EME-035 Advanced Dynamics of Machines
6. EME-036 Management Information System

Department Elective - IV

1. EME-041 Total Quality Management
2. EME-042 Thermal Turbo Machines
3. **EME-043 Mechanical System Design**
4. EME-044 Tribology
5. EME-045 Industrial Ergonomics
6. EME-046 Concurrent Engineering

BUNDELKHAND INSTITUT OF ENGINEERING & TECHNOLOGY, JHANSI

Department of Mechanical Engineering

B.Tech.

Mechanical Engineering

YEAR IV, SEMESTER-VIII

S. No.	Course Code	SUBJECT	PERIODS			Evaluation Scheme				Subject Total	Credits
						SESSIONAL EXAM.			ESE		
			L	T	P	CT	TA	Total			
		THEORY									
1.	EOE-083	(Open Elective-II**) Product Development	3	1	0	30	20	50	100	150	4
2.	EME-055	Departmental Elective - V (Six Sigma Methods & application*	3	1	0	30	20	50	100	150	4
3.	EME-064	Departmental Elective – VI (Production & operation management)***	3	1	0	30	20	50	100	150	4
4.	EME-801	Power Plant Engineering	3	1	0	30	20	50	100	150	3
7	*EHU*	**Human values & professional Ethics*	*2*	*0*	*0*	*15*	*10*	*25*	*50*	*75*	-
		PRACTICAL/TRAINING/PROJECT									
6.	EME-851	Project	0	0	12	-	100	100	250	350	8
10.	GP-601	General Proficiency	-	-	-	-	-	50	-	50	1
		Total	**12**	**3**	**12**	-	-	-	-	**1000**	

Paper Code Open Electives – II

EOE-081 Non Conventional Energy Resources
EOE-082 Nonlinear Dynamic Systems
EOE-083 Product Development**
EOE-084 Automation and Robotics

DEPARTMENTAL ELECTIVES:

Department Elective-V

1. EME-051 Operations Research
2. EME-052 Maintenance Engineering & Management
3. EME-053 Design of Thermal Systems
4. EME-054 Advanced Synthesis of Mechanisms
5. **EME-055 Six Sigma Methods & Applications***
6. EME-056 Concepts of Modern Physics

Department Elective-VI

1. EME-061 Finite Element Method
2. EME-062 Non-Destructive Testing
3. EME-063 Advanced Materials Technology
4. **EME-064 Production & Operations Management*****
5. EME-065 Energy Management
6. EME-066 Fundamentals of Bio Medical Engineering

Note: (1) The students who had taken Open elective EME-073 Operations Research in VII Sem. can not take the course EME-051 Operations Research as a Departmental Elective in VIII Sem.

(2) The students who had taken departmental elective EME 021 Non Conventional Energy Resources & Utilization in VI Sem. can not take the open elective course EOE-081 Non Conventional Energy Resources in VIII Semester.

EOE-073: OPERATIONS RESEARCH

Unit	Topic	Periods
I	**Introduction:** Basics of Operations Research **Linear Programming-** Introduction & Scope, Problem formulation, Graphical Method, Simplex methods,primal & dual problem sensitivity analysis.	8
II	**Transportation & Assignment problems**. **Deterministic Dynamic Programming-** Multistage decision problems & solution, Principle of optimality.	8
III	**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 **Sequencing-** Basic assumption**,** n Jobs through two / three machines, 2 Jobs on m machines.	8
IV	**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.	8
V	**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.	9

EME-031: COMPUTER AIDED MANUFACTURING (CAM)

