# Jabalpur Engineering College, Jabalpur

## Semester VI Credit Based Grading System (CBGS) w.e.f. July 2017

### Scheme of Examination

### Bachelor of Engineering B.E. (Mechanical Engineering)

### Subject wise distribution of marks and corresponding credits

**Scheme of Examination w.e.f. July-2017 (Academic Session-2017-18)**

| S. No. | Subject Code | Subject Name & Title | Maximum Marks Allotted | | | | | | Hours / week. | | | Total Credits | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Theory | | | Practical | | Total Marks | | | | | |
| | | | End Sem | Mid Sem. MST | Quiz, Assign ment | End Sem. | Lab Work | | L | T | P | | |
| 1 | **ME6001** | Power Plant Engineering | 70 | 20 | 10 | - | - | 100 | 3 | 1 | - | 4 | |
| 2 | **ME6002** | Heat & Mass Transfer | 70 | 20 | 10 | 30 | 20 | 150 | 3 | 1 | 2 | 6 | |
| 3 | **ME6003** | Metal Cutting & Machine Tools | 70 | 20 | 10 | 30 | 20 | 150 | 3 | 1 | 2 | 6 | |
| 4 | **ME6004** | Industrial Engineering & Management | 70 | 20 | 10 | 30 | 20 | 150 | 3 | 1 | 2 | 6 | |
| 5 | **ME6005** | Elective-II | 70 | 20 | 10 | - | - | 100 | 3 | 1 | - | 4 | |
| 6 | **ME6006** | Departmental Lab-III (Simulation & Modeling Lab) | - | - | - | 30 | 20 | 50 | - | - | 2 | 2 | |
| 7 | **ME6007** | Creativity and Entrepreneurship Development (Internal Assessment) | - | - | - | - | 50 | 50 | - | - | 2 | 2 | |
| 8 | **ME6008** | Startup / Industrial Lectures (Internal Assessment) | - | - | - | - | 50 | 50 | - | - | 2 | 2 | |
| **Total** | | | **350** | **100** | **50** | **120** | **180** | **800** | **15** | **5** | **12** | **32** | **800** |

**MST:** Minimum of two mid semester tests to be conducted.

**L: Lecture** **T: Tutorial** **P: Practical**

- **Students have to go for Industrial Training /Internship of 4 weeks at the end of VI Semester.**

| **Department Elective-II (Four Subjects)** | |
|---|---|
| **Subject Code** | **Subject Name** |
| **ME6005A** | Solid Mechanics |
| **ME6005B** | IPR (Intellectual Property Right) |
| **ME6005C** | Total Quality Management & Statistical Quality Control |
| **ME6005D** | Finite Element Method |

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**Jabalpur Engineering College, Jabalpur (M.P)**
**Programme: B.E. Mechanical Engineering (VI-Semester) CBGS**

| Credits: 4 | ME-6001 | Power Plant Engineering | L: 3, T: 1, P: 0 |
|---|---|---|---|

***Course Objective:***

- *Understanding the process of converting various renewable energy sources to electric power, Layout of renewable energy power plant and their advantages and limitations*
- *Understand layout of working principle of fossil thermal power plant. & co-generation system, including coal handling system, pulverization of coal, steam generation system, steam turbine, condenser, cooling tower and control systems.*
- *Understand the layout of nuclear power plant, nuclear fuels & chain reactions, components and working principle of different types of nuclear power plants.*
- *Understand the layout of hydroelectric power plant with plant components, hydrology- hydrographs, flow duration curve, mass curve & power control systems.*
- *Understand the power plant economics, estimate the prediction loads, and factors.*

**Course Contents:**

**Unit I**: **Renewable Energy Power Plants:** Introduction to methods of converting various energy sources to electric power, direct conversion methods renewable energy sources, solar, wind, tidal, geothermal, bio-thermal, biogas and hybrid energy systems, fuel cells, thermoelectric modules, MHD-Converter.

**Unit II: Fossil Fuel Steam Stations:** Basic principles of sitting and station design, recent trends in turbine and boiler sizes and steam conditions, plant design and layout, outdoor and indoor plant, system components, fuel handling, burning systems, feed water treatment plant, condensing plant and circulating water systems, cooling towers, turbine room and auxiliary plant equipment., instrumentation, testing and plant heat balance. Combined cycle power generation, heat recovery steam generator, co-generation plant.

**Unit III: Nuclear Power Station**: Importance of nuclear power development in the world and Indian context, Review of atomic structure and radio activity, binding energy concept, fission and fusion reaction, fissionable and fertile materials, thermal neutron fission, important nuclear fuels, moderators and coolants, Types of reactors, pressurized water reactor, boiling water reactor, breader reactor, CANDU reactor, gas cooled reactor,

**Unit IV: Hydro-Power Station:** Classification of hydroelectric power plant, introduction to hydrology, plant layout, hydro plant auxiliaries, cost of plant, life of plant, hydro power control, electrical and mechanical components, comparison of hydro power station with thermal power station, automatic and remote control of power plant, safety measures and preventive maintenance of hydro power plant, calculation of available hydro power.

**Unit V: Power Station Economics**: Estimation and prediction of load. Maximum demand, load factor, diversity factor, plant factor and their influence on plant design, operation and economics; comparison of hydro and nuclear power plants typical cost structures, simple problems on cost analysis, economic performance and tariffs, interconnected system and their advantages, elements of load dispatch in interconnected systems.

