Jabalpur Engineering College, Jabalpur

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

Scheme of Examination

Bachelor of Engineering B.E. (Industrial and Production 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, Assignment	End Sem.	Lab Work		L	T	P		
1	**IP6001**	Advance Manufacturing Process	70	20	10	-	-	100	3	1	-	4	
2	**IP6002**	Operations Research	70	20	10	30	20	150	3	1	2	6	
3	**IP6003**	Work Study and Ergonomics	70	20	10	30	20	150	3	1	2	6	
4	**IP6004**	Manufacturing Technology	70	20	10	30	20	150	3	1	2	6	
5	**IP6005**	Elective-II	70	20	10	-	-	100	3	1	-	4	
6	**IP6006**	Departmental Lab-III (Applied Thermodynamics)	-	-	-	30	20	50	-	-	2	2	
7	**IP6007**	Creativity and Entrepreneurship Development (Internal Assessment)	-	-	-	-	50	50	-	-	2	2	
8	**IP6008**	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**
IP6005A	IPR (Intellectual Property Right)
IP6005B	Applied Thermodynamics
IP6005C	Product Design and Development
IP6005D	Quality Engineering

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Jabalpur Engineering College, Jabalpur (M.P)
Programme: B.E. Industrial &Production Engineering (VI-Semester) CBGS

Credits: 4	IP6001	Advance manufacturing processes	L: 3, T: 1, P: 0

Course Objective:
To learn about advance manufacturing processes their process parameters and working principle.

Course content:

ADVANCED MANUFACTURING PROCESSES (IP6001)

UNIT I

Abrasive Jet Machining (AJM): Principles of Abrasive jet machining, Process parameters, Metal removal rate, Effect of parameters on Abrasive jet machining, Application & limitation.
Water Met Machining: Procedure of Water jet machining, Jet cutting equipments, process detail, Practical applications.

UNIT II

Ultrasonic Machining: Principle, Process parameters, Cutting tool design, tool feed mechanism, transducer, design of velocity transformers, Mechanics of cutting , Effect of parameters, Economic consideration, Applications & limitations.
Plasma Arc Machining: Non-thermal generation of plasma, Mechanics of metal removal, Parameters, Accuracy & surface finish, Applications.

UNIT III

Electrochemical Machining: Principle, Elements of process, Metal removal rate, Electro-chemistry of process, tool design, Applications, choice of electrolyte. Electrochemical grinding, Electrochemical deburring and Electrochemical honing.
Chemical Machining: Elements of process, Applications and advantages.

UNIT IV

Electro Discharge Machining: Process, Mechanism of metal removal, Electrode feed control , Metal removal rate, Machining accuracy, tool material, dielectric fluid, flushing, application & limitation. Wire cut EDM, Electro discharge grinding.

UNIT V

Laser Beam Machining: Features, Metal removal rate, Thermal analysis, Cutting speed and accuracy.
Electron Beam Machining Procedure, Forces in machining, Process capability.
High Energy Rate Forming: High energy rate forming process, High Velocity Forming process, Explosive Forming, Electro Hydraulic Forming. Electromagnetic forming, High speed forming machines.

References:

1 Modern Machining Process, P.C.Pandey &H.S. Shan, Tata McGraw hill.
2 New Technology, Dr. Amitabh Bhattacharya, The Institution of Engineers.
3 Unconventional Manufacturing Process, Dr. V.K. Jain, Allied Publishers
4 Principles of Engineering Production, A.S. Lissaman & S.J. Martin
5 Production Engineering, P.C. Sharma, S Chand company Ltd

Course Outcomes:

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

CO1	Understand Principles of Abrasive jet machining.
CO2	Understand Non-thermal generation of plasma, Mechanics of metal removal in plasma arc machining.
CO3	Understand Electrochemical deburring and Electrochemical honing.
CO4	Understand Process of electro discharge machining.
CO5	Understand Process of Laser Beam Machining, electron beam machining