Unit	Topic	Periods

I	**Automation** Introduction to CAM; Automated Manufacturing system; Need of automation, Basic elements of automation, Levels of automation, Automation Strategies, Advantages & disadvantages of automation, Historical development and future trends. **Features of NC Machines-** Fundamental of Numerical Control, elements of NC machine tools, classification of NC machine tools, Advantages, suitability and limitations of NC machine tools, Application of NC system, Methods for improving Accuracy considering the factors such as tool deflection and chatter and Productivity.	7
II	**NC Part Programming-** (a) Manual (word address format) programming. Examples Drilling, Turning and Milling; Canned cycles, Subroutine, and Macro. **5** (b) APT programming. Geometry, Motion and Additional statements, Macro-statement.	9
III	**System Devices** Introduction to DC motors, stepping motors, feed back devices such as encoder counting devices, digital to analog converter and vice versa. **Interpolators** Digital differential Integrator-Principle of operation, exponential decelarion; DDA Hardware Interpolator- Linear, Circular; DDA Software Interpolator. **Control of NC Systems** Open and closed loops. Control of point to point systems- Incremental open loop control, Incremental close loop, Absolute close loop; Control loop in contouring systems; Adaptive control.	10
IV	**Computer Integrated Manufacturing system** Group Technology, Flexible Manufacturing System, CIM, CAD/CAM, Computer aided process planning-Retrieval and Generative, Concept of Mechatronics, Computer aided Inspection.	6
V	Types and generations of Robots, Structure and operation of Robot, Robot applications. Economics, Robot programming methods. VAL and AML with examples. **Intelligent Manufacturing**	8

	Introduction to Artificial Intelligence for Intelligent manufacturing.	

EME-043: MECHANICAL SYSTEM DESIGN

Units	**Topic**	Periods
I	**Engineering process and System Approach** Basic concepts of systems, Attributes characterizing a system, system types, Application of system concepts in Engineering, Advantages of system approach, Problems concerning systems, Concurrent engineering, A case study Viscous lubrication system in wire drawing **Problem Formulation** Nature of engineering problems, Need statement, hierarchical nature of systems, hierarchical nature of problem environment, problem scope and constraint, A case study: heating duct insulation system, high speed belt drive system	8
II	**System Theories** System Analysis, Black box approach, state theory approach, component integration approach, Decision process approach, A case study- automobile instrumentation panel system. **System modeling** Need of modeling, Model types and purpose, linear systems, mathematical modeling, concepts, A case study compound bar system	8
III	**Graph Modeling and Analysis** Graph Modeling and analysis process, path problem, Network flow problem, A case study: Material handling system **Optimization Concepts** Optimization processes, Selection of goals and objectives-criteria, methods of optimization, analytical, combinational, subjective. A case study: aluminium extrusion system.	7
IV	**System Evaluation** Feasibility assessment, planning horizon, time value of money, Financial analysis, A case study: Manufacture of maize starch system **Calculus Method for Optimization** Model with one decision variable, model with two decision variables, model with equality constraints, model with inequality constraints, A case study: Optimization of an insulation system.	8

V	**Decision Analysis** Elements of a decision problem, decision making, under certainty, uncertainty risk and conflict probability, density function, Expected monetary value, Utility value, Baye's theorem, A case study: Installation of machinery **System Simulation** Simulation concepts, simulation models, computer application in simulation, spread sheet simulation, Simulation process, problem definition, input model construction and solution, limitation of simulation approach, A case study: Inventory control in production plant	9

EME-701: COMPUTER AIDED DESIGN (CAD)

Units	**Topic**	Periods
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-I CAD/CAM systems, Graphics Input devices-cursor control Devices, Digitizers, Keyboard terminals, Image scanner, Speech control devices and Touch, panels, Graphics display devices-Cathode Ray Tube, Random & Raster scan display, Colour CRT monitors, Direct View Storage Tubes, Flat Panel display, Hard copy printers and plotters	8
II	**Computer Graphics-II** Graphics standards, Graphics Software, Software Configuration, Graphics Functions, Output primitives- Bresenham's line drawing algorithm and 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, multiple transformation	8
III	**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, Periodic and non-periodic B-spline curves	8

IV	**3D Graphics:** Polygon surfaces-Polygon mesh representations, Quadric and Superquadric 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 & ProE software	9
V	**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 2D space (truss element)	7

EME-702: AUTOMOBILE ENGINEERING

Units	**Topic**	Periods
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.	7
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.	8
III	**Braking System:** General requirements, Road, tyre adhesion, weight transfer, Braking ratio. Mechanical brakes, Hydraulic brakes. Vacuum and air brakes. Thermal aspects. **Chasis and Suspension System:** Loads on the frame. Strength and stiffness. Various suspension systems.	8
IV	**Electrical System :** Types of starting motors, generator & regulators, lighting system, Ignition system, Horn, Battery etc.	9