**References:**


1. Nag PK; Power plant Engg; TMH
2. Al-Wakil MM; Power plant Technology; TMH
3. Sharma PC; Power plant Engg; Kataria and sons, Delhi
4. Domkundwar; Power Plant Engg; Dhanpatrai& sons.
5. Rajput RK; A text book of Power plant Engg.;Laxmi Publications.
6. Yadav R; Steam and gas turbine and power plant engg by


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**Course Outcomes:**

At the completion of this course, students should be able to

| | |
|---|---|
| CO1 | Define the procedure of site selection for power plant and able to know the procedure to convert renewable, fossil fuel energy, nuclear energy & fluid energy in to electric power |
| CO2 | Explain function of different mechanism of power plant like fuel handling, its combustion , Utilization of potential of energy to convert in power by using mechanical and electrical equipments. |
| CO3 | To draw the layout of power plant like renewable energy based , fossil fuel based, hydro and nuclear based power plants. |
| CO4 | Estimate the power plant load, maximum demand, load factors, diversity factor, plant factor and their influence on plant design, operation and economics. |

**Mapping of Course outcomes (COs) with Program Outcomes (POs):**

| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | - | - | - | - | - | - | - | - | - | - |
| CO2 | - | 2 | 1 | - | - | - | - | - | - | - | - | - |
| CO3 | - | 1 | 2 | - | - | - | - | - | - | - | - | - |
| CO4 | - | 1 | 2 | - | - | - | - | - | - | - | - | - |

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**Jabalpur Engineering College, Jabalpur (M.P)**
**Programme: B.E. Mechanical Engineering (VI-Semester) CBGS**

| Credits: 6 | ME-6002 | Heat & Mass transfer | L: 3, T: 1, P: 2 |
|---|---|---|---|

***Course Objective:***

*1. Understand the application of various experimental modes of heat transfer i.e. conduction convection, radiation and solve problems related to heat transfer and learn about critical thickness of insulation.*

*2. Extend the conduction and convection laws in extended surfaces and solve unsteady state heat transfer problems applied to various applications.*

*3. Categories the free and forced convection processes and utilizes empirical relations for laminar and turbulent flow.*

*4. Solve heat exchanger problems using LMTD and NTU methods with the help of heat transfer data book and learn the basics of mass transfer.*

*5. Understand boiling and condensation phenomena and the laws of radiation and solve problem related to radiation heat transfer for black body and gray body.*

**Unit-1 Basic Concepts:** Modes of heat transfer, StefanFourier'sBoltzmanlaw; law, New thermal resistance and conductance, analogy between flow of heat and electricity, combined heat transfer process;

**Conduction:** Fourier heat conduction equation, its form in rectangular, cylindrical and spherical coordinates, thermal diffusivity, linear one dimensional steady state conduction through a slab, tubes, spherical shells and composite structures, electrical analogies, critical-insulation-thickness for pipes, effect of variable thermal conductivity.

**Unit 2 Extended surfaces (fins):** Heat transfer from a straight and annular fin (plate) for a uniform cross section; error in measurement of temperature in a thermometer well, fin efficiency, fin effectiveness, applications;

**Unsteady heat conduction:** Transient and periodic conduction, heating and cooling of bodies with known temperatures distribution, systems with infinite thermal conductivity, response of thermocouples.

**Unit 3 Convection:** Introduction, free and forced convection; principle of dimensional analysis, Buckinghamrem,'pie'application theoofdimensional analysis of free and forced convection, empirical correlations for laminar and turbulent flow over flat plate and tubular geometry; calculation of convective heat transfer coefficient using data book.

**Unit 4 Heat exchangers**: Types- parallel flow, counter flow; evaporator an condensers, overall heat transfers coefficient, fouling factors, long-mean temperature difference (lmtd), method of heat exchanger analysis, effectiveness of heat exchanger, NTU method;

**Mass transfer:** Fick's law,-molar diffusion,equidiffusion coefficient, analogy with heat transfer, diffusion of vapour in a stationary medium.

**Unit 5 Thermal radiation**: Nature of radiation, emissive power, absorption, transmission, reflection and emission of radiation, Planck's distribution law, radiation from rea between black and gray surfaces, shape factor, analogical electrical network, radiation shields.

**Boiling and condensation:** Film wise and drop wise condensation; Nusselt theory for film wise condensation on a vertical plate and its modification for horizontal tubes; boiling heat transfer phenomenon, regimes of boiling, boiling correlations.

**References:**


1. Sukhatme SP; Heat and mass transfer; University Press Hyderabad
2. Holman JP; Heat transfer; TMH
3. Dutta Binay K; Heat Transfer; PHI
4. Kumar DS; Heat and mass transfer; SK Kataria and Sons Delhi
5. Kreith; Heat transfer,
6. Sachdeva RC; Fundamentals of engineering heat and mass transfer,.
7. Gupta & Prakash; Engineering heat transfer,


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**EVALUATION:**

Evaluation will be continuous an integral part of the class as well through external assessment.