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	1	2	1	0	0	1	0	1	0
CO2	1	2	1	0	2	1	0	1	0	1	0	0
CO3	1	1	1	1	2	0	1	0	0	0	0	1
CO4	1	1	1	0	2	0	0	0	0	0	0	0
CO5	1	0	1	1	2	0	0	0	0	0	0	1

Jabalpur Engineering College, Jabalpur (M.P)
Programme: B.E. Industrial &Production Engineering (VI-Semester) CBGS

Credits: 6	IP6002	Operations Research	L: 3, T: 1, P: 2

Course Objective:

- Identification and developing operational research models from the verbal description of the real system.
- Explain the mathematical tools that are needed to solve optimisation problems.
- Provide knowledge of mathematical software to solve the proposed models.
- Analyze the results To learn about Linear Programming.
- Explain network analysis, Game theory

Course content:

OPERATIONS RESEARCH
(IP6002)

UNIT 1

Linear Programming: Introduction, History and development of Operations Research, Model building, Linear programming-formulation, Graphical method, Conical and standard forms of linear programming problems, Theory of simplex method, Big-M method, Two-phase method, Degeneracy in linear programming problems, Revised simplex, Sensitivity analysis.

UNIT II

Allocations in Linear Programming Problem: Assignment model-Hungarian method, Travelling salesman and miscellaneous problem, Assumptions in Transportation model, Optimality test, Degeneracy in Transportation Problem, Unbalanced Transportation Problem and Transshipment Problem.

UNIT III

Decision and Game theory: Decision tree, Decision making models under certainty, Risk and uncertainty, Hurwicz criteria, Game theory, two persons zero sum games, maximin and minimax principles, Saddle point, Dominance rule, Graphical and algebraic methods of solution.

UNIT IV

Dynamic Programming: Characteristics of dynamic Programming, Bellman principal, Typical problems, Salesmen problem, Forward and backward recursion, Use of software to solve linear programming and Dynamic programming.

UNIT V

Queuing Theory Network Analysis: Characteristics of queuing system, Poisson formula, birth-death system, equilibrium of queuing system, Analysis of M/M/1 queues, Project Planning, Project scheduling, Project controlling, Basic tools and technique of project management, AOA and AON diagrams, Critical path method, Program evaluation and review technique.

References:

1. Taha. H.A. Operations Research, PHI, Publications.
2. Hiller and Liberman Introduction to Operations Research, TMH Publications.
3. Sharma.J.K. Operations Research Theory and Applications, Macmillan Publications.
4. Ramamurthy.P. Operations Research, New Age Publications.
5. Banerjee.B. Operations Research, Business Publicity, Bombay.
6. Hira and Gupta. Operations Research, S. Chand Publication.

OPERATIONS RESEARCH LAB
(IP6002)

LIST OF EXPERIMENTS :

1. To Solve L.P.P. (Maximization Problem) by graphical method Using Operations Research software.
2. To Solve L.P.P. (Minimization Problem) by graphical method Using Operations Research software.
3. To Solve L.P.P. (Maximization Problem) by simplex method Using Operations Research software.
4. To Solve L.P.P. (Minimization Problem) by simplex method Using Operations Research software.
5. To find Initial basic feasible Solution of the given Transportation Problem.
6. To find Initial Optimal Solution of the given Transportation Problem.
7. To find optimal Solution of the given Assignment Problem.
8. To find optimal solution of two person zero sum game.

Course Outcomes:

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

CO1	Understand methodology of Operations Research.
CO2	Analyze the results to learn about Linear Programming.
CO3	Solve optimization problems
CO4	Develop a report that describes the model and the solving technique.
CO5	To carry out network analysis.