	Fuel Supply System: Diesel & Petrol vehicle system such as Fuel Injection Pump, Injector & Fuel Pump, Carburetor etc. MPFI.	
V	**Automobile Air Conditioning:** Requirements, Cooling & heating systems. **Cooling & Lubrication System:** Different type of cooling system and lubrication system. **Maintenance system:** Preventive maintenance, break down maintenance and over hauling.	6

EME-751 : CAD/CAM LAB

Topic
Minimum 10 experiments out of following (or such experiment).
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 computer 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

EME-752 : I.C. ENGINES AND AUTOMOBILE LAB

Topic
Minimum 10 experiments out of following (or such experiment).
1. Performance Analysis of Four stroke S.I. Engine- Determination of indicated and brake thermal efficiency, specific fuel consumption at different loads, Energy Balance. 1. Determination of Indicated H.P. of I.C. Engine by Morse Test. 2. Performance Analysis of Four stroke 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.Visit to a Modern Automobile Workshop. 17. Experiment on Engine Tuning. 18. Experiment on Exhaust Gas Analysis of an I.C. Engine.

EME-083: PRODUCT DEVELOPMENT]

Unit	Topic	Periods
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.	7
II	**Morphology of Design** Divergent, transformation and convergent phases of product design. Identification of need, Analysis of need. Design for what? Design criteria, functional aspects. Aesthetics, ergonomics, form (structure). Shape, size, color. Mental blocks, Removal of blocks, Ideation Techniques. Creativity, Checklist.	7
III	**Transformations** Brainstorming & Synaptics. Morphological techniques. Utility concept, Utility value, Utility index. Decision making under multiple criteria. Economic aspects of design. Fixed and variable costs. Break-even analysis.	9
IV	**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.	7
V	**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.	7

EME-055: Six Sigma Methods & Application

Unit	Topic	Periods
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	9
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. Z score, Understanding Six Sigma organization, Leadership council, Project sponsors and champions, Master Black Belt, Black Belt, Green Belts.	6
III	Methodology of Six Sigma, DMAIC, DFSS, Models of Implementation of Six Sigma, Selection of Six Sigma Projects.	5
IV	Six Sigma Tools: Project Charter, Process mapping, Measurement system analysis, Hypothesis Testing, Quality Function deployment, Failure mode effect analysis, Design of Experiments.	6
V	Sustenance of Six Sigma, Communication plan, Company culture, Reinforcement and control, Introduction to softwares for Six Sigma, Understanding Minitab, Graphical analysis of Minitab plots.	9

EME-064: PRODUCTION & OPERATIONS MANAGEMENT

Units	Topic	Periods
I	**Managing Operations** Operations Management – Function, Evolution, Definition, Systems view of P&OM; Operations Strategies for Competitive Advantage;	-
II	**Planning (Designing) the conversion System** Designing Products, Services and Processes; Operations Capacity; Locating Production and Service facilities; Layout Planning.	-
III	**Organizing the conversion System** Job design, Production and Operations standards, and work measurement;	-

	Project Management.	
IV	**Scheduling Production and Service System** Scheduling systems, Aggregate Planning for Production and service system; Operations Scheduling.	-
v	**Material Requirements Planning** Planning for needs, applying MRP, Detailed capacity planning, MRP II. **Managing for World class Competition** World class Manufacturing practices; Managing for Quality; Conversion Process in change.	-

EME-801: POWER PLANT ENGINEERING

Units	**Topic**	Periods
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. Power plant economics and selection 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 plant selection, other considerations in plant selection.	8
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 and 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.	8

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, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant. **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	8
IV	**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. Hydro electric station Hydrology, Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems. **Non Conventional Power Plants** Introduction to non-conventional power plants (Solar, wind, geothermal, tidal)etc.	9
V	**Electrical system** Generators and generator cooling, transformers and their cooling, bus bar, etc. **Instrumentation** Purpose, classification, selection and application, recorders and their use, listingof various control rooms. **Pollution** Pollution due to power generation	7