**COURSE OUTCOMES:**

**Upon successful completion of this course the student will be able to:**

| | |
|---|---|
| **CO1** | Illustrate the real time applications of fluid, solid medium and radiation heat transfer, |
| **CO2** | Utilize the knowledge of design skills of heat exchangers |
| **CO3** | Examine the real time applications of various mode of heat transfer equipments. |
| **CO4** | Estimate the heat transfer rate for various conditions |

**Mapping of course outcomes (COs) with Program Outcomes (POs):**

| Course outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | - | - | - | - | - | - | - | - | - | - |
| CO2 | 2 | - | 2 | - | - | - | - | - | - | - | - | - |
| CO3 | 1 | 2 | - | - | - | - | - | - | - | - | - | - |
| CO4 | 3 | 2 | - | - | - | - | - | - | - | - | - | - |

**LIST OF EXPERIMENTS :**

1 Conduction through a rod to determine thermal conductivity of material 2 Forced and free convection over circular cylinder
3 Free convection from extended surfaces
4 Parallel flow and counter flow heat exchanger effectiveness and heat transfer rate
5 Calibration of thermocouple
6 Experimental determination of Stefen-Boltzman constant

At the completion of this course, students should be able to

| | |
|---|---|
| CO1 | Analyze conduction , convection and radiation heat transfer processes |
| CO2 | Illustrate the working of various heat transfer equipments |

**\Mapping of Course outcomes (COs) with Program Outcomes (POs):**

| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | - | - | - | 2 | - | - | - | - | - | - | - |
| CO2 | 2 | - | - | - | - | - | - | - | - | - | - | - |

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# Jabalpur Engineering College, Jabalpur (M.P)

## Programme: B.E. Mechanical Engineering (VI-Semester) CBGS

| Credits: 6 | ME-6003 Metal Cutting & Machine Tools | L: 3, T: 1, P: 2 |
|---|---|---|

*Course Objective:*

To learn about various machine tools and their applications.

**Course Contents:**

**Unit I: Lathe**: Classification of machine tools and their basic components; lathe- specification, components & accessories, various operations on lathes, capstan & turret lathes, tool layout, methods of thread production, machining time, single point cutting tools, tool signature and nomenclature

**Unit II: Grinding**: Types of grinding machines, surface, cylindrical and internal grinding, grinding wheels, specifications, wheel turning and dressing without eccentricity, centre-less grinding.

**Unit III: Milling:** Vertical, horizontal and universal type machines, specifications and classifications of milling machines, universal dividing head plain and different indexing, gear cutting, milling cutters.

**Drilling & Broaching**: Fixed spindle, radial and universal drilling machines, drilling time, broaching principle, broaches and broaching machines.

**Unit IV: Shapers**: Classification and specifications, principle parts, quick return mechanism, shaper operations, speed feed, depth of cut, machining time. Surface qualities, equipment used for rating surfaces, rms. CLA value, causes for surface irregularities.
**Gear Cutting**: Die casting, methods of forming gears, generating process, Gear shaping, gear shaving, gear grinding gear testing.

**Unit V: Tool Wear, Tool Life and Machinability:** Tool wear mechanisms, Types of tool damage during cutting, Wear and chipping characteristics of different tool materials, Tool wear equations, tool failure criteria, Tool life equations, Effect of process parameters on Tool life, Tool life testing, Machinability, Surface finish and surface integrity.

**References**


1. Rao PN; Manufacturing Technology vol I and II; TMH.
2. HazraChadhary; Workshop Tech.II; Media Promoter and Pub.
3. Lindberg RA; Processes and Materials of Manufacturing; PHI.
4. Raghuvanshi;BS; Work shop technology Vol-I, II; Dhanpat Rai Delhi.
5. Alciatori DG, Histand MB; Introduction to Mechatronics andMeasurement system; TMH.
6. HMT; Production Processes; TMH.


**List of Experiments**

1. To make a job on lathe machine with all operations like turning, step turning, drilling, tapper turning, thread cutting and knurling.
2. Study of center less grinding machine/ tool and cutter type grinding machine.
3. Study of horizontal/ universal milling machine, diving head and indexing mechanism of it.
4. To cut a spur gear on milling machine using rapid indexing method.
5. Study of radial drilling machine and preparing a job on it.

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6. To study a sapping machine to learn about working of quick return mechanism.

**Evaluation**

Evaluation will be continuous an integral part of the class as well through external assessment.

## Course Outcomes:

At the completion of this course, students should be able to

| | |
|---|---|
| CO1 | Classify lathe machines and operations. |
| CO2 | Knowledge of Grinding machine principle and applications. |
| CO3 | Demonstrate working and operations of milling machine. |
| CO4 | Knowledge of shaper machines and operations. |
| CO5 | Analyze Tool Wear, its variables and estimation of tool life. |

## Mapping of Course outcomes (COs) with Program Outcomes (POs):

| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 0 | 1 | 1 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| CO2 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| CO3 | 0 | 0 | 1 | 2 | 2 | 0 | 1 | 1 | 0 | 0 | 0 | 0 |
| CO4 | 0 | 0 | 2 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| CO5 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 0 | 2 | 1 | 1 | 1 |

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JABALPUR ENGINEERING COLLEGE, JABALPUR (M.P.)
PROGRAMME: BE MECHANICAL ENGINEERING (VI SEMESTER) CBGS

**CREDITS: 6 ME- 6004 - Industrial Engineering & ManagementL: 3, T: 1, P: 2**

**COURSE OBJECTIVE:**

1. **To be familiar with all the production processes, production planning methods, inventory control techniques and industry plant layouts.**
2. **To calculate the various critical path with the help of CPM and PERT methods.**
3. **To perform an analysis for inventory control.**
4. **To understand the various industry acts.**
5. **To understand the Design of various plant layouts.**

**COURSE CONTENTS:**

**Unit 1. Production, Planning and Control:** Definition and importance, types of production: job, batch and mass production, routing, scheduling, dispatching and follow up. Forecasting elements, time series, regression, causal and Delphi methods. Break even analysis and Gantt chart, Project scheduling, application of CPM and PERT techniques, Analysis and control of project cost in CPM and PERT, simple numerical problems.