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	2	1	1	1	1	0	0	1	1	1	1
CO2	1	3	1	0	3	1	0	1	0	1	1	0
CO3	1	3	3	1	3	0	1	0	0	1	1	1
CO4	1	1	1	0	1	0	0	0	0	1	1	1
CO5	1	2	1	1	2	0	0	0	0	1	1	1

Jabalpur Engineering College, Jabalpur (M.P)
Programme: B.E. Industrial &Production Engineering (VI-Semester) CBGS

Credits: 6	IP6003	Work study and ergonomics	L: 3, T: 1, P: 2

Course Objective:

- To be familiar with work study procedure and its application
- To learn about human factor engineering.
- To learn about basic procedure of method study.
- To be familiar with Job Evaluation process and Merit Rating.

Course content:

WORK STUDY & ERGONOMICS
(IP6003)

UNIT I

Work Study: Purpose of Work Study, Objectives, Procedure, and Applications of Work Study, Prerequisites of conducting Work Study, the human factor in the application of Work Study, The influence of working condition on work study.

Human Factor Engineering: Objective of Ergonomics, Applications of Ergonomics, Man-Machine System, Characteristics of Man-Machine System, Classification of Man-Machine System, Working environment, Workplace design.

UNIT II

Method study: Method Study definition and objective of Method Study, Basic procedure, Process Analysis, Process Chart Symbol. Selection of job, Various Recording techniques like Outline Process Charts, Flow Process Charts, Man Machine Charts, Two handed Process Charts, String diagram, Flow diagram, Multiple activity chart, Simo, Cyclographs and Chrono-cyclographs, Critical examination, Development, Installation and Maintenance of improved method, Principles of Motion Economy ,Therbligs, Micro motion study, Memo motion study.

UNIT III

Work Measurement: Introduction & Definition, Objectives and basic procedure of Work Measurement, Time study, basic procedure, equipments needed, Methods of Measuring time, Selection of jobs, Breaking a job into Elements, Numbers of Observations, Performance Rating, Rating Procedure Allowances, Calculation of Standard Time, Predetermined motion time system (PMTS), Method time measurement (MTM).

UNIT IV

Job Evaluation and Merit Rating: Concept and objectives of Job Evaluation and Merit Rating, Job Evaluation Methods, Different Methods of Merit Rating.

Wage Incentive Plans: Requirement, Objectives of Wage Incentive Plans, Types of Wage Incentive Plans.

Work Sampling: Basic procedure, determining time standards by Work Sampling, Procedure for selecting random observations, Work Sampling errors.

UNIT V

Display Systems and Controls: Display- Types of display, Visual display, Quantitative display, Qualitative display, Representational display, Alphanumeric display, Types of controls, Selection of control, Control resistance, Relationship between controls and displays, Use of anthropometric data.

Reference:

1. ILO; work-study; International Labour Organization
2. Barrnes RM; Motion and Time Study, Wiley pub
3. Currie RM; Work study; BIM publications
4. Megaw ED; Contemporary ergonomics; Taylor & Fracis
5. Mynard; Hand book of Industrial Engineering.

WORK STUDY & ERGONOMICS LAB (IP6003)

LIST OF EXPERIMENTS :

1. Preparation of two handed process chart.
2. Preparation of Multiple Activity chart.
3. Preparation of flow process charts on activities in Workshop/ Laboratory/Office .
4. To conduct time study of the bulb holder assembly operation for the existing method .
5. Determination of time standard for a given job using stopwatch time-study.
6. Preparation of man-machine charts for an existing setup and development of an improved process.
7. Determination of time by MTM.

Course Outcomes:

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

CO1	Understand work study procedure application and its objective.
CO2	Able to prepare flow process chart, Man Machine Charts, Two handed Process Charts, String diagram, Flow diagram
CO3	Understand Job Evaluation and Wage Plans & Industrial Legislation.
CO4	Use Applications of work Measurement and work sampling.
CO5	To carry out micro motion and memo motion analysis.

