JABALPUR ENGINEERING COLLEGE, JABALPUR (MP)
(An Autonomous Institute of Govt. of M.P.)

Affiliated to Rajiv Gandhi Technological University, Bhopal (MP)
Scheme of Study and Examination (w.e.f. July 2010)

B.E. Third Year **Branch - Industrial & Production** **Sem :Sixth**

Course Code	Subject	Periods			EVALUATION SCHEME					Credits
					SESSIONAL EXAM			ESE	SUB TOTAL	
		L	T	P	TA	CT	TOTAL			
IP-21	Work Study and Ergonomics	3	1	-	10	20	30	70	100	4
IP-23	Applied Thermodynamics	3	1	-	10	20	30	70	100	4
IP-25	Manufacturing Technology	3	1	-	10	20	30	70	100	4
IP-26	Advanced Manufacturing Processes	3	1	-	10	20	30	70	100	4
IP-27	Operations Research	3	1	-	10	20	30	70	100	4
(PRACTICAL/DRAWING/DESIGN)										
IP-22L	Work Study & Ergonomics Lab	-	-	2	20	-	20	30	50	2
IP-24L	Applied Thermodynamics Lab	-	-	2	20	-	20	30	50	2
IP-28L	Operations Research Lab	-	-	2	20	-	20	30	50	2
IP-29L	Minor Project	-	-	2	20	-	20	30	50	2
IP-50L	Professional Activity			2	50	-	50	-	50	2
IP-51L	Seminar/Group Discussion			2	50	-	50	-	50	2
	Total	**15**	**5**	**12**	**230**	**100**	**330**	**470**	**800**	**32**

T.A. Teachers Assessment, CT- Class Test, ESE - End Semester Examination, Total Marks 800
Total Periods : 32, Total Credits : 32

COURSE CONTENT & GRADE (w.e.f. July 2010)

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
BE	**WORK STUDY &ERGONOMICS**	IP-21	Min "D"	Min "D"	5.0

WORK STUDY &ERGONOMICS

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;

COURSE CONTENT (w.e.f. July 2010)

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
BE	**APPLIED THERMODYNAMICS**	IP-23	Min "D"	Min "D"	5.0

APPLIED THERMODYNAMICS

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 CONTENT (w.e.f. July 2010)

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
BE	**MANUFACTURING TECHNOLOGY**	IP-25	Min "D"	Min "D"	5.0

MANUFACTURING TECHNOLOGY

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 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 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 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 CONTENT (w.e.f. July 2010)

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
BE	**ADVANCED MANUFACTURING PROCESSES**	IP-26	Min "D"	Min "D"	5.0

ADVANCED MANUFACTURING PROCESSES

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 CONTENT (w.e.f. July 2010)

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
BE	**OPERATIONS RESEARCH**	IP-27	Min "D"	Min "D"	5.0

OPERATIONS RESEARCH

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.

COURSE CONTENT & GRADE (w.e.f. July 2010)

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
BE	**WORK STUDY AND ERGONOMICS LAB**	IP-22L	Min "D"	Min "D"	5.0

WORK STUDY AND ERGONOMICS LAB

SUGGESTED 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 CONTENT & GRADE (w.e.f. July 2010)

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
BE	**APPLIED THERMODYNAMICS LAB**	IP- 24L	Min "D"	Min "D"	5.0

APPLIED THERMODYNAMICS LAB

SUGGESTED LIST OF EXPERIMENTS :

1. Determination of overall coefficient of heat transfer for parallel flow heat exchanger.
2. Determination of overall coefficient of heat transfer for counter flow heat exchanger.
3. Study of stefan boltzman constant appratus.
4. Study of emissivity appratus.
5. Study of vapour compression test rig.
6. Study of one ton thermax unit.
7. Study of ice plant.
8. Study of window air conditioner.

COURSE CONTENT & GRADE (w.e.f. July 2010)

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
BE	**OPERATIONS RESEARCH LAB**	IP- 28L	Min "D"	Min "D"	5.0

OPERATIONS RESEARCH LAB

SUGGESTED 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 CONTENT & GRADE (w.e.f. July 2010)

Branch	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
BE	**MINOR PROJECT**	IP- 29L	Min "D"	Min "D"	5.0

Study regarding field data/Laboratory investigating Analysis /Design of the subject related to Industrial & Production Engineering.

COURSE CONTENT & GRADE (w.e.f. July 2010)

Course	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
BE	**PROFESSIONAL ACTIVITY**	IP-50L	Min "D"	Min "D"	5.0

PROFESSIONAL ACTIVITY
(Suggested Exercise)

- Student shall visit a nearby Industry and shall prepare a technical report suggesting some improvement in operation.
- Student shall Design and fabricate a new laboratory equipment. He shall prepare a design report.
- Student shall improve an existing lab equipment and prepare chart or lab manual .
- Student shall publish a review paper in some Indian Journal.
- Student shall make a report on an Industry employing latest technology/ Innovation.
- Student shall prepare a working model of a machine part.
- Student shall make a software/ comp. program for the Institute to enhance efficiency in its working.
- Student shall prepare a detailed project report to start a small-medium enterprise.
- A group of student shall register with the Industry cell and submit a report on work done there about Institute-Industry linkage.
- Experimental work on a new set of equipments.
- Seminar Presentation with a report submitted to the supervisor.

Note : The list of activities can be modified as per requirements of the department.

A hand written report of about 30 pages duly signed by the student and the concerned teacher should be submitted.

COURSE CONTENT & GRADE (w.e.f. July 2010)

Course	Subject Title	Subject Code	Grade for End Sem		CGPA at the end of every even semester
			T	P	
BE	**SEMINAR/GROUP DISCUSSION**	IP-51L	Min "D"	Min "D"	5.0

Objectives of Group Discussion & Seminar is to improve the Mass Communication and Convincing/ understanding skills of students and it is to give student an opportunity to exercise their rights to express themselves.

Evaluation will be done by assigned faculty based on group discussion and power point presentation.