**Unit 2. Inventory Control:** Definition, types of inventory - Codification and standardization ABC analysis. Economic ordering quantity Procurement cost, carrying charges, lead-time, re-order point, simple problems. Definitions, types of inspection and procedure Statistical quality control - Basic theory of quality control, Process capability Control charts for variables - and R, relationship between control limits and specification limits. Control chart for fraction defective (p), control chart for number of defect

**Unit 3. Job Evaluation and Wage Plans & Industrial Legislation**: Objective, Methods of job evaluation, job evaluation procedure, merit rating (Performance appraisal), method of merit rating, wage and wage incentive plans. Need for Industrial legislation, Factories act 1948, Industrial dispute act 1947, The Indian trade unions act 1926, and Industrial employment act 1946, Payment of wage act 1936, Workmen compensation act 1923, Payment of bonus act 1965, and Employees provident fund scheme.

**Unit 4. Work Study:** Definition, advantages and procedure of work-study. Difference between production and productivity, Factors to improve productivity. Method Study: - Definition, objectives and procedure of method study. Symbols, flow process chart (man-machine and material), flow diagram, machine chart, two hand chart Critical examination. Developing a new method Principles of motion economy. Therblig symbols, SIMO chart simple problems. Work Measurement -time study, definition, principle and method of time study Stop watch study - number of reading, calculation of basic time, rating techniques, normal time, allowances, and

standard time Simple numerical problems. Work Sampling - Definition, method, advantages and disadvantage of work sampling Applications.

**Unit 5. Plant Location and Layout:** Definition, factors affecting the site selection of plant, Factor affecting plant layout. Types of layout: process, product, combination and fixed position layout Techniques in making layout-Flow diagram, templates, distance volume matrix, travel chart Line balancing, and workstation. Material Handling: Principles of economic material handling Hoisting equipment - forklift truck, Cranes- mobile motor cranes, overhead cranes, travelling bridges crane and Derrick crane. Whiler crane Conveying equipment - Package conveyors, gravity roller conveyors, screw conveyors, flight or scraper conveyors, bucket conveyors, bucket elevators, belt conveyors, and pneumatic conveyors.

**EVALUATION:**

**Evaluation will be continuous an integral part of the class as well through external assessment.**

**COURSE OUT COMES:**

**As the completion of this course, student will able to**

| | |
|---|---|
| **CO1** | Make use of Various Inventory Control Models to solve real industrial inventory problems. |
| **CO2** | Utilize CPM and PERT methods for finding out critical path, control charts for quality control and regression analysis. |
| **CO3** | Design and elaborate the Various Plant Layout. |
| **CO4** | Apply Various Work Study Methods in industrial engineering and Various Job Evaluation, Wage Plans &Industrial Legislations. |

**Mapping of course outcomes (COs) with Program Outcomes (POs):**

| course outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 1 | 2 | - | - | - | - | - | - | - | - |
| CO2 | 2 | 2 | - | 1 | - | - | - | - | - | - | - | - |
| CO3 | 1 | - | 3 | 1 | - | - | - | - | - | - | - | - |
| CO4 | 2 | 1 | - | 1 | 1 | - | - | - | - | - | - | - |

REFERENCES:


1. SeetharamaL.Narasimhan, Dennis W.McLeavey, Peter J.Billington, "Production Planning And Inventory Control" , PHI, 2nd Edition, 2002.
2. Norman Gaither, Greg Frazier, Operations Management, Thomson Learning, 9th Edition, 2002.
3. Monks J.G, "Operations Management", McGraw Hill, 1997

4. Panneerselvam. R, Production and operations Management,PHI,2005
5. Lee J.Krajewski, Larry P.Ritzman, "Operations Management Strategy and Analysis", PHI, 6th Edition, 2003.
6. Kenneth R.Baker, "Introduction to Sequencing and Scheduling", John Wiley & Sons, New York, 2000.
7. Dilip R. Sule, "Industrial Scheduling", PWS Publishing company, Boston, 1997.

**CREDITS: 2 ME- 6004 - Industrial Engineering & management Lab**

**COURSE OBJECTIVE:**

1. **To be familiar with all the production processes, production planning methods, inventory control techniques and industry plant layouts.**
2. **To calculate the various critical path with the help of CPM and PERT methods.**
3. **To perform an analysis for inventory control.**
4. **To understand the various industry acts.**
5. **To understand the Design of various plant layouts.**

**COURSE CONTENTS:-**

**LIST OF EXPERIMENTS:**

1. Study of Break Even Analysis
2. Study of various inventory control techniques.
3. Study of Various Critical Path and Pert Methods.
4. Study of Regression Analysis.
5. Study of ABC Analysis.
6. Study of Work Measurement Method's Like Work Studyand Time Study.
7. Study of Various Plant Location and Layouts.