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	3	1	1	2	1	0	0	1	0	1	0
CO2	1	3	2	1	2	3	0	1	0	1	0	0
CO3	1	2	1	1	2	1	1	0	0	0	0	1
CO4	1	2	2	1	2	2	0	0	0	0	0	0
CO5	1	1	1	1	2	3	0	0	0	0	0	1

Jabalpur Engineering College, Jabalpur (M.P)
Programme: B.E. Industrial &Production Engineering (VI-Semester) CBGS

Credits: 6	IP6004	Manufacturing technology	L: 3, T: 1, P: 2

Course Objective:
To learn about working procedure of arc welding, gas welding, special welding process,soldering,brazing ,surface finishing process, press working , their process parameters and working principle.

Course content:

MANUFACTURING TECHNOLOGY
(IP6004)

UNIT I : Arc welding: Arcing phenomenon, Metal transfer in arc welding, Arc blow, Types of electrodes, Carbon Arc Welding, Flux Shielded Metal Arc Welding, Submerged Arc Welding, TIG Welding, MIG Welding, Plasma Arc Welding, Arc Welding equipments.
Gas welding: Oxy Acetylene Welding, Welding flames, Leftward and Rightward welding, filler metals and rods, Gas Welding equipments, Oxy Hydrogen and other Fuel gas welding, Air acetylene welding. Pressure welding; Spot, Seam and Butt welding, Thermo Chemical welding.

UNIT II : Resistance welding:
Electric resistance welding, Variables in resistance welding, Spot welding: procedure, spot welding methods, Heat balance in spot welding, Spot welding equipment, Seam welding: Seam welding equipments, Principle of operation, Applications, Projection welding, Resistance butt welding, Flash butt welding, Percussion welding.
Special welding process: Cold pressure welding; Diffusion welding, Ultra sonic welding, Explosive welding, Friction welding and Inertia welding, Forge welding, Electron beam welding, laser beam welding, Atomic hydrogen welding, Thermit welding, Under water welding process, Thermal spraying & Metal-addition.

UNIT III : Soldering & Brazing: Soldering: Definition. Principles of soldering process, Soldering alloys, Soldering fluxes, Soldering methods.
Brazing: Principle of operation, Brazing procedure, Brazing fluxes, Constituents of fluxes, Brazing processes, limitations in brazing.
Surface finishing process: Super finishing, Lapping, Honing, Tumbling, Electroplating, Metal spraying.

UNIT IV : Press working: Press operations, Classification of Presses, Press working terminology, Types of
dies, drawing dies, Bending dies, Punch design, Pilots, Types of pilots, Shearing operations: Piercing, Blanking, Notching, Drawing, Spinning, Bending, Stretch Forming, Embossing and Coining.
Powder Metallurgy: Process, Method of production of powder, Metal powder characteristics, Application of powder metallurgy.

UNIT V : Distortion & discontinuities in weld-jobs: Weld-jobs distortion and its control, various discontinuities in welds, Residual stresses in weld-jobs residual stresses-distortion-relieving of stresses. **Automation in welding**: Structure analysis; Basic operations, Robotic welding, Types of welding robots.

Non Destructive Testing and inspection of weld-jobs: Non destructive methods of testing weld-jobs; stages of weld inspection and testing, visual inspection ,leak test; stethoscopes test; X-ray and γ-ray radiography, magnetic particle inspection; liquid(dye) penetrate test; fluorescent penetrate inspection; ultrasonic inspection and Eddy current testing.

References

1. Malhotra; Handbook on Non-destructive Testing of Concrete; CRC Press,
2. Henrique L M; Non Destructive Testing and Evaluation for Mfg, Hemisphere Pub NY,
3. Rao PN; Manufacturing Technology Vol 1; TMH
4. Groover MP; Fundamentals of Modern mfg; Wiley India
5. Kaushish JP; Manufacturing Processes; PHI Learning
6. Oswald PF; Mfg Processes and Systems; Wiley India
7. Parmar, R.S; Welding Processes and Technology
8. Srinivasan.N.K.; Welding Technology; Khanna Pub.