**COURSE OUT COMES:**

**As the completion of this course, student will able to**

| | |
|---|---|
| **CO1** | Make use of Various Inventory Control Models and break even analysis for industry. |
| **CO2** | Utilize CPM and PERT methods for finding out critical path. |
| **CO3** | Design and elaborate the Various Plant Layout. |
| **CO4** | Apply Various Work Study, Time Study Methods. |

**Mapping of course outcomes (COs) with Program Outcomes (POs):**

| course outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 2 | - | - | - | - | - | - | - | - |
| CO2 | 2 | 2 | - | 2 | - | - | - | - | - | - | - | - |
| CO3 | 1 | - | 2 | - | 1 | - | - | - | - | - | - | - |
| CO4 | 2 | 1 | - | - | 1 | - | - | - | - | - | - | - |

# Jabalpur Engineering College, Jabalpur (M.P)
## Programme: B.E. Mechanical Engineering (VI-Semester) CBGS

| Credits: 4 | Elective-II | ME-6005 A | Solid Mechanics | L: 3, T: 1, P: 0 |
|---|---|---|---|---|

*Course Objective:*
*To familiarize the students with the fundamentals of strain energy, deflection of fixed beam and continuous beam and thick cylinders.*

**Course Contents:**

**Unit 1: Strain Energy or Resilience:**
Strain Energy- Elastic, plastic and rigid members, Stresses due to different types of axial loading, Gradually applied loads, Impact loads, Deflection of beam using strain energy method, Strain energy stored due to bending, The first theorem of Castigliano and its applications, Laminated Springs or Leaf springs.

**Unit 2: Conjugate Beam Method, Propped Cantilevers and Beams:**
Conjugate Beam Method: Deflection and slope of simply supported beam (point load at the centre, carrying an eccentric point load), Relation between actual beam and conjugate beam.
Propped Cantilever And Beam: Shear force and Bending moment for a propped cantilever carrying (point load at the centre and propped at the free end, uniformly distributed load and propped at the free end).

**Unit 3: Fixed Beam And Continuous Beam:** Relation between the free B.M. diagram and the fixed B.M. diagrams, Slope and deflection, Effect of sinking of supports, Fixed beam subjected to couple, Degree of fixity, Advantages and disadvantages of fixed beam, Clapeyron's theorem of three moments, Column Analogy method.

**Unit 4: Thick Cylindrical Shells:**
Introduction, Stresses in a thick cylindrical shell, Lamme's equation, Hoop stresses and radial pressure distribution, Stresses in Compound thick cylinders, Thick spherical shells.

**Unit5: Theories of Failures**:
Maximum normal stress theory; Maximum shear stress theory; Principal stress theory; Maximum normal and shear strain energy theory; Maximum distortion energy theory; Application of theories to different materials and loading conditions.

**EVALUATION**
Evaluation will be continuous an integral part of the class as well through external assessment.

**References:**


1. Beer FP,Johnson Mechanics of Materials, Sixth Edition; Mc Graw Hills.
2. Stephen Timoshenko; Strength of materials;part1&2; CBS Pub.
3. Singh Arbind K; Mechanics of Solids; PHI
4. R Subramannian, Strength of materials OXFORD University press, Third Edition.
5. Egor P.Popov; Engineering Mechanics Of Solids; PHI
6. S Ramamurthum, Strength of materials,Dhanpat Rai.


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## Course Outcomes:

At the completion of this course, students should be able to-

| | |
|---|---|
| **CO1** | Estimate strain energy stored due to bending. |
| **CO2** | Calculate Slope and deflection using Conjugate beam method. |
| **CO3** | Calculate Slope and deflection in fixed beam and continuous beam. |
| **CO4** | Analyze stresses in thick cylinders and spheres. |
| **CO5** | Apply theories of failures in different materials and loading conditions. |

## Mapping of Course outcomes (COs) with Program Outcomes (POs):

| Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 1 | 1 | - | - | - | - | - | - | - | - |
| CO2 | 2 | 2 | 1 | 2 | - | - | - | - | - | - | - | - |
| CO3 | 2 | 2 | 1 | 2 | - | - | - | - | - | - | - | - |
| CO4 | 2 | 3 | 2 | 3 | - | - | - | - | - | - | - | - |
| CO5 | 3 | 3 | 2 | 3 | - | - | - | - | - | - | - | - |

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# Jabalpur Engineering College, Jabalpur (M.P)

## Programme: B.E. Mechanical Engineering (VI-Semester) CBGS

| Credits: 4 | (Elective-II) ME6005 B Intellectual Property Rights | L: 3, T: 1, P: 0 |
|---|---|---|

*Course Objective:*

Acquaint the students with the basic concepts of Intellectual Property Rights; and sensitize the students with the emerging issues in IPR and the rationale for the protection of IPR.

**Course Contents:**

**UNIT I Introduction**

Introduction and Justifications of IPR, Nature of IP, Major forms of IP- Copyright, Patent, TradeMarks Designs, Geographic indication, layout design of Semiconductors, Plant varieties, Concept & Meaning of Intellectual Property.

Major international documents relating to the protection of IP - Berne Convention, Paris Convention, TRIPS. The World Intellectual Property Organization (WIPO).

**UNIT II Copyright**

Meaning and historical development of copyright , Subject matter , Ownership of copyright, Term of copyright, Rights of owner, Economic Rights, Moral Rights. Assignment and licence of rights, Infringement of copyright, Exceptions of infringement, Remedies, Civil, Criminal, Administrative, Registration Procedure.

**UNIT III Patents**

Meaning and historical development. Criteria for obtaining patents, Non patentable inventions, Procedure for registration, Term of patent, Rights of patentee, Compulsory license, Revocation, Infringement of patents, Exceptions to infringement, Remedies, Patent office and Appellate Board.

**UNIT IV – Trade Marks, Designs & GI**

**Trade Marks:** Functions of marks, Procedure for registration, Rights of holder, Assignment and licensing of marks, Infringement, Trade Marks Registry and Appellate Board.

**Designs:** Meaning and evolution of design protection, Registration, Term of protection, Rights of holder, unregistered designs.

**Geographical Indication:** Meaning and evolution of GI, Difference between GI and Trade Marks, Registration, Rights, Authorised user.

**UNIT V Contemporary Issues & Enforcement of IPR**

IPR & sustainable development, The Impact of Internet on IPR. IPR Issues in biotechnology,Ecommerceand IPR issues, Licensing and enforcing IPR, Case studies in IPR

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**References:**


1. P. Narayanan, Intellectual Property Law, Eastern Law House
2. Neeraj Pandey and Khushdeep[ Dharni, Intellectual Property Rights, PHI, 2014
3. N.S Gopalakrishnan and T.G. Agitha, Principles of Intellectual Property, Eastern Book Co. Lucknow, 2009.
4. AnandPadmanabhan, Enforcement of Intellectual Property, Lexis NexisButterworths, Nagpur, 2012.
5. Managing Intellectual Property the Strategic Imperative, Vinod V. Sople, PHI.
6. PrabuddhaGanguli, "Intellectual Property Rights" Mcgraw Hill Education, 2016.


**Evaluation**

Evaluation will be continuous an integral part of the class as well through external assessment.

**Course Outcomes:**

At the completion of this course, students should be able to

| | |
|---|---|
| CO1 | Students will be able to understand Primary forms of IPR. |
| CO2 | Students will be able to asses and critique some basic theoretical justification for major forms of IP Protection. |
| CO3 | Students will be able to compare and contrast the different forms of IPR in terms of key differences and similarities. |
| CO4 | Students will be able understand the registration procedures related to IPR. |
| CO5 | Students will be exposed to contemporary issues and enforcement policies in IPR. |

**Mapping of Course outcomes (COs) with Program Outcomes (POs):**

| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 |
| CO2 | 0 | 1 | 1 | 0 | 0 | 2 | 1 | 1 | 2 | 2 | 0 | 1 |
| CO3 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 |
| CO4 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 |
| CO5 | 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 1 |

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# Jabalpur Engineering College, Jabalpur (M.P)
## Programme: B.E. Mechanical Engineering (VI-Semester) CBGS

**Credits: 4 Elective-II ME6005C Total Quality Management & Statistical Quality Control L: 3, T: 1, P: 0**

*Course Objective:*

- To understand the importance of quality for mechanical engineer.
- To apply various tools and techniques of SQC to improve productivity.
- To learn process diagnostics and process improvement techniques.

**Course Contents:**

**Unit 1 Evolution** of total quality management, historical perspective, teamwork, TQM and ISO9000; information technology and Business Process Re-engineering (BPR); TPM and quality awards; aids and barriers to quality mgt, creating vision and initiating transformation, establishing programs for education and self-coordination, policy setting and review, flowchart of policy mgt and relation with daily mgt. improvements, measurement of key indicators; quality mgt leader; cross functional teams and coordination, policy setting and review, flowchart of policy mgt and relation with daily mgt.

**Unit 2 Process-** definition, variation and feedback, funnel-marble experiment- rules of adjustment and its effects, quality- definition, goalpost and kaizen view, quality of design, conformance and performance; Taguchi loss function, cost of quality, chain action of improving quality to productivity to motivation and low cost; Deming's theory of mgt, fourteen points and variance reduction; attributes enumerative and variables analytic studies.

**Unit 3 SQC-Control charts:** basic discrete and continuous distributions, measures of central tendency, variability and shapes, sampling, size and central value theorem, control chart structure, process plotting and stability, study of out-of-control evidences, defect detection and prevention, use of control charts in evaluating past, present and future trends; attribute control charts, count and classification charts, construction and interpretation of p , np , c and u charts, PDSA cycle(plan, do, study, act), and R charts, and s charts, individual and moving range chart, trial control limits and out of control points.

**Unit 4 Process diagnostics:** Between and Within Group variations, periodic and persistent disturbances, control chart patterns-natural, level-shift, cycle, wild, multi-universe, relationship and other out of control patterns; diagnosing a process, brainstorming; cause-effect, Ishikava, interrelationship, systematic and matrix diagrams; change concepts and waste elimination

**Unit 5 Process improvement:** Performance and technical specifications, attribute-process and variable-process capability studies; unstable and stable process capability studies and examples; attribute and variable improvement studies; Inspection: acceptance sampling(AS)- lot formation, single, double and multiple/sequential sampling plans, operating characteristic (OC) curve, producer and consumer risk, theoretical invalidation of AS, kp rule for stable and chaotic processes.