Course Outcomes:

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

CO1	Understand Principles and working procedure of arc welding and gas welding.
CO2	Understand soldering,brazing ,surface finishing process.
CO3	Find out Distortion & discontinuities in weld-jobs.
CO4	Perform non destructive testing and inspection of weld jobs.
CO5	Understand Application of powder metallurgy.

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	1	0	1	1	0	0	1	0	1	0
CO2	2	2	1	0	2	1	0	1	0	1	0	0
CO3	1	3	1	2	2	0	1	0	0	0	0	1
CO4	1	2	1	1	2	0	0	0	0	0	0	0
CO5	1	0	1	0	1	0	0	0	0	0	0	1

Jabalpur Engineering College, Jabalpur (M.P)
Programme: B.E. Industrial &Production Engineering (VI-Semester) CBGS

Credits: 4	IP6005B	Applied thermodynamics	L: 3, T: 1,P:0

Course Objective:

- To understand the fundamentals of heat transfer mechanisms in fluids and solids and their applications in various heat transfer equipment.
- To understand the principles of refrigeration and air conditioning.
- To calculate the cooling load for different applications.
- To design and implement refrigeration and air conditioning systems using standards

Course content:

APPLIED THERMODYNAMICS
(IP6005B)

UNIT I:

Conduction: Basic concepts ,Conduction, Convection and Radition,Electrical Analogy, Fourier's law of conduction, Conduction of heat transfer through slabs, hollow cylinder, Sphere,Composite systems, Critical radius of insulation for Pipes/cables.

Convection: Natural & forced convection.Simple problems on correlations based on horizontal Pipe and Plate .

UNIT II:

Heat exchangers: Logarithmic Mean Temperature difference for Parallel and Counter flow Heat Exchanger.LMTD correction factor & Fouling factor, Effectiveness of Heat Exchanger. Simple problems based on LMTD method.

UNIT III:

Radiation: Basic introduction to radiation heat transfer.Black body laws, Emissivity, solid angle, Intesity of Radiation, Shap factor, Heat transfer by radiation for simple configurations.

Refrigeration: Methods of refrigeration, unit of refrigeration and COP, Carnot refrigeration cycle, Air refrigeration cycle, Bell Coleman air refrigeration cycle, Introduction to air craft refrigeration system. Simple and Boot strap air craft refrigeration system , Simple problems on air refrigeration cycle.

UNIT IV:

Refrigerants: Classification, Nomenclature, Desirable properties of Refrigerants, Comparative study of Refrigerant,Leak detection, Future Refrigerants.

Simple vapour compression refrigeration cycle: P-H, T-S and H-S diagrams for vapour compression refrigeration system, Analysis of simple saturated cycle, Effect of Condensor and Eveporator pressure,Subcooling and Super heating. Simple problems.

UNIT V:

Air Conditioning: Psychometric properties & relations. Psychometric chart, Psychometric processes, Sensible heat factor,Bypass factor,Infiltrated air and Ventilation.Requirement of comfort air conditioning ,Simple problems based on Psychrometry, Psychrometric processes and cooling load calculations.

References:

1. Heat transfer - J.P. Holmon
2. Engineering Heat transfer - Gupta & Prakash
3. Fundamental of Engineering Heat and Mass transfer- P.K.Nag
4. Refrigeration & air conditioning - Stoecker & Jones
5. Refrigeration & air conditioning - C.P. Arora

Course Outcomes:

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

CO1	Ability to understand and solve conduction convection and radiation problems.
CO2	Ability to analyze the performance of heat exchangers.
CO3	Illustrate the basic concepts of refrigeration system.
CO4	Analyze the vapour compression cycle and interpret the usage of refrigerants.
CO5	Explain the components of vapour compression system.

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	1	1	2	1	2	0	1	0	1	0
CO2	2	2	1	2	2	1	1	1	0	1	0	0
CO3	3	1	1	1	2	0	1	0	0	0	0	1
CO4	2	1	1	2	2	0	2	0	0	0	0	0
CO5	3	0	1	1	2	0	0	0	0	0	0	1