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**References:**


1. Gitlow HS, Oppenheim et al; Quality Management; TMH.
2. Gryna FM; Juran's Quality Planning and Analysis; TMH.
3. Crosby Philips; Quality is still free; New Amer Library.
4. Kulkarni VA and Bewoor AK; Quality Control; Wiley.
5. Jankiraman B and Gopal RK; Total Quality Management- Text and Cases; PHI Learning.
6. Sugandhi L and Samual A; Total Quality Management; PHI Learning.
7. Subburaj R; Total Qality Management; TMH.
8. Naidu Babu and Rajendran; TQM; New age International pub.
9. Chase Richard B et al; Operations management; SIE-TMH.
10. Chary SN; Production and Operations Management; TMH.


## Evaluation

Evaluation will be continuous an integral part of the class as well through external assessment.

## Course Outcomes:

At the completion of this course, students should be able to

| | |
|---|---|
| CO1 | Understand the concept of quality, its measurement, and improvements techniques. |
| CO2 | Knowledge of quality of design, conformance and performance, motivation attributes. |
| CO3 | Selection and application of sampling techniques and use of control charts. |
| CO4 | Able to diagnose a process and prepare systematic and matrix diagrams. |
| CO5 | Ability of inspection, process improvement and capability studies. |

## Mapping of Course outcomes (COs) with Program Outcomes (POs):

| Course Outcome | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| CO2 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CO3 | 1 | 0 | 3 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| CO4 | 0 | 1 | 1 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 0 |
| CO5 | 0 | 0 | 0 | 0 | 2 | 1 | 1 | 1 | 1 | 0 | 2 | 1 |

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# Jabalpur Engineering College, Jabalpur (M.P)

## Programme: B.E. Mechanical Engineering (VI-Semester) CBGS

| Credits: 4 | Elective-II ME6005 D (Finite Element Method) | L: 3, T: 1, P: 0 |
|---|---|---|

**Course Contents:**

### Unit-I: Introduction

Structural analysis, objectives, static, Dynamic and kinematics analyses, Skeletal and continuum structures, Modeling of infinite D.O.F. system into finite D.O.F. system, Basic steps in finite element problem formulation, General applicability of the method.

### Unit-II Element Types and Characteristics

Discretization of the domain, Basic element shapes, Aspect ratio, Shape functions, generalized co-ordinates and nodal shape functions. 1D bar and beam elements, 2D rectangular and triangular elements, Axisymmetirc elements.

### Unit-III Assembly of Elements and Matrices

Concept of element assembly, Global and local Co-ordinate systems, Band width and its effects, Banded and skyline assembly, Boundary conditions, Solution of simultaneous equations, Gaussian elimination and Choleksy decomposition methods, Numerical integration, 1D and 2D applications.

### Unit-IV Higher Order and Iso-parametric Elements

One dimensional quadratic and cubic elements, Use of natural Co-ordinate system, Area Co-ordinate system continuity and convergence requirements, 2D rectangular and triangular requirement.

### Unit-V Static & Dynamic Analysis

Analysis of trusses and frames, Analysis of machine subassemblies, Use commercial software packages, Advantages and limitations Hamilton's principle, Derivation of equilibrium, Consistent and lumped mass matrices, Derivation of mass matrices for ID elements, Determination of natural frequencies and mode shapes, Use of commercial software packages.

**References:**


1. Rao, S.S., The Finite Element Method in Engineering, 2nd ed.., Peragamon Press,Oxford.
2. Robert, D. Cook. David, S. Malkins, and Michael E. Plesha, Concepts andApplication of Finite Element Analysis 3rd ed., John Wiley.
3. Chandrupatla, T.R. anBelegundu, A.D., Introduction to Finite Elements inEngineering, Prentice Hall of India Pvt. Ltd.
4. Zienkiewicz O C, The Finite Element Method, 3rd ed, Tata McGraw Hill.


### Evaluation

Evaluation will be continuous an integral part of the class as well through external assessment.

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## Course Outcomes:

At the completion of this course, students should be able to-

| | |
|---|---|
| **CO1** | Make use of finite element method to solve simple problems from Structural & Dynamic domain. |
| **CO2** | Develop the concept of various elements and their characteristics. |
| **CO3** | Create element and global stiffness, displacement and force matrices for 1D and 2D FEA Problems. |
| **CO4** | Make use of different element types to obtain the convergence criteria. |
| **CO5** | Apply the finite element analysis using available commercial FEA tools. |

## Mapping of Course outcomes (COs) with Program Outcomes (POs):

| Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | 1 | 3 | 1 | - | - | - | - | - | 2 |
| CO2 | 2 | 2 | 1 | 2 | 3 | - | - | - | - | - | - | 1 |
| CO3 | 2 | 2 | 2 | 2 | 3 | 1 | - | - | - | - | - | 2 |
| CO4 | 2 | 2 | 2 | 2 | 3 | 1 | - | - | - | - | - | 2 |
| CO5 | 2 | 2 | 2 | 3 | 3 | 2 | - | - | - | - | - | 2 |

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# Jabalpur Engineering College, Jabalpur (M.P)

**Programme: B.E. Mechanical Engineering (VI-Semester) CBGS**

| Credits: 2 | ME6006 Simulation and Modeling Laboratory | L: 0, T: 0, P: 2 |
|---|---|---|

**Course Contents:**

Introduction to Modeling Software Packages like Solid Works, CATIA, ANSYS, Assembly of Sleeve and Cotter joint, Gib and Cotter joint/ Knuckle Joint/ Flanged Coupling, Assembly of Connecting Rod.

Introduction to Simulation software Packages like ANSYS, Fluent, and etc. Various types of analysis. Structure analysis, Thermal analysis, Stress analysis, CFD analysis, FEM analysis, and their problem solving in actual situations.

**List of Experiments (Expandable)**

1. Introduction to CATIA software.
2. Introduction to ANSYS software.
3. Assembly of Sleeve and Cotter joint/ Gib and Cotter joint/ Knuckle Joint/ Flanged Coupling using CATIA.
4. Assembly of Connecting Rod using CATIA.
5. Stress analysis using ANSYS (examples: plate with a circular hole, rectangular L bracket, Axis-symmetric components, various types of beams, etc.)
6. Thermal stress analysis of a 2D component.
7. Conductive and convective heat transfer analysis of a 2D component.
8. CFD Simulation of various situations (example: Laminar pipe flow, Flat plate boundary layer, steady flow past a cylinder, Compressible flow in a Nozzle, Flow over an airfoil.)

**References:**


1. User manual of CATIA software.
2. User manual of ANSYS and Fluent software.
3. Chandrupatla, T.R. and Belegundu, A.D., Introduction to Finite Elements in Engineering, Prentice Hall of India Pvt. Ltd.
4. Zienkiewicz O C, The Finite Element Method, 3rd ed, Tata McGraw Hill.


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## Course Outcomes:

At the completion of this course, students should be able to-

| | |
|---|---|
| **CO1** | Explain the importance of modeling and simulation in design cycle. |
| **CO2** | Create various models and their assembling using CAD packages. |
| **CO3** | Analyze various problems from Structural domain by using CAE Tools. |
| **CO4** | Analyze Simple problems from Fluid domain by using CAE Tools. |

## Mapping of Course outcomes (COs) with Program Outcomes (POs):

| Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 1 | 2 | 1 | 3 | 1 | - | - | - | - | - | 2 |
| **CO2** | 2 | 3 | 3 | 3 | 3 | - | - | - | - | - | - | 2 |
| **CO3** | 2 | 3 | 3 | 3 | 3 | 1 | - | - | - | - | - | 2 |
| **CO4** | 2 | 3 | 3 | 3 | 3 | 1 | - | - | - | - | - | 2 |

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# B.E. (CBGS) VI SEMESTER
## MECHANICAL ENGINEERING
## CREATIVITY AND ENTREPRENEURSHIP DEVELOPMENT

| Course | Subject Title | Subject Code | Grade for End Sem. | | CGPA at the end of every even semester |
|---|---|---|---|---|---|
| | | | T | P | |
| B.E. (CBGS) | Creativity and Entrepreneurship Development | ME6007 | Min. "D" | Min. "D" | 5.0 |

**Course Objective:**

- Understand and use tools for generating entrepreneurial ideas and problem solving.
- Understand and use tools for the selection of ideas.
- Understand and gain the skills that are needed to implement ideas in today's society
- Understand Entrepreneurship's part in process that includes idea generation and implementation.
- Understand the concept of Entrepreneurship and its place in today's society

**Course Contents:**

1. The concept of Entrepreneurship, its history and its place in society.
2. The concept of Entrepreneurship and its relation to concept of innovation.
3. Creative processes for idea generation and problem solving.
4. Business plan.
5. Role of creativity, innovation and business research.
6. Entrepreneurship opportunities in contemporary business environment.

**Course Outcomes:**

1. Recognize an opportunity for a user group and frame an appropriate design challenge that addresses the need for the user.
2. Practice observation, interview and empathy skills to evolve a thorough understanding of the needs of the user.
3. Share and integrate team leanings.
4. Generate, develop and describe creative ideas that address the design challenge.

**Books Reference:**


1. Dollinger M.J. "Entrepreneurship strategies and resources," 3rd edition Pearson Education New Delhi.
2. Panda, Shiba charan "Entrepreneurship development", Anmol publication New Delhi.
3. Richard Blundel & Nigel locket, "Exploring Entrepreneurship: practices & perspectives Oxford.
4. Charles E. Banford & Garry D. Bruton, "Entrepreneurship – A small business Approach, Mc-graw-hill Education.
5. P. Narayana Reddy, "Entrepreneurship": Text and cases, Cengage learning.
6. Rajeev Roy, "Entrepreneurship" Oxford.


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## Course Outcomes:

At the completion of this course, students should be able to-

| | |
|---|---|
| **CO1** | Recognize and opportunity for a user group & friend & appropriate design challenge that address the need for the user |
| **CO2** | Practice observation, interview and empathy skills to evolve a thorough understanding of the needs of the user |
| **CO3** | Share & integrate team learning |
| **CO4** | Generate, develop & describe creative ideas that address the design challenge |

## Mapping of Course outcomes (COs) with Program Outcomes (POs):

| Course Outcomes | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 1 | - | - | - | 1 | - | - | 2 | - | - | 2 |
| **CO2** | 1 | 1 | - | - | - | - | 1 | 1 | - | 2 | - | 2 |
| **CO3** | 1 | 1 | - | - | - | 1 | - | - | 2 | - | - | 2 |
| **CO4** | 1 | 1 | 2 | - | - | 1 | - | 1 | - | - | - | 2 